2025 PROGRESS REPORT OF THE PARTIES

Pursuant to the 2012 Canada-United States Great Lakes Water Quality Agreement

Canada

U.S. spelling is used throughout this report except when referring to Canadian titles. Units are provided in metric or U.S. customary units for activities occurring in Canada or the United States, respectively.

Discussions of funding levels or costs in dollars is provided using Canadian dollars for activities occurring in Canada and U.S. dollars for activities occurring in the United States.

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Acronyms

ACPF	Agricultural Conservation Planning Framework
AFT	American Farmland Trust
AIS	aquatic invasive species
AM	adaptive management
AOC	Area of Concern
ARS	Agricultural Research Service
ARTS	Agricultural Runoff Treatment System
BAFF	BioAcoustic Fish Fence
BMP	best management practice
BPA	Bisphenol A
BUI	Beneficial Use Impairment
CANUSLAK	Canada-United States Great Lakes Geographic Annex
CCCS	Canadian Centre for Climate Services
CCG	Canadian Coast Guard
CEAP	Conservation Effects Assessment Project
CEC	chemical of emerging concern
CFS	Canadian Forest Service
CIGLR	Cooperative Institute for Great Lakes Research
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CMC	Chemical of Mutual Concern
CMIP	Coupled Model Intercomparison Project
CMP	Chemicals Management Plan
COA	Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health
COIP	Canadian Ocean Infrastructure Portal
CORDEX-NA	North American Coordinated Regional Climate Downscaling Experiment
CREP	Conservation Reserve Enhancement Program
CSMI	Coordinated Science and Monitoring Initiative
CSO	combined sewer overflow
CWA	Canada Water Agency
CWMP	Great Lakes Coastal Wetland Monitoring Program
CyAN	Cyanobacteria Assessment Network
decaBDE	Decabromodiphenyl ether
DFO	Fisheries and Oceans Canada
DNA	deoxyribonucleic acid
DNR	Department of Natural Resources
DUC	Ducks Unlimited Canada
ECCC	Environment and Climate Change Canada
ECF	engineered containment facility
ECP	EPA Council on PFAS
ECRA	Essex Region Conservation Authority
EDBS	Electric Dispersal Barrier System
eDNA	environmental DNA
EGLE	Michigan Department of Environment, Great Lakes and Energy
GBF	Georgian Bay Forever
GIS	geographic information system
GLCA	Great Lakes Coastal Assembly
GLEC	Great Lakes Executive Committee
GLERL	Great Lakes Environmental Research Laboratory
GLFC	Great Lakes Fishery Commission
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GLISA	Great Lakes Integrated Sciences and Assessments
GLP	Great Lakes Panel
GLPC	Great Lakes Phragmites Collaborative
GLPI	Great Lakes Protection Initiative

GLRI	Great Lakes Restoration Initiative
GLSHyFS	Great Lakes Seasonal Hydrologic Forecast System
GLWQA	Great Lakes Water Quality Agreement
GPS	geographic positioning system
GRIP	Great Lakes Runoff Intercomparison Project
HAB	harmful algal bloom
HBCD	hexabromocyclododecane
IADN	International Atmospheric Deposition Network
ICLEI	International Council for Local Environmental Initiatives
ICRCC	Invasive Carp Regional Coordinating Committee
IDEM	Indiana Department of Environmental Management
IMC	Invasive Mussel Collaborative
IMO	International Maritime Organization
IPCA	Indigenous Protected and Conserved Area
ISC	Invasive Species Centre
LAMP	Lakewide Action and Management Plan
LC-PFCA	long-chain perfluorinated carboxylic acid
LEADS	Lake Erie Agriculture Demonstrating Sustainability
LTBB	Little Traverse Bay Bands of Odawa Indians
LTVCA	Lower Thames Valley Conservation Authority
MAEAP	Michigan Agriculture Environmental Assurance Program
MARPOL	International Convention for the Prevention of Pollution from Ships
MDARD	Michigan Department of Agriculture and Rural Development
MDNR	Minnesota Department of Natural Resources
MECP	Ministry of the Environment, Conservation and Parks
MNO	Métis Nation of Ontario
MPART	Michigan PFAS Action Response Team
NBIC	National Ballast Water Information Clearinghouse
NCC	Nature Conservancy of Canada
NCCA	National Coastal Condition Assessment
NDMNRF	Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry
NEW Water	Green Bay Metropolitan Sewage District
NOAA	National Oceanic and Atmospheric Administration
NPS	U.S. National Park Service
NRCAN	Natural Resources Canada
NRCS	Natural Resources Conservation Service
NWM	National Water Model
NYSDEC	New York State Department of Environmental Conservation
Ohio EPA	Ohio Environmental Protection Agency
OIT	Organisms in Trade
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OMECP	Ontario Ministry of the Environment, Conservation and Parks
ORMGP	Oak Ridges Moraine Groundwater Program
PADEP	Pennsylvania Department of Environmental Protection
PAH	polycyclic aromatic hydrocarbon
PAMF	Phragmites Adaptive Management Framework
PBDE	polybrominated diphenyl ether

PCB	polychlorinated biphenyl
PFAS	per- and polyfluoroalkylated substance
PFOA	Perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POP	persistent organic pollutant
RAP	Remedial Action Plan
RV	research vessel
SCCP	short-chain chlorinated paraffin
SDWA	Safe Drinking Water Act
SOGL	State of the Great Lakes
SRMT	Saint Regis Mohawk Tribe
SWAT	Soil and Water Assessment Tool
TAM	Tribal Climate Adaptation Menu
TEK	traditional ecological knowledge
TMDL	total maximum daily load
TNC	The Nature Conservancy
TSCA	Toxic Substances Control Act
UNESCO	United Nations Educational, Scientific and Cultural Organization
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
uv	ultraviolet
UW	University of Wisconsin
VAST	Visual Assessment Survey Tool
VIDA	Vessel Incidental Discharge Act
VinES	Vested in Environmental Sustainability
VPDCR	Vessel Pollution and Dangerous Chemicals Regulations
WDNR	Wisconsin Department of Natural Resources
WLEB	Western Lake Erie Basin
WRRF	Water Resource Recovery Facility

Executive Summary

The Great Lakes are the largest system of fresh surface water on earth and vital to the environmental health and economies of Canada and the United States. The surface waters of the Great Lakes provide drinking water for more than 10 million Canadians and 20 million Americans. Over 36 million people live in thousands of communities along their shores and within their watersheds, and the lakes support a fishery valued at $5.1 billion annually. Recognizing the close connection between water quality, human health, and economic prosperity, Canada and the United States are committed to the restoration and protection of this important resource.

The Canada-United States Great Lakes Water Quality Agreement (Agreement or GLWQA) identifies shared priorities and coordinates actions to restore and protect the water quality of the Great Lakes. For over 50 years it has guided the installation of infrastructure for sewage treatment, remediation of highly contaminated sites, and reduction of excess nutrients and algae. The domestic environmental programs which implement the Agreement – implemented in cooperation and partnership with state, provincial, Tribal, First Nation, Métis, local governments, and watershed management agencies – have delivered significant improvements in Great Lakes water quality.

Key accomplishments described in this report over 2023 to 2025 include:

Annex 1. Areas of Concern

Over the past three years, Canada and the U.S. have exceeded their goals for remediating contamination and restoring habitat in communities throughout the Great Lakes basin. Two U.S. Areas of Concern (AOC), Muskegon Lake and the Rochester Embayment, were restored and formally delisted. All management actions are complete, and environmental recovery is progressing at 11 U.S. and 5 Canadian AOCs, setting them on the path for eventual delisting. A total of 29 (20 U.S. and nine Canadian) ecosystem impairments (known as Beneficial Use Impairments, or BUIs) have been addressed, resulting in more communities that are able to swim safely at Great Lakes beaches, have improved drinking water, and can enjoy improved fish and wildlife populations. As part of these clean-up efforts, over 672,500 cubic yards of contaminated sediment have been remediated during this reporting period (575,000 cubic yards in U.S. and over 97,000 cubic yards in Canada). These environmental improvements have also revitalized local economies, with some U.S. studies showing a benefit of $3.35 in economic activity for every $1 invested in the Great Lakes Restoration Initiative. In Canada, the remediation of the Randle Reef contaminated sediment site in the Hamilton Harbour AOC alone is estimated to bring $174 million in economic benefits to the community through job creation, business development and tourism (about $1.25 in economic return for every $1 invested).

Annex 2. Lakewide Management

Canadian and U.S. environmental protection and natural resources management agencies work together at the lakewide scale to assess past progress and identify actions to further improve water quality. This work is done on each lake through a multi-agency Lake Partnership: a collaborative team of federal agencies, state and provincial governments, Tribal governments, First Nations, Métis, municipal governments, and watershed management agencies. Through the development of Lakewide Action and Management Plans (LAMPs), governmental partners work together to reduce chemical contamination, eliminate excess

nutrients, protect and restore native species and their habitats, manage invasive species, and restore Great Lakes watersheds. During this 3-year period, a new streamlined format for LAMPs was developed and drafts of the Lake Ontario, Lake Erie, and Lake Michigan LAMPs are expected to be released for public feedback in early 2026.

Annex 3. Chemicals of Mutual Concern

Canada and the U.S. are actively reducing the release of chemicals through domestic chemical management programs and clean-up of contaminated sediments in Areas of Concern. Contamination levels have significantly decreased in the Great Lakes; however, some chemicals still bioaccumulate in the food web to levels that harm wildlife and create the need for fish consumption advisories to protect human health. Over the past three years, chemical management programs and clean-up efforts have reduced the risks posed by chemical contaminants in the Great Lakes. Efforts are also underway to enhance the efficiency of the review of chemicals nominated as candidate Chemicals of Mutual Concern (CMCs).

Annex 4. Nutrients

Reducing excess phosphorus inputs to Lake Erie remains the highest priority for action under this Annex. Government agencies and their partners are implementing on-the-ground actions identified in the Domestic Action Plans to slow phosphorus inputs from municipal and agricultural sources. There are signs of progress, but significant and sustained effort is still needed to meet targets. Researchers continue to monitor the impact of phosphorus load reductions on the lake ecosystem to assess progress and inform future management actions.

Annex 5. Discharges from Vessels

Over the past three years, the United States and Canada have effectively managed vessel discharges and coordinated responses to vessel emergencies that had the potential for oil or hazardous substance spills. In addition, all vessels entering the Great Lakes Seaway system from outside the Exclusive Economic Zone receive ballast management exams to ensure that no noncompliant ballast water is discharged. Both federal governments have made significant strides in advancing management programs and contingency planning that safeguard the Great Lakes waters, protect shoreline communities, and secure the safety of vessels and crew.

Annex 6. Aquatic Invasive Species

Throughout the Great Lakes watershed, government agencies and partners collaborated on early detection and control projects for invasive species. Governmental partners continued to reduce populations of invasive carp species in the Illinois River and remove Grass Carp in tributaries of Lake Erie. Early detection monitoring for invasive species is also taking place in locations throughout the Great Lakes. Canada and the United States also made progress on developing new technologies and strategies to prevent and control for high-risk aquatic invasive species.

Annex 7. Habitat and Species

Over the last three years, United States and Canadian agencies have supported many high-impact projects that restore the health of Great Lakes watersheds, coastlines, and aquatic habitats. Both countries also enhanced their ability to conserve and manage coastal wetlands through complementary domestic science initiatives. Restoration of free-flowing rivers is unlocking habitat for migratory fish spawning, improving water quality, and offering new opportunities for angling. Targeted species conservation efforts are also making strong strides in restoring some of the iconic Great Lakes species, including the Piping Plover, Walleye, and Lake Trout.

Annex 8. Groundwater

Canadian and U.S. governmental agencies continue to actively manage contaminated groundwater sites and issues in the Great Lakes watershed. Cooperation between local, state, provincial, and federal agencies has continued to improve understanding of

groundwater's influence on surface water quality and ecosystem health. Over the last three years, the Groundwater Annex facilitated communication among members from local, state, provincial, and federal agencies on a variety of groundwater-quality topics. Both countries also conducted research to study groundwater contaminant sources and the dynamic interaction between the groundwater system and surface waters, to further understand and prevent risks to Great Lakes water quality.

Annex 9. Climate Change Impacts

Canadian and U.S. governmental agencies continue to collect meteorologic, hydrologic and environmental information for use by regional and local project planners. In addition, agencies and researchers are also developing analytic tools and studies for resource managers, local communities, and other decision-makers. Over the last three years, governmental agencies have facilitated communications and shared information on environmental conditions to support the development of resilient infrastructure and restoration projects.

Annex 10. Science

Over the last 3 years Canada and the United States have continued monitoring to assess water quality and aquatic ecosystem health, guide restoration actions, and measure progress in Great Lakes protection and restoration. A comprehensive State of the Great Lakes Report was developed that assesses the overall health of the Great Lakes using a suite of ecosystem indicators. Work continued to identify ways that Traditional Ecological Knowledge (TEK) can help Annexes implement actions to assess, protect and restore the Great Lakes.

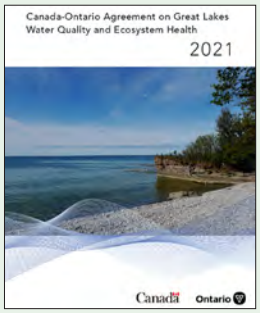
OUR PROGRAMS

The Agreement provides the framework for binational cooperation towards restoration and protection of Great Lakes water quality. These efforts are supported by each country's own domestic programs to implement the Agreement's commitments.

Within the United States, legislation at the federal, state, Tribal, municipal, and local levels authorizes and directs environmental protection and restoration programs. These programs are the foundation for the restoration and protection of the Great Lakes. In recent years, the Great Lakes Restoration Initiative (GLRI) has greatly increased implementation activities by funding over 8,000 new projects that address the most significant Great Lakes environmental issues, including restoring Areas of Concern, reducing excess nutrients, preventing and controlling invasive species, and restoring native habitats and species. Every dollar spent through GLRI is expected to return $3.35 in additional economic activity.

Great Lakes RESTORATION

Within Canada, national, provincial, and regional policies, programs, and initiatives are applied to restore and protect the Great Lakes. The Great Lakes Freshwater Ecosystem Initiative, led by the Canada Water Agency, is a key federal program that combines science and action to tackle the most pressing challenges affecting Great Lakes water quality and health. Priority areas for action under the Initiative include restoring Areas of Concern; preventing toxic and nuisance algae; improving the health of coastal areas, including coastal wetlands; reducing harmful chemicals; engaging Indigenous Peoples in governance, stewardship and monitoring; and engaging the public through community-based science. Science plays a key role and is the basis of the work to restore and protect the Great Lakes, which contributes to our shared understanding of the issues facing the lakes, and also supports priority setting, decision making and action.



Since protection and restoration of the Great Lakes is a shared responsibility, Canada also continues to work in close collaboration with the Province of Ontario through the 2021 Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA). The Canada-Ontario Agreement is a targeted 5-year action plan that outlines how the governments of Canada and Ontario will cooperate and coordinate their efforts to restore, protect, and conserve the Great Lakes basin ecosystem and help meet Canada's obligations under the Canada-U.S. Great Lakes Water Quality Agreement.

Visit the governments of Canada and United States Great Lakes websites for further information:

Great Lakes protection - Canada.ca

Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health - Canada.ca

Great Lakes Restoration Initiative - U.S.

Binational.net – Canada-U.S. Great Lakes Water Quality Agreement

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Introduction

The Canada-United States Great Lakes Water Quality Agreement (Agreement or GLWQA) provides a binational framework for pursuing cooperative domestic actions to restore and protect the water quality of the Great Lakes. Today, strong environmental programs are in place—in cooperation with federal, state and provincial governments, municipalities and local authorities, First Nations, Métis and Tribal governments, industry, nongovernment organizations, and the public—to make progress toward our shared General Objectives under the Agreement (see text box).

About this Report and the Great Lakes Executive Committee

Pursuant to Article 5, Section 2(e) of the GLWQA, Canada and the United States produce and release a binational Progress Report of the Parties every 3 years to document recent binational and domestic actions taken to fulfill the commitments in the Agreement. This report provides an update on key activities called the "2023–2025 Binational Priorities for Science and Action" that were established by the United States and Canada at the beginning of this 3-year period. It also reports on other governmental actions that deliver on Agreement commitments. The development of this report was led by the governments of Canada and the United States in consultation and cooperation with the broader Great Lakes Executive Committee (GLEC).

As described in Article 5 Section 2, the GLEC oversees implementation of the Agreement. The Canada Water Agency (CWA) and the U.S. Environmental Protection Agency (EPA), which serve as chairs, convened meetings of the GLEC twice per year during the 2023–2025 reporting period.

GLEC membership consists of senior representatives of environmental protection and natural resource management agencies within the governments of Canada and the United States, state and provincial governments, Tribal governments, First Nation and Métis peoples, municipal governments, watershed management agencies, and other local public agencies. In addition to its regular meetings, pursuant to Article 6(c), GLEC member agencies also

The General Objectives of the Great Lakes Water Quality Agreement

"The waters of the Great Lakes should:

i. Be a source of safe, high-quality drinking water;

ii. Allow for swimming and other recreational use, unrestricted by environmental quality concerns;

iii. Allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants;

iv. 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;

v. Support healthy and productive wetlands and other habitats to sustain resilient populations of native species;

vi. 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;

vii. 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;

viii. Be free from the harmful impact of contaminated groundwater; and

ix. 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."

provide notification of planned activities that could lead to a pollution incident or could have a significant cumulative impact on the waters of the Great Lakes.

While the report is an extensive account of GLEC member agency efforts over the last 3 years, this report cannot comprehensively describe all the restoration and protection efforts that are being implemented within the Great Lakes basin ecosystem.

This report is organized following the structure of the Agreement itself. The subsequent sections of this report describe implementation progress made under the 10 annexes of the Agreement. The 10 annexes, listed in the side box, address the major environmental issues that can affect the quality of the waters of the Great Lakes.

Major sections of the Agreement and the basic outline of this report:

- Annex 1. Areas of Concern
- Annex 2. Lakewide Management
- Annex 3. Chemicals of Mutual Concern
- Annex 4. Nutrients
- Annex 5. Discharges from Vessels
- Annex 6. Aquatic Invasive Species
- Annex 7. Habitat and Species
- Annex 8. Groundwater
- Annex 9. Climate Change Impacts
- Annex 10. Science

Annex 1: Areas of Concern

Over the past three years, Canada and the U.S. have exceeded their goals for remediating contamination and restoring habitat in communities throughout the Great Lakes basin. Two U.S. Areas of Concern (AOC), Muskegon Lake and the Rochester Embayment, were restored and formally delisted. All management actions are complete, and environmental recovery is progressing at 11 U.S. and 5 Canadian AOCs, setting them on the path for eventual delisting. A total of 29 (20 U.S. and nine Canadian) ecosystem impairments (known as Beneficial Use Impairments, or BUIs) have been addressed, resulting in more communities that are able to swim safely at Great Lakes beaches, have improved drinking water, and can enjoy improved fish and wildlife populations. As part of these clean-up efforts, over 672,000 cubic yards of contaminated sediment have been remediated during this reporting period (575,000 cubic yards in U.S. and over 97,000 cubic yards in Canada). These environmental improvements have also revitalized local economies, with some U.S. studies showing a benefit of $3.35 in economic activity for every $1 invested in the Great Lakes Restoration Initiative. In Canada, the remediation of the Randle Reef contaminated sediment site in the Hamilton Harbour AOC alone is estimated to bring $174 million in economic benefits to the community through job creation, business development and tourism (about $1.25 in economic return for every $1 invested).

Purpose and Overview

The purpose of Annex 1 (Areas of Concern) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to restore beneficial uses that have become impaired due to local conditions at Areas of Concern (AOCs), through the development and implementation of Remedial Action Plans (RAPs) for each AOC designated pursuant to this Agreement.

An AOC is a designated geographic area where significant impairment of beneficial uses has occurred because of human activities at the local level (Figure 1). Forty-three AOCs were designated, including 26 in the United States, 12 in Canada, and five binational areas shared between the two countries.

The Agreement commits the United States and Canada to developing and implementing a RAP for each AOC to restore beneficial uses that have become impaired due to local conditions. A BUI is a reduction in the chemical, physical, or biological integrity of the Waters of the Great Lakes sufficient to cause any of the impairments listed on page 2. All AOCs have a RAP that identifies which of the impairments are present, the criteria used to confirm restoration of these impairments, the remedial measures required for restoration, and the monitoring/evaluation program(s) used to track progress towards restoration. Generally, each AOC has a "RAP Team" of local partners and stakeholders that help develop and implement these plans.

ANNEX IMPLEMENTATION

The U.S. Environmental Protection Agency (EPA) and Canada Water Agency (CWA) co-lead implementation of the AOC Annex. AOC cleanup efforts in the United States are led by EPA, with significant contributions from other federal agencies (National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and U.S. Geological Survey); state, Tribal, and local governments; communities; and non-governmental organizations. Within Canada, the CWA and the Ontario Ministry of the Environment, Conservation and Parks lead actions to restore AOCs, with significant contributions from other federal departments, provincial ministries, municipalities, conservation authorities, First Nations, Métis, and community stakeholders. Working with these key partners, the United States and Canada have continued efforts to restore environmental quality in remaining AOCs.

Key Achievements

- The final BUI – Loss of Fish and Wildlife Habitat – was removed at the Rochester Embayment AOC in September 2023 and the AOC was successfully delisted in October 2024.
- Muskegon Lake AOC was successfully delisted in September 2025.
- For the first time in more than 10 years a BUI, Beach Closings, was redesignated in St. Lawrence River at Cornwall/Akwesasne.
- The Nipigon Bay Remedial Action Plan Completion Report was provided to the AOC community in 2023 and engagement on delisting concluded in 2025.
- In the U.S., all restoration and management actions were completed at Black River, Buffalo River, Eighteenmile Creek, Manistique River, River Raisin, Sheboygan River, St. Clair River, St. Marys River, and Waukegan Harbor.
- In Canada, all restoration actions were completed at Peninsula Harbour, St. Clair River and Port Hope Harbour.
- The United States assessed and removed 20 BUIs in nine AOCs. Canada assessed and removed nine BUIs across six AOCs.
- The United States remediated 575,000 cubic yards of sediment under the Great Lakes Legacy Act. Canada managed over 74,000 cubic meters (over 97,000 cubic yards) of contaminated sediment.

Binational Actions and Achievements

Priority for Action: Implement remedial actions - In the U.S., implement remedial actions to remove BUIs, including sediment remediation actions at the Clinton River, Cuyahoga River, Detroit River, Rouge River, Maumee and Grand Calumet River AOCs; and habitat restoration actions at the Grand Calumet River, Niagara River, Detroit River, and Maumee River AOCs.

Beneficial Use Impairments

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degradation of fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproduction problems
6. Degradation of benthos
7. Restrictions on dredging activities
8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption, or taste and odor problems
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture or industry
13. Degradation of phytoplankton and zooplankton populations
14. Loss of fish and wildlife habitat

Figure 1. U.S. and Canadian Great Lakes Areas of Concern. Map and status of the 43 Canadian and U.S. Great Lakes Areas of Concern designated under the 1987 Canada-U.S. Great Lakes Water Quality Agreement. Credit: EPA and Government of Canada.

Sediment remediation actions

- **Clinton River AOC.** One of the last uncompleted management actions within the Clinton River AOC centers on sediment remediation. Currently, PCB-contamination impacts sediments located inside and outside of the Federal Navigation Channel in the Lower Clinton River. The project is currently conducting evaluations to inform remedial actions that will ultimately lead to delisting the AOC.
- **Cuyahoga River AOC.** Sediment remediation in the Cuyahoga River AOC has begun in the dam pool behind the Gorge Dam. The project totaling over $130 million will include removal of approximately 865,000 cubic yards of contaminated sediment. Remediation of an additional 100,000 cubic yards of contaminated sediments is being evaluated in the Old Channel section of the Cuyahoga River.
- **Detroit River AOC.** Several projects were completed within Detroit River AOC with the goal of improving sediment quality. In 2024, Ralph C. Wilson Centennial Park was unveiled, which caps approximately 3.8 acres of contaminated sediments while providing public leisure space and restored habitat. In Monguagon Creek-Upper Trenton Channel, an ongoing project seeks to remediate 30,000 cubic yards of sediment contaminated with petroleum compounds, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and heavy metals – which will benefit not only the river stretch, but the downstream regions as well.

- **Rouge River AOC.** Several projects within the Rouge River AOC are addressing contaminated sediments. The Lower Rouge River-Old Channel project is ongoing and will remove 70,000 cubic yards of sediments contaminated with PAHs and petroleum compounds.
- **Maumee AOC.** The Maumee AOC had its dredging BUI successfully removed in August of 2024. Future work is planned to address additional sediment contamination, including remediating the lower four miles of Swan Creek and the Lower Maumee River
- **Grand Calumet River AOC. T**hrough the Lake George Canal Middle Capping project, USACE stabilized banks, installed geotextile fabric and sheet pile, and conducted ecosystem restoration. An engineered cap was installed in 2023 over existing sediment to help contain and minimize resuspension of contaminated sediment under partnership with the EPA, the East Chicago Waterway Management District, and Atlantic Richfield-British Petroleum.
- (Other sediment remediation projects beyond these locations identified as Priorities for Action are listed below in the Domestic Actions and Achievements section.)

Habitat restoration actions

- **Grand Calumet River AOC.**
  - USACE restored 7.4 acres of upland and wetland habitat for fish and wildlife in coordination with the EPA as a component of the Lake George Canal Middle sediment remediation project.
  - Within the Grand Calumet River AOC, 900 acres of globally rare dune, swale and shelf wetlands have been restored through the control of woody and herbaceous invasive species through Phases 1 and 2 of the Dune and Swale and Shelf Wetlands Restoration project. In addition, the EPA is funding the U. S. Fish and Wildlife Service to augment native mussel populations in the West Branch of the Grand Calumet River to reduce eutrophication and improve water quality.
- **Niagara River AOC.** After several years of drafting and development, the Habitat Restoration Plan for the Niagara River AOC was published in 2019, detailing 12 habitat restoration projects. Of the 12, over half are either ongoing or completed. Work is expected to continue, resulting in nearly 100 acres of habitat restored.
  - The Ralph Wilson Park Habitat Restoration Project began construction in fall 2023 and was substantially complete fall 2024, with plantings and site restoration work in the shoreline area continuing in 2025. The project removes the collapsing seawall and improves the resilience of the shoreline. Approximately 5.6 acres of restored and created shallow water habitat will provide habitat for fish and other species.
  - Phase II of the Emerald Shiner Fish Passage restoration project began construction in late 2024. The project continues work completed on the initial 78 feet of seawall in Phase I. Work includes existing seawall impairments, and the installation of baffle units designed to reduce the water velocity below what is necessary to support emerald shiner, a critical prey species, migration along approximately 800 feet of seawall. Phase II continues installation of baffles units along the remaining 700 feet of seawall. Once the project is complete, Emerald Shiner will have migratory access to Lake Erie.
  - The Outer Harbor Slip 3 Habitat Restoration is being conducted in three phases – construction of the breakwater, placement of dredged material, and formation of aquatic and sub-aquatic habitat. Construction of the breakwater was completed summer 2024. For the second phase, approximately 285,000 cubic yards of cleaned sediment dredged from the Buffalo River, the site of a previous Great Lakes Legacy Act (GLLA) cleanup, will be placed over a six-year period (an estimated three cycles) in Slip 3. This will create 6.7 acres of coastal wetland habitat. Great Lakes Restoration Initiative (GLRI) funds are being leveraged with a match from the Erie Canal Harbor Development Corp. USACE is the lead on the project, through an interagency agreement with the EPA.
- **Detroit River AOC.**
  - Owned and managed by USFWS, Sugar Island is part of the Detroit River International Wildlife Refuge and is one of the most important

spawning areas for fish in western Lake Erie. This project enhanced fish and wildlife habitat through the restoration and stabilization of 1,600 feet of shoreline and the strategic construction of five habitat shoals, over five acres of marsh, and 20 acres of submergent wetland. NOAA's Office of Habitat Conservation funded the project's engineering, design, and construction phases through the GLRI and a regional partnership with the Friends of the Detroit River. The restored area was completed in 2024, which now provides habitat for native Great Lakes fish, amphibians, reptiles, and birds.

- South Hennepin Marsh is an important coastal marsh is in the Trenton Channel of the Detroit River that provides habitat for lake sturgeon, walleye, bass, and northern pike. The original shoals eroded over time, leaving the marsh exposed to stressors, such as boat traffic, wave action, and ice flows that degraded the habitat. Through a NOAA partnership grant, the Friends of the Detroit River led the effort to rebuild the shoals and restore the marsh. The project was completed in 2023, with over 1,130 linear feet of shoals constructed to protect 25 acres of marsh habitat.

Detroit skyline as seen from across the Detroit River, in Windsor, Ontario. Credit: Steven_Kriemadis @ iStock.

- **Maumee AOC.** A wide set of projects are increasing the amount of viable habitat across the Maumee AOC. These include, but are not limited to, i) an expansion of the Maumee State Forest, expected to restore a total of 140 acres of oak-dominated woodlands, ii) 155 acres of coastal wetland habitat restored and reconnected to Lake Erie's hydrology at Cedar Point National Wildlife Refuge , and iii) a stream restoration at Oregon Recreational Complex, which restored approximately 3.5 acres of floodplain habitat. Additional projects addressed Turtle Creek, Howard Marsh and Blue Creek Stream, among others. Work is expected to continue.
- (Other habitat restoration remediation projects beyond these locations identified as Priorities for Action are listed below in the Domestic Actions and Achievements section.)

Priority for Action: Implement remedial actions - In Canada, implement remedial actions to remove BUIs, including sediment remediation actions at the Hamilton Harbour AOC (Randle Reef) and Port Hope Harbour AOCs; habitat restoration actions in the Detroit River, Hamilton Harbour, St Marys River and Thunder Bay AOCs; and nutrient reduction actions at the Hamilton Harbour, Toronto, Bay of Quinte, and St. Lawrence River AOCs.

Sediment remediation actions

- **Randle Reef, Hamilton Harbour.** As previously reported, in 2021, a 6.2-hectare engineered containment facility (ECF) was constructed over the most contaminated area of sediment, and the surrounding contaminated sediment was dredged for placement within the ECF. Work began in 2023 to cover and seal the ECF with a multi-layered environmental cap, and a major milestone was achieved in 2024 with the placement of the flexible membrane layer, effectively sealing the contaminants and isolating them from the environment.

Aerial view Randle Reef, Hamilton Harbour. Credit: CWA.

Aerial View Port Hope Town and Plant, Port Hope. Credit: jimfeng @ iStock.

Capping of contaminated sediment at St. Clair River. Credit: CWA.

- **Port Hope.** Remediation work in the harbour began in 2019 and was completed in 2025. The work includes strengthening harbour sheet pile walls, dredging contaminated sediment within the inner harbour and disposing of the dredged material in a nearby, specially designed landfill. A total of 97,000 cubic meter of contaminated sediment was managed as part of this project.
- **St. Clair River.** In addition to the above priorities, sediment remediation was completed at St. Clair River in 2025. For decades, industrial activities along the Canadian side of the St. Clair River released pollutants, including mercury, into the river. Mercury is a persistent toxic substance that can bioaccumulate in the food web. The last management action in this AOC was completed in 2025 when DOW placed an erosion resistant gravel cap over approximately 11,000 cubic meters of mercury contaminated sediment in three depositional zones. The cap will improve water quality and ecosystem health in the river by preventing the contamination from migrating downstream and by minimizing environmental exposure.

Habitat restoration actions

- **Detroit River.** CWA, in partnership with the Essex Region Conservation Authority (ERCA) and local landowners, is finalizing designs and permits for two key wetland restoration projects. The first project will enhance aquatic habitat and support rare species by repairing eroded sections of a finger dyke to protect the largest wetland complex and wild celery bed on the Canadian side of the river. This dyke is essential to shield the wetland habitat against erosional forces. The second project aims to restore historic wetlands at the south end of Fighting Island where erosion and changing water levels have washed away natural habitat. The project involves building six arc-shaped rock berms to serve as natural barriers, creating a sheltered embayment to support the return and growth of wetland plants.
- **Hamilton Harbour.** The Bird Islands project aims to repair a set of specific nesting locations to provide necessary habitat for colonial waterbirds. On-site investigations and surveys were concluded, alternatives for design were assessed and a recommendation was presented to an advisory group of local subject matter experts. The next steps for this project are detailed design and construction. Work continues to maintain and improve habitat in Cootes Paradise and Grindstone marshes.
- **Thunder Bay.** Projects are underway to implement a Wildlife Habitat Strategy for the AOC, focusing on riparian and coastal habitat improvements in five targeted areas within the AOC. Projects currently being delivered by local proponents include:

Cootes Paradise, Hamilton, Ontario. Credit: davidfillion @ iStock.

Erosion control structure along Ashbridges Bay Landform. Credit: Toronto and Region Conservation Authority.

- revitalizing 10 kilometers of aquatic habitat along the Neebing-McIntyre floodway corridor by the Lakehead Region Conservation Authority;
- adding marshes, bioswales and habitat bridges and culverts at a former industrial property known as Pool 6 by the City of Thunder Bay and Lakehead University;
- improving fish passage between Lake Superior and a 50-kilometer segment of cold-water spawning habitat in the Current River by the North Shore Steelhead Association;
- stream restoration and wetland rehabilitation at the Fine Papers Site by Lakehead University to restore nearshore aquatic habitat, stabilize wetlands, and re-establish diversity; and
- Implementation of the Shoreline Protection Program including the restoration of 35 shoreline and riparian sites (total of 7425 square meters) by Lakehead Region Conservation Authority.

Nutrient reduction actions

- **Hamilton Harbour.** The completion of upgrades to the Woodward Wastewater Treatment Plant in 2023 was a significant milestone for the Hamilton Harbour Remedial Action Plan, reducing total phosphorous loading to Hamilton Harbour by nearly 30 percent. Next steps will focus on upgrades to the Dundas sewage treatment plant and addressing phosphorus inputs from tributaries to further improve water quality in the AOC.
- **Toronto and Region.** Implementation of the Don River and Central Waterfront Combined Sewer Overflow project is underway to capture, store and treat combined sewer discharges. The 25-year, $3 billion project is targeted for completion by 2038. The Ashbridges Bay Wastewater Treatment Plant landform, designed to provide additional space for treatment infrastructure, is approximately 95 percent complete and the opening is planned for the summer of 2026. Stage 1 of the Coxwell bypass tunnel, intended to capture and store stormwater was completed in May 2025. The Ashbridges Bay Treatment Plant Outfall project is approximately 95 percent complete. This project involved construction of a 3.5km tunnel under Lake Ontario to improve capacity and reduce the nearshore impacts of treated effluent. The tunnel is flooded and commissioning is scheduled for the end of 2026.
- **Bay of Quinte.** Canada and Ontario continue to support nutrient reduction actions delivered by the Lower Trent Conservation Authority, including programs to encourage adoption of rural and urban Best Management Practices. These are expected to be completed in 2025-2026. Agricultural land, along with urban point sources and urban non-point sources are the main sources of phosphorus to the Bay of Quinte, and a Phosphorus Management Plan is being developed to ensure continued reductions from these sources in the future and to address

impacts from legacy phosphorous in the sediments within the Bay of Quinte.

- **St. Lawrence River.** Canada and Ontario continue to support nutrient reduction actions delivered by Raisin Region Conservation Authority, including implementation of Agricultural Stewardship Best Management Practice projects on private lands to improve watershed health. These projects are expected to be completed in 2025-2026 and represent the initial implementation of a local Eutrophication Strategy being developed to ensure the long-term health of the St. Lawrence River.

Priority for Action: Complete delisting processes - In the U.S., complete the delisting process, including the public comment period, for the Rochester Embayment and Muskegon Lake AOCs.

- New York's Rochester Embayment was successfully delisted in October 2024 following a public comment period. Throughout the remediation process, eight habitat restoration projects were completed and funded by nearly $14 million dollars. As a result of these projects, 275 acres of habitat and 30,000 feet of wetland channeling have restored the physiological and biological integrity of critical habitat embayment areas of the AOC.
- Muskegon Lake AOC was formally delisted in September 2025, following a public comment period. Seven restoration projects resulted in 190,000 cubic yards of contaminated sediment removal, restoration of 134 acres of habitat, and removal of 110,000 tons of logging-era sawmill debris.

Nipigon Bay. Credit: Dave Crawford.

Priority for Action: Complete delisting processes - In Canada, finalize the Nipigon Bay RAP Completion Report and undertake a process to engage local governments, First Nations, Métis and the public in the delisting of this AOC.

- Over the last three years, the Nipigon Bay RAP Completion Report has been updated to reflect the 2021 upgrade of the Red Rock Wastewater Treatment Plant from primary to secondary treatment, as well as document the redevelopment of the former paper mill site. The process to engage local governments, First Nations, Métis and the public in the delisting of this AOC is scheduled for completion in 2025.

Priority for Science: Conduct sediment sampling - In the U.S., conduct sediment sampling activities necessary for the implementation of sediment remediation projects in Areas of Concern (AOCs), including sampling in the Detroit River, Grand Calumet River and Niagara River AOCs.

- **Detroit River AOC.** A project is currently underway in the Upper Trenton Channel, seeking to remediate sediment contaminated with PAHs, polychlorinated naphthalenes (PCNs), non-aqueous phase liquid (NAPL), PCBs, mercury, and high pH, with a Final Remedial Design completed in July 2025. Additional sampling efforts across the entire Detroit River AOC are on-going in coordination with Michigan Department of Environment, Great Lakes, and Energy. Remedial Investigations cover six separate target areas within the AOC and are planned for completion in 2026.
- **Grand Calumet River AOC.** In 2024, field investigation work was conducted along the Junction Reaches footprint to geotechnically characterize sediment and near-shore banks to support remedial design activities. In 2024 and 2025, EPA and U.S. Steel worked together to characterize the nature and extend of sediment impacts within the Eastern 5 Miles of the Grand Calumet River and Marquette Lagoons.
- **Niagara River AOC.** Sediment contamination is a large impediment for the Niagara River AOC, with several BUI designations linked to it as the cause of impairment. The Niagara AOC Sediment Workgroup, which includes technical staff from

New York State Department of Environmental Conservation (NYDEC), GLNPO, USACE, U.S. Geologic Survey, and U.S. Fish and Wildlife Service, continues to evaluate the chemical and biological conditions within the AOC and its tributaries. Data gathered will inform decisions on where sediment remediation is required and establish baselines to support future BUI removals. Based off the evaluations and recommendations by the Sediment Workgroup, NYDEC and the EPA agreed upon the AOC boundary expansion to incorporate four additional tributaries in fall 2023. The addition of one more tributary is pending.

- (Other sediment sampling projects beyond these locations identified as Priorities for Action are listed below in the Domestic Actions and Achievements section.)

Priority for Science: Conduct sediment sampling - In Canada, conduct sediment sampling activities necessary for the implementation of sediment remediation projects in AOCs including Thunder Bay, St. Marys River, St. Clair River, Niagara River, and St. Lawrence River AOCs.

- **Thunder Bay.** Canada, Ontario, and the Thunder Bay Port Authority have confirmed the feasibility of the remedial approach recommended by a local working group in 2022. This approach involves removing the contaminated sediment from its current location and placing it in an onsite confined disposal facility that would be built as part of the remediation.

View of downtown Thunber Bay Ontario. Credit: sianc @ iStock.

- **St. Marys River.** The Contaminated Sediment Management Strategy for the Canadian side of the AOC outlines specific management actions for targeted locations along the river. Active science and monitoring are ongoing at a federal waterlot owned by Transport Canada to assess natural recovery. In October 2023, sediment sampling was undertaken to evaluate improvements over time. Nine stations at the waterlot were assessed for sediment chemistry and toxicity, with eight stations found to require no further actions and one station determined to require follow-up monitoring in 2028.
- **St. Clair River.** Managing mercury-contaminated sites has been a top priority for this AOC. In March 2025, mercury-contaminated sediment was successfully managed in three key areas downstream of Sarnia's industrial complex on the Canadian side of the St. Clair River. Fine gravel was used to cover the areas, effectively isolating the contamination and preventing any further environmental risks to the river. The total area capped was approximately 1.09 hectares or slightly more than two football fields and the average thickness was 25 centimeters. This final action to complete the implementation of the St. Clair RAP was funded by Dow Canada.
- **Niagara River.** One contaminated sediment site, located at Lyons Creek East, requires management action on the Canadian side of the AOC. Sediment sampling and other studies were carried out from 2022 to 2025 to support the evaluation of sediment management options for parts of the creek that require remediation to address on-going contamination issues not managed by monitored natural recovery.
- **St. Lawrence River.** A long-term monitoring plan is in place to assess the recovery of mercury-contaminated sediments along the Cornwall, Ontario waterfront. Monitoring sediments, invertebrates, fish tissue, and sediment stability took place in 2022-2023 and was compared against 2017 baseline conditions. Monitoring results provide evidence of system recovery over time, the processes that are controlling system recovery, and whether recovery is occurring at a rate sufficient

to meet the objectives of the Cornwall Sediment Strategy. The next survey is scheduled for 2027.

Priority for Science: Conduct monitoring to confirm beneficial use impairment (BUI) criteria have been met - In the U.S., conduct monitoring activities to confirm that BUI removal criteria have been met in the following AOCs: Waukegan Harbor for the Restrictions on Fish Consumption BUI; River Raisin for the Bird or Animal Deformities or Reproduction Problems BUI; Muskegon Lake for the Degradation of Benthos BUI; and Black River for the Degradation of Fish Populations, Benthos, and Loss of Fish Habitat BUIs.

- **Waukegan Harbor.** All management actions have been completed in Waukegan Harbor AOC; post-dredging fish tissue sampling occurred in 2025 to inform the remaining Restrictions on Fish Consumption BUI. The U.S. worked with state partners to develop a revised monitoring plan with targeted species and analysis is ongoing.
- **River Raisin.** Monitoring is ongoing to determine whether BUI criteria have been satisfied regarding the Bird or Animal Deformities or Reproduction Problems.
- **Muskegon Lake.** Assessments of benthic macroinvertebrate data indicated that communities had improved from initial conditions and that BUI removal criteria were being met in the AOC. The Degradation of Benthos BUI was removed on October 31, 2024, which was the final BUI removal.
- **Black River.** All management actions have been completed at the Black River AOC. The Degradation of Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat BUIs have been removed following monitoring. Monitoring is ongoing to assess whether BUI criteria have been satisfied regarding the Degradation of Benthos BUI. It is anticipated that this BUI will be removed by the end of 2027.
- (Other monitoring and BUI removals beyond these locations identified as Priorities for Action are listed below in the Domestic Actions and Achievements section.)

Priority for Science: Conduct monitoring to confirm beneficial use impairment (BUI) criteria have been met - In Canada, conduct monitoring activities to confirm that BUI delisting criteria have been met in AOCs, including: Jackfish Bay and Niagara River for the Loss of Fish and Wildlife Habitat BUI; Thunder Bay and St. Marys River for the Degradation of Fish and Wildlife Populations BUI; Bay of Quinte and St. Lawrence River for the Eutrophication and Undesirable Algae BUI.

Fish and Wildlife Habitat

- Preliminary assessments have been undertaken to determine how recovery efforts have impacted the Loss of Fish and Wildlife Habitat BUI for the Canadian side of the Niagara River AOC. The assessments also identify data gaps that will be filled in a final evaluation based on established delisting criteria.
- Niagara River monitoring was completed for both the Degradation of Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat BUIs. For the former, a BUI assessment report and community engagement process has been completed with a recommended change in BUI status to "not impaired;" Canada and Ontario's review of this recommendation will be complete in 2025. For the latter, an assessment report is in preparation for community engagement to start in 2026.

Niagara Glen park and Niagara River in Canada before Niagara Falls. Credit: DoraDalton @ iStock.

Fish and Wild Populations

- Thunder Bay monitoring was completed. A BUI assessment and community engagement process led to the BUI being redesignated "not impaired" in May 2025.

- St. Marys River monitoring was completed. A BUI assessment and community engagement process led to the BUI being redesignated "not impaired" in January 2024.

Eutrophication

- Bay of Quinte surface-water collection and analysis took place annually from March to October at several locations to assess conditions related to excess nutrient loading in the AOC.
- St. Lawrence River water quality sampling was conducted in 2022, 2023 and 2025 at several nearshore and offshore sites in Lake St. Francis, including five sites in Akwesasne. Total phosphorus concentrations were compared to the relevant guidelines and AOC delisting criteria to support a partial assessment of the Eutrophication or Undesirable Algae BUI, and to update baseline conditions to inform the development of a local Eutrophication Strategy.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, the United States and Canada pursued a variety of domestic projects that also support Annex 1 (AOCs).

United States

Other Sediment Remediation actions

Efforts to improve and remediate sediment quality are ongoing in additional AOCs across the Great Lakes Basin, including:

- **St. Louis River AOC.** Five additional projects were completed under the Great Lakes Legacy Act.
  - The EPA and U.S. Steel worked with project partners to remediate contaminated sediment from Spirit Lake, a large open area in the St. Louis River AOC near the former U.S. Steel plant in Duluth, Minnesota. The Spirit Lake GLLA Project began implementation in 2020 and continued throughout 2023, with approximately $186.5M in funding through a partnership with the United States Steel Corporation. The project remediated contaminated sediment from Spirit Lake, a large open area in the St. Louis River AOC near the former U.S. Steel plant in Duluth, Minnesota. The project included dredging 460,000 cubic yards of contaminated sediment, placing 119 acres of sediment cap, and placing material into two on-site confined disposal facilities.
  - With approximately $42 million in funding from GLRI, WDNR, MPCA, and industry partners, a project at Munger Landing was completed in 2023, removing 100,000 cubic yards of contaminated sediment, including beneficial use of sediment from upstream to create 8 acres of fish spawning habitat. The project restored a community motorboat launch, fishing pier, and created an ADA accessible sandy kayak launch.
  - The EPA and an industrial partner removed 5,000 cubic yards of contaminated soil and sediment at Snively Creek to address source control needs for Munger Landing in 2023.
  - A project in Thomson Reservoir, began implementation in 2024, with approximately $35 million in funding from GLRI, MPCA and industry partners that addresses 225,000 cubic yards or sediment contaminated with dioxin/furans. The reservoir is commonly used for paddling sports and recreation. A partnership between the EPA, the C. Reiss Company, the Wisconsin Department of Natural Resources, and the U.S. Army Corps of Engineers remediated contaminated sediment within the C. Reiss Slip in Superior, WI. The project was completed in June 2024 with approximately 20,000 cubic yards of contaminated sediment removed from the slip and permanently contained on-site.
  - The EPA, USFWS, the City of Superior, the Wisconsin DNR and an industrial partner finished remediation Pickle Pond in 2024. This effort included removal of 16,500 cubic yards of polluted sediment remediation as well as significant habitat restoration for fish and birds.
- **Milwaukee Estuary AOC.** Five additional projects were completed as part of the $476 million GLLA Sediment Remediation project. The following progress was completed between 2023 and 2025:
  - Five Focused Feasibility Studies were completed to determine cleanup alternatives to address all

remaining contaminated sediment. Final data gap sampling, technical evaluations, and extensive treatability study analyses were performed as part of the Pre-Design Investigation. The remedial design was initiated by GLNPO and their contractors.

  - We Energies performed two sediment cleanups as part of the GLLA project, remediating over 46,000 cubic yards of contaminated sediment.

  - Milwaukee Metropolitan Sewerage District (MMSD) completed the design and initiated the construction of a new Dredge Material Management Facility for ultimate placement of contaminated sediment.

- **Torch Lake AOC.** Between 2023 and 2025 the Focused Feasibility Study and the Remedial Design to address contaminated sediment and mining stamp sand waste were completed in a GLLA partnership with Honeywell, in close coordination with the Michigan EGLE, Keweenaw Bay Indian Community, and other community stakeholders. A Drum Removal Pilot Study was performed at the Hubbell Processing Area to evaluate the feasibility of removing drums from the lakebed at various water depths, also in partnership with Honeywell.

Other Habitat Restoration Actions

- Efforts to restore habitat are ongoing in additional AOCs across the Great Lakes Basin, including:

  - **Milwaukee River AOC.** Two additional major habitat restoration projects were completed:

    - Kletzsch Dam Fish Passage Restoration – Kletzsch Dam was one of the largest remaining barriers to fish passage on the Milwaukee River, and repairs were needed to maintain the safety and functionality of the dam. To address this barrier and allow native fish to move upstream while keeping the historic dam intact, MMSD designed and constructed a channel that bypasses the dam to the east, creating an open stream passageway. The passageway allows fish in the Milwaukee Estuary to move from Lake Michigan to upstream areas encompassing 25 miles of river, 29 miles of tributary streams, and 2,400 acres of wetlands, significantly contributing to broader efforts to improve fish passage in the AOC and the Milwaukee Estuary watershed. Construction of the channel was completed in December 2023, and fish regularly use the channel to move upstream of the Kletzsch Dam.

    - South Shore Park was opened on September 2025, following a rehabilitation project to improve swimming quality. The swimming beach was relocated south to an area with improved water circulation and the former site was transformed into a greenspace.

  - **Black River AOC.** The final Management Action Project for the Black River Area of Concern was completed in 2024, restoring more than 14 acres of uncovered steel slag and steel mill waste areas along the Black River. This project stabilized and revegetated 5 areas of steel slag piles, improving stability, reducing erosion, and improving habitat for wildlife. Completing all Management Action Projects represents a significant milestone in the work and improvements made across the entire AOC.

  - **St. Louis River AOC.** Two additional major habitat restoration projects were completed:

    - At the Spirit Lake GLLA Project site, habitat restoration and habitat enhancement efforts were completed across 138 acres. Plantings took place through fall 2024 in upland and in-water portions of the site. This work will improve the aquatic ecosystem by creating new public waters, including a 42-acre shallow sheltered bay, restoring open-water aquatic habitat for fish spawning, and restoring wetlands. Additional recreational features were completed in summer 2024, including a pedestrian trail, interpretive signage, a publicly accessible waterfront with fishing, and canoe-kayak launches.

    - Significant wild rice restoration and seeding efforts continue across the AOC. These encompass several projects, including: in Mud Lake, where wild rice provides critical habitat for marsh birds; Allouez Bay, where vegetation removal allowed wild rice re-establishment; and a continuing project dedicated to restoring culturally and ecologically significant species throughout the AOC. These projects are

supported through the GLRI by the EPA, the Minnesota DNR, the Wisconsin DNR, the St. Louis River Alliance, the Manoomin Restoration Partnership, and others.

- **Rouge River AOC.** A variety of habitat restoration projects were substantially completed, including construction both in-water (Wilcox, Pheonix, and Nankin lakes) and on land (Lower Rouge Reforestation, Riverview Park, Lawrence Technological University Wetland). Habitat restoration and enhancement were completed across 8 project sites, totaling approximately 120 acres. 50 miles of the Rouge River were reconnected by the construction of fish passage at the Henry Ford Estate Dam. Vegetation maintenance will continue 1-2 years after construction is complete.
- **Torch Lake AOC.** In 2024, a Benthos Pilot Study was completed which demonstrated benthos population improvement on restored shorelines containing mining stamp sand material. This work was implemented by the Michigan Department of Environment, Great Lakes, and Energy, with support from the GLRI. Planning and technical advice was provided by the Torch Lake Public Action Council, federal agencies, state agencies, industry partners, Michigan Technical University, in addition to GLIFWC and its member tribes, including the Keweenaw Bay Indian Community.

Other monitoring and BUI removals

- Efforts to monitor and remove BUIs are ongoing in additional AOCs across the Great Lakes Basin, including:
- Monitoring was completed for the Degradation of Fish and Wildlife Populations and Degradation of Benthos BUI at the Eighteenmile Creek AOC, these BUIs were removed in September 2024 and August 2025, respectively.
- Monitoring was completed for the Loss of Fish and Wildlife Habitat, Degradation of Benthos, and Fish Tumors or Other Deformities BUIs at the Buffalo River AOC, these BUIs were removed in July 2023, September 2023, and September 2024, respectively.
- In 2023, the first watershed-scale monitoring effort in Saginaw region began to support the future removal of the Eutrophication or Undesirable Algae BUI for the Saginaw River & Bay AOC.
- Engagement with Public Advisory Committees and partnership with federal and state agencies will continue to be a priority in monitoring for these and other BUI removals in the U.S. AOCs.

Communicating Fish Consumption Guidelines to Detroit Anglers

- Michigan Department of Health and Human Services supported the Detroit River Walker Program. In this program, designated River Walkers communicate Michigan's Eat Safe Fish guidelines information directly with Detroit River shoreline anglers. During the past six years, River Walkers have interacted with over 15,000 people fishing along the river and through more than 100 community outreach events in the Detroit area held by local organizations.

Detroit River, Belle Isle State Park in Detroit, Michigan. Credit: Davslens Photography @ iStock.

Canada

- **Toronto and Region AOC's Don Mouth Naturalization and Port Lands Flood Protection Project.** A major milestone was reached in November 2024 when the Don River began flowing through the newly constructed river valley—part of the $1.5 billion Don Mouth Naturalization and Port Lands Flood Protection project. During construction of the river valley from 2019-2023, reinforced sections called "plugs" prevented the flow of water. Starting in January 2024, the river was gradually filled with water, and the plugs were removed in stages – starting with the west plug in July 2024, followed by the north plug in November 2024, which

reconnected the Don River to Lake Ontario through the Port Lands. This transformative waterfront revitalization effort, located in Toronto's inner harbour, adds 30 hectares (74 acres) of new aquatic and riparian habitat to the AOC. The project included excavation of 1.4 million cubic meters of soil to contour the bottom, banks, floodplains, and mouth of the Don River. Woody material and boulders, cobbles, and gravels were installed in the new channel to create aquatic habitat. The project established two new coves for fish and wildlife habitat as part of the revitalization. Native fish species, including largemouth bass, pike, pumpkinseed, bluegill, rock bass, and white sucker, now frequently use the new habitat. With this foundational work complete, where 39.6 hectares (98 acres) of prime land for development and green space have now been unlocked on the newly renamed island of Ookwemin Minising.

Don Mouth Naturalization and Port Lands Flood Protection Project. Credit: Waterfront Toronto.

- **Peninsula Harbour.** As reported in the previous Progress Report of the Parties, the Peninsula Harbour AOC has one remaining BUI – Restrictions on Fish Consumption. With the completion of community fish consumption surveys for the AOC in 2024, the last action required under the Remedial Action Plan is now complete and the assessment of this last BUI is underway. Results will be discussed with the community starting in 2026.

More information about the U.S., Canadian, and binational AOCs is online at EPA's Great Lakes AOCs, Canada's Great Lakes AOCs, and local RAP websites.

Table 1. Progress towards Removing Beneficial Use Impairments in the United States Great Lakes Areas of Concern

★ BUI Previously Removed ♦ BUI Removed 2023–2025 ■ BUI Impared

AOC	State	Restrictions on fish and wildlife consumption	Tainting of fish and wildlife flavor	Degradation of fish and wildlife populations	Fish tumors or other deformities	Bird or animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions on drinking water consumption, or taste and odor problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phytoplankton and zooplankton populations	Loss of fish and wildlife habitat
Ashtabula River Delisted	OH	★ 2014		★ 2014	★ 2020		★ 2018	★ 2020							★ 2014
Black River	OH	★ 2017		♦ 2025	♦ 2024		■	★ 2022	★ 2017		♦ 2024	★ 2021			♦ 2025
Buffalo River	NY	■	★ 2020	■	♦ 2024		♦ 2023	★ 2022				★ 2018			♦ 2023
Clinton River	MI	■		■			■	■	■		❖ 2025	★ 2020			■
Cuyahoga River	OH	★ 2019		■	♦ 2023		■	■	★ 2021		♦ 2024	★ 2018			■
Deer Lake Delisted	MI	★ 2014				★ 2011			★ 2011						
Detroit River	MI/ ON	■	★ 2013	■	■	■	■	■		★ 2011	■	■			■
Eighteenmile Creek	NY	■		♦ 2024		■	♦ 2025	★ 2020							
Grand Calumet River	IN	■	■	■	■	■	■	■	■	★ 2012	■	■	★ 2011	■	■
Kalamazoo River	MI	■		■		■	■	■			★ 2011	★ 2012			■
Lower Green Bay/Fox River	WI	■	★ 2020	■	■	■	■	★ 2021	■	♦ 2025	■	★ 2022		■	■
Lower Menominee River Delisted	MI/ WI	★ 2018		★ 2019			★ 2017	★ 2017			★ 2011				★ 2019
Manistique River	MI	■					★ 2007	★ 2021			★ 2010				★ 2008
Maumee	OH	★ 2022		■	■		■	♦ 2024	■		■	♦ 2023	★ 2015		■
Milwaukee Estuary	WI	■		■	■	■	■	■	■		■	★ 2021		■	■
Muskegon Lake Delisted	MI	★ 2013		♦ 2023			♦ 2025	★ 2011	♦ 2024	★ 2013	★ 2015	★ 2022			♦ 2023
Niagara River	NY/ ON	■		■	★ 2016	■	■	■							■
Oswego River Delisted	NY	★ 2006		★ 2006					★ 2006						★ 2006
Presque Isle Bay Delisted	PA				★ 2013			★ 2007							
River Raisin	MI	■		★ 2015		■	■	■	★ 2013		★ 2013	★ 2012			★ 2015
Rochester Embayment Delisted	NY	★ 2021	★ 2018	★ 2021	★ 2015	★ 2022	★ 2017	★ 2019	★ 2019	★ 2011	★ 2019	★ 2022	★ 2011	★ 2016	♦ 2023
Rouge River	MI	■		■	■		■	■	■		■	■			■

Table 1. Progress towards Removing Beneficial Use Impairments in the United States Great Lakes Areas of Concern

★ **BUI Previously Removed** ♦ **BUI Removed 2023–2025** ■ **BUI Impared**

AOC	State	Restrictions on fish and wildlife consumption	Tainting of fish and wildlife flavor	Degradation of fish and wildlife populations	Fish tumors or other deformities	Bird or animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions on drinking water consumption, or taste and odor problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phytoplankton and zooplankton populations	Loss of fish and wildlife habitat
Saginaw River & Bay	**MI**	■	★ 2008	■		■	■	■	■	★ 2008	■	■		■	★ 2014
Sheboygan River	**WI**	■		■	■	■	★ 2021	★ 2015	★ 2016					★ 2021	■
St. Clair River	**MI/ ON**	■	★ 2009			★ 2017	★ 2014	★ 2011		❖ 2025	★ 2016	★ 2012	★ 2012		★ 2017
St. Lawrence River at Massena/Akwesasne	**NY/ ON**	■		■	■	■	■							★ 2015	■
St. Louis River	**WI/ MN**	■		♦ 2023	★ 2019		■	■	★ 2020		■	★ 2014			■
St. Marys River	**MI/ ON**	■		★ 2019	■	★ 2014	■	★ 2018	★ 2017		★ 2016	★ 2014			★ 2019
Torch Lake	**MI**	■			★ 2007		■								
Waukegan Harbor	**IL**	■					★ 2018	★ 2014			★ 2011			★ 2020	★ 2013
White Lake Delisted	**MI**	★ 2013		★ 2014			★ 2012	★ 2011	★ 2012	★ 2014		★ 2014			★ 2014

Table 2. Progress toward Removing Beneficial Use Impairments in Canada's Great Lakes Areas of Concern

★ **BUI Previously Removed** ♦ **BUI Removed 2023–2025** ■ **BUI Impared**

AOC	Restrictions on fish and wildlife consumption	Tainting of fish and wildlife flavor	Degradation of fish and wildlife populations	Fish tumors or other deformities	Bird or animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions - drinking water consumption, taste/odor problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phyto- and zoo-plankton populations	Loss of fish and wildlife habitat
Thunder Bay			♦ 2025			■	★ 2012			♦ 2023	★ 2019	★ 2004		■
Nipigon Bay Delisting Pending		★ 1995	★ 2016			★ 2016	★ 1995	★ 2016			★ 2016			★ 2016
Jackfish Bay In Recovery			■	★ 2010		■	★ 1998							■
Peninsula Harbour	■					★ 2022	★ 2012							
St. Marys River	■		♦ 2024	■		■	♦ 2024	★ 2018		★ 2018	★ 2018			■
Spanish Harbour In Recovery	■		★ 1999			■	★ 2020			★ 1999		★ 1999		
Severn Sound Delisted	★ 2002		★ 2002				★ 2002	★ 2002						★ 2002
Collingwood Harbour Delisted	★ 1994		★ 1994		★ 1994	★ 1994	★ 1994	★ 1994		★ 1994	★ 1994		★ 1994	
St. Clair River	■					■	★ 2018		♦ 2024	★ 2018	★ 2016	★ 2012		■
Detroit River	■	★ 2014	■	★ 2020	♦ 2025	★ 2020	★ 2019		★ 2010	★ 2016	★ 2016	★ 2010		■
Wheatley Harbour Delisted	★ 2010		★ 2010				★ 2010	★ 2010						★ 2010
Niagara River	■		♦ 2025		★ 2009	■	★ 2009	★ 2019		♦ 2023				■
Hamilton Harbour	■		■			■	■	■		■	■			■
Toronto and Region	■		■			★ 2016	★ 2016	■		■	★ 2020			■
Port Hope Harbour							■							
Bay of Quinte	■		★ 2018			★ 2018	★ 2017	■	★ 2020	★ 2019	★ 2022		■	★ 2018
St. Lawrence River at Cornwall/Akwesasne	■		■			★ 2007	★ 2007	■	★ 1997	♦ 2023	★ 1997	★ 1997		■

Annex 2: Lakewide Management

Canadian and U.S. environmental protection and natural resources management agencies work together at the lakewide scale to assess past progress and identify actions to further improve water quality. This work is done on each lake through a multi-agency Lake Partnership: a collaborative team of federal agencies, state and provincial governments, Tribal governments, First Nations, Métis, municipal governments, and watershed management agencies. Through the development of Lakewide Action and Management Plans (LAMPs), governmental partners work together to reduce chemical contamination, eliminate excess nutrients, protect and restore native species and their habitats, manage invasive species, and restore Great Lakes watersheds. During this 3-year period, a new streamlined format for LAMPs was developed and drafts of the Lake Ontario, Lake Erie, and Lake Michigan LAMPs are expected to be released for public feedback in early 2026.

Key Achievements

- Implemented restoration and protection actions identified within the LAMPs in all five lakes;
- Developed a new simplified LAMP document format to streamline publication and draft LAMPs using this new format are expected to be released in early 2026;

Purpose and Overview

The purpose of Annex 2 (Lakewide Management) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to assess the status of each Great Lake; and to address environmental stressors that adversely affect the Waters of the Great Lakes. These stressors are best addressed on a lakewide scale through an ecosystem approach.

Given the size and ecological complexity of the Great Lakes, restoring and protecting water quality requires an approach specifically tailored to an individual lake. In the Lakewide Management Annex, Canada and the United States commit to establishing LAMPs for each of the five Great Lakes and their connecting river systems:

- Lake Superior
- Lake Huron and the St. Marys River
- Lake Erie and the St. Clair River, Lake St. Clair, and the Detroit River
- Lake Ontario and the Niagara River and the St. Lawrence River to upstream of the international boundary, and
- Lake Michigan (for which United States has sole responsibility)

Except for Lake Michigan, as noted above, LAMPs are binational 5-year ecosystem-based strategies that identify and prioritize restoration and protection activities required to attain the General Objectives for each Great Lake. Each LAMP is developed by a Lake Partnership of environmental protection and natural resource management agency representatives working on that lake. LAMPs are updated on a rotating basis, with one of the five lakes being updated each year.

ANNEX IMPLEMENTATION

Canada Water Agency (CWA) together with the U.S. Environmental Protection Agency (EPA) co-lead the implementation of the commitments within Annex 2 (Lakewide Management), with support from a Lake Partnership for each of the Great Lakes. A complete list of agency membership for each lake is found within the respective LAMP.

- Established science and monitoring priorities for the Lake Michigan and Lake Superior Cooperative Science and Monitoring Initiative (CSMI) field years. (See Annex 10 for a discussion of the intensive science and monitoring that occurred during these CSMI field years.)
- Completed Great Lakes nearshore assessments in both the Canadian and U.S. waters of the Great Lakes to guide protection and restoration actions.
- Established science and monitoring priorities for the Lake Huron, Lake Ontario, and Lake Erie Coordinated Science and Monitoring Initiative (CSMI) field years. See Annex 10 for a discussion of the intensive science and monitoring that occurred during these CSMI field years.

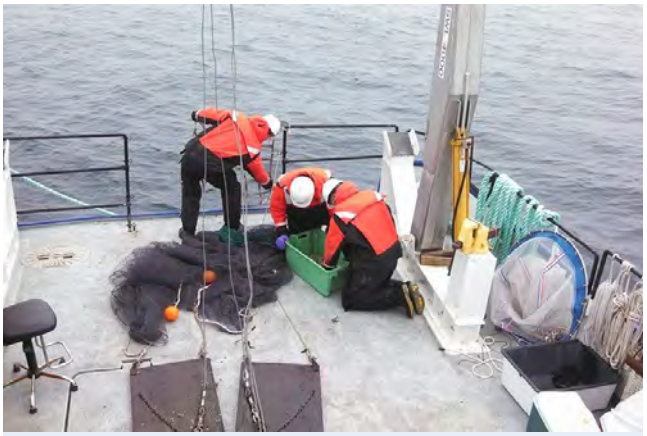
Binational Actions and Achievements

Priority for Action: Implement actions identified in existing Lakewide Action and Management Plans (LAMPs). By the end of 2023, update and publish the Lake Ontario LAMP. By the end of 2024, update and publish the Lake Erie LAMP. By the end of 2025, update and publish the Lake Michigan LAMP. Enhance opportunities for public engagement in the development and implementation of LAMP activities.

- The draft LAMPs for Lake Ontario, Lake Erie, and Lake Michigan are expected to be released in early 2026 for public input.
- Despite publication delays, Lake Partnership agencies continued to undertake protection and restoration actions without interruption (see Domestic Actions and Accomplishments).
- The Lake Partnerships published annual updates and hosted "Let's Talk" webinars to share implementation progress with the public.

Priority for Science: Establish CSMI Priorities. By the end of 2023, establish science and monitoring priorities for the 2025 Lake Michigan CSMI field year. By the end of 2024, establish science and monitoring priorities for the 2026 Lake Superior CSMI field year. By the end of 2025, establish science and monitoring priorities for the 2027 Lake Huron CSMI field year.

- Canada and the United States established science and monitoring priorities for Lakes Michigan, Superior. The Lake Huron priorities are under development. These priorities address issues such as chemical contaminants, nutrient and bacterial pollution, native species and their habitat, aquatic invasive species, and other challenges specific to each lake. They guide CSMI field year activities for each lake to support future management actions.



Sampling in Lake Michigan. Credit: NOAA @ flickr.

Domestic Actions and Achievements

Canada and the United States have pursued extensive protection and restoration projects throughout the Great Lakes watershed, all of which have a benefit to overall lakewide health and further the goals of Annex 2 (Lakewide Management). A full discussion of this work however, is beyond the scope of this document. The following sections highlight examples of actions

Great Lakes coastline and sunset, Lake Ontario. Credit: Douglas Rissing @ iStock.

to reduce chemicals, prevent nutrients and bacterial pollution, protect and restore habitat and species, and prevent and control invasive species. Cross-references are also provided to other parts of this document which highlight other actions that support the goals of lakewide management.

Actions to Prevent and Reduce Chemical Contamination

Canadian and U.S. agencies continue to manage chemical contamination that causes fish and wildlife consumption advisories in the Great Lakes. Highlighted lake-specific activities in 2023–2025 are described below. Other activities that reduce lakewide chemical contamination are described in Annex 1 (Areas of Concern) and Annex 3 (Chemicals of Mutual Concern) sections of this Progress Report of the Parties.

Lake Superior

- In Canada, contamination from substances like Polychlorinated Biphenyls (PCBs), mercury, and pollutants such as Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) continue to pose health risks in Lake Superior, where fish are a vital source of nutrition and are culturally significant, especially for Indigenous and local communities. The State of the Great Lakes reports fish contamination in Lake Superior as "good," with consumption advisories in place, making ongoing monitoring and education essential. A 2023 assessment of Jackfish Bay fish shows recovery, and long-term data from Ontario's Fish Contaminant Monitoring Program indicate significant declines in dioxins, furans, and mercury—particularly in Lake Trout, Lake Whitefish, and Northern Pike—thanks to stricter pollution controls and reduced mercury emissions. Education efforts, including Ontario's interactive Guide to Eating Fish (2023), a Métis Nation of Ontario video, and outreach by the Lakehead Region Conservation Authority, promote informed, safe fish consumption practices, while supporting the fishery's long-term health and sustainability.
- In the U.S., government agencies are raising awareness of fish consumption guidelines across Lake Superior. Lake Superior fish not only serve as a nutritious food source but also hold significant cultural value. The historical decline in contaminants

over the past 40–50 years is a positive trend; advisories persist, however, particularly due to PCBs and mercury. The consumption of fish can be safe if proper guidance is followed. Educating communities, especially those that are heavily reliant on fish, on contaminants and consumption advisories is crucial. The States of Minnesota, Wisconsin, and Michigan all provide fish consumption information, and the Mercury Program for Promoting Safe Fish Consumption by the Great Lakes Indian Fish and Wildlife Commission focuses on communicating information about mercury

Fly fishing for coaster brook trout on Nipigon Bay, Lake Superior. Credit: Eric Berglund, Ontario Ministry of Natural Resources and Forestry.

levels in culturally-significant fish species. Sharing fish consumption information with Great Lakes communities is vital for protecting human health and preserving cultural traditions. Individual tribes such as Keweenaw Bay Indian Community have also developed specific guidance for their communities.

Lake Huron

- In Canada, the Toronto Metropolitan University (TMU), supported by the CWA, developed and piloted cutting-edge technologies designed explicitly for PFAS removal in Canadian wastewater treatment plants. TMU's project explored various treatment technologies, novel bioreactor designs, and microbial formation strategies to effectively capture and break down PFAS within wastewater streams. Their research, published in 2025, can enhance Canada's wastewater infrastructure to meet emerging contaminants' demands and ensure cleaner water.
- In the U.S., the United States Geological Survey (USGS) released a report in 2024 assessing mercury and concentrations in plankton, Dreissenid Mussels, and prey fish (deepwater sculpin, bloater, round goby, and yellow perch), across tributary, nearshore, and offshore regions of Lake Huron. Within the pelagic food web of both areas, higher mercury bioaccumulation was observed in plankton within nearshore zones, which may be attributed to tributary mercury inputs and the redirection of nutrient and energy flow due to Dreissenid establishment (e.g., nearshore shunt). This survey highlighted areas with elevated bioaccumulation factors and has improved understanding of how mercury moves through the ecosystem.

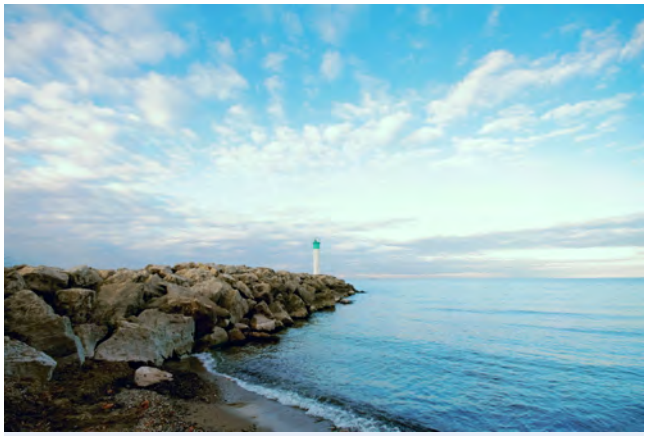
Lake Erie

- In Canada, many areas near roadways exceed the safe threshold of 120 mg/L chloride level for aquatic life due to de-icers and road salts, particularly affecting sensitive species like freshwater mussels. A study by ECCC and Fisheries and Oceans Canada that explores alternative de-icers found that beet juice may be up to 10 times more toxic to mussel larvae than salt brine. However, salt brine contains significantly less total chloride than road salt and poses the least hazard to freshwater mussels.
- In the U.S., the health of Lake Erie continues to be improved through the remediation of polluted sites. In the Buffalo River AOC, monitoring revealed that remedial dredging completed in 2021 – which removed over 1 million cubic yards (760,000 metric tons) – successfully addressed contamination. Cleaner dredged materials from subsequent maintenance dredging are suitable for aquatic and upland beneficial reuse, with no negative toxic effect to benthic organisms. In the Detroit River, the EPA in partnership with the Detroit Riverfront Conservancy, remediated ~30,000 cubic yards of contaminated sediment at the Ralph C. Wilson Jr. Centennial Park just upstream of the Ambassador Bridge. Two additional sediment remediation projects are in design, and remaining investigations are nearing completion. In the Rouge River, the EPA and Honeywell, Inc. are working to clean up

a ¾ mile stretch of the Lower Old Channel. Steel sheet piles are currently being stalled with the goal of dredging in 2026. Along 3 ½ miles of the Main Channel, a Remedial Investigation and Feasibility Study was completed, with design studies pending.

Lake Ontario

- In Canada, the University of Toronto, in partnership with ECCC, identified sources in outdoor textiles, metal coatings, paints, and sealants, which, when applied to exterior surfaces, can release harmful PFAS substances into the environment. This research can inform efforts to further reduce Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA).
- In the U.S, in October 2024, the Rochester Embayment Area of Concern (AOC) was delisted under the Great Lakes Water Quality Agreement, marking a major milestone for the Lake Ontario basin. The Rochester Embayment AOC was the seventh AOC to be delisted or removed from the international list of most impacted areas since the Great Lakes AOC program began in 1987. The Embayment was listed as an AOC due to pollution and ecological degradation associated with the industrialization of Rochester. Actions needed to delist the AOC included remediation of six former manufactured gas plants, removal of thousands of tons of contaminated sediment, and combined sewer overflow mitigation.



Lighthouse on Fifty Point Conservation Area, Lake Ontario. Credit: Orchidpoet @ iStock.

Lake Michigan

- The Chippewa Ottawa Resource Authority (CORA), an inter Tribal fishery management authority for the 1836 Treaty, has maintained a decades long program of monitoring contaminants in fish. The results help inform the public on the risks and benefits of consuming Great Lakes fish. CORA educational outreach includes brochures, social media communications, and live public demonstrations on how to clean and prepare fish to help remove contaminants.

Actions to Prevent and Reduce Nutrient and Bacterial Pollution

Canadian and U.S. agencies continue to manage excess nutrients and investigate the causes and impacts of algal blooms and episodic beach closings in the Great Lakes. Highlighted lake-specific activities from 2023–2025 are described below. Other activities that reduce lake impacts from nutrients are found in the Annex 4 (Nutrients) section of this Progress Report of the Parties.

Lake Superior

- In Canada, The Biigtigong Nishnaabeg community is leading a Lake Superior water quality monitoring initiative, which also raises community awareness of water quality issues and ensures safety of the waters for drinking, food, and recreation. In summer of 2023, *E. coli* testing at three sites showed all met Canadian Recreational Water Quality Guidelines. The initiative also sparked increased youth interest in environmental restoration with plans to expand participation. Complimentary monitoring in Lake Superior by Ontario Ministry of the Environment, Conservation and Parks (MECP) in 2024 at ten nearshore sites found cyanobacteria species, including some toxin-producers, and while blooms were not widespread the study recommended increased monitoring. The Lakehead Region Conservation Authority also confirmed cyanobacteria in four conservation areas in 2024, with one location experiencing a bloom. They are undertaking ongoing monitoring to minimize public exposure to harmful cyanobacteria and their potential toxins. In August 2025, MECP confirmed

the presence of blue-green algae in a water sample in Pukaskwa National Park.

- In the U.S., the Lake Superior Partnership Algal Bloom and Nutrient Subgroup is working to determine factors affecting algae bloom locations and intensity. The group is comprised of federal, Tribal, and state agencies as well as academia cooperatively tracking the frequency, composition, and extent of cyanobacterial blooms within the lake. This information will inform management activities in the Lake Superior National Estuarine Research Reserve. NPS, state agencies, and academic partners continue monitoring nearshore waters at the Apostle Islands to understand drivers of cyanobacteria.

Lake Huron

- In Canada, CWA identified nuisance algae as a growing threat to Great Lakes nearshore waters, impacting water quality, recreation, and ecosystems. In 2023, CWA and Georgian Bay Forever used sonar and an autonomous underwater vehicle to survey southern Georgian Bay, confirming low-density *Cladophora* linked to Quagga Mussels. Data from over 375 sites improved satellite mapping verification of submerged aquatic vegetation and understanding of nearshore health. Further south, the Healthy Lake Huron partnership worked to protect water quality along Lake Huron's southeast shores by tackling nuisance algae and bacterial concerns. MECP and partners addressed algae and bacteria in six priority watersheds, implementing over 600 best management practices, including erosion control, septic upgrades, and shoreline cleanups. Long-term monitoring shows improved water quality. Outreach efforts have engaged tens of thousands in protecting the lake's nearshore health.
- In the U.S., through detailed analysis and sampling, USGS researchers have discovered that microbial genetic markers may be used to quantify non-point source pollution output in Saginaw Bay. Historically, non-point pollution in the watershed has been often difficult to track, due to complex impacts of land uses and watershed properties. In this project, researchers used geographic, geochemical, and microbiological data to investigate relationships between land uses, water quality parameters, and microbial community characteristics. This study leveraged the enormous depth of data encoded in the genetic content of natural microbial communities (1000's of genes per organism and millions of organisms per sample) and unlocked its potential as a novel tracer of watershed properties. Preliminary results show a strong relationship between stream order, (i.e., small tributaries to large rivers) and nutrient load, and changes in microbial community composition and function along the reach of the watershed. Specifically, the information that the microbes contain is more directly tied to land use in smaller watersheds and becomes more complex and integrated in larger streams and rivers.

Shore in Tobermory, Georgian Bay, Ontario. Credit: imagixian @ iStock.

Lake Erie

- In Canada, the Lake Erie Agriculture Demonstrating Sustainability (LEADS) initiative (2018-2023) supported Ontario farmers in improving soil health and water quality within the Lake Erie and Lake St. Clair watersheds. With support from the Canadian Agricultural Partnership and delivered by the Ontario Soil and Crop Improvement Association, LEADS resulted in over 1,100 on-farm projects and 500 risk assessments. The initiative reduced soil loss across 81,000 hectares and retained over 50 metric tons of phosphorus, helping protect local water resources and enhance ecosystem health.
- In the U.S., the National Oceanic and Atmospheric Administration (NOAA) successfully launched a new solar-powered, uncrewed surface vehicle to

improve shallow-water algal sampling. The SeaTrac is capable of accessing water depths less than 1.5 meters deep and can collect and analyze water samples from a bloom with the same methods that scientists use in the lab. The autonomous vehicle can also stay on the lake continuously, continuing to monitor in conditions unsafe for human research teams.

Lake Ontario

- In Canada, in 2023, MECP and McMaster University tested a rapid quantitative polymerase chain reaction (qPCR) method that detects *Enterococcus* bacteria and provides results in under four hours, compared to the 18–24 hours required for traditional *E. coli* testing. Studies at Toronto and Niagara beaches, demonstrated the method's ability to provide timely and accurate beach postings, improving public health protection by speeding up the identification of health-risk days and reducing false positive results. Complementing this work, MECP studied nearshore water quality in Lake Ontario's western basin, finding that tributaries, land inputs, currents, and reduced winter ice cover influence nutrient distribution and nearshore water quality. These efforts show how innovative science and monitoring support faster, more effective responses to nearshore challenges and more effective responses to nutrient-driven algal growth.
- In the U.S., the U.S. Geological Survey assessed nearshore water quality in Lake Ontario's urbanized western basin and released a new water-quality dashboard highlighting the Oswego and Genesee Rivers. The sampling updated the Lake Ontario Nearshore Nutrient Study (LONNS) with 2023 data, building off data collected in 2018, 2013, and 2008. The LONNS approach is designed to characterize the connection between nutrient inputs to tributaries and nearshore water quality along the New York State Lake Ontario shoreline from the Niagara River to Chaumont Bay. USGS also announced the availability of the new online water-quality dashboard for the 24 major U.S. tributaries to the Great Lakes. The dashboard provides a map and graphical displays of percent change in flow and the predicted change in nutrient concentration (phosphorus and nitrogen) and sediment. The two major tributaries monitored in Lake Ontario are the Oswego and the Genesee Rivers. These two projects will be used to evaluate ongoing progress toward nutrient reduction goals.

Lake Michigan

- Scientists from the USGS continued monitoring water quality parameters and the composition of algal blooms within the Green Bay region. A primary focus of this effort is to characterize algal bloom formation and transport from Lake Winnebago to Green Bay, via the Fox River. By conducting surveys throughout the summer months, USGS scientists were able to capture shifts in algal composition across Lake Winnebago, along the Fox River, and Lower Green Bay. The algal composition and molecular data will be used by the Wisconsin Department of Natural Resources and other stakeholders to determine possible management actions to address undesirable algae in Lower Green Bay, based on whether algal blooms are localized or originate from further upstream.

Actions to Protect and Restore Habitat and Species

Canadian and U.S. agencies continue to implement efforts to restore and protect healthy watersheds in the Great Lakes. Highlighted lake-specific activities in 2023–2025 are described below. Other activities that support a healthy watershed through habitat restoration are found in the Annex 7 (Habitat and Species) section of this Progress Report of the Parties.

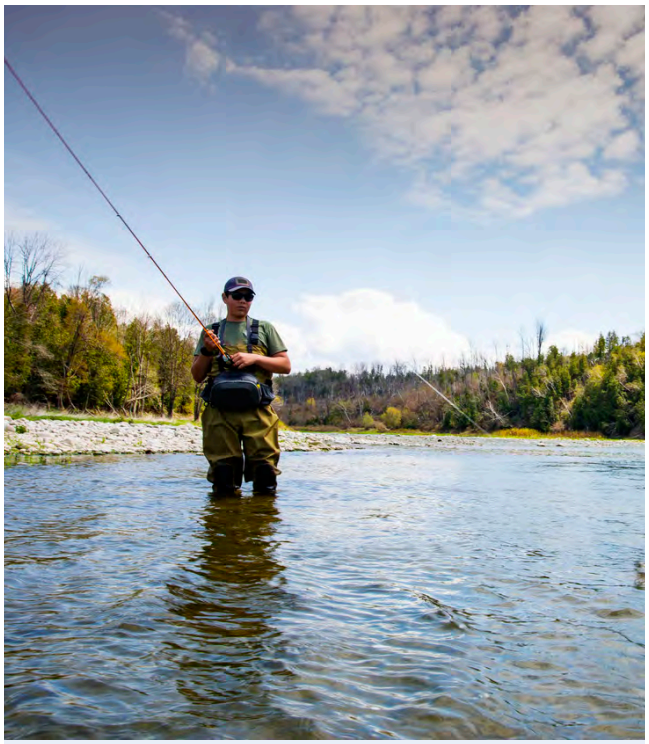
Evanston and its shores, Lake Michigan. Credit: Oren Ravid @ iStock.

Lake Superior

- In Canada, walleye populations in Black Bay, once the cornerstone of Lake Superior's north shore fishery, have declined from their historic levels due to overfishing and habitat degradation. Since 2016, the Ontario Ministry of Natural Resources (MNR) has tracked walleye movement using acoustic telemetry, revealing spawning activity in the Black Sturgeon River and Black Bay. Approximately 60 percent of tagged walleye migrated upriver. Monitoring indicates population improvements will help guide efforts to restore and manage this vital fishery. A Draft Black Bay Fisheries Management Plan was developed in 2025 and public consultation on the plan closed September 2025. Meanwhile, habitat restoration in the Thunder Bay Area of Concern is improving riparian and coastal ecosystems with support from the Canada Water Agency, MECP, and MNR. Community partners' projects have included stormwater management, wetland development, shoreline stabilization and restoration, and invasive species control.
- In the U.S., bottom trawling surveys for fish in the Saint Louis Estuary are completed spring, summer, and fall each year by the 1854 Treaty Authority. The surveys are used to develop an index of fish populations and complete early detection for invasive species. No new invasive fish species were detected. Annual results indicate a fluctuating population of a variety of native fish species, with the prevalence of existing invasive fish species at lower and stable levels. For wild rice, an updated plan was completed in 2024 to manage vegetation control, wild rice seeding, herbivory management, and monitoring of wild rice growth. Since 2015, the cooperative network of partners, including Wisconsin DNR, 1854, Red Cliff, and others, have seeded 80,000 pounds of wild rice (nearly 21,000 pounds from 2022-2024) over about 260 acres of restoration area. Monitoring results are summarized annually and show continuing restoration success with this ongoing effort. In 2023, the Michigan DNR seeded 21 acres with 1,986 pounds of germination-ready rice, through partnership with the Keweenaw Bay Indian Community.

Lake Huron

- In Canada, degraded streams and eroded shorelines across the Great Lakes threaten water quality, aquatic habitat, and ecosystem resilience. In 2023, the Severn Sound Environmental Association planted 12,000 native trees and shrubs with community support. The Maitland Valley Conservation Authority and partners, in 2023, restored Naftel's Creek by removing a dam and creating an offline wetland, improving water quality and restoring 4 kilometers upstream connectivity for fish migration. These efforts enhance habitat for cold-water species, including self-sustaining brook trout populations, supporting the long-term health of the ecosystem.



Fishing on a tributary of Lake Huron. Credit: Fertnig @ iStock.

- In the U.S., invasive zebra and quagga mussels have been negatively impacting the Great Lakes region since their introduction in the 1980s. Among other impacts, invasive mussels clog fish spawning reefs, potentially decreasing native fish spawning success. The Spawning Whitefish and Invasive Mussels (SWIM) Project – a cooperative effort including U.S. federal agencies, state, Tribal, and academic entities

– was launched to improve understanding of whitefish spawning and reduce potential impacts of invasive mussels. Several task teams created by the SWIM project are exploring i) mussel control, ii) lake whitefish behavior, iii) lake whitefish egg deposition and larval emergence, iv) habitat mapping, and v) nutrients, mussels, and algae interactions within the Thunder Bay Reef in Lake Huron. These efforts aim to slow the declines in whitefish populations by improving understanding of the effect of invasives and bolstering reproductive success.

Lake Erie

- In Canada, through the Nature Smart Climate Solutions Initiative (2021–2024), Conservation Ontario, with ECCC support, is leading over 70 restoration projects across 20 Conservation Authorities. Efforts focus on restoring wetlands, grasslands, and riparian areas while enhancing carbon sequestration and climate resilience:
  - Essex Region Conservation Authority — wetland creation to reduce phosphorus runoff and flood risks.
  - Grand River Conservation Authority — financial incentives to nearly 100 farmers to adopt soil-stabilizing cover crops supporting 410 hectares of habitat restoration and 10,558 hectares of cover crops. These efforts will improve water quality, mitigate climate impacts, restore habitat, and support wildlife.
- Essex Region Conservation Authority, with support from the Canada Water Agency and MECP, will help restore Hillman Marsh by reinforcing the barrier beach, which protects the marsh from the open waters of Lake Erie, and wetland plant communities to withstand climate change impacts.
- In the U.S., substantial work has been completed for the Cedar Point Causeway Wetland Complex - one of several projects developed through the Ohio Department of Natural Resources' Sandusky Bay Initiative, a multi-year program to improve water quality and fish and wildlife habitats in Sandusky Bay. The innovative project is the first of its kind in Lake Erie, as it creates a wetland on the shore of the lake using dredged materials. Funded by H2Ohio and the GLRI, the design uses seiche-driven water level fluctuations between East Sandusky Bay and the Outer Bay to move water through a 32-acre (13-hectare) wetland complex. The project included the construction of two low-relief sediment retention cells which were subsequently filled with 280,000 cubic yards (212,800 metric tons)

Lighthouse on the tip of Long Point hamlet, north shore of Lake Erie. Credit: SkyF @ iStock.

of fine-grained clean dredged sediments from the Sandusky Harbor federal navigation channel. Once the dredged material has solidified, the next step will be to regrade the surface and install plantings and habitat features. The new wetland is expected to be functional in 2026, and monitoring the site will continue for another ten years. The lessons learned from this project will be applied to future projects aimed at improving Sandusky Bay, other Lake Erie harbors, and throughout the Great Lakes.

Lake Ontario

- In Canada, a collaborative restoration effort by the CWA, MECP, Toronto and Region Conservation Authority, and the City of Toronto completed the Gibraltar Point Erosion Control Project in 2023. The project created a 30,000 m^2 nearshore reef, restored a 2-hectare beach-dune system using over 55,000 tonnes of sand, and planted over 3,500 native trees and shrubs and 8,000 beach grasses to stabilize the shoreline. The revitalized habitat enhances flood resilience and supports fish and wildlife, with monitoring revealing increased species diversity in the restored reef.
- In the U.S., lake trout—an ecologically important native species that supports a world-class sport fishery—were fitted with 320 tracking tags to help researchers determine migration patterns, spawning locations, and habitat use in Lake Ontario to maximize the impact of habitat restoration and protection efforts. These efforts were led by the U.S. Fish and Wildlife Service (USFWS) in collaboration with USGS, New York State Department of Environmental Conservation (NYDEC), and New York Sea Grant, with the local charter fishing industry providing critical help catching lake trout in Mexico and Wilson Bay.

Lake Michigan

- In both Michigan and Wisconsin, undersized culverts were replaced with larger "stream simulation" culverts and bridges to restore fish passage. In Cadillac, Michigan, Trout Unlimited, Wexford County Road Commission, the U.S. Forest Service and other partners recently completed the 12th aquatic organism passage restoration project within the Hinton Creek watershed, completely reconnecting the mainstem of Hinton Creek with its fish-bearing tributaries and improving the resiliency of the wild brook trout population. In a portion of the Brule River watershed along the Wisconsin-Michigan border, four road-stream crossing replacements were completed to enhance over two miles of coldwater streams. When fully implemented, the plan will upgrade 17 additional road-stream crossings reopen over 60 miles of blocked streams to aquatic organism passage, reduce the risk of road washouts, and prevent 3,299 cubic yards of sediment from being discharged to streams. This work also supports rural jobs and economies by improving water quality, reconnecting habitat in valuable fisheries, and increasing the safety and sustainability of roads.

Actions to Prevent and Control Invasive Species

Canadian and U.S. agencies continue to implement measures to prevent and manage the spread of invasive species populations in the Great Lakes. Highlighted lake-specific activities in 2023–2025 are described below. Other activities that reduce, prevent, and manage invasive species are found in Annex 6 (Aquatic Invasive Species) section of this Progress Report of the Parties.

Lake Superior

- In Canada, with support from the Invasive Species Centre, the Lakehead Region Conservation Authority (LRCA) launched the Thunder Bay Regional Phragmites Collaboration, uniting over 35 organizations to map, monitor, and treat invasive *Phragmites*. In 2023, eight stands (0.49 hectares) were treated with herbicides. LRCA also tested management strategies for Invasive Narrow-leaved Cattail along the Neebing-McIntyre Floodway and mapped its presence in Hurkett Cove. Volunteer efforts through LRCA's Stewardship Program targeted other invasive species, such as Tatarian Honeysuckle and Purple Loosestrife, replacing them with native plants to restore biodiversity. In 2024, the Thunder Bay Regional Phragmites Collaboration managed 1 hectare and 23 stands of Invasive *Phragmites* thanks to support from the Ministry of Natural Resources and the Invasive Species Centre. Management is still underway in 2025, with a total of 13 new stands managed so far. In addition, while

ballast water regulations have reduced shipping as a pathway for invasive species such as Dreissenid Mussels, Sea Lamprey, and Invasive Carp, these species remain established threats.

- In the U.S., USFWS in Ashland contributed to a project on environmental DNA (eDNA) metabarcoding this year for early detection of aquatic invasive species. eDNA metabarcoding, a technique that analyzes genetic material shed into the environment, provides insights into entire fish communities rather than focusing on individual species. Collaborating with Keweenaw Bay Indian Community's natural resources staff, USFWS collected 150 water samples in the Keweenaw Waterway, Michigan. Preliminary findings indicate that eDNA metabarcoding detected species missed by traditional sampling methods in 2023. Data from this project will guide USFWS in incorporating eDNA metabarcoding for improved early detection of invasive species in the Great Lakes.

Lake Huron

- MNR studied the impact of invasive Dreissenid Mussels on the Lake Huron ecosystem. The mussels have disrupted the food web, leading to the decline of *Diporeia*, a crucial fish food source, and negatively affecting Lake Whitefish populations. Changes in diet, distribution, and growth have contributed to population declines. MNR collaborated with partners to assess these impacts and develop strategies to support fisheries and ecosystem health. Although invasive species continue to represent established threats, ballast water regulations have reduced shipping as a pathway for invasive species.
- In the U.S., the Arenac Conservation District invasive species strike team has monitored, on behalf of the Saginaw Bay Cooperative Invasive Species Management Area (SB CISMA), over 700 acres (283 hectares) and treated over 315 acres (127 hectares) for non-native invasive plants on priority shoreline, roadsides, and private land sites. Some of the removal work is reducing invasion on adjacent sites that have previously been restored and treated for invasive species. In addition to on-the-ground work, the team has hosted 6 outreach events, engaging over 300 members of the public through education about invasive species and methods of removal. With support from United States Department of Agriculture's Forest Service, SB CISMA's invasive species strike team is making an impact on invasive species both immediately and for the long term, by engaging and educating the public.

Lake Erie

- In Canada, invasive *Phragmites australis*, an aggressive reed species, has rapidly spread across southern Ontario, outcompeting native vegetation, degrading wetlands, and threatening biodiversity, particularly in the Lake Erie basin. Since 2019, Agriculture and Agri-Food Canada, the University of Toronto, and Ducks Unlimited Canada have released 21,000 biocontrol moths that feed exclusively on *Phragmites*, weakening the plant from the inside and allowing native species to recover. Complementing this, the ERCA is restoring 30 hectares of wetland at the mouth of the Canard River — an ecologically significant site along Lake Erie. With support from CWA and the Detroit River Canadian Cleanup, ERCA uses water level management, burning, herbicides, and biocontrol to reduce *Phragmites* and restore native vegetation, improving aquatic bird and wildlife habitat. As in Lake Superior and Lake Huron, ballast water regulations have reduced shipping as a pathway for invasive species, though invasive species like Dreissenid Mussels, Sea Lamprey, and Invasive Carp continue to be established threats.
- In the U.S., the Emerald Ash Borer (EAB) is an invasive insect that decimates ash trees, killing nearly all the mature trees in areas of infestation. Lucas County was the first place in Ohio where EAB was found. As a result of EAB and other stressors, just 12 percent of Lucas County's land area remains forested. In the spring of 2023, Metroparks Toledo, in partnership with the City of Toledo and with Great Lakes Restoration Initiative funding through the U.S. Forest Service, planted over 4,000 trees to address forest loss due to EAB. The plantings established a matrix of native hardwood species well-suited to floodplains and not susceptible to EAB. The project is part of the Greater Toledo Regional Reforestation Initiative. Overall, the Initiative planted 30,000 native hardwood trees on existing parklands across the greater Toledo

metropolitan area to create 44 acres (18 hectares) of new forests within the Maumee River watershed in Lake Erie's western basin. Planting occurred at 5 Metroparks Toledo sites: Bend View, Brookwood, Fallen Timbers Battlefield, Oak Openings Preserve, Side Cut, and the City of Toledo's Ravine Park. Volunteers, including students from Waite High School, assisted with the plantings.

Lake Ontario

- In Canada, invasive water soldier, first detected in the Trent-Severn Waterway in 2008, has spread to the Bay of Quinte, threatening sensitive ecosystems and fisheries. In 2022–2023, Quinte Conservation, MNR, and the Bay of Quinte Water Soldier Working Group used plant surveys and eDNA analysis to map infestations, guiding targeted removals and herbicide treatments. These actions are protecting native species, fish habitat, and ecosystem integrity, with ongoing monitoring to support rapid response. Ballast water regulations continue to reduce shipping as a pathway for invasive species, though risks associated with established invasive species remain.
- In the U.S., the United States Army Corps of Engineers (USACE) continues its long-term control of monoecious hydrilla within the Erie Canal, Tonawanda Creek, and the Upper Niagara River. Treatment focused on known hydrilla infestations that pose the greatest potential for fragmentation and spread into Lake Ontario. USACE worked with NYDEC and USFWS to monitor a 15-mile stretch of the Erie Canal and portions of the Upper Niagara River to confirm existing infestations and identify any new ones, as well as determine effectiveness of treatments. An integral component of the project is developing and testing a variety of treatment methods that would be suitable for use in other portions of the Great Lakes Basin should new infestations of hydrilla be detected. New information regarding treatment methods and the growth of hydrilla in the Great Lakes region is shared with stakeholders and interested parties through the federal, state, and local collaborative partnership.

Lake Michigan

- NOAA GLERL is partnering with an industrial partner and the University of Wisconsin-Milwaukee in a multi-year study to use underwater vehicles for invasive Dreissenid Mussel control in deeper, soft substrate environments. The team operated a tracked remote operated vehicle (ROV) in small test plots at a depth of 45 meters in Lake Michigan. They monitored the plots before and after treatment using multibeam sonar, video surveys, and physical grab samples. The team learned several lessons from this initial stage of the study, which was the first time that this type of vehicle has been used for invasive mussel control. The tracked ROV with no implements attached was easy to steer and caused minimal disturbance to the sediment. Adding implements designed to displace and/or damage the mussels did increase sediment disturbance and reduced maneuverability, but preliminary results reveal fewer live mussels in those plots six weeks post-treatment. None of the methods tested appeared to negatively impact non-target benthic organisms.

Zebra mussels (mostly) on a beach in Sleeping Bear Dunes National Lakeshore, Michigan. Credit: corfoto @ iStock.

Annex 3: Chemicals of Mutual Concern

Canada and the U.S. are actively reducing the release of chemicals through domestic chemical management programs and clean-up of contaminated sediments in Areas of Concern. Contamination levels have significantly decreased in the Great Lakes; however, some chemicals still bioaccumulate in the food web to levels that harm wildlife and create the need for fish consumption advisories to protect human health. Over the past three years, chemical management programs and clean-up efforts have reduced the risks posed by chemical contaminants in the Great Lakes. Efforts are also underway to enhance the efficiency of the review of chemicals nominated as candidate Chemicals of Mutual Concern (CMCs).

Key Achievements

- Continued to assess and manage the environmental and human health risks posed by chemicals, including CMCs, through comprehensive domestic chemical management programs.
- The criteria-based screening of the CMC nomination for polycyclic aromatic hydrocarbons (PAHs) was completed in 2022 with PAHs becoming a candidate CMC, and a second stage of analysis is underway.
- Determined that sulfate releases are not causing transboundary impacts in the Great Lakes and federal and state efforts are underway to study and manage sulfates on the U.S. side of the Lake Superior basin.

Purpose and Overview

The purpose of Annex 3 (CMCs) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to protect human health and the environment through cooperative and coordinated measures to reduce the anthropogenic release of chemicals of mutual concern into the Waters of the Great Lakes.

Under the CMC Annex, the United States and Canada have committed to (1) identify CMCs and potential candidate CMCs on an ongoing basis; (2) act to prevent, control, and reduce CMCs; and (3) ensure that research, science, and monitoring programs are in place to guide management actions. Chemicals management in the United States and Canada occurs primarily through national domestic programs and laws as well as programs at the provincial, state, Tribal, and local levels.

The United States and Canada have designated the following chemicals as CMCs:

- Hexabromocyclododecane (HBCD)
- Perfluorooctane sulfonate (PFOS), Perfluorooctanoic acid (PFOA), and Long-chain perfluorinated carboxylic acids (LC-PFCAs)
- Mercury
- Polybrominated diphenyl ethers (PBDEs)
- Polychlorinated biphenyls (PCBs)
- Short-chain chlorinated paraffins (SCCPs).

ANNEX IMPLEMENTATION

U.S. Environmental Protection Agency (EPA) and Canada Water Agency (CWA) co-lead the implementation of the commitments within Annex 3 (CMCs) with support from an Annex 3 Extended Subcommittee comprised of members from provincial, state, Indigenous and Tribal governments; and other participants including, industry organizations, and nongovernmental organizations.

Binational Actions and Achievements

Priority for Action: Implement strategies to reduce CMCs in the Great Lakes environment, including through the Chemicals Management Plan (Canada) and the *Comprehensive Environmental Response, Compensation, and Liability Act and Toxic Substances Control Act (U.S.).*

Highlights of these efforts are described below in the Domestic Actions and Achievements section.

Priority for Action: Recognizing that fish consumption is the major Great Lakes route of exposure for bioaccumulative CMCs, U.S. and Canadian jurisdictions will provide fish consumption advisories and raise awareness about the risks to minimize potential impacts to human health, including vulnerable populations.

- Many CMCs are monitored by the states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York) and Ontario (Guide to Eating Ontario Fish) to support fish consumption advice and minimize the potential risk to human health. All eight U.S. states bordering the Great Lakes and Ontario conduct public outreach on fish consumption advice for the Great Lakes.
- U.S. federal agencies supported twelve Tribal and state projects with GLRI funding to collect and share information on Great Lakes fish and wildlife consumption with communities. Funded partners conducted outreach targeting populations that consume high amounts of Great Lakes fish, including sensitive populations and subsistence anglers, providing information on the benefits and risks of fish consumption. They also monitored contaminant levels from fish in the Great Lakes and inland waters that will be used by state agencies to update safe fish consumption guidelines. Other funded projects enabled Tribes and states to collect updated fish tissue contaminant information to improve fish consumption advice for mercury, PCBs, per- and polyfluoroalkyl substances (PFAS), and other contaminants.
- The Great Lakes Consortium for Fish Consumption Advisories (Consortium) is a collaboration of fish advisory program managers from government health, water quality, and fisheries agencies in the eight states and Ontario. The purpose of the Consortium is to share information about contaminants found in fish of the Great Lakes region, evaluate human health effects of those contaminants, and develop protocols and methods for determining fish consumption advice and communications. Information on the Consortium is available online for Great Lakes states and Ontario.
- The fish consumption guidance for waterbodies in Ontario includes considerations for the protection of vulnerable or sensitive populations, for example, children under 15 and anyone who is pregnant or may become pregnant.
- Members of the Consortium also provide contaminant concentration data for the fish consumption indicator, reported via State of the Great Lakes reports.

Priority for Action: By the end of 2023, complete the criteria-based screening of the CMC nomination for PAHs, sulphates, and lead.

- The criteria-based screening of the CMC nomination for PAHs was completed in 2022 with PAHs becoming a candidate CMC, and a second stage of analysis underway. A binational summary report that includes a recommendation on whether PAHs should be designated as a CMC is anticipated in 2026.
- The criteria-based screening of the CMC nomination for sulfates was completed in 2024. It was determined in 2025 that sulfate releases are not causing transboundary impacts in the Great

Lakes and there are ongoing and planned research and management efforts at the federal and state level to address sulfates on the U.S. side of the Lake Superior basin.

- The criteria-based screening of the CMC nomination for lead is underway. A formal recommendation is anticipated to be made in 2026.

Priority for Action: By the end of 2024, complete the criteria-based screening of the CMC nomination for radionuclides.

- In response to the revised radionuclide nomination, EPA and CWA sought advice from their respective nuclear regulatory agencies. Both the U.S. Nuclear Regulatory Commission (NRC) and the Canadian Nuclear Safety Commission (CNSC) undertook a detailed review of concerns raised in the renomination, with each agency documenting their analysis. The responses from the CNSC and NRC were posted on binational.net in 2024.
- The criteria-based screening of the CMC nomination for radionuclides is underway. A formal recommendation is anticipated in 2026

Priority for Science: Conduct monitoring and surveillance in Great Lakes environmental media to track trends of Chemicals of Mutual Concern (CMCs) and other priority chemicals, enhance these efforts through the Cooperative Science and Monitoring Initiative, and communicate results.

- EPA's contaminant monitoring and surveillance activities include the Great Lakes Fish Monitoring and Surveillance Program, the Integrated Atmospheric Deposition Network, the Great Lakes Sediment Surveillance Program, and the National Atmospheric Deposition Program's Mercury Deposition Network.
- ECCC delivers ecosystem monitoring and surveillance programs in the Great Lakes watershed that monitor status and trends of CMCs in water, sediments, fish tissue, air, and waste water as part of the National Freshwater Quality Monitoring Program, Air Quality Monitoring programs and Chemicals Management Plan.
- Ministry of the Environment, Conservation and Parks' Great Lakes nearshore monitoring network monitors CMC and other priority chemicals to track spatial and temporal trends in nearshore water and sediments.
- The trends and results for the monitoring and surveillance of CMCs and other priority chemicals in Great Lakes environmental media are communicated through the toxic chemicals sub-indicators of the State of the Great Lakes reports.
- Additional Great Lakes monitoring and surveillance results have been published and shared in a variety of formats, as available throughout the 2023-2025 time period to maximize the intended audience (e.g., scientific journals/manuscripts, online and open data portals, government reports, presentations at science forums, web-based products).
- Led by Annex 2, EPA and CWA hosted several Let's Talk! public webinars to share information on monitoring and surveillance for CMCs and other priority chemicals.

Priority for Science: Coordinate research, monitoring and surveillance activities to address information gaps and needs for existing CMCs.

- The Annex 3 Subcommittee, through the Annex 2 Lake-specific Partnerships, supported identification of chemical-related lakewide and Cooperative Science and Monitoring Initiative (CSMI) priorities including CMCs and priority chemicals as part of the 5-year CSMI cycle. Coordinated science and monitoring activities to support binationally identified chemical priorities were implemented under the CSMI for the following field years: Lake Ontario in 2023, Lake Erie in 2024, and Lake Michigan in 2025.
- The EPA and CWA continued to liaise with additional departments and agencies to communicate research, monitoring and surveillance needs; facilitated coordination of activities; and supported the establishment of binational project collaborations. This includes participation in the binational Annex 3 subcommittee, and annual priority setting workshops for Canada's Chemicals Management Plan (CMP).

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, the United States and Canada pursued a variety of domestic projects that also support Annex 3 (CMCs).

United States

Chemicals are managed in the United States under a combination of federal, state, Tribal, and local programs, including activities under the Toxic Substances Control Act; the Comprehensive Environmental Response, Compensation, and Liability Act; Safe Drinking Water Act; and Clean Water Act. The Areas of Concern program, as previously described, is actively remediating historical chemical contamination in Great Lakes harbors and rivers. Some selected chemical-specific work by U.S. governmental agencies is described below.

HBCD

- **HBCD chapter in Minnesota Toxic Free Kids (TFK) Program.** Through the TFK program, the Minnesota Department of Health communicates the potential for hazardous chemical exposures from consumer products that could be harmful to human health. In 2024, the TFK Program Training Curriculum published a chapter on ways to reduce exposure to HBCD.

PFOS, PFOA, and LC-PFCAs

- **Combating PFAS contamination.** In April 2025, the EPA administrator announced major actions to combat PFAS contamination which include strengthening the science, fulfilling statutory obligations and enhancing communication, and building more effective partnerships. This suite of actions includes the designation of an agency lead for PFAS, the creation of effluent limitations guidelines for certain PFAS to stop these forever chemicals from entering drinking water systems, and initiatives to engage with Congress and industry to establish a clear liability framework that ensures the polluter pays and passive receivers are protected.
- **Research on PFAS in the aquatic environment.** U.S. Geological Survey, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service are studying PFAS in the Great Lakes aquatic environment and their effects on sediment-dwelling organisms. They selected three watersheds with varying PFAS levels and are measuring PFAS in air-water surface, water, suspended and bed sediments, and sediment porewater to understand its distribution and sediment's role as a source or sink. Samples collected in 2024 are undergoing analysis, with results expected in late 2025.

Scientists collect bed sediments using a custom hand core. Credit: Luke Loken, U.S. Geological Survey.

Scientists collect water from the stream surface microlayer layer for analyses of the partitioning of PFAS within stream ecosystems. Credit: Matthew Pronschinske, U.S. Geological Survey.

Custom method for collecting water from the stream surface microlayer layer for analyses of partitioning of PFAS within stream ecosystems. Credit: Luke Loken, U.S. Geological Survey.

- **New York PFAS apparel prohibitions.** Since January 2025, the sale of any new, not previously used, apparel containing PFAS as intentionally added chemicals has been prohibited. A similar prohibition of PFAS in outdoor apparel for severe wet conditions goes into effect in January 2028. New York also passed legislation restricting the distribution and sale of food packaging containing PFAS substances as intentionally added chemicals on or after December 31, 2022.
- **Michigan PFAS Action Response Team (MPART) efforts.** MPART continues to monitor and investigate PFAS contamination in 300 PFAS Sites. Each year, MPART hosts the Great Lakes PFAS Summit which brings together PFAS experts, researchers, consultants, regulators and citizens from around the world. MPART publishes an annual summary of PFAS accomplishments called Fast Facts. MPART has added a Resources for Residents page to the MPART website to provide educational information on PFAS, residential well sampling and consumer products information.
- **Minnesota comprehensive PFAS pollution prevention law.** Starting in January 2025, through Amara's Law, 11 categories of common consumer products, including cosmetics, cookware, dental floss and furniture, sold or distributed in Minnesota must be made without PFAS. Amara's Law will phase out PFAS in consumer products by January 2032.
- **Minnesota PFAS monitoring.** As part of Minnesota's PFAS Blueprint, the monitoring program expanded to collect monitoring data from 379 facilities identified as potential emitters of PFAS, this includes wastewater treatment plants, industrial facilities, airports and landfills.
- **Ohio Aqueous Film-Forming Foam (AFFF) Takeback Program.** Launched in March 2024, the AFFF Takeback Program collects and destroys PFAS-containing foam from Ohio fire departments, local governments and government-owned airports. Since June 2024, Ohio EPA collected 13,600 gallons of known, sealed AFFF material from 118 fire departments across Ohio.
- **H2Ohio Rivers program.** As part of the H2Ohio Rivers program, in 2023 and 2024 Ohio EPA conducted a statewide assessment of PFAS in 29 of Ohio's largest rivers. A total of 149 river locations across the state were sampled for the presence of PFAS.
- **Pennsylvania PFAS drinking water standards.** In January 2023, the Pennsylvania Department of Environmental Protection adopted new limits in drinking water on two PFAS. The standard sets maximum contaminant level goals and maximum contaminant levels for PFOA and PFOS.

Mercury

- **Minnesota mercury air emissions target.** The Minnesota Mercury Emissions and Reduction Plans 7007.0502 has a statewide mercury air emissions goal of 789 pounds per year from Minnesota sources by December 31, 2025. Actions are targeted through mercury reduction plans for targeted facilities, performance standards in certain industries, and a tracked mercury emission inventory.

- **Minnesota phase-out on mercury lamps.** Since January 2025, Minnesota has started the phase-out of certain fluorescent and mercury lamp sales.
- **Updates to Michigan Mercury Emissions Inventory.** Work is underway to update the 2020 Michigan Mercury Emissions Inventory. The updates are expected in 2025 and will be posted at Michigan Department of Environment, Great Lakes, and Energy.
- **Michigan Multiple Discharger Variance and Permitting Strategy for Mercury.** Effective October 2024, Michigan published guidance outlining methodologies for developing mercury variances and associated permitting for applicable facilities. Michigan will develop and implement discharger-specific mercury permit limits that reflect the level currently achievable.
- **Michigan updated list of impaired water bodies.** In 2024, Michigan published a statewide mercury total maximum daily load (TMDL) addendum, updating the list of impaired water bodies. Revisions to the list occur every other year and updates are based on additional water quality and fish contaminant monitoring data.

PCBs

- **Wisconsin PCB project.** The Fox River PCB clean-up project, one of the largest of its kind worldwide, was completed in 2020. Actions to remediate PCB-contaminated sediment were certified completed by Wisconsin in 2023.

Multiple Chemicals

- **Great Lakes Indian Fish and Wildlife Commission's (GLIFWC) PFAS and mercury program.** GLIFWC started testing walleye for PFAS from inland lakes in the ceded territories of Minnesota, Wisconsin, and Michigan. The objective is to quantify the presence of PFAS and mercury and assess their potential for food-chain bioaccumulation. Results will be shared with state partners to guide source identification, mitigation, and inform fish consumption advisories. Lakes are first tested using composite samples, where tissue from several fish of the same species are combined and analyzed. If results come back showing elevated PFAS, the lake will be retested as individual samples to identify trends in PFAS levels by fish age, length, weight, and sex, and subsequently issue fish consumption advisories based on fish size.

Canada

The Government of Canada, through programs such as Canada's Chemicals Management Plan and CWA's Great Lakes Freshwater Ecosystem Initiative, is taking risk mitigation and management actions to address and reduce releases of all eight CMCs, as well as risks posed by other chemicals. Selected activities and projects are highlighted below.

Chemicals Management Plan (CMP)

- Canada assesses and manages the environmental and human health risks posed by chemicals, including CMCs, through the CMP. As of March

Collecting otolith for aging the fish and the egg mass (and fillet) for sexing the fish. Credit: Great Lakes Indian Fish and Wildlife Commission.

2025, 4,355 prioritized substances have been assessed under the CMP, and 366 of these substances have been found to be toxic to the environment and/or human health. These toxic substances may be added to a list under the *Canadian Environmental Protection Act (CEPA*), 1999, for further regulations and other risk management measures to prevent or control their release or use.

- Since the launch of the CMP, over 200 risk management actions have been implemented, and additional risk management measures are in development. All designated CMCs are listed as toxic under CEPA in Canada, and their manufacture, use, sale, and import—along with products containing them—are prohibited (with limited exemptions), helping to reduce releases to the Great Lakes.

HBCD and other CMCs

- **Proposed tightened restrictions for multiple CMCs.** HBCD, PBDEs, and PFOS, PFOA, LC-PFCAs, and their salts and precursors have been found to be toxic to the environment and are currently prohibited under Canada's *Prohibition of Certain Toxic Substances Regulations, 2012*. Work is underway to further restrict the limited number of uses that are currently allowed by amending the current regulations. The final regulations are expected in 2025.
- **CMCs in waste management streams.** The Ontario Ministry of the Environment, Conservation and Parks is assessing select CMCs (HBCDs, PBDEs, chlorinated paraffins, PFAS) in industrial, commercial, and institutional waste streams to quantify their presence in recycled or disposed of materials and identify appropriate disposal methods to protect health and the environment.

PFAS

- **Addressing PFAS as a class of chemicals and risk management.** In March 2025, Canada published the State of Per- and Polyfluoroalkyl Substances (PFAS) Report and a Risk Management Approach for PFAS, excluding fluoropolymers. The report concludes that the class of PFAS, excluding fluoropolymers as defined in the report, meets CEPA's criteria for toxic and poses risks to human health and the environment. To manage these risks, Canada is proposing to add PFAS, excluding fluoropolymers, to CEPA and address PFAS in firefighting foams to better protect firefighters and the environment; limit exposure to PFAS in products not essential for health, safety, or environmental protection; and evaluate other sectors through stakeholder engagement and further assessments. These actions align with Canada's Great Lakes Strategy for PFOS, PFOA and LC-PFCAs Risk Management to amend or develop new regulatory controls in response to human health and ecological assessments and new data.
- **Addition of 163 PFAS to the National Pollutant Release Inventory (NPRI).** Reporting requirements for 163 PFAS have been added to NPRI. Reporting for releases of PFAS that occurred during 2025 will take place by June 2026 and by June in each subsequent year. This data will improve understanding of PFAS use in Canada, help evaluate possible industrial PFAS contamination, and support efforts to reduce environmental and human exposure to harmful substance.
- **Great Lakes Freshwater Ecosystem Initiative.** In 2024, the CWA, through its Great Lakes Freshwater Ecosystem Initiative, provided support to three partner-led projects related to enhancing energy efficiency of a system to destroy PFAS in landfill wastewater; innovative technologies for removing PFAS from wastewater; and monitoring for contaminants like PFAS, nutrients, and chloride/road salt in the western basin of Lake Erie.

Scientists in the Water Research and Resource Recovery Lab developing PFAS removal technologies. Credit: Dr. Rania Hamza, Toronto Metropolitan University.

- ECCC advanced the understanding of PFAS through a series of studies examining their occurrence, pathways, and effects in wildlife, ecosystems, and wastewater systems, including:
  - The universe of fluorinated polymers and polymeric substances and potential environmental impacts and concerns.
  - The effects of two short-chain perfluoroalkyl carboxylic acids (PFCAs) on northern leopard frog (*Rana pipiens*) tadpole development.
  - Per- and polyfluoroalkyl substances (PFAS) in Canadian municipal wastewater and biosolids: Recent patterns and time trends 2009 to 2021.
  - The ins and outs of PFAS in the Great Lakes: The role of atmospheric deposition.
  - Effects of perfluoroalkyl sulfonic acids on developmental, physiological, and immunological measures in northern leopard frog tadpoles.
  - Per- and polyfluoroalkyl substances (PFASs) contamination of groundwater in Canada: a (too) short review.
  - Assessing the shifts in atmospheric per- and polyfluoroalkyl substances (PFAS) levels in the Great Lakes and implications for the environmental transport and fate.
- Health Canada advanced scientific knowledge of PFAS through research on human exposure, biological pathways, and potential health effects, including:
  - Prenatal exposure to legacy PFAS and neurodevelopment in preschool-aged Canadian children: The MIREC cohort.
  - Per- and polyfluoroalkyl substances (PFAS) in mixtures show additive effects on transcriptomic points of departure in human liver spheroids.
  - Prenatal exposure to perfluoroalkyl substances and inflammatory biomarker concentrations.
  - Serum concentrations of legacy, alternative, and precursor per- and polyfluoroalkyl substances: a descriptive analysis of adult female participants in the MIREC-ENDO study.
  - Personal care product use and per- and polyfluoroalkyl substances in pregnant and lactating people in the Maternal-Infant Research on Environmental Chemicals study.
  - Prenatal exposure to PFAS and the association with neurobehavioral and social development during childhood.
  - Deciphering per- and polyfluoroalkyl substances mode of action: comparative gene expression analysis in human liver spheroids.
  - Prenatal PFAS exposures and cardiometabolic health in middle childhood in the MIREC cohort.
- **New PFAS Substances notified to the Government of Canada.** Under CEPA's *New Substances Notification Regulations (Chemicals and Polymers)*, new PFAS substances introduced to the Canadian marketplace continue to be assessed for potential risks and subject to appropriate control measures.
- **Collection of commercial status of certain PFAS.** On July 2024, a notice under CEPA was published, requiring companies to report on 312 PFAS substances (whether alone, in mixtures, products, or manufactured items) in Canadian commerce for the 2023 calendar year. The collected information will be used to establish baseline data and support analysis for future actions.
- **PFAS standard for commercial biosolids imported or sold in Canada as fertilizers.** In October 2024, the Canadian Food Inspection Agency began enforcing an interim standard for PFAS in biosolids as part of the Government of Canada's coordinated suite of risk mitigation measures intended to minimize human and environmental exposure to PFAS throughout the life cycle for commercial biosolids imported or sold in Canada as fertilizers or supplements.
- **Destruction of PFAS compounds in contaminated media.** In October 2024, the Government of Canada launched a challenge under the Innovative Solutions Canada Program to seek innovative, cost-effective, safe, and scalable solutions that lead to the destruction of PFAS compounds in contaminated media.
- **Objective for PFAS in Canadian Drinking Water.** In August 2024, the Government of Canada, in collaboration with the Federal-Provincial-Territorial Committee on Drinking water, established an

objective value of 30 ng/L (for the sum total of 25 specific PFAS) to reduce potential exposure to PFAS in drinking water while the reassessment of the guidelines and screening values is being completed. This objective replaces the two previous drinking water guidelines for PFOS and PFOA, and nine screening values derived for individual PFAS.

- **Understanding concentrations of PFAS in Ontario fish.** The Ontario Ministry of the Environment, Conservation and Parks initiated a project to monitor and analyze PFAS levels in Ontario fish to assess potential impacts to human health from fish consumption.

Mercury

- **Mercury regulation amendments.** The *Regulations Amending the Products Containing Mercury Regulations*, published in May 2024, will reduce the amount of mercury in the Great Lakes environment as it will prohibit the import and manufacture of all products containing mercury, with some limited exemptions, and also prohibit the import and manufacture of the most common lamps containing mercury for general lighting purposes as of December 31, 2025. These efforts will fulfill Canada's international commitments to accelerate transitions to mercury-free products and meet the action outlined in the Great Lakes Binational Strategy for Mercury Risk Management.
- **National strategy for lamps containing mercury.** In 2019, the Government of Canada released the National Strategy for Lamps Containing Mercury (the Strategy). The Strategy's vision is to eliminate lamps as a source of mercury pollution in Canada by ensuring lamps containing mercury are collected and recycled responsibly while encouraging Canadians to buy mercury-free lighting alternatives. The five-year report to Parliament, released in 2025, describes the key developments towards achieving the Strategy's goals on the environmentally sound end-of-life management for lamps containing mercury.
- **Measuring atmospheric oxidized mercury.** In July 2024, a study on the measurement of atmospheric mercury: current limitations and suggestions for paths forward, involving ECCC scientists, was published. The study identifies limitations in current methods for measuring atmospheric oxidized mercury and suggests the need for improved techniques to enhance accuracy and understanding of the global mercury cycle.
- **Methylated mercury in Lake Erie's nearshore.** In 2024, the CWA's Great Lakes Freshwater Ecosystem Initiative supported a project by Brock University to investigate how mercury is methylated in nearshore settings of Lake Erie during *Cladophora* (filamentous green algae) blooms.

Scientists investigate mercury cycling in *Cladophora* blooms in Lake Erie. Credit: Dr. Vaughn Mangal, Brock University.

PBDEs

- In November 2024, ECCC scientists published a study on Dietary and terrestrial exposure to methoxylated polybrominated diphenoxybenzenes in Great Lakes herring gulls. The study analyzed methoxylated polybrominated diphenoxybenzenes (MeO-PB-DPBs), PBDEs and non-PBDE halogenated flame retardants in gull regurgitant and feces, soil and earthworms. Research findings suggest that Great Lakes herring gulls are likely exposed to MeO-PB-DPBs through terrestrial

bioaccumulation and not through aquatic bioaccumulation pathways.

PCBs

- *Regulations amending the PCB Regulations and the Regulations Designating Regulatory Provisions for Purposes of Enforcement*, published in December 2023, intend to clarify some provisions of the regulations and provide flexibility for the use and storage of PCB-containing equipment under unique circumstances that were neither foreseen when the Regulations came into force in 2008 nor in subsequent amendments. The publication of the final amendments is targeted for 2025.

SCCPs

- In February 2025, the Government of Canada published a *Consultation Document on the Risk Management on Short-chain, Medium-chain and Long-chain Chlorinated Alkanes*. It proposes banning the manufacture, import, use, and sale of medium- and long-chain alkanes (up to 20 carbons) and products containing them, plus controls on exports. The consultation also sought input on concentration thresholds for short- and medium-chain alkanes. Feedback helped shape Canada's position for proposing MCCPs at the *Stockholm Convention on Persistent Organic Pollutants* Conference of the Parties in April-May 2025.

Annex 4: Nutrients

Reducing excess phosphorus inputs to Lake Erie remains the highest priority for action under this Annex. Government agencies and their partners are implementing on-the-ground actions identified in the Domestic Action Plans to slow phosphorus inputs from municipal and agricultural sources. There are signs of progress, but significant and sustained effort is still needed to meet targets. Researchers continue to monitor the impact of phosphorus load reductions on the lake ecosystem to assess progress and inform future management actions.

Key Achievements

- Implemented new and enhanced programs to reduce phosphorus loads to Lake Erie in support of Domestic Action Plans.
- Published the Binational Lake Erie Nutrient Adaptive Management Framework and the 5-Year Binational Adaptive Management Evaluation for Lake Erie (2017-2021) to assess changes in phosphorus loads and progress towards achieving the Lake Ecosystem Objectives outlined in the GLWQA, which include minimizing the impact of excessive phosphorus loading and maintaining healthy aquatic ecosystems.
- Published binational Lake Erie phosphorus loads annually on the Great Lakes Commission's Lake Erie Algae (ErieStat) website.
- Canada and the United States agreed to retain the existing interim binational phosphorus targets for Lake Ontario based on the completion of a scientific assessment of nutrients and engagement with partners and the public.

Purpose and Overview

The purpose of Annex 4 (Nutrients) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to coordinate binational actions to manage phosphorus concentrations and loadings, and other nutrients if warranted, in the Waters of the Great Lakes.

Harmful and nuisance algal blooms continue to be of concern in localized areas of the Great Lakes, with Lake Erie experiencing the most significant impacts. In warm, nutrient-rich water, cyanobacteria (also known as blue-green algae), can multiply quickly and create blooms that form at or just below the water's surface. These algal blooms can use up the oxygen and nutrients in the water that other organisms need to live. Some algae create toxins, called cyanotoxins, that can harm people, pets, and wildlife.

The Nutrients Annex guides Canadian and U.S. efforts to meet objectives related to algal growth in each of the Great Lakes, which includes: (1) keeping levels of blue-green algae low enough to prevent formation of harmful toxins, (2) reducing areas of low dissolved oxygen water, (3) maintaining levels of algal biomass below nuisance conditions, and (4) ensuring that algae species in nearshore waters are consistent with those found in healthy aquatic ecosystems. To meet these objectives, Canada and the United States have established binational phosphorus concentration and loading targets for each lake, while also continuing to assess and implement programs and measures designed to reduce phosphorus loadings from point and non-point sources.

ANNEX IMPLEMENTATION

Implementation of Annex 4 (Nutrients) is supported by a Subcommittee, which is co-led by Canada Water Agency (CWA) and U.S. Environmental Protection Agency (EPA). Other Annex 4 Subcommittee members include Agriculture and Agri-Food Canada (AAFC); Chiefs of Ontario; Conservation Ontario; Environment and Climate Change Canada (ECCC); Ontario Ministry of Agriculture, Food and Agribusiness (OMAFA); Ontario Ministry of the Environment, Conservation and Parks (MECP); Ontario Ministry of Natural Resources (MNR); Indiana Department of Environmental Management; Indiana State Department of Agriculture; Michigan Department of Agriculture and Rural Development (MDARD); Michigan Environment, Great Lakes, and Energy (EGLE); New York State Department of Environmental Conservation (NYSDEC); Ohio Department of Agriculture; Ohio Environmental Protection Agency (Ohio EPA); Ohio Lake Erie Commission; Pennsylvania Department of Environmental Protection; Wisconsin Department of Natural Resources; U.S. Army Corps of Engineers (USACE); U.S. Department of Agriculture (USDA); U.S. Geological Survey (USGS); and U.S. National Oceanic and Atmospheric Administration (NOAA).

- Produced a preliminary estimate of binational Lake Ontario phosphorus loads to address a significant knowledge and data gap.

Binational Actions and Achievements

Priority for Action: Lake Erie - All jurisdictions continue to take action and make progress towards achieving phosphorus load reduction targets for Lake Erie.

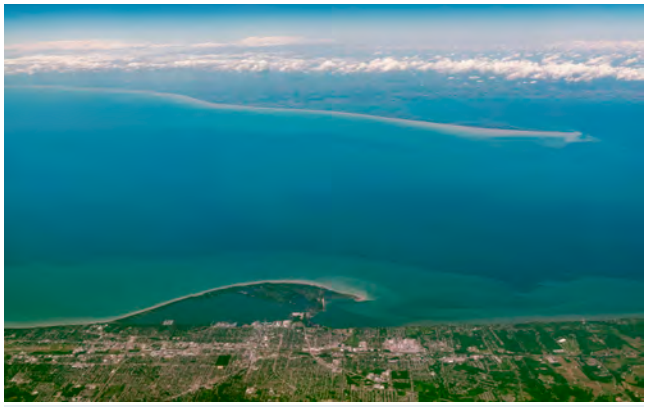
- Each jurisdiction in the Lake Erie basin is taking actions to reduce phosphorus through domestic programs and initiatives. In Canada, this includes projects supported by the CWA's Great Lakes Freshwater Ecosystem Initiative and MECP's Great Lakes Program. In addition, the Sustainable Canadian Agricultural Partnership includes programs funded by Canada and Ontario such as the Resilient Agricultural Landscape Program, which has co-benefits for water quality, and the Agricultural Stewardship Initiative, which provides enhanced funding for phosphorus reduction projects in the Lake Erie and Lake St. Clair watersheds. In the U.S., major funding programs like the Western Lake Erie Basin Initiative, Great Lakes Restoration Initiative (GLRI), H2Ohio and the Western Lake Erie Basin Partnership's Regional Conservation Partnership Program have increased projects to reduce non-point source runoff through wetlands and farmer conservation. Specific actions and progress are described in the Domestic Actions and Achievements section of this report.
- Jurisdictions evaluated the implementation of their Domestic Action Plans over the past five years toward achieving Lake Erie's phosphorus targets. Updated Domestic Action Plans for Ohio, Indiana, Michigan, and Canada-Ontario have been released.

Priority for Action: Lake Erie - Improve communication and engage stakeholders on progress towards achieving Lake Erie phosphorus load reduction targets and Lake Ecosystem Objectives (LEOs).

- The Annex 4 Subcommittee's Lake Erie Adaptive Management Task Team, led by CWA and the EPA, completed an evaluation to assess changes in phosphorus loads and progress towards achieving the Lake Ecosystem Objectives, which was published in 2024.
- CWA and the EPA co-host an annual public "GLWQA Nutrients Webinar: Lake Erie update" webinar to share information and discuss Lake Erie harmful algal blooms and the activities being undertaken to achieve Lake Erie phosphorus load reductions.
- Progress in Lake Erie is also reported through the Great Lakes Commission's Lake Erie Algae (ErieStat) website, Lake Erie Lakewide Action and Management Plan Annual Reports, EPA's Lake Erie Nutrients webpage, the Ohio Lake Erie Commission's Annual Water Monitoring Summary, Ontario's website regarding the Canada-Ontario Lake Erie Action Plan (LEAP), NOAA's Lake Erie Harmful Algal Bloom Forecast/ Seasonal Assessment, scientific conferences (e.g.,

International Association for Great Lakes Research), and the Great Lakes Executive Committee meetings.

- Through the Canadian Environmental Sustainability Indicators program, Canada provides information on the state of the phosphorus loadings to Lake Erie.



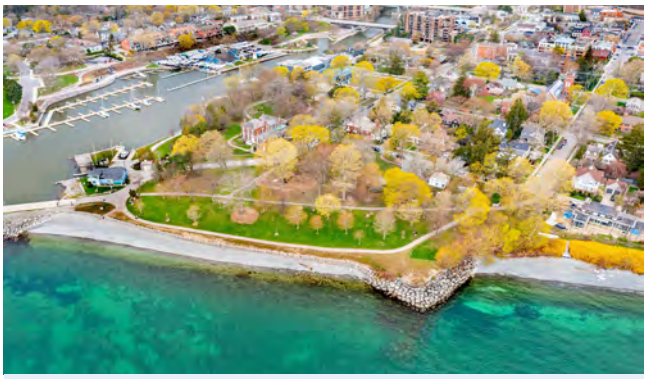
Aerial view over Lake Erie, Presque Isle State Park, Pennsylvania. Credit: Alex Potemkin @ iStock.

Priority for Action: Priority for Action: Lake Ontario - By the end of 2023, complete the review of interim phosphorus targets for Lake Ontario.

- During 2023, the Annex 4 Subcommittee completed the review of interim phosphorus targets and conducted broad-based engagement on the findings and outcomes. Following the 2023 review, Canada and the U.S. agreed to retain existing binational phosphorus targets for Lake Ontario and continue to implement nutrient management and science programs to better understand and mitigate the impacts of nutrients in offshore and nearshore waters of Lake Ontario.

Priority for Action: Lake Ontario - By the end of 2025, identify locations where management actions may be needed to address nearshore algae issues in Lake Ontario.

- Initial areas where nearshore algae is an issue have been identified. The Subcommittee is developing a comprehensive approach to build on this action using satellite observations of cyanobacteria and targeted sampling and mapping of nuisance benthic algae (e.g., *Cladophora*) and using input from shoreline users to assess the spatial and temporal extent of nuisance and harmful algae impacts in Lake Ontario's nearshore.



Lake Ontario shoreline with in-lake algae growth. Credit: jimfeng @ iStock.

Priority for Science: (General to all Lakes) - Improve our understanding of factors affecting nuisance and harmful algae growth in the Great Lakes, particularly in nearshore areas.

- The Lake Erie Adaptive Management Task Team's Nuisance Algae Working Group, led by USGS and MECP, is coordinating monitoring approaches and tracking the extent and severity of nuisance algae growth and washup. ECCC, MECP and USGS continue implementing binational *Cladophora* research, modeling and monitoring at multiple sentinel sites around the Great Lakes to track status and trends in biomass and better define at what point submerged aquatic vegetation constitutes a nuisance condition.

Priority for Science: Lake Erie - Improve tracking and reporting on phosphorus loads to Lake Erie and the extent of harmful algal blooms..

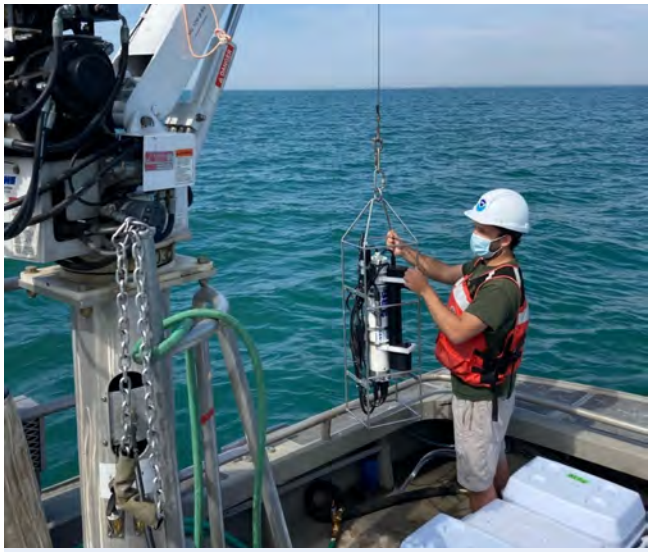
- The Lake Erie Adaptive Management Team's Loadings Working Group, led by ECCC and the EPA, updates and publishes binational phosphorus loads annually on the Great Lakes Commission's Lake Erie Algae (ErieStat) website. They are continuing to assess the best methods to estimate binational phosphorus loads and trends that account for changes in annual data collection and fluctuations in precipitation, including flow-normalized loads.
- In 2024, the Lake Erie Adaptive Management Task Team published the 5-Year Binational Adaptive Management Evaluation for Lake Erie (2017-2021), which reports on phosphorus loading and resulting lake ecosystem conditions related to harmful algal blooms (HABs), hypoxia, and nuisance algae. This is

the first evaluation conducted since the adoption of phosphorus load reduction targets in 2016 and the implementation of nutrient management Domestic Action Plans in 2018 and will be repeated every 5 years.

- To further improve phosphorus load estimates to Lake Erie's western basin, ECCC established a new nutrient monitoring site on the Detroit River in 2024 to complement USGS Detroit River monitoring.
- In 2024, the Lake Erie Adaptive Management Task Team published the Binational Lake Erie Nutrient Adaptive Management Framework and established five Working Groups comprised of U.S. and Canadian agency and academic experts. The HABs, Hypoxia, Nuisance Algae, Data and Modeling, and Loadings Working Groups will support reporting in the next 5-year Binational Adaptive Management Evaluation (2022-2026).

Priority for Science: Lake Erie - Improve hypoxia assessment methods.

- The Lake Erie Adaptive Management Task Team's Hypoxia Working Group, led by CWA and the EPA, tracks and maintains a directory of hypoxia research and monitoring efforts in Lake Erie to identify data gaps and improve assessments of hypoxia in the central basin.



Scientist aboard a NOAA research vessel preparing to deploy an instrument to measure water quality in Lake Erie. Credit: University of Michigan Cooperative Institute for Great Lakes Research @ flikr.

Priority for Science: Lake Erie - Explore the feasibility of a toxicity prediction model for harmful algal blooms.

- The Lake Erie HAB forecasts continue to be refined with the latest technologies available and researchers are getting closer to being able to predict whether blooms are likely to be toxic. In 2023 and 2024, the NOAA Great Lakes Environmental Research Laboratory deployed a network of sophisticated instruments in Lake Erie that can collect and analyze water samples in situ to provide near-real time measurements of the dangerous toxin often present in these blooms, microcystin. NOAA is planning to expand their bloom forecasts to include a prediction on the probability of exceeding toxin threshold levels in 2026.

Priority for Science: Priority for Science: Lake Erie Conduct edge-of-field and in-stream research and monitoring to improve our understanding of phosphorus retention on the landscape and techniques for controlling and trapping phosphorus.

- Edge of field and in-stream research and monitoring continues to be advanced by various Annex 4 member agencies and enhanced through Canada – United States discussion of domestic progress and lessons learned. Research projects include for example:
- In Canada and Ontario, the On-Farm Applied Research and Monitoring (ONFARM) program is an initiative funded by the Sustainable Canadian Agricultural Partnership that implements select agricultural beneficial management practices (BMPs) on participating commercial farms and measures how these practices impact soil health, water quality and productivity. Results from ONFARM investigations can be found in the ONFARM Reports.
- AAFC continued to research ways that farmers can improve nutrient efficiency and reduce nutrient losses off-farm, including an edge-of-field monitoring project investigating the stacking of cover crop and controlled drainage BMPs. It also supported the Environmental Change OneHealth Observatory to fully integrate ecohydrogeological watershed models for both water quantity and quality (nitrogen and phosphorus) and fecal indicator bacteria (*E. coli*).

Lake Erie BMPs-Lower Thames Valley – cover crop field verification conducted in Lower Thames Valley Conservation Authority (LTVCA) watershed in winter 2025. Credit: LTVCA.

Lake Erie BMPs-Middlesex Centre – project example of overwinter cover 2025. Credit: Upper Thames River Conservation Authority.

- MECP continues to analyze and publish findings related to nutrient dynamics in agricultural headwaters from the Multi-Watershed Nutrient Study conducted between 2015 and 2020. More than 10 peer-reviewed manuscripts have been published, including new findings on the impacts of seasonal (including winter) stream flow events, extreme events, enhanced water quality models, and nutrient balances including phosphorus losses and additions in Ontario's agricultural watersheds.
- USGS is integrating edge-of-field and headwater tributary data at several sites in the Great Lakes basin, to evaluate links in timing and concentrations of nutrient and sediment loads.
- USDA Natural Resources Conservation Service (NRCS) partners with the USDA Agricultural Research Service to operate approximately 20 pairs of edge-of-field water quality monitoring sites to evaluate conservation practice effects in the western Lake Erie watershed. These data document small watershed outcomes of conservation efforts under the USDA Conservation Effects Assessment Project and are also leveraged to support projects such as the Western Lake Erie Basin Legacy Phosphorus Assessment Study and a National Legacy Phosphorus Assessment Project, research efforts that aim to advance the understanding of legacy phosphorus mitigation strategies in a variety of watersheds.

Lake Ontario Tributary. Credit: jimfeng @ iStock.

Priority for Science: Lake Ontario - Conduct coordinated monitoring and modeling to improve understanding of phosphorus inputs, fate, and transport in Lake Ontario.

- Agencies are collaborating on monitoring and research to improve understanding of the nature of phosphorus delivery to the lake and to support updated estimation of phosphorus loads.
- Building on the information compiled previously by the Annex 4 Lake Ontario Objectives and Targets Task Team, Canadian researchers completed an inventory and assessment of Lake Ontario models in 2024.
- The USGS and NYSDEC conducted the 4th Lake Ontario Nearshore Nutrient Study during the 2023 CSMI year and included additional contaminant and biological analysis including PFAS and cyanobacterial toxins. These data inform an improved understanding of nearshore nutrient dynamics and the relationship to nuisance and harmful algal blooms.

Nuisance algae shoreline accumulation in Port Hope. Credit: Gary Bowen, 2023.

Priority for Science: Lake Ontario - By 2025, update binational estimates of annual phosphorus loads to Lake Ontario.

- Produced preliminary estimates of annual binational phosphorus loads for Lake Ontario for 2018-2023.
- In 2024, the Annex 4 Subcommittee established a multijurisdictional Lake Ontario Loadings Work Group to develop a coordinated and standardized binational process to calculate and report updated phosphorus loads. The work group conducted an inventory of available information for various source types, gathered and assessed the coverage and usability of data from Canadian and U.S. partners, evaluated approaches to estimating loads, and implemented a process consistent with that in use for Lake Erie.

Progress Towards Phosphorus Load Reduction Targets in Lake Erie

Since the mid-1990s, Lake Erie has experienced harmful and nuisance algal blooms resulting from excess nutrients, specifically phosphorus, which is the primary nutrient limiting algal growth in the lake. In 2016 the Parties agreed that phosphorus loads to the western and central basins of Lake Erie need to be reduced on the order of 40 percent from 2008 baseline levels, which is a reduction from the U.S. and Canada of 3,316 tonnes and 212 tonnes, respectively. The U.S. and Canada subsequently developed a binational phosphorus reduction strategy, coupled with Domestic Action Plans, describing their approach to meet this goal. The Domestic Action Plans were assessed and updated in the 2023-2025 timeframe.

Lake Erie continues to exhibit eutrophic conditions and the largest sources of phosphorus to the lake, the major tributaries, routinely exceed target levels. In addition, smaller tributaries can still contribute at times high concentrations of phosphorus leading to smaller, but still significant, localized algal blooms. The fact that there is not yet a discernible improvement in Lake Erie as a whole reflects the challenges of undertaking collective efforts in a large geographic area and the time required for the ecosystem to respond.

The good news is that there are indications that the actions being taken by the U.S. and Canada are on the right track. First, compared to the early 2000s, Lake Erie conditions (i.e., presence of HABs and hypoxia) have not further deteriorated. Second, in the Maumee River, where actions in the watershed are well underway, there is a sign of improvement in terms of the amount of soluble phosphorus being delivered during the spring months. When we take flow into account, the spring soluble phosphorus appears to have declined by 10 percent from 2008 to 2024. Despite a divergent trend in the particulate type of phosphorus entering Lake Erie, the reduction in soluble phosphorus is a sign of success because it is more bioavailable to algae, and the single best predictor of the chronic and massive harmful algal blooms that span the western half of the lake each summer.

The U.S. and Canada systematically monitor and evaluate progress as part of an adaptive management approach. An evaluation by the Annex 4 Subcommittee's Lake Erie Adaptive Management Team in 2023 reaffirmed that phosphorus remains the primary and most manageable driver of HABs and hypoxia in Lake Erie, and an observable response in water quality will require substantial reductions in phosphorus loads across the basin. Significant efforts are underway in Canada and the U.S. to reduce phosphorus loads that, when sustained, targeted and given time to be effective, will provide major improvements to Lake Erie water quality.

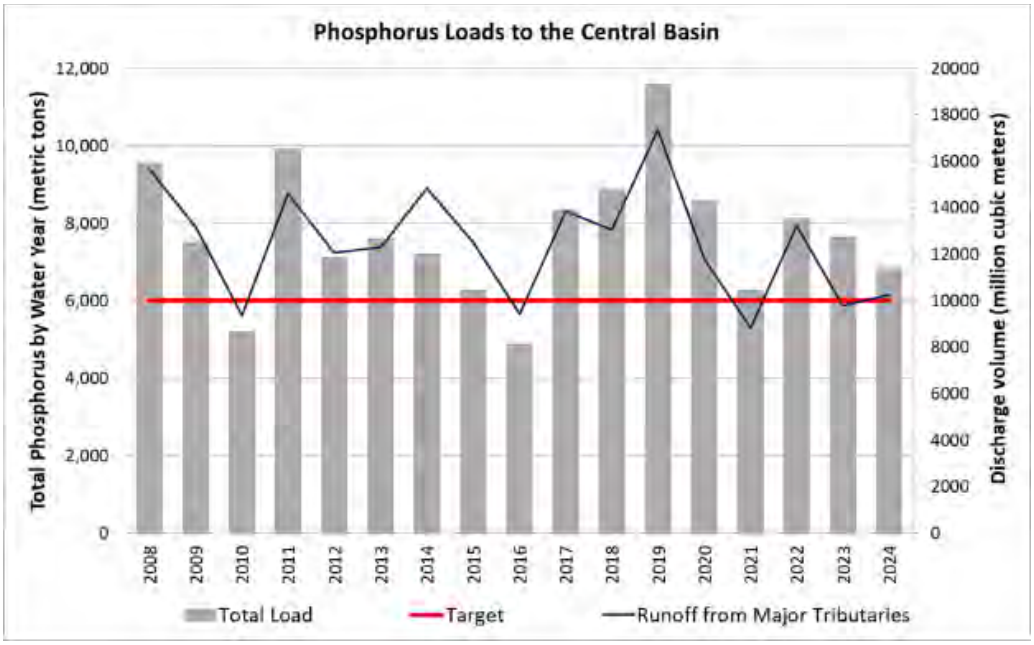


Figure 1: Total phosphorus loading to Lake Erie's western and central basins, 2008-2024. Source: the EPA and ECCC. In 2024, the total phosphorus load to the western and central basins was 6,850 metric tons, higher than the desired target of 6,000 metric tons annually. As shown in Figure 1, this target has only been met twice since 2008. Loads are highly correlated with streamflow discharge, and the years 2010, 2016, and 2021 had drier conditions with less discharge from major tributaries. You can view phosphorus loads to the western and central basins and several priority tributaries in more detail on the Lake Erie Algae (ErieStat) website.

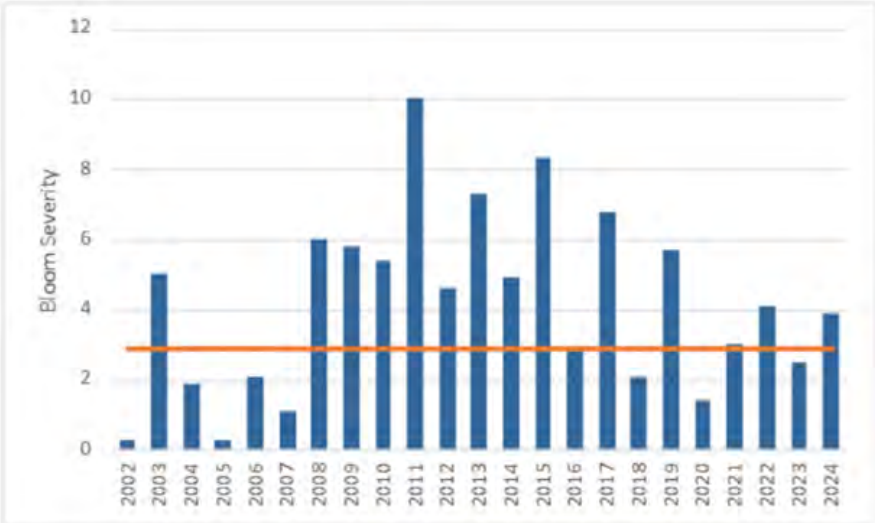


Figure 2: Lake Erie western basin bloom severity, 2002 – 2024. Target threshold depicted with orange line. Source: EPA and NOAA.

The Lake Erie Severity Index (SI) is derived from NOAA's National Centers for Coastal Ocean Science HAB Monitoring Program. The desired threshold not to exceed 9,600 metric tonnes corresponds to a target SI of 2.9. An SI above 5 is considered a "severe" bloom, while blooms over 7 are "very severe." Overall, there is high interannual variability in the severity of the bloom. Between 2017 to 2024, the bloom SI target was met in 2018, 2020, and 2023. The largest blooms to date have occurred in 2011 and 2015. Blooms from 2021-2024 were generally perceived as less intense with fewer "scum" events as compared to 2008-2010 and 2014. NOAA updated the HABs Severity Index time series record for 2002-2024 in May 2025.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, Canada and the United States pursued a variety of domestic projects that also support Annex 4 (Nutrients).

Canada and Ontario-Implementing Canadian Nutrient Reduction Strategies in Lake Erie and Lake Ontario

Reducing phosphorus loads to Lake Erie

- Canada committed to reduce loads from Canadian sources to achieve a 40 percent reduction to Lake Erie (212 tonnes from estimated 2008 levels). Implementation partners are taking action to achieve reductions. In 2018, the Canada-Ontario Lake Erie Action Plan was released, which summarized actions to be taken.
- In 2024, Canada and Ontario released the Canada-Ontario Lake Erie Action Plan Evaluation and Update Report. This report shares accomplishments made by Canada, Ontario and partners since 2018. It also outlines new insights and priorities to guide future actions to reduce phosphorus loads to Lake Erie.
- In 2025, the Canada-Ontario Lake Erie Action Plan Status of Actions was released. This provides the status of each of the 120+ actions under the plan and will be updated on an ongoing basis.
- Through the Great Lakes Freshwater Ecosystem Initiative, the CWA is increasing implementation in the Lake Erie basin through funding of partner efforts to (1) implement on-the-ground phosphorus load reduction measures in critical source areas for nutrient loss, and (2) demonstrate innovative approaches and best management practices that can be used at the broader scale, and filling knowledge gaps through research and science. A total of 13 nutrient-related projects are receiving $53 million over a four-year period, from 2024 to 2028.
- Canada and Ontario have initiated the development of a Canadian Nutrients Strategy for Lake Ontario to meet a commitment in the 2021 Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health to reduce harmful and nuisance algae blooms including in Areas of Concern and other nearshore areas in Lake Ontario. The development of the strategy will continue to be informed by binational initiatives and activities of the GLWQA Nutrients Annex and other domestic initiatives.
- Through the Great Lakes Freshwater Ecosystem Initiative, the CWA is also supporting partner-led projects to advance key nutrient-related priorities in the Lake Ontario watershed to (1) conduct targeted science to generate new information and understanding of key knowledge gaps, (2) develop new watershed-scale nutrient management planning where there is demonstrated risk from known and recurring nearshore toxic or nuisance algal blooms, and (3) implement actions in existing nutrient management plans. A total of 3 nutrient-related projects are receiving over $0.7 million over a two-year period, from 2025 to 2027.

Programs to Reduce Phosphorus Loadings from Agricultural Sources

- The 4R Nutrient Stewardship Program©— which refers to using the Right Source of Nutrients at the Right Rate and Right Time in the Right Place— is led by Fertilizer Canada, OMAFA, the Ontario Agri Business Association, the Grain Farmers of Ontario, the Ontario Federation of Agriculture, and the Christian Farmers Federation of Ontario. As of 2023, over 2,500 farms and 384,000 hectares are following the 4R© best management practices to improve on-farm crop productivity and fertilizer efficiency.
- Through the five-year (2023-2028) Sustainable Canadian Agricultural Partnership, Canada and Ontario are committing more than $68 million under the Ontario Agricultural Sustainability Initiative to fund three programs designed to support farmers in making their agricultural lands more productive and resilient:
  - The Resilient Agricultural Landscape Program, a $56.7 million, five-year program that will continue to make funds available to support projects to measurably reduce greenhouse

gas emissions and/or sequester carbon, while addressing other environmental co-benefits like water quality and soil health. This includes $25 million delivered by Ontario Soil and Crop Improvement Association to provide funding directly to farmers, $21.6 million delivered by Conservation Ontario to support organizations working with farmers and $5 million for Ontario Forage Council to support improvements on Community Pastures.

  - The Agricultural Stewardship Initiative (ASI), a supplemental cost-share program that provided $3.5 million in 2023 for farmers to modify and adapt their equipment and operating practices, support soil health, water quality and productivity benefits. ASI provides enhanced funding on a regional basis for projects contributing to phosphorus reductions in the Lake Erie and Lake St. Clair watershed areas.

  - The ONFARM program received $7 million to extend and enhance its work, continuing from the Canadian Agricultural Partnership. The program helps farmers better understand and communicate best on-farm management practices to improve soil health and water quality through paired trials on 30 commercial farms across Ontario.

- Ontario supports research and innovation projects through the Ontario Agri-Food Innovation Alliance to address various priorities of the agri-food sector, including water and soil nutrient use efficiency to reduce the loss of nutrients to streams and lakes. In 2023, OMAFA, the University of Guelph and the Agricultural Research and Innovation Ontario renewed the Ontario Agri-Food Innovation Alliance Agreement.

- The Ontario Greenhouse Environmental Strategy (OGES) is a committee that acts as a forum for Ontario's greenhouse industry and government to collaborate on environmental impacts and risks associated with the greenhouse sector. The committee consists of OMAFA, MECP, and the Ontario Greenhouse Alliance, (including Ontario Greenhouse Vegetable Growers and Flowers Canada (Ontario)). OGES objectives include, but are not limited to, mitigating environmental risks and improving on environmental performance associated with greenhouse production, encouraging compliance, and investigating technology and methods for phosphorus reductions and water efficiencies in the greenhouse sector.

Combine harvester in a wheat field. Credit: AlbertPego @ iStock.

Programs to Reduce Phosphorus Loadings from Municipal Sources

- **Wastewater Optimization.** Ontario is providing funding to support the Grand River Conservation Authority Watershed-wide Wastewater Optimization Program. This program works collaboratively with municipal wastewater treatment plant owners and operators to improve the performance of plants in the Grand River, including reducing phosphorus discharges. Through this program, Ontario worked with municipal wastewater practitioners to increase the uptake of wastewater treatment plant optimization.

- **Municipal Sewage Overflows/By-passes Monitoring and Reporting.** Ontario continues to collaborate with municipal partners to better manage wastewater and stormwater across the province, including $9.5 million funding support for municipal monitoring and public reporting of municipal sewage overflows and bypasses across Ontario. This includes funding to six municipalities (Amherstburg, Leamington, London, Sarnia, Niagara Region and Windsor) in the Lake Erie watershed, to help increase transparency around monitoring and public reporting of municipal sewage bypasses and overflows. Municipalities used this support to install and upgrade monitoring equipment, acquire,

and implement software approaches to model event forecasting and develop user-friendly public reporting systems. This program concluded on March 31, 2025.

- **Increasing Stormwater Best Management Practices.** Ontario supported projects that encourage stormwater best management practices including Low Impact Development (LID) which can help reduce nutrients. For example, a municipal workshop to increase awareness of the benefits of long-term planning for stormwater green infrastructure; Sustainable Technologies Evaluation Program tools to improve awareness and knowledge (e.g., a WIKI); and municipal LID maintenance toolkit and training for over 500 municipal inspectors and asset managers across Ontario.

Watershed-Based Planning and Restoration Efforts

- Conservation authorities have continued to lead the development and implementation of watershed and phosphorus management plans, with funding support from Canada and Ontario, and working in partnership with municipalities, local communities, and Indigenous Peoples.
- Canada, Ontario, and conservation authorities continue to engage Indigenous communities in LEAP implementation activities, including the Thames River (Deshkan Ziibi) Shared Waters Approach, supporting First Nations Youth stewardship programs, participation on the LEAP Implementation Team, Lake Erie/Great Lakes governance, and support of specific projects, including watershed planning initiatives and the development of agricultural land management plans.
- Beginning in 2021, OMAFA supported a collaboration between the Chippewas of the Thames First Nation (COTTFN) and the Lower Thames Valley Conservation Authority to develop and implement a COTTFN Agricultural Management Plan. This Plan includes a 4-year water quality monitoring program of surface waters in the Thames River (Deshkan Ziibi), event-based nutrient loading monitoring, soil sampling of agricultural lands, soil biological health assessments, natural restoration of legacy and non-productive agricultural lands, and education and outreach to farmers, farm leaseholders, and general community members about agricultural BMPs for nutrient management, environmental farm plans, and local restoration organizations.

Science, Research, and Monitoring

- ECCC, with Ontario's support, provides annual assessments of phosphorus loads entering Lake Erie from Canadian sources.
- ECCC, in collaboration with partners including the University of Waterloo and the Toronto Metropolitan University are undertaking research and modeling to improve understanding of the efficacy of various phosphorus reduction best management practices.
- ECCC is building a network of water quality buoys to provide continuous in-situ monitoring of algal pigments and other sensor-based water quality parameters in priority areas experiencing algal blooms. These data are provided in real-time on the Great Lakes Observing System. The first water quality monitoring buoy was deployed near Leamington in Spring 2024, and four more buoys are set to be deployed by 2026 in Western Lake Erie, Lake St. Clair, Lake Huron and Georgian Bay. Data will be used to validate and improve remote sensing.
- ECCC continues to conduct research and monitoring to further understand the biomass concentrations of toxins that pose a threat to human and ecosystem health in the waters of the Great Lakes. ECCC has worked with the National Laboratory for Environmental Testing to create an Algal Toxin analysis starting with Great Lakes water samples in 2025.
- ECCC implemented whole-lake ecosystem models for Lake Erie and developed and implemented satellite-derived algal bloom products with EOLakeWatch. Information is posted daily to a public web interface that documents seasonal progression of blooms. This information is consolidated annually into summary reports. ECCC scientists have developed and are testing an enhanced EOLakeWatch platform with additional functionality and extended data coverage across

the Great Lakes and to other freshwater systems in Canada.

- AAFC continued to research ways that farmers can improve nutrient efficiency and reduce nutrient losses off-farm. Four trials were conducted looking at sustainable phosphorus levels in soils. Results identified thresholds at which additional fertilizer did not improve crop yield (corn, soybean, wheat) and increased risk of phosphorus loss. Research continues to look at improving 4R commercial fertilizer nutrient stewardship practices for crop production systems receiving manures.
- AAFC has updated background algorithms in the longstanding Indicator of Risk of Water Contamination by Phosphorus, a tool used to assess the risk of phosphorous loss from agricultural lands resulting from agricultural practices. The updated algorithms reflect current research findings, such as improved understanding of flow pathways and associated phosphorous forms through different pathways on the landscape.
- AAFC's Agricultural Climate Solutions – Living Labs accelerates the co-development, testing, adoption, dissemination, and monitoring of beneficial management practices that sequester carbon and/or reduce greenhouse gas emissions, including co-benefits for water quality. To date, 14 living labs have been announced across Canada, each with a nutrient management component.
- AAFC's Agricultural Solutions – On-Farm Climate Action Fund supports farmers in the adoption of beneficial management practices that store carbon and reduce greenhouse gas emissions in three areas: nitrogen management, cover cropping, and rotational grazing. These activities have co-benefits for water quality.
- CWA is advancing precision conservation through field-scale watershed modeling to identify critical source areas of nutrient loss in the Thames River watershed.
- CWA's Great Lakes Freshwater Ecosystem Initiative is funding partner-led projects to demonstrate innovative approaches and agricultural best management practices in priority Lake Erie watersheds to fill knowledge gaps through science. For example, the Upper Thames River Conservation Authority is testing methods to decrease accumulated phosphorus in soil and demonstrate an edge-of-field water recycling system, and Flowers Canada (Ontario) is testing the effectiveness of a novel approach to remove and recover phosphorus using hybrid treatment swales.
- Ontario is undertaking research studies to better understand phosphorus loadings and algal blooms. With partners, MECP completed a Multi-Watershed Nutrient Study, to understand how phosphorus losses from the land surface have changed over the last 50 years. This study confirmed that the largest proportion of phosphorus is lost during major storm events, many of which now occur outside the growing season. Stream phosphorus monitoring conducted in a sub-watershed inflowing to the Thames River also demonstrated evidence of these changing seasonal patterns. OMAFA continues to support research across multiple disciplines, including water quality and soil health. Several such research projects have been completed and are currently underway, specifically focusing on reducing agri-food sector's adverse impact on the health of the Great Lakes and developing solutions to mitigate future adverse impacts on these vital water bodies.

United States

Governmental agencies and their partners implemented conservation activities to reduce nonpoint sources of pollution that threaten Great Lakes nearshore regions. These partners worked collaboratively to target nonpoint sources of excess phosphorus runoff that contribute to HABs around the Great Lakes in priority watersheds, including the Lower Fox River, Saginaw River, and Maumee River. GLRI-funded projects implemented since the program's inception have prevented more than 2.6 million pounds of phosphorus (including over 450,000 pounds of phosphorus in fiscal Years 2023-2025) from leaving farms and entering the Great Lakes. In addition, GLRI federal agencies and their partners worked collaboratively in urban and suburban areas to prevent more than 230million gallons of polluted stormwater from entering the Great Lakes in Fiscal Years 2023 -2025.

Major Cross-cutting Programs & Partnerships to Reduce Phosphorus Loads to Lake Erie

- **Domestic Action Plans.** Strategies that develop and implement phosphorus reduction activities, called Domestic Action Plans, are currently in the process of being updated. Ohio, and Indiana released theirs in December 2023; Michigan's was released in May 2025; and Pennsylvania is in the process of updating theirs. In addition, the EPA, NOAA, NRCS, USACE, and USGS in collaboration with the five Lake Erie states have been working to update the overarching U.S. Action Plan.

The Fruth Wetland Nature Preserve – an 18-acre wetland restoration project in Seneca County, Ohio – filters agricultural runoff from surrounding farm fields and reduces sediment and nutrient loads to western Lake Erie. Source: ODNR.

- **H2Ohio Initiative.** Since Governor DeWine introduced H2Ohio in 2019, Ohio has appropriated over $600 million for this important water quality initiative through 2025. H2Ohio has been incredibly successful to date in expanding the implementation of agricultural best management practices, wetland restoration, and improvements to wastewater infrastructure.
  - Though H2Ohio is a statewide initiative, it has been designed, in part, to address the specific needs of Lake Erie. Approximately half of H2Ohio funds are spent in the western Lake Erie basin (WLEB) watershed.
  - Nearly $250 million in H2Ohio funding has been allocated by Ohio Department of Agriculture support cropland nutrient management in the WLEB. More than 2,600 farmers have enrolled 1.85 million acres of farmland across the 24 counties that make up the WLEB watershed.
  - Additionally, H2Ohio funds are being used to construct and enhance 183 wetland projects in the Lake Erie watershed and established a long-term monitoring program to evaluate the effectiveness of the wetlands at retaining nutrients.
  - Yearly Phosphorus source reduction estimates and other data can be viewed on the Data Ohio Portal and in H2Ohio Annual Reports.
- **Michigan WLEB Community Advisory Group.** Michigan partnered with University of Michigan Water Center to form an external WLEB Community Advisory Group and Science Panel in August 2023. Together these groups provide a broad conduit for public input into the DAP. Michigan held its first State of the Western Lake Erie Basin Conference in 2023 and a second event was held in 2025.
- **WLEB Partnership.** Federal and state partners in Ohio, Michigan, and Indiana collaborate on strategies to maximize the impacts of their projects through the Western Lake Erie Basin Partnership. Participation was hindered during the pandemic, but since then the Partnership has re-engaged with multiple in person meetings and events in 2023-2025.
- **Great Lakes Restoration Initiative.** Phosphorus reduction and HABs are a funding priority under the GLRI. Approximately $22 million in GLRI funding is invested in Lake Erie nutrient reduction efforts each year, with about 85 percent for on-the-ground projects and 15 percent on the supporting science. EPA created a new GLRI funding opportunity to enhance technical assistance and outreach to farmers in the western Lake Erie basin watershed, awarding $3.7 million for state and locally-led projects in 2025.

Programs to Reduce Phosphorus Loadings from Agricultural Sources

- **Widespread farmer engagement in western Lake Erie.** Federal and state agencies in the U.S. have significantly increased conservation assistance to

farmers over the past several years, with new and enhanced programs focused on improving nutrient management practices in priority watersheds (such as the H2Ohio Initiative described above). As of 2025, about half of the 4 million acres of cropland in the western Lake Erie watershed is or was recently enrolled in a federal or state conservation program. This is an outstanding adoption level, that if maintained will significantly reduce phosphorus contributions from agricultural sources to Lake Erie.

- **USDA Conservation Efforts to Reduce Phosphorus Loads to Lake Erie.** From 2018-2023, the USDA's Natural Resources Conservation Service doubled the amount of financial assistance available to farmers in the Lake Erie watershed. The Agency executed more than 3,000 cost-sharing contracts with private landowners, covering over 742,000 cropland acres. Approximately 30 percent of the contracts went to nutrient management practices, 41 percent to cover crops, and 20 percent to animal waste storage and management.
- **Ohio Agriculture Conservation Initiative (OACI).** OACI is a partnership of the agriculture, conservation, environmental, and research communities, which conducts statistical surveys to better understand current on-farm conservation and nutrient management efforts. OACI's recent surveys indicate enrollment in cost-sharing programs is high, the majority of farmers routinely test their soils, and more advanced precision agriculture is widely used in much of northwest Ohio.
- **Expanding Agricultural Programs in Michigan.** MDARD has expanded work with agricultural producers in the WLEB. Implementation of conservation practices has largely been driven by the Michigan Agriculture Environmental Assurance Program and the tri-state Regional Conservation Partnership Program (RCPP). During Fiscal Year 2025 the RCPP signup saw 25 applications submitted totaling approximately $3 million, which exceeded the available funding by nearly $2 million. Currently, there are 115 Cropping System verifications in the WLEB. This totals 59,154 acres, which is approximately six percent of the farmland in Michigan's portion of the WLEB.
- **Michigan's Conservation Reserve Enhancement Program (CREP).** CREP is a formal partnership between MDARD and USDA Farm Service Agency (FSA) to further incentivize implementation of voluntary conservation in priority areas in Michigan, specifically the WLEB, Saginaw Bay and Lake Macatawa watersheds. In exchange for cost share, land rental, and incentive payments landowners agree to install conservation practices on eligible farmland and maintain those practices for 15 years. Michigan's CREP was revived in 2022 with $4.4 million in onetime funds to MDARD for program administration, promotion, and implementation. At the end of Fiscal Year 2024, Michigan's CREP had a total of 1,523 new and existing contracts equaling 17,433 acres enrolled, including 7,031 acres in the WLEB. For the WLEB, conservation practices established on this acreage resulted in the reduction of approximately 14,439 tons of sediment, 19,622 pounds of phosphorus, and 57,444 pounds of nitrogen from entering rivers and streams.
- **Farmers mentoring other farmers.** An EPA GLRI grant to The Nature Conservancy supported a pilot project that successfully recruited 26 farmers to train and mentor others on conservation practices. From 2020-2024, the mentors, who manage 28,590 acres themselves, directly engaged over 11,680 farmers in the Maumee River watershed through workshops, field days, and one-on-one interactions. The goal is to expand the program across Ohio to train 1-3 farmers in each county and continue building a culture of conservation in the region.

Aerial of farm on Lake Erie. Credit: DarrensProFotos @ iStock.

Programs to Reduce Phosphorus Loadings from Municipal Sources

- **Michigan lowers permitted effluent limits to more facilities in the western Lake Erie basin.** Michigan has continued making significant reductions in phosphorus loading to Lake Erie as the result of major improvements in facility operations and stricter permit requirements. These reductions are especially attributable to the Great Lakes Water Authority (GLWA), the Detroit region's primary municipal wastewater service provider, where annual total phosphorus (TP) loads have been reduced by over 55 percent. Building on this success, EGLE established a framework for achieving a 0.5 mg/L TP effluent limit (i.e., a growing season average) at all 25 major publicly owned wastewater treatment facilities located within the western Lake Erie basin. To help facilities meet the lower TP effluent limits, EGLE published Phosphorus Removal Guidance for Wastewater Utilities in Michigan's Western Lake Erie Basin, a document that describes low-cost, practical methods to optimize phosphorus removal, in October 2024.
- **Fort Wayne Deep Tunnel.** In Indiana, 5 miles of the Fort Wayne Deep Tunnel project, an essential part of its Combined Sewer Overflow (CSO) long-term control plan, became operational in 2024, one year ahead of schedule. The final phase, a pumping station, is currently under construction and will mark the official completion of the project. The Deep Tunnel project will reduce CSOs into the St. Marys and Maumee rivers from 72 per year to four per year or fewer.
- **New York Updates Phosphorus Guidance.** In December 2024, New York State Department of Environmental Conservation released draft water quality guidance values for phosphorus that will advance the state's regulation of phosphorus in ambient freshwaters. Because phosphorus is naturally occurring and an essential nutrient for most aquatic systems, linked biological response variables that aid in identifying when phosphorus concentrations have become excessive have also been developed. The water quality guidance values are supplemented by updated draft guidance for inclusion of total phosphorus requirements in permits for existing and new facilities discharging sanitary wastewater to lakes, lake watersheds, and flowing waters of New York State, including Lake Erie and Lake Ontario, which should result in decreased phosphorus loads and subsequent improvements to water quality.

Watershed-Based Planning and Restoration Efforts

- **New expanded water quality monitoring network and field inventories.** Michigan is implementing a strategic and targeted approach to accelerate progress towards nonpoint source reductions. Five subwatersheds within Michigan's portion of the western Lake Erie basin were selected for more focused and accelerated activities including completing agricultural inventories, finer-scale water quality monitoring, and prioritized conservation practice implementation. This ongoing effort is informed by a 2024 report, *The Magnitude and Cost of BMP Implementation: Strategic Planning for Michigan's Priority Subwatersheds*, which was used to assess and estimate the impact of conservation practice scenarios in the five priority subwatersheds.
- **Maumee River Total Maximum Daily Load (TMDL).** Ohio EPA finalized and submitted the Maumee Watershed Nutrient TMDL to the EPA in June 2023. The TMDL identifies phosphorus load allocations for point source and nonpoint source pollution occurring throughout Ohio's portion of the Maumee drainage basin to meet the reduction goals established under Annex 4. It includes an implementation strategy which identifies several mechanisms and funding programs that state and local entities can utilize to reduce phosphorus loads. The first Biennial report on progress was issued in 2024.
- **Wetlands for nutrient reduction.** The EPA continues to prioritize GLRI nonpoint source activities on the restoration of wetlands, floodplains and riparian buffers along agricultural drainage ditches and other areas that receive agricultural runoff. As an example, one EPA GLRI grant will restore over 50 acres of cropland and 15 acres of floodplain, add floodplain to at least 2 miles of agricultural ditches, which will reduce phosphorus loads to the Maumee River by 2,000 pounds annually.

- **Conservation Easements.** NRCS efforts under the GLRI recently expanded to include wetland and floodplain easements, as well. By 2029 NRCS estimates that 30 acres of restored wetland easements and 500 acres of floodplain easements will be secured in the western Lake Erie watershed with NRCS GLRI funding. In addition, FSA and the State of Ohio are implementing a new CREP agreement that will expand the amount of land in permanent vegetative cover adjacent to rivers and streams in the WLEB. So far, they have enrolled nearly 50,000 acres of their 67,000 acre goal.
- **Watershed modeling in the eastern basin.** The USGS and NYDEC developed new SWAT models for 9 watersheds in the eastern basin of Lake Erie to evaluate the effects that conservation practices, point source discharges, and green infrastructure can have on nutrient and sediment loads. Model results were used to inform the 9 Element Plan for NY's Lake Erie Watershed, one of New York's major efforts identified in the U.S. Action Plan for Lake Erie, and were published in 2024; Monitoring and Simulation of Hydrology, Suspended Sediment, and Nutrients in Selected Tributary Watersheds of Lake Erie, New York. Scientific Investigations Report 2024-5022.

Science, Research, and Monitoring

- **Supporting science under GLRI.** From 2023 to 2025, NOAA, USGS, and USACE conducted over $15 million in critical science activities to support Lake Erie nutrient-reduction goals. GLRI supports critical HABs monitoring and decision-support tools, including the Lake Erie HABs Tracker tool and biweekly forecasts; tributary and edge-of-field monitoring and nutrient load computations; and ecosystem and watershed modeling.
- **HABs Forecasting.** NOAA's Great Lakes Environmental Research Laboratory leads efforts to track and forecast blooms in Lake Erie, Saginaw Bay, Green Bay, and Muskegon Lake (eastern Lake Michigan). NOAA has continued to improve the Lake Erie HABs forecasting tools with cutting edge technology and research. The Lake Erie Harmful Algal Bloom forecast system currently provides stakeholders critical information including current location, most recent accurate estimate of size (area), and a 5-day forecast of transport, mixing, scum formation, and bloom decline. As noted earlier in this report, NOAA expects the forecasts will be expanded to include algal toxins by 2026. This is made possible through use of sophisticated instruments that can collect and analyze water samples on the spot without human help. Sometimes referred to as a "lab in a can," there are only around 10 of these instruments in use globally and the first to ever be deployed in a freshwater system was in Lake Erie. Reliable and timely detection of HAB location and potential toxicity is vital to protect human health.
- **Ohio Technology Assessment Program.** Several new technologies to help achieve phosphorus reduction goals for Lake Erie are currently being evaluated by Ohio EPA's H2Ohio Technology Assessment Program. The EPA partnered with Ohio EPA to establish GLRI Pilot Projects for three out of ten of them. The first two will test innovative fertilizer technologies including field demonstrations of a slow-release fertilizer. The third project will quantify their phosphorus reduction potential of automated drainage water management systems, which is a proven conservation practice that offers significant potential to improve water quality in regions with tile-drained cropland, as well as enhance farm economic viability via increased crop resiliency and yields.
- **Great Lakes Tributary Water Quality Dashboard.** USGS has been monitoring water quality in 24 U.S. tributaries to the Great Lakes since 2011. A recent analysis found that flow-normalized total phosphorus loads have decreased or remained steady in most (21 of the 24) of the monitored tributaries, indicating widespread progress toward the nutrient reduction goals of the GLRI and the GLWQA. All of the results of this analysis are published on an interactive, web-based dashboard, at https://rconnect.usgs.gov/glritrends/ and will be regularly updated as new data become available.
- **GLRI Demonstration Farm.** A demonstration farm in northeast Wisconsin is providing a unique opportunity to measure the impacts of two innovative practices applied as a system designed to remove dissolved phosphorus and nitrates.

Kinnard Farms will be the first demonstration farm in the nation to have a denitrifying bioreactor and a Phosphorus Removal System built in-line on the same tile system within a field. Over the next several years USGS will monitor the system at three different points, collecting data that will help tell a more complete story about the impact of pairing these two technologies on subsurface water quality.

- **Wetlands research.** The EPA is collaborating with USACE, ODNR and other partners to assess wetlands for nutrient reduction potential in the western Lake Erie watershed. In 2020, USACE built a phosphorus-optimized demonstration wetland in Defiance, Ohio, that is being intensively monitored; and in 2025, USACE began work on a second site with the City of St. Marys. The EPA also partnered with ODNR to expand their H2Ohio Wetland Monitoring Program to provide a more robust monitoring network using autonomous sensors. The aim of both of these projects is to use hydrology and water quality data collected from the wetlands to create meaningful indices of nutrient removal, to inform future management decisions.
- **Ohio Department of Higher Education Harmful Algal Bloom Research Initiative (HABRI).** HABRI is a statewide research program created in 2015 in response to the 2014 Toledo HAB toxin drinking water advisory. From 2015 - 2025, Ohio invested $24 million in funds for 115 HABs projects to 15 Ohio-based universities. Projects are selected with input from state agencies, and the program has been extremely successful at providing quick and reliable information to address their needs and knowledge gaps.
- **Ohio EPA Total Maximum Daily Load (TMDL) Program.** The TMDL Program, established under the Clean Water Act, focuses on identifying and restoring polluted rivers, streams, lakes, and other surface water bodies. A TMDL is a written, quantitative assessment of water quality problems in a water body and contributing sources of pollution. It specifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions, and provides the basis for taking actions needed to restore a water body.
- **HABs Mitigation and Research.** NYDEC continues to collaborate with partners to study, manage, and mitigate HABs in New York. Since releasing the NYDEC HAB Research Guide in 2021, NYDEC has supported $14.4 million in HABs research projects. Recently completed projects include an overview of HABs detected in NY from 2012-2020, an evaluation of a spectral fluorometer for monitoring chlorophyll, an investigation into patterns and impacts of cyanobacteria, and a HAB mitigation pilot project in cooperation with Clarkson University on electrochemical oxidation. NYDEC is currently working with SUNY ESF to characterize occurrence of benthic cyanobacteria and toxin production statewide and investigate the use of high-definition satellite images to estimate HAB pigments in lakes.

Annex 5: Discharges from Vessels

Over the past three years, the United States and Canada have effectively managed vessel discharges and coordinated responses to vessel emergencies that had the potential for oil or hazardous substance spills. In addition, all vessels entering the Great Lakes Seaway system from outside the Exclusive Economic Zone receive ballast management exams to ensure that no noncompliant ballast water is discharged. Both federal governments have made significant strides in advancing management programs and contingency planning that safeguard the Great Lakes waters, protect shoreline communities, and secure the safety of vessels and crew.

Key Achievements

- Conducted ballast management exams on all vessels bound for the Great Lakes from outside the Exclusive Economic Zone to ensure that no noncompliant ballast water was discharged in the Great Lakes St. Lawrence Seaway system.
- Implemented environmental programs to prevent and control vessel discharges that are harmful to the waters of the Great Lakes.
- Responded to spills and groundings under the Canada-United States Joint Marine Pollution Contingency Plan, which provides a coordinated mechanism and established procedures for responses.

Purpose and Overview

The purpose of Annex 5 (Discharges from Vessels) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to prevent and control vessel discharges that are harmful to the quality of the Waters of the Great Lakes, through the adoption and implementation of regulations, programs, and other measures that facilitate coordinated and cooperative implementation and enforcement, where appropriate.

The Discharges from Vessels Annex supports the coordination of responsible authorities in the United States and Canada as they work to protect water quality, ensure safety, consider the standards and guidance of the International Maritime Organization, and implement vessel discharge-related domestic laws and regulations. This annex focuses on preventing and controlling the following vessel discharges that are harmful to the waters of the Great Lakes:

- Oil and Hazardous Polluting Substances;
- Garbage;
- Wastewater and Sewage;
- Biofouling;
- Antifouling Systems; and
- Ballast Water.

ANNEX IMPLEMENTATION

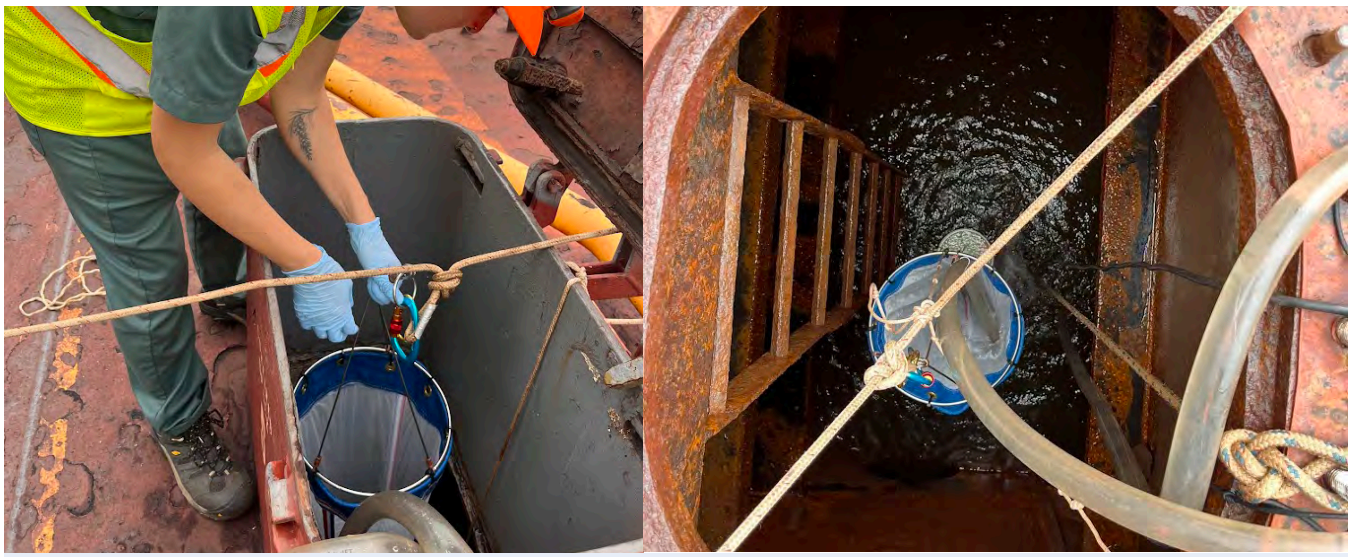
Implementation of Annex 5 (Discharges from Vessels) is co-led by USCG and TC with support from the EPA, Fisheries and Oceans Canada (DFO), and the Canadian Coast Guard (CCG). Pursuant to Annex 5, the authorities responsible for implementing the commitments of the Discharges from Vessels Annex met annually to discuss and coordinate the vessel discharges management programs that deliver upon the Annex commitments.

Annex 5 Subcommittee membership includes the responsible authorities noted above, as well as members from Wisconsin Department of Natural Resources, Indiana Department of Environmental Management, the Lake Carriers' Association, the Chamber of Marine Commerce, the Shipping Federation of Canada, and Ontario Ministry of Transportation. U.S. Department of State and Global Affairs Canada also participated in these discussions with the responsible authorities. The Annex 5 Subcommittee provides a forum to discuss vessel discharge standards development, implementation, and compliance, as well as shared issues and concerns related to vessel discharges that are brought to their attention by members, constituents, and other stakeholders.

- Following the U.S. Environmental Protection Agency (EPA) finalization of the Vessel Incidental Discharge National Standards of Performance in October 2024, the U.S. Coast Guard (USCG) is developing compliance and enforcement regulations to support these performance standards
- Ongoing bilateral meetings have strengthened collaboration on maritime and environmental governance through regular exchanges on regulatory initiatives and policy developments related to vessel biofouling.
- In December 2023, Transport Canada (TC) launched the Ballast Water Innovation Program to support industry-led projects addressing challenges in installing, operating, and maintaining ballast water management systems in the Great Lakes and St. Lawrence River region.

Binational Actions and Achievements

Priority for Action: Continue to work together and with stakeholders towards increased compatibility and environmental protection in ballast water requirements and, where possible, develop common implementation approaches.



Sampling Ballast Water with a plankton net. Credit: U.S. Coast Guard.

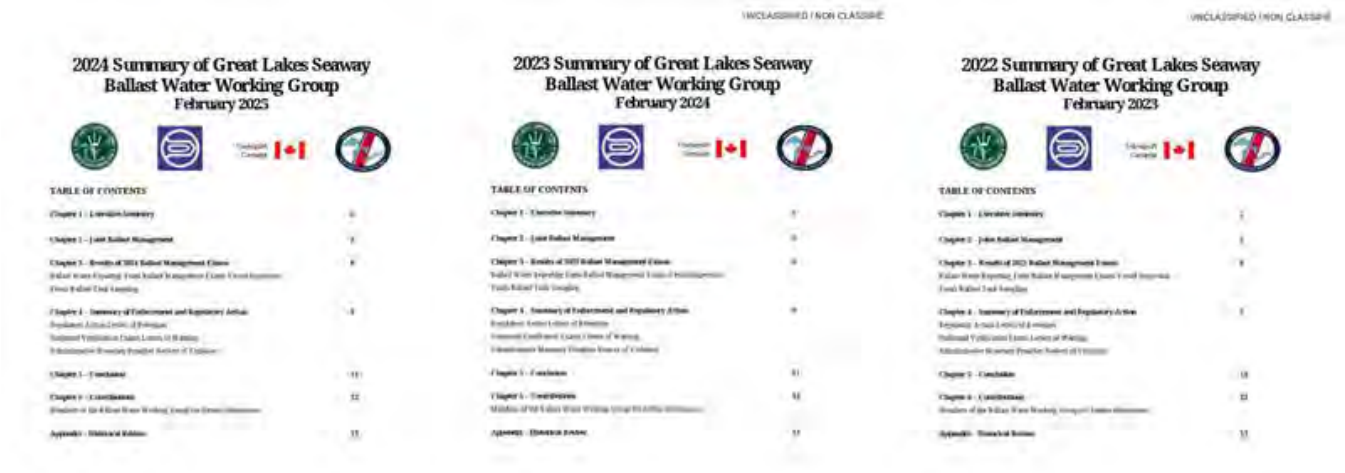
- The U.S. and Canada collaborated both bilaterally and through the International Maritime Organization (IMO) to develop contingency procedures for stalled or inoperable Ballast Water Management Systems at Great Lakes ports, with a focus on vessels operating in challenging water conditions.
- In August 2024, a binational meeting was held at the University of Wisconsin-Superior, bringing together universities and contracted research partners. During the event, stakeholders, sponsored by five U.S. agencies and two Canadian agencies, delivered presentations on a wide range of topics relating to vessel discharges, including analysis of ballast water reporting and monitoring data, field sampling procedures, risk analysis related to biofouling, ballast, chlorine and disinfection byproducts, exhaust gas cleaning systems, fire protection from aqueous film-forming foam, graywater, limitations of scaling models used in type approval and sampling technologies, and regional transit analysis.

Priority for Action: Use the Canadian/U.S. Ballast Water Working Group to maximize consistent and compatible compliance monitoring of Canadian and U.S. ballast water rules.

- Through the Great Lakes Seaway Ballast Water Working Group the U.S. and Canada continue management, oversight and enforcement to ensure vessels arriving from beyond Canada's Exclusive Economic Zone meet ballast water compliance to reduce the introduction of aquatic invasive species via ballast water and residuals. This ensured no noncompliant ballast water was discharged in the Great Lakes Seaway system during the reporting period.
- USCG and TC have been working closely to further align operational procedures for vessels reporting issues with the use of their Ballast Water Management Systems (BWMS) due to water conditions in the Great Lakes Basin (e.g., cold, fresh and mixed with sediment) that create difficulties for BWMS to operate effectively.
- Published annual Great Lakes Seaway Ballast Water Working Group summary reports assessing compliance with ballast water regulations throughout the Great Lakes:
  - 2024 Summary of Great Lakes Seaway Ballast Water Working Group
  - 2023 Summary of Great Lakes Seaway Ballast Water Working Group
  - 2022 Summary of Great Lakes Seaway Ballast Water Working Group.

Priority for Action: Share best management practices and develop agreements for the compliance and enforcement of wastewater discharge regimes, which may include sampling, for greywater and sewage under MARPOL Annex IV.

- The USCG analyzed graywater sampling data submitted through Vessel General Permit (VGP)



2022, 2023, and 2024 Summaries of Great Lakes Seaway Ballast Water Working Group.

requirements to assess the levels of conventional pollutants (Total Suspended Solids, Fecal Coliform, Biochemical Oxygen Demand, pH, and Total Residual Chlorine) in the graywater produced by vessels covered under the VGP.

- TC announced new voluntary measures in April 2022 to reduce pollution from cruise ships with 100 passengers or more operating in Canadian waters during the 2022 cruise season. These measures, which apply to the Great Lakes, became mandatory for the 2023 season and beyond through an *Interim Order Respecting the Discharge of Sewage and the Release of Greywater by Cruise Ships in Canadian Waters*.
- TC continues its ongoing regulatory amendments process to strengthen the *Vessel Pollution and Dangerous Chemicals Regulations*, which implements the International Convention for the Prevention of Pollution from Ships (MARPOL) annexes and the International Convention on the Control of Harmful Anti-fouling Systems on Ships.

Priority for Action: Review and share best practices and available technologies for control and management of vessel biofouling.

- Both countries have held ongoing ad hoc meetings to facilitate discussions on jurisdiction-specific initiatives, share updates on regulatory and policy developments, and address key international advancements in maritime and environmental governance related to vessel biofouling.

Priority for Science: Use best available science to examine effectiveness of greywater discharge requirements in preparation for U.S. and Canadian domestic regulations.

- The USCG partnered with the U.S. Department of Transportation's John A. Volpe National Transportation Systems Center to analyze graywater characteristics using vessel samples collected by the EPA under the VGP. The review of treated samples demonstrated that current Advanced Wastewater Treatment Systems are capable of meeting the Vessel Incidental Discharge Act (VIDA) discharge standards for graywater.

Priority for Science: Conduct coordinated binational ballast water and biofouling Aquatic Invasive Species research through interagency strategic project planning and sharing of latest results.

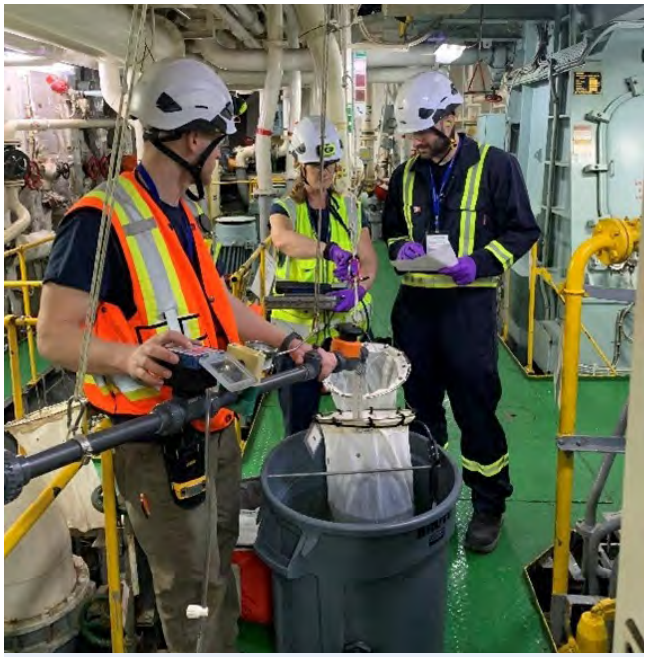
- Both countries participated in semi-annual binational science-policy meetings to discuss their Aquatic Invasive Species research programs and promote coordination and collaboration. The meeting also included shared scientific and economic analyses, such as testing in-water cleaning technologies and exploring approaches to protect the Great Lakes basin ecosystem.
- Interagency strategic planning and coordination of research projects was conducted through a science planning meeting in Washington, DC held in winter 2024 before the start of the 2024 Great Lakes field season. Participants included representatives from five U.S. agencies, two Canadian agencies, and university research partners. The meeting included sharing research plans for projects, identifying opportunities for collaboration and coordination, and highlighting potential areas for future work.
- Latest science results were shared through the addition of a Great Lakes day and interagency participation at the 2024 USCG-Naval Research Lab summer program review meetings and stakeholder meetings of the U.S. Great Lakes Ballast Water Research and Development program.

Priority for Science: Undertake and collaborate on research and development regarding technical challenges to the use of ballast water management systems on the Great Lakes.

- Both countries held a semi-annual binational science-policy meeting to strategically plan and coordinate Great Lakes ballast water management and biofouling research and development, with a focus on future funding and long-term planning to promote better alignment of efforts.
- In 2023, a joint sampling effort was undertaken to compare methods for sampling ballast water and assess how sampling method can impact assessment of ballast water management system challenges.
- In 2022-2023, DFO undertook research on the challenges of using ballast water management systems by ships loading ballast at Hamilton Harbour, Lake Ontario and shared preliminary

results through presentations at the above-noted science meetings. A scientific publication is under review.

- The USCG partnered with the Naval Research Laboratory, in collaboration with the Lake Superior Research Institute at the University of Wisconsin-Superior, to study Great Lakes water quality and how key parameters influence treatment efficiency. Preliminary results were shared through presentations at the above-noted science meetings and analyses are ongoing.



Researchers with Fisheries and Oceans Canada collect a sample of ballast water for a project examining the effectiveness of ballast water treatment technology. Credit: Fisheries and Oceans Canada.

Priority for Science: Examine risk to the Great Lakes from wash water discharges related to exhaust gas recirculation and exhaust gas cleaning systems discharges (aka scrubbers).

- The USCG assessed the long-term water quality impacts of wash water discharges from open-loop, closed-loop, and hybrid exhaust gas cleaning systems in the Great Lakes. Results of the review study and recommendations for potential future efforts were shared through presentations at the above-noted science meetings.
- The USCG evaluated available technologies for managing exhaust gas discharges and their long-term environmental impacts, applying the IMO framework for risk assessment. Results were shared through presentations at the above-noted science meetings.

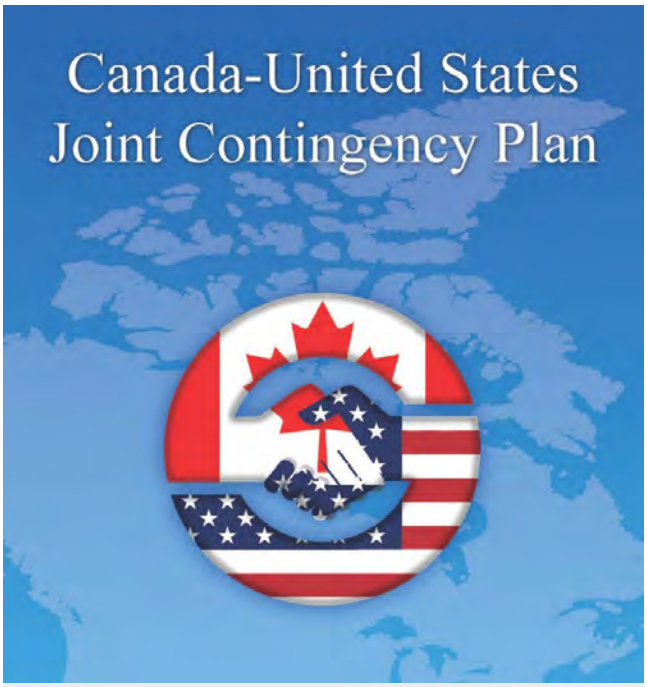
Other Binational Achievements

- **Canada-United States Joint Marine Pollution Contingency Plan.** Canada and the United States continued to implement the Canada-United States Joint Marine Pollution Contingency Plan, which provides a coordinated mechanism for planning, preparing for, and responding to discharges and releases in contiguous waters and provides established procedures for the coordination of spill response efforts between the United States and Canada.

Demonstrating deployment of international oil spill response equipment to test bilateral Geographical Response Strategies. Credit: U.S. Coast Guard.

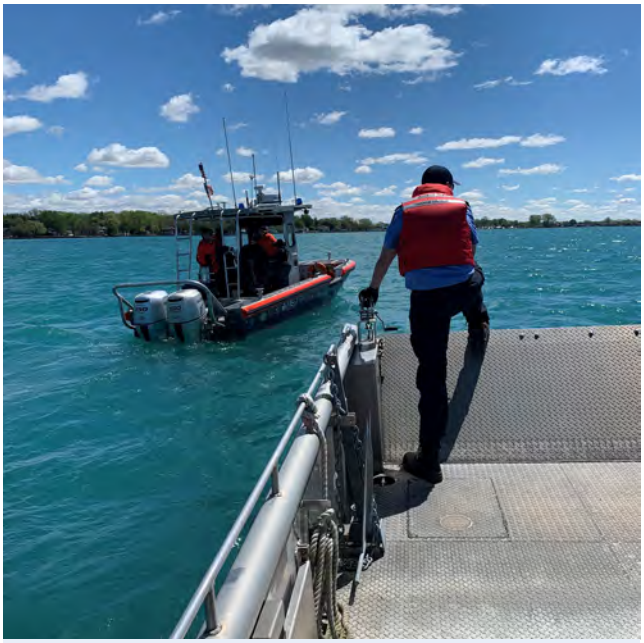
- **Canada-U.S. Joint Marine Contingency Plan's CANUSLAK Joint Response Team.** The Canada–United States Great Lakes Annex (CANUSLAK Plan) covers all potential sources of marine pollution (e.g., ships, offshore platforms, mystery spills) to the Great Lakes and St. Lawrence River. The CANUSLAK Joint Response Team held their 2024

meeting which included agency updates related to: CCG advancements in vessel wreck removal and unmanned systems; Canada Energy Regulator regulatory scope, emergency preparedness, and cybersecurity efforts; Environment and Climate Change Canada new shoreline cleanup training and wildlife response; USCG updates on spill response, unmanned systems, Endangered Species Act consultations, and an Enbridge Line 5; Great Lakes Oil Spill Center of Expertise training and research initiatives; and Great Lakes Marine Firefighting Task Force incident response insights. The U.S. and Canada responds to approximately 10 significant marine occurrences a year that have an actual or potential oil or hazardous substance discharge. In these situations, both parties activate the CANUSLAK Plan and mobilize personnel and equipment.



Canada – U.S. Joint Marine Pollution Contingency Plan (CANUSLAK).

- **Regular testing of the CANUSLAK Plan.** In addition, the U.S. and Canada conduct regular testing of the CANUSLAK Plan through exercises and drills. The CCG is leading the Exercise Border Alliance held in the St. Lawrence Seaway region, including a tabletop exercise in October 2024 and a full-scale exercise is scheduled for July 2026; the exercise involves the simulation of a major maritime incident in the area of Kingston, Ontario, including mass rescue operations and on-water pollution emergency response.
- **Great Lakes Marine Firefighting Task Force.** Commercial vessel fires in the Great Lakes have prompted bilateral action to create an International Great Lakes Marine Firefighting Task Force. Given the shared waters between the U.S. and Canada, international cooperation is essential for a swift, coordinated response. The task force ensures consistent training, shared resources, and clear communication, enabling both nations to collaborate seamlessly. By minimizing response time and optimizing resource allocation, this partnership enhances firefighting effectiveness, ultimately protecting lives, property, and the environment.
- **International efforts.** The United States and Canada also continued to further international efforts related to developing international guidance on biofouling and in-water cleaning of ship's biofouling; participating in the IMO Pollution Prevention and Response Sub-Committee to revise MARPOL Annex IV, which deals with the prevention of pollution by sewage from ships.



Full-scale pollution response exercise, St. Clair River, with Canada-US border at middle of river. Credit: U.S. Coast Guard.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, the United States and Canada pursued a variety of domestic projects that also support Annex 5 (Discharges from Vessels).

Subsurface pollution removal operation from sunken barge near the Canada-US border in western Lake Erie. Credit: U.S. Coast Guard.

Oil and Hazardous Polluting Substances

- The Naval Research Laboratory published in March 2024, "Environmentally Acceptable Lubricants: Requirements in the Vessel Incidental Discharge Act and Implementation Strategies" as NRL/6130/MR—2024/9.

Wastewater and Sewage

- **Wastewater and sewage regulation.** The United States has worked on issues related to vessel wastewater and sewage regulation at both the national and international levels, focusing on rates of discharge and no-discharge areas. As graywater is incorporated into VIDA, efforts continue to determine the best methods for ensuring compliance and enforcement of the forthcoming EPA standard. This includes completing some preliminary research and development to better understand the limitations of current graywater treatment technology.

Biofouling

- **International contributions.** Canada actively contributed to the IMO Subcommittee on Pollution Prevention and Response to complete the revised 2023 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. Canada coordinated the IMO correspondence group responsible for development of the upcoming Guidance on in-water cleaning of ships' biofouling and co-sponsored a proposal on the Development of a legally binding framework for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species.
- **Voluntary Guidance.** Canada published V*oluntary Guidance for Relevant Authorities on In-Water Cleaning of Vessels* to provide best practices for in-water cleaning of vessel biofouling to prevent the introduction and spread of AIS.
- **Risk assessment for vessel biofouling.** Following a risk assessment and science advice published in 2022 based on decade-old data, Canada began collecting new data on vessel biofouling to assess if the current level of risk has changed with the release of international guidelines for management of vessel biofouling.
- **In-Water Cleaning and Capture Demonstrations.**
  - TC launched an initiative in September 2023 to assess in-water cleaning and capture (IWCC) technologies to address vessel biofouling. IWCC systems are designed to remove fouling organisms from submerged surfaces, including a vessel's hull and niche areas (e.g., propeller, rudder, sea chest, etc.), while the vessel remains in water. These systems incorporate capture and filtration/treatment mechanisms to prevent the release of harmful contaminants into marine environments.
  - TC funded two IWCC system demonstrations in 2024 and 2025 showcasing hull cleaning technologies, and filtration and capture systems. The IWCC project outcomes will:
    - Advance the understanding of IWCC technologies in Canadian conditions by assessing key performance metrics such as hull coating damage, the removal of hard macrofouling from hull and niche areas, and the

effectiveness of capturing and treating fouling and other hull contaminants.

- Provide insights into the feasibility of existing testing methodologies and contribute to the development of improved testing standards.
- Enable Canada to formulate scientifically supported policies based on robust data from comprehensive in-situ testing.

Ballast Water

- **Annual Report to Congress.** Section 1102(f)(4) of the National Invasive Species Act of 1996, as amended by the Vessel Incidental Discharge Act of 2018, requires the USCG to collaborate with the National Aquatic Nuisance Species Task Force and the Smithsonian Environmental Research Center (SERC) to submit an annual report to Congress. The reports synthesize information from ballast water management reports submitted to the National Ballast Information Clearinghouse per 33 Code of Federal Regulations 151.2060. Each report contains analysis for the preceding two-year period to evaluate nationwide trends relating to ballast water management and delivery in U.S. ports. The most recent report was submitted June 3, 2024.
- **Ballast water performance standards.** USCG continues to implement rulemaking that established a performance standard for the allowable concentration of living organisms in ballast water discharged from ships in waters of the United States.
  - Several independent laboratories are testing systems for type approval. The multifaceted type approval process consists of land-based and shipboard-based testing that focuses on the biological efficacy of the ballast water management system and includes additional testing criteria for operation in the cold, turbid fresh water of the Great Lakes.
  - Since June 2019, the USCG Marine Safety Center has issued type approval certificates for 25 ballast water management systems (of a total of 47 certificates issued). Many vessels entering the Great Lakes have these types of approved systems aboard for use during ballasting operations.
- **Developing and finalizing Vessel Incidental Discharge National Standards of Performance.** In 2022–2025, the EPA and USCG worked on their respective regulatory mandates per the 2018 VIDA. The statute directs the EPA to develop a uniform national standard to govern discharges that are incidental to vessel operations, such as ballast water discharges. Per VIDA, the EPA is the lead for establishing these standards and USCG is the lead for implementing compliance and enforcement regulations.
  - On Monday, October 9, 2024, the EPA published the final rule Vessel Incidental Discharge National Standards of Performance in November of 2024, which establishes national standards of performance for 23 discharges incidental to the normal operation of a vessel. This Final Rule became effective on November 8, 2024.
  - The USCG is now required to develop the rules for implementing, monitoring, and enforcing compliance as set by the EPA's performance standards. This new rulemaking will streamline existing regulations by replacing multiple state and federal requirements with a unified national framework, reducing regulatory confusion for vessel operators. In the interim, vessels continue to be subject to the existing discharge requirements established in the EPA's 2013 Vessel General Permit and the USCG's current ballast water regulations.
- **Ballast Water Research undertaken included:**
  - Quarterly Ballast Water Delivery and Management Trends in the U.S. and U.S. Great Lakes, SERC.
  - Ship Transit Analysis in the Great Lakes, Halifax, Nova Scotia, May 2024.
  - Validation of an Automated Cell Imaging System to Count Living Microorganisms, ICMB-XI, May 2023.
  - Validation of a Tetraselmis Genus Probe for RNA Transcript Detection, February 2023.
- **Canada published the following research to inform ballast water policy development and implementation:**

- Biological testing of ships' ballast water indicates challenges for the implementation of the Ballast Water Management Convention, February 2024.
- Ballast water management systems protect the Great Lakes from secondary spread of non-indigenous species, October 2023.
- Efficacy of ballast water management systems operating within the Great Lakes and St. Lawrence River (2017-2022), August 2023.
- Examining the performance of three ballast water compliance monitoring devices for quantifying live organisms in both regulated size classes (≥ 50 µm and ≥ 10 – < 50 µm), May 2023.
- Managing risk of non-indigenous species establishment associated with ballast water discharges from ships with bypassed or inoperable ballast water management systems, October 2022.
- First evaluation of ballast water management systems on operational ships for minimizing introductions of nonindigenous zooplankton, September 2022.
- Assessing the performance of indicative analysis devices for measuring phytoplankton in ballast water samples, September 2022.

- **Ballast Water Innovation Program.** In December 2023, TC launched the Ballast Water Innovation Program (BWIP) to support industry-led projects addressing challenges in installing, operating, and maintaining ballast water management systems in the Great Lakes and St. Lawrence River region, which has unique conditions of cold, fresh water with high sediment levels. This initiative is part of Canada's commitment to reducing the risk of introducing and spreading invasive aquatic species, aligning with the 2021 Ballast Water Regulations. The BWIP has funded three projects related to improving ballast water treatment, addressing technical challenges in system installation and operation, and optimizing performance on commercial vessels to ensure regulatory compliance.

Annex 6: Aquatic Invasive Species

Throughout the Great Lakes watershed, government agencies and partners collaborated on early detection and control projects for invasive species. Governmental partners continued to reduce populations of invasive carp species in the Illinois River and remove Grass Carp in tributaries of Lake Erie. Early detection monitoring for invasive species is also taking place in locations throughout the Great Lakes. Canada and the United States also made progress on developing new technologies and strategies to prevent and control for high-risk aquatic invasive species.

Key Achievements

- Prevented the introduction of Bighead Carp, Silver Carp and Black Carp into the Great Lakes from populations established downstream in the Illinois River and Mississippi River basin.
- Prohibited and restricted new invasive species under provincial regulations to help prevent and reduce their spread in Ontario.
- Developed and implemented early detection and rapid response strategies to prevent the establishment of AIS.
- Developed and tested technologies, including telemetry, electrical and sound deterrents, and molecular surveillance tools, to prevent the introduction and spread of AIS in the Great Lakes.
- Conducted extensive early detection surveillance for Tench in Canadian Great Lakes waters.
- Conducted surveillance and removals of invasive Grass Carp through monitoring, electrofishing, and gill netting.
- Undertook extensive and coordinated efforts to control existing invasive aquatic plants, including Phragmites, and to eradicate

Purpose and Overview

The purpose of Annex 6 (Aquatic Invasive Species) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to prevent the introduction of aquatic invasive species (AIS), to control or reduce the spread of existing AIS, and to eradicate – where feasible – existing AIS within the Great Lakes Basin Ecosystem.

Effective implementation of Annex 6 depends on coordination with ongoing AIS prevention and management efforts led by state, provincial, and local authorities. By aligning federal and binational actions with these regional initiatives, Annex 6 supports a more comprehensive approach to minimizing the ecological and economic impacts of AIS and protecting the water quality of the Great Lakes.

ANNEX IMPLEMENTATION

The AIS Annex Subcommittee is co-led by Fisheries and Oceans Canada (DFO) and the U.S. Fish and Wildlife Service (USFWS). Organizations within the extended subcommittee include Chiefs of Ontario; Ontario Ministry of Natural Resources (MNR); Parks Canada; 1854 Treaty Authority; Chippewa Ottawa Resource Authority; Great Lakes Indian Fish and Wildlife Commission; Illinois Department of Natural Resources; Michigan Department of Environment, Great Lakes, and Energy (EGLE); Michigan Department of Natural Resources (MDNR); Minnesota Department of Natural Resources; New York State Department of Environmental Conservation (NYDEC); National Oceanic and Atmospheric Administration (NOAA); Ohio Department of Natural Resources (ODNR); U.S. Environmental Protection Agency; U.S. Geological Survey (USGS); Wisconsin Department of Natural Resources (WDNR); Great Lakes Commission (GLC); Great Lakes Fishery Commission (GLFC); Great Lakes and St. Lawrence Cities Initiative; The Nature Conservancy (TNC); Ontario Federation of Anglers and Hunters (OFAH) Foundation; and the Invasive Species Centre (ISC).

Annex 6 builds on and supports established interjurisdictional efforts across the basin, including collaborations with the Great Lakes Panel on Aquatic Nuisance Species, the Governors' and Premiers' AIS Task Force, the Invasive Carp Regional Coordinating Committee, and others. These partnerships enable strong coordination among binational, regional, and local agencies to reduce AIS impacts and protect Great Lakes water quality.

new invasive aquatic plants, including Water Soldier and Hydrilla, as well as new invasive invertebrates such as Marbled Crayfish.

Binational Actions and Achievements

Priority for Action: Prevent introductions of new invasive species into the Great Lakes, including Silver Carp, Bighead Carp, and Black Carp, and other species identified through risk screening and assessment.

Invasive Carp

- Actions in Canada and the United States continue to focus on the early detection and suppression of Silver Carp, Bighead Carp, and Black Carp; no populations have been introduced and established in the Great Lakes.
- MNR conducted eDNA surveillance at 174 Lake Erie basin sites in 2023–2024, with no detections of Black, Bighead, or Silver Carp. Additional fisheries monitoring and commercial fishing also caught no invasive carp.
- U.S. Army Corps of Engineers (USACE) operated and upgraded the Electric Dispersal Barrier System (EDBS) in the Chicago Sanitary and Ship Canal – about 37 miles from Lake Michigan. The EDBS serves as a primary measure for defending the Great Lakes from invasive carp. During the 2023-2025 timeframe, additional electric barrier arrays at the EDBS were added to enhance protection for the Great Lakes.
- USACE, State of Illinois, and State of Michigan advanced the Brandon Road Interbasin Project near Joliet, Illinois, to prevent the upstream transfer of AIS (including invasive carp) from the Mississippi River basin into the Great Lakes. USACE, Illinois and Michigan signed a Project Partnership Agreement in July 2024, and the site preparation contract was awarded in November 2024 to begin construction of the innovative multi-layered AIS deterrent system.
- From 2023 to 2025, the Invasive Carp Regional Coordinating Committee (ICRCC) supported interagency efforts to prevent invasive carp from entering and establishing in the Great Lakes Basin. Through annual Action Plans the ICRCC helps member agencies coordinate detection, prevention, and control actions targeting carp populations migrating from the Mississippi River basin through the Illinois River towards the Great Lakes.
- Collaboration continued on the binational ecological risk assessment for Black Carp in the Great Lakes Basin.

An eDNA backpack being used to collect water as part of a partnership between DFO and Mississauga First Nation to surveil for Grass Carp. Credit: DFO.

Other species

- In 2024, DFO's AIS Program supported research on Marbled Crayfish and Goldfish by contracting McGill University and University of Toronto Scarborough to study their biology and distribution, informing future control and management actions.
- In 2024, USFWS launched a horizon scan to identify future AIS threats to the Great Lakes Basin, with input from 22 different Canadian and U.S. federal, state, provincial, Tribal, local, regional, and academic entities. Rapid risk screening of species in the aquarium, pet, pond, and water garden trades continued in 2025. Horizon scans and associated risk screening results help agencies inform risk management strategies.

Priority for Action: Enhance early detection for invasive carps and for other high-risk aquatic invasive species.

Invasive carp

- Agencies and organizations continued focused early detection surveillance and response actions for Grass, Black, Silver and Bighead Carps:
  - DFO's Invasive Carp Program completed targeted early detection surveillance for Grass Carp in Canadian waters of Lake Huron, Lake Erie and Lake Ontario and their tributaries.
  - DFO is continuing partnerships, such as those with Indigenous communities, to implement eDNA surveillance for Grass Carp in the Great Lakes and their tributaries, which compliments both the MNR's eDNA surveillance program and DFO's traditional surveillance efforts, such as those with fishing gear.
  - MNR undertook invasive carp surveillance in the Lake Erie basin, which revealed two recent positive eDNA detections and follow-up targeted sampling did not capture any individuals in Lake St Clair and Long Point Bay.
  - DFO and MNR are finalizing a joint research project to evaluate the catchability of invasive carps, which can be used to further refine the detection effort required for invasive carp surveillance activities in the Great Lakes Basin.
  - DFO is evaluating potential Grass Carp spawning and feeding sites in the Great Lakes to identify priority areas for early detection sampling.
  - DFO, in conjunction with USGS, is finalizing a detailed spawning suitability assessment of the Thames River to identify potential spawning sites by invasive carps to inform future surveillance within the river.
  - DFO and USGS are finalizing a real-time tool to predict the spawn timing of invasive carp in select Canadian tributaries in the Great Lakes Basin.
  - USGS continues to support SpawnCast for existing rivers and develop it for new potential spawning rivers. SpawnCast allows teams sampling for direct evidence of spawning of Grass Carp to plan sampling events.
  - USFWS continues to conduct routine, targeted (quantitative polymerase chain reaction, qPCR) sampling for Bighead and Silver Carp in Great Lakes tributaries at highest risk for invasion, with approximately 10,000 samples processed annually.
  - The OFAH Foundation, funded by the MNR, operates the Invading Species Hotline and the Early Detection and Distribution Mapping System to track reports of invasive carps and other high-risk AIS, supporting early warning efforts in the Canadian Great Lakes.

Other Species

- Agencies continued implementation and refinement of targeted, comprehensive multi-species surveillance for AIS in the Great Lakes:
  - DFO continues to work bi-nationally with agencies on the St. Marys River to monitor the establishment and spread of AIS on the connecting channel between Lake Superior and Huron.
  - DFO undertook multi-gear fish community assessment work focused on early detection of high-risk AIS fishes in Lake Huron, Lake Erie and Lake Ontario and their tributaries.
  - MNR conducted invasive species eDNA surveillance within the Lake Ontario Basin in 2023, 2024 and 2025, sampling approximately 60 sites a year spanning from Lake St. Francis in the St. Lawrence River to the Niagara River in western Lake Ontario.
- MNR, DFO, Québec, New York State, and USFWS collaborate through the Tench Binational St. Lawrence River Working Group to coordinate relevant sampling and surveillance activities, reporting, and research projects with the aim of preventing a Tench invasion of the Great Lakes.
- MNR and NYDEC continue to collaborate to conduct surveillance of the Niagara River to determine if Hydrilla is present in Canadian waters.
- EGLE, USFWS, USGS, Tribal, and academic partners are collaborating on the Great Lakes Basin Inland Waters Early Detection Pilot project, which seeks to detect and identify potential new invaders, including Hydrilla and invasive crayfish, as part of the U.S. National Early Detection and Rapid Response Framework.
- Efforts to engage citizens in surveillance were enhanced through public outreach by partners, including the ISC's Early Detection and Rapid Response Network.
- ISC developed an online training course on Marbled Crayfish, which will allow participants to learn about biology, impacts, and how to identify and report suspected sightings.

Priority for Action: Conduct response actions to prevent the establishment of Grass Carp and other high-risk species in the Great Lakes.

- DFO responds to the capture of Grass Carp in the Canadian waters of the Great Lakes by initiating an Incident Command System protocol and coordinating response activities with MNR. In 2023 and 2024, DFO and MNR responded to three Grass Carp captures in Canadian Great Lakes waters (see Domestic Actions and Achievements – Canada – Conduct Response Actions).
- The ISC supports DFO in their response efforts with communications tactics to alert the public to recent captures or sightings of Grass Carp in the Canadian Great Lakes.
- The OFAH Foundation is collaborating with partners (e.g., federal, provincial, NGOs, Indigenous, etc.) in working groups aimed at responding to new detections of high-risk species (e.g., Marbled Crayfish Working Group, Hydrilla Working Group, and the Water Soldier Working Group). OFAH Foundation's Invading Species Awareness Program continues to follow strict protocols to ensure partners such as DFO and MNR receive confirmed reports of Grass Carp and other high-risk AIS species within the same business day.
- The Great Lakes Grass Carp Advisory Committee (GCAC) and its task groups continue to support Grass Carp monitoring and response actions outlined in the *Lake Erie Grass Carp Adaptive Response Strategy (GCARS) for 2019–2023*, and developed an updated *Lake Erie GCARS for 2024–2028*. The GCAC is a binational committee with members from DFO, MNR, GLFC, USGS, USFWS, ODNR, MDNR, University of Toledo, Pennsylvania Fish and Boat Commission, and NYDEC. GCAC members collaborate on Grass Carp control across the Great Lakes Basin through targeted interjurisdictional response actions, acoustic telemetry studies, seasonal barrier evaluations, commercial fishers' bounty payments for their removal, and new control methods.
- USGS continues to lead monitoring of Grass Carp spawning in U.S. tributaries to Lakes Erie and Huron by surveying for eggs, larvae, and eDNA during high-flow events, and tracking behavior

and movements with acoustic telemetry to guide capture efforts.

- The State of Michigan conducted targeted response efforts to eradicate occurrences of State watch list aquatic invasive plants. During 2023-2025, several sites were eradicated with many additional sites nearing eradication; generally, three to five new reports of aquatic invasive plants are received annually.

Priority for Action: Implement control projects for invasive species already in the Great Lakes Basin, including Red Swamp Crayfish, monecious Hydrilla, Water Soldier, Water Chestnut, and Phragmites.

- Canadian and U.S. government agencies continue to work with partners to implement control projects for invasive species in the Great Lakes basin. Control measures for Red Swamp Crayfish and other Crayfish, Hydrilla, Water Soldier and Water Chestnut, Phragmites, and Invasive Mussels are discussed below.
- The OFAH Foundation continues to work with partners including governments, conservation authorities, non-governmental organizations and researchers on control programs for high-risk species to the Great Lakes Basin, such as Red Swamp Crayfish, Marbled Crayfish, Hydrilla, and Water Soldier.

Red Swamp Crayfish and other Crayfish

- In 2023, MNR, DFO, and partners began surveillance and dewatering to address Marbled Crayfish detected in a Burlington, Ontario pond. DFO supports MNR-led efforts through trapping, removal, and monitoring to prevent spread, with over 2,000 crayfish removed in 2024. DFO is also pursuing Emergency Use Registration (under the *Pest Control Products Act*) for a pyrethrin-based pesticide to support eradication.
- Red Swamp Crayfish was first detected in Tilbury Creek, Ontario, in 2024. DFO, MNR and the OFAH Foundation conducted follow-up surveillance resulting in one additional Red Swamp Crayfish captured 1.5 kilometers from the original site. MNR has established a Red Swamp Crayfish working group with representatives from DFO, OFAH Foundation, Conservation Authorities, municipalities and other partners to plan prevention and response actions.
- USGS, MDNR, and Michigan State University continued collaborative efforts to eradicate Red Swamp Crayfish in Michigan, including testing hot water and CO_2 as lethal controls, identifying white spot syndrome in live shipments, supporting neurotoxic pyrethrin treatments, exploring sex-skewing methods (which tip the male-female ratio and lower reproduction), and analyzing organism movement data from an infested pond.

Hydrilla

- In 2024, MNR led a multi-partner Hydrilla Working Group with DFO, Parks Canada, Essex Region Conservation Authority, University of Waterloo, and NGOs. They responded to the first Canadian Hydrilla detection at Hillman Marsh, Ontario, in 2024, which included mapping, access closures, waterfowl hunting suspension, and a 30-hectare herbicide treatment. ISC are supporting by developing a management plan and assisting local eradication efforts.
- EGLE conducted a rapid response to Hydrilla detection in southwest Michigan with herbicide treatment along with surveillance of surrounding waters.
- USACE and NYDEC continue to collaborate on Hydrilla management and related habitat restoration efforts within the Erie Canal, Tonawanda Creek, and the Upper Niagara River.

Water Soldier and Water Chestnut

- MNR and partners conducted surveillance in 2024 to determine the extent of a new occurrence of Water Soldier detected in southern Lake Simcoe, near Keswick Ontario, to support implementation of management actions in 2025.
- ISC is coordinating a Lake Simcoe water soldier working group to align actions and co-develop a management plan, participating with OFAH Foundation, Parks Canada, Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, Ducks Unlimited, Ontario Ministry of Natural Resources, Lake Simcoe Region Conservation Authority and others.

- MNR, Parks Canada, OFAH Foundation, Ducks Unlimited Canada, ISC, Quinte Conservation and others collaborated to control and monitor Water Soldier in the Trent-Severn Waterway and the Bay of Quinte; and control European Water Chestnut (EWC) in Lake Ontario, Welland River, and inland occurrences within the Great Lakes Basin.
- Parks Canada is using mechanical and chemical methods to manage Water Soldier in the Trent-Severn Waterway, supported by Artificial Intelligence-driven drone imagery for improved detection and mapping.

European water chestnut pulled from the Welland River 2024 and disposed of away from any water body to prevent reintroduction. Credit: Invasive Species Centre.

- With support from the Invasive Species Action Fund and MNR, ISC is supporting Water Soldier monitoring and control in other priority areas, including the Bay of Quinte with Quinte Conservation, and Red Horse Lake with OFAH.
- ISC's EWC Rapid Response Program continues efforts to eradicate European Water Chestnut in the Welland River, achieving over a 50 percent population reduction year over year. In 2024, a new detection 25 kilometers from the known area was reported by a paddler and monitoring and removal will be prioritized there in 2025. Through the program, ISC works with OFAH, Niagara Peninsula Conservation Authority, and local municipalities to support eradication and train paddlers to identify and report EWC across the Niagara Region.
- European Water Chestnut populations are declining at all six known locations along the Rideau Canal due to coordinated on-going monitoring and control efforts by Parks Canada, Ducks Unlimited Canada, and Conservation Ontario.

Phragmites

- In 2024, MNR, ISC, and Nature Conservancy Canada launched the Ontario Phragmites Action program, supported by $11 million of funding from the Government of Ontario over three years to expand local Phragmites control efforts into a coordinated, province-wide strategy. The program also established the Invasive Phragmites Control Fund, supporting 38 local, Indigenous, and municipal projects in 2024.
- Collaboration continued with the Long Point Phragmites Action Alliance, led by MNR, the Nature Conservancy of Canada, Ontario Parks, the Canadian Wildlife Service, municipalities, and landowners, to control Phragmites in the Long Point Region, with efforts expanding to include other priority landscapes in the Great Lakes Basin.
- Ongoing environmental monitoring is demonstrating effectiveness of large-scale Phragmites control using herbicide, as well as the return of native plants and wildlife in the Long Point Crown Marsh.
- Managing Phragmites remains a conservation priority across all Ontario sites administered by Parks Canada, through initiatives like the marsh restoration project at Point Pelee National Park.
- The Great Lakes Phragmites Collaborative (GLPC) supports basin-wide control efforts through its adaptive management approach. The GLPC's Phragmites Adaptive Management Framework (PAMF) Strategic Plan 2020–2026, co-lead by GLC and USGS, established 5-year goals and objectives for enhancing Phragmites management. Funding for 2024–2025 was awarded to 17 organizations across six Great Lakes states for performing underutilized, PAMF-specific management actions.
- Ohio DNR continued work to control invasive Phragmites in the Lake Erie watershed in Ohio.
- Wisconsin DNR continued efforts to control invasive phragmites in the Lake Superior basin in Wisconsin.

- USGS, USACE, and academic partners continued to develop species-specific bioherbicidal treatments for control of Phragmites and other invasive plants, focusing on genetic biocontrol treatments that limit the expression of characteristics that help invasive plants outcompete native plants.

Invasive Mussels

- The Invasive Mussel Collaborative (IMC), led by USGS, GLC, GLFC, and NOAA Great Lakes Environmental Research Laboratory, continues to support zebra and quagga mussel control across the basin and links efforts to broader initiatives. In 2024, the IMC continued to promote multiple products developed in recent years, including refining best practices for conducting control tool toxicity testing, establishing a database of dreissenid control and toxicity studies, launching an Invasive Mussel project mapper, and summarizing research projects and priorities and identified research gaps.
- USGS conducted research to develop methods for open-water application of copper-based molluscicides to suppress zebra and quagga mussel populations.

Priority for Action: Identify gaps in current AIS policies and regulations and reduce the risk of pathways into and within the Great Lakes Basin.

- Collaboration continued through the Great Lakes Commission's Great Lakes Detector of Invasive Aquatics in Trade to identify online sales of priority AIS and take enforcement action if needed.
- ISC, with support from DFO, developed targeted campaigns for the "Organisms in Trade" (OIT) and Pet Release pathways using influencer marketing, social media campaigns, and attending pet shows and trade shows.
- In 2025, OFAH Foundation collaborated with DFO on their AIS Gap Analysis through focus groups and case studies on Grass Carp and Marbled Crayfish.
- DFO is developing a decision-support framework for undertaking pathway-level AIS risk assessments.
- Research by University of Toronto Scarborough and DFO assessed arrival and survival risk of aquatic species in Canadian trade, which identified the Great Lakes as a high-risk region for future freshwater non-native species from live trades.
- Effective January 1, 2024, Ontario prohibited and restricted 10 new non-native species and four genera under the Ontario Invasive Species Act, 2015, to help prevent and reduce their spread to protect Ontario's economy and biodiversity.
- The Ontario Invasive Species Strategic Plan continues to guide MNR's efforts to prevent new invasive species introductions into the Great Lakes through regulation, enforcement and outreach. In 2023, MNR conducted a 10-year progress review to support renewal of the plan.

ISC at The Canadian Pet Expo spreading awareness on the pet pathway. Credit: Invasive Species Centre.

Organisms in trade, "Don't Let it Loose" art installation addressing the pet pathway of invasive species (Artist Laura Fedynyszyn at Evergreen Brick Works Toronto). Credit: Invasive Species Centre.

Priority for Action: Collaboratively update the list of "Least Wanted" highest-risk species for the Great Lakes Basin.

- Discussions of updating AIS lists, as warranted, continued based on new information from horizon scanning and other risk analyses.
- USFWS completed AIS Ecological Risk Screening Summaries to identify high-risk aquatic species that are not yet present or widespread in the Great Lakes, but which have a history of invasiveness and could survive in the region's climate.

Priority for Science: Research and identify opportunities to utilize, where feasible, technology that prevents the spread of Aquatic Invasive Species (AIS) while allowing the movement of other ecosystem components through canals and waterways.

- USGS is completing a multi-year study at Lock and Dam 19 on the upper Mississippi River to evaluate the effectiveness of an Underwater Acoustic Deterrent System (UADS) against invasive carp. Preliminary results from 2021–2022 showed the UADS reduced upstream Silver Carp movement by 50 percent with minimal effect on native species. In 2025, the sound-only deterrent, designed by USGS and USACE, will be operated continuously to assess its effectiveness over a full shipping season and is being considered for use in the multi-deterrent system at Brandon Road Lock to prevent invasive carp from entering the Great Lakes.
- USFWS, USGS, and USACE are concluding a field study on the effectiveness of a BioAcoustic Fish Fence (BAFF) as a behavioral invasive carp deterrent at Barkley Lock and Dam in Kentucky. The BAFF uses a combination of underwater sound, bubbles, and lights to deter fish movement. Final results will be available in late 2025 or early 2026. In 2023, the BAFF was cycled weekly on and off and preliminary 2021–2022 data suggested a 50 percent reduction in full upstream passage through the lock for invasive Silver Carp when the BAFF was active. In 2024, the BAFF was continuously operated, reflecting an integrated management approach to be used by managers. Research findings were provided to USACE to inform decisions in Section 509 TNCR deterrent planning and for the Great Lakes Advisory Committee's deterrent planning in tributaries of the Great Lakes.
- USGS is in the third year of evaluating a bubble screen as a deterrent to Grass Carp trying to reach spawning areas and to disrupt drifting eggs to prevent them from hatching. Laboratory tests demonstrated a longitudinal deployment can divert drifting eggs toward shorelines, where they could be removed. Field-scale tests are scheduled for subsequent fiscal years.
- A total of 26 U.S. and Canadian agencies continue to participate in the binational ICRCC to collaborate on opportunities to develop and test technologies focused on protecting the Great Lakes Basin from invasive carp.
- Agencies are assessing and tracking Goldfish, Rudd, and Common Carp using acoustic telemetry array to explore active management options for Goldfish and Rudd, inform modifications to passive management (i.e., barriers) for Common Carp, and further the understanding of movement and habitat selection of these species within freshwater systems.

Priority for Science: Develop and evaluate early AIS detection technologies and methods, including eDNA and genetic barcoding.

- DFO is updating an existing model to determine response effort required to detect and remove populations of invasive carp in the Great Lakes Basin.
- DFO analyzed the potential use of eDNA as an early detection tool for AIS in urban stormwater management systems and assessed the potential use of stormwater treatment ponds as a control point in the introduction pathway.
- MNR continues to use eDNA for surveillance and monitoring of high-risk invasive species (e.g., invasive carp, Water Soldier, Hydrilla, Marbled Crayfish) and is working to improve these methods, including development of community eDNA assessment tools that can be used to detect many species from a single water sample.
- The OFAH Foundation continues to assist partners, including the MNR, in collecting eDNA for high-priority AIS species, such as Water Soldier and

Marbled Crayfish. OFAH Foundation's Invading Species Awareness Program will also assist Trent University in developing an assay for Red Swamp Crayfish by providing them with specimens that are captured during surveillance efforts in the spring and summer of 2025.

- Research in Canada on genetic markers for Prussian Carp has shown that morphometrics and meristics alone are insufficient for most professionals to reliably distinguish Goldfish from Prussian Carp. Going forward, Great Lakes agencies may conduct eDNA testing in water for Prussian Carp, followed by fish tissue analysis to confirm or rule out its presence.
- USFWS and state partners are implementing metabarcoding sampling – a new molecular surveillance tool – as part of the comprehensive Great Lakes Early Detection and Monitoring Program in high priority locations throughout the Great Lakes Basin to detect new aquatic invaders.
- U.S. and Canadian agencies and partners continue work to develop, test, and refine new technologies and sampling methodologies for early detection of high-risk AIS in the Great Lakes Basin.
- USGS is developing automated water samplers with eDNA analysis as an early detection tool for new spawning populations of Grass Carp in Great Lakes tributaries. A 2023 pilot study in the Sandusky River detected an eDNA spike on the same day egg sampling crews collected eggs, demonstrating the method's effectiveness. Further testing occurred in 2024.
- USGS developed and validated methods using autonomous underwater vehicles to collect images of the bottom, which are then analyzed using Artificial Intelligence to identify bottom-dwelling dreissenid mussels and Round Goby.
- USGS, USACE, and academic partners conducted additional field trials and expanded testing of newly developed treatments to increase understanding of RNA interference (RNAi) and microbe-based management approaches and supported adaptation of the technologies to invasive plant species. RNAi is a species-specific method for controlling invasive species that has no effect on other species and does not persist in the environment.

Priority for Science: Research and develop technologies and methods for control and eradication of AIS.

- DFO is working on updating a model of Grass Carp in Canadian waters to identify optimal locations for Grass Carp surveillance and refine existing Canadian early surveillance sites given the reproducing population of Grass Carp in western Lake Erie; and identify control targets for Grass Carp in Canadian waters.
- Through the Green Shovels Program, ISC supported the Ontario Invasive Plant Council in updating the new Aquatic Plant Best Management Practices Document, which contains identification, lookalikes, biology and life cycle, habitat, distribution, pathways of spread, impacts, and control information for 23 aquatic invasive plant species.
- USGS continued collaboration within the ICRCC on development, testing, and pilot-deployment of invasive carp control technologies and methods, including maximizing effectiveness of invasive carp mass-removal through targeted intensive harvest, and field testing of deterrents (e.g., acoustics, carbon dioxide) focused on blocking invasive carp passage.
- USGS is working to re-register antimycin-a and develop a species-specific delivery system to control Bighead and Silver Carp without affecting native species.
- USGS developed Carbon Dioxide Carp, which uses concentrated carbon dioxide to control invasive carp populations. USGS is working with USACE to develop a carbon dioxide backup system for the Chicago Area Waterway's Electric Deterrent Barrier System to prevent invasive carp from entering the Great Lakes.
- USGS continues to lead research on developing new lampricides or new delivery methods for existing lampricides for controlling Sea Lamprey. USGS also collaborates with the GLFC and others on using the Integrated Pest Management paradigm to identify where more than one method can enhance deterrence or removal (e.g., electric deterrents, dams, and lampricides).

Other Binational Accomplishments

- As of 2024, Ontario has regulated all 21 species on the Great Lakes and St. Lawrence Governors' and Premiers' Aquatic Invasive Species Task Force's "least wanted list".
- In 2024, under the mutual aid agreement, Ontario notified states and provinces of a new detection of Hydrilla within the Great Lakes Basin. Great Lakes states shared their knowledge and experience of conducting management actions for this species. The state of Michigan also shared decontamination equipment and staff to assist with surveillance and implementation of Ontario's response.
- MNR collaborated with U.S. state and federal partners to conduct coordinated binational surveillance and monitoring for invasive fishes using multiple sampling methods in the St. Marys River between 2022 and 2024.
- Interagency collaboration on OIT advanced in the Great Lakes Basin with the "Hitchhikers" work group and the Great Lakes Panel on Aquatic Nuisance Species' OIT Ad Hoc Committee playing key roles in coordinating efforts to address AIS risks from commercial or hobby-related activity pathways.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, Canada and the United States pursued a variety of domestic projects that also support commitments under Annex 6 (AIS).

Canada

Prevent introductions of new invasive species into the Great Lakes

- Through the Invasive Carp Response Plan, DFO and MNR coordinated early detection surveillance for four invasive carp species (Silver Carp, Bighead Carp, Black Carp, and Grass Carp), focusing on high-risk areas to support rapid response and prevent establishment.
- DFO's Invasive Carp Program conducted early detection surveillance from May to November in 2023 and 2024, using traditional sampling gear to target various life stages of Grass Carp. Efforts focused on high-risk sites in Lake Ontario, Lake Erie, and southern Lake Huron.
- DFO's Invasive Carp Program launched new initiatives to engage the public and partners in detecting and preventing invasive carps in the Great Lakes, including new outreach tools (e.g., videos of Indigenous and non-Indigenous commercial fishers' perspectives on invasive carps threats); collaborating with partners (e.g., ISC, OFAH Foundation, Federation of Ontario Cottagers' Associations, Toronto and Region Conservation Authority, Royal Ontario Museum) to raise awareness among key audiences; and updating the Baitfish Primer booklet.
- MNR continued working with partners like ISC's Green Shovels Collaborative and the OFAH Foundation to increase public engagement in invasive species prevention and detection.
- The OFAH Foundation continues to deliver the Invading Species Awareness Program to raise awareness of AIS, address key pathways, and facilitate monitoring and early detection in Ontario. They also delivered in-person and virtual curriculum-based outreach on invasive carp and other high-risk AIS in Ontario classrooms.

Conduct response actions

- In 2023, DFO and MNR responded to three Grass Carp captures in Canadian Great Lakes waters—two sterile specimens in the Grand River and in the Upper Niagara River of Lake Erie that did not trigger further action, and one fertile specimen in the Bay of Quinte of Lake Ontario that activated a 5-day response involving electrofishing crews, though no others were found.
- In 2024, DFO's Invasive Carp Program captured one Grass Carp in Jordan Harbour in Lake Ontario, which was a sterile male and no on-the-water response was conducted.
- DFO's Invasive Carp Program partnered with ISC to focus outreach on Grass Carp using webinars, videos, social media, influencer marketing, and angler-focused ads.

DFO's Invasive Carp Program team conducting an on-the-water response to a Grass Carp capture by a commercial fisher in the Bay of Quinte in July 2023. Credit: DFO.

Invasive Carp Program field technician holding a captured Grass Carp in Jordan Harbour on July 3, 2024. Credit: DFO.

- DFO, MNR, and the OFAH Foundation developed a guide to identify Grass Carp, distinguish them from similar species, and explain how to legally report and retain them.
- Starting in 2024, Ontario invested $16 million over three years to help municipalities, conservation authorities, and Indigenous communities stop invasive species from establishing or spreading. Funds, managed by ISC and Nature Conservancy of Canada, support a province-wide Phragmites control plan and grants through the Invasive Species Action Fund.
- MNR and Queen's University researchers published a study on watercraft decontamination to reduce AIS spread during overland transport, supporting prevention efforts in the Great Lakes Basin.
- MNR and Canadian federal researchers monitored lower trophic levels, including population trends of invasive zooplankton in Lake Ontario, and updated Bay of Quinte ecosystem models to project future invasion impacts.

Other efforts

- DFO and the University of Toronto developed a tool to assess invasive species survival under current and future climate conditions (Hubbard *et al.* 2023, 2024).
- DFO researched the number and spatial distribution of aquatic species released in Canada through the aquarium, water garden, and live food pathways, identifying key control points and release hotspots.
- DFO completed public engagement activities on three potential amendments to the *Aquatic Invasive Species Regulations* pertaining to authorities for the deposit of pesticides to control aquatic invasive species and published a "What we heard report" on DFO's Public Consultations webpage in January 2025.
- Parks Canada's Indigenous Guardians program funded a 2025 project for Indigenous nations to lead work on the health of the Great Lakes.
- ISC, with DFO and partners, continued its Invasive Carp Canada program, using digital outreach and events to help anglers identify and report Grass Carp and the other three invasive carp species.
- The OFAH Foundation, through the Invading Species Awareness Program and in partnership with MNR, continues education, outreach, surveillance, monitoring, and control for high-priority AIS in, or threatening, the Great Lakes Basin.

United States

States, Tribes, and Federal governmental agencies and their partners continued efforts to prevent the introduction of new invasive species and to control existing invasive species in the U.S. Great Lakes basin.

Prevent introduction of new invasive species into the Great Lakes

- USFWS completed AIS Ecological Risk Screening Summaries to identify high-risk aquatic species that are not yet present or widespread in the Great

Lakes, but which have a history of invasiveness and could survive throughout the region's seasons.

- GLC and TNC updated Great Lakes and inland lake surveillance site prioritization models to forecast invasion risk. The method is based on the likelihood that a watch list species could be introduced by any of the key pathways of spread (e.g., shipping, recreational boating, and organisms in trade). The method categorizes high-risk, priority sites for fish, invertebrates, and plants. A comparable site-prioritization system is in development for Great Lakes waters of Canada.
- ODNR, USACE, and partners continued AIS pathway closures for three Great Lakes/Mississippi River interbasin connections at the Ohio Erie Canal, Little Killbuck Creek, and Grand Lake St. Marys. The Ohio Erie Canal was closed in 2020. ODNR will phase multi-year work to stabilize and upgrade the Little Killbuck Creek berm. Previously built barriers at Eagle Marsh (Indiana) and the Ohio & Erie Canal (Ohio) are maintained by local agencies and ODNR.
- ODNR, USACE, and other partners continued AIS pathway closure actions for Great Lakes/Mississippi River interbasin connections at the Ohio Erie Canal (closed in 2020 and now undergoing long-term maintenance), Little Killbuck Creek, and Grand Lake St. Marys.

Conduct response actions

- Agency and academic partners monitored and contained Grass Carp populations in the Lake Erie basin following the Lake Erie Grass Carp Response Strategy (2019–2023) and the Lake Erie Grass Carp Adaptive Response Strategy 2024-2028, developed by ODNR, MDNR, and other partners as a road map for Grass Carp management.
- Binational GCAC partners continue deploying Grass Carp "strike teams" to capture and remove Grass Carp from Lake Erie's western basin, including key tributaries of the Sandusky River and Maumee River, using tagging and real-time tracking technology.
- ODNR partnered with the University of Toledo, MDNR, GLFC, USFWS, and USGS to determine Grass Carp catchability and population size in the Sandusky River, a key focal area for Grass Carp control in the western basin.
- USGS is using model simulations to identify probable Grass Carp spawning areas in the Maumee River and analyzing eggs and larvae collected by field crews. Analyses focused on identifying the conditions for the highest Grass Carp recruitment potential.

Great Lakes Interstate Early Detection and Rapid Response Team

- Federal and state management agencies participating in the Great Lakes Interstate Early Detection and Rapid Response Team, in partnership with GLC and TNC, met for their Annual Surveillance Coordination Meeting to share updates and discuss sampling strategies.

Implement control projects for invasive species already in the Great Lakes Basin

- EGLE Water Resources Division continues to lead response efforts on Michigan's watch list of aquatic invasive plants, with control actions (herbicide/hand pull) at nine inland and coastal locations and post-treatment monitoring at other sites to ensure long-term success.
- Efforts to manage European Frog-bit are being evaluated by comparing conditions before and after treatment.
- Wisconsin continues controlling and monitoring European Frog-bit, working with Michigan to share and improve management techniques.

Other efforts

- Nonindigenous Aquatic Species Database (NAS) continues to serve as the primary source for cataloging new invasive species in the Great Lakes, supporting data for the Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS). GLANSIS is a NOAA-led interagency partnership between NOAA, USGS, and Michigan Sea Grant. USGS maintains the NAS database, with NOAA and Michigan Sea Grant compiling and updating the Great Lakes records and information for GLANSIS.
- Illinois-Indiana Sea Grant developed a new five-year plan (2025–2029) to guide invasive crayfish

management and outreach in support of the Great Lakes Invasive Crayfish Collaborative.

- In 2024, the GLC and The Nature Conservancy released the Great Lakes Basin Aquatic Invasive Species Interstate Response Framework, offering a standardized process to assess new AIS threats and guide response decisions.
- The binational Sea Lamprey Aquaculture and Procurement (SLAP) initiative, supported by GLFC, advances research on sea lamprey control. The SLAP effort is advancing understanding of sea lamprey metamorphosing and juvenile stages to ultimately better develop and target efficient control mechanisms.
- NOAA, Michigan Sea Grant, and the University of Michigan identified the top 10 most impactful invaders based on analysis of almost 200 different nonnative aquatic species in the Great Lakes Aquatic Nonindigenous Species Information System, a key tool for managing invasive species by providing a "one-stop shop" for comprehensive information about each aquatic invader.
- The OIT Program, led by WDNR with support from partners, addresses invasive species in trade. In 2024, a pilot Pet Store Outreach and Monitoring protocol was continued, visiting 17 pet stores and contacting online sellers of regulated species. Other efforts included addressing invasive species in nurseries, outreach to gardeners, presenting on OIT topics, co-leading an invasive species alternatives workshop, participating at exotic pet expos, and presenting at a science teachers conference.

Invasive silver carp Credit: Dan O'Keefe, Michigan Sea Grant.

Annex 7: Habitat and Species

Over the last three years, United States and Canadian agencies have supported many high-impact projects that restore the health of Great Lakes watersheds, coastlines, and aquatic habitats. Both countries also enhanced their ability to conserve and manage coastal wetlands through complementary domestic science initiatives. Restoration of free-flowing rivers is unlocking habitat for migratory fish spawning, improving water quality, and offering new opportunities for angling. Targeted species conservation efforts are also making strong strides in restoring some of the iconic Great Lakes species, including the Piping Plover, Walleye, and Lake Trout.

Key Achievements

- Protected thousands of hectares of natural habitat for the benefit of communities throughout the Great Lakes region.
- Restored degraded habitat to support Great Lakes water quality and populations of native species.
- Strengthened the understanding of ecosystem vulnerability to support more resilient coastal habitats.
- Developed novel survey and assessment approaches and reported on coastal habitats and native species to support conservation, protection, and restoration efforts.

Binational Actions and Achievements

Priority for Action: Through existing programs, including the Nature Fund (Canada) and the Great Lakes Restoration Initiative (U.S.), implement actions to protect and restore the resilience of native species and their habitats with a focus on activities that restore and maintain natural hydrology and water quality.

Purpose and Overview

The purpose of Annex 7 (Habitat and Species) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to conserve, protect, maintain, restore and enhance the resilience of native species and their habitat, as well as support essential ecosystem services, to help achieve the GLWQA's General Objectives.

The Great Lakes support a rich diversity of fish, wildlife, and plant species. Thriving habitats and native fish and wildlife communities contribute to the social and economic vitality of the Great Lakes region and provide important ecosystem services. In turn, healthy watersheds support healthy water quality ultimately entering the Great Lakes.

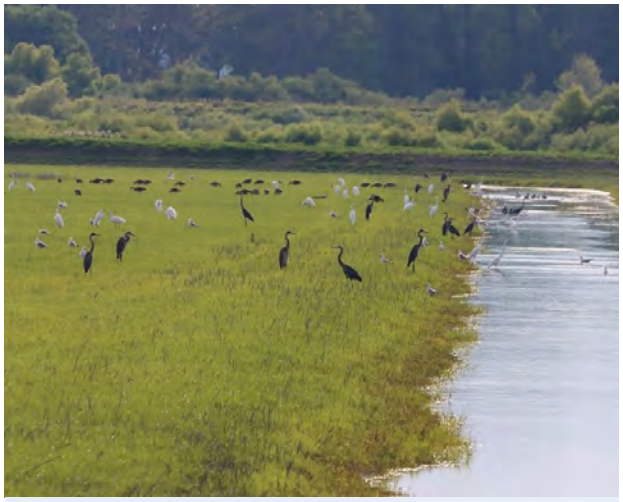
ANNEX IMPLEMENTATION

Implementation of the Annex 7 commitments is led by U.S. Fish and Wildlife Service (USFWS) and Canada Water Agency (CWA). Lakewide Action and Management Plans under Annex 2 (Lakewide Management) are the principal mechanisms for coordinating the development and implementation of the lakewide habitat and species protection and restoration conservation strategies under Annex 7, with support from a Lake Partnership for each of the Great Lakes. The Lake Partnerships are collaborative teams of environmental protection and natural resources managers led by the governments of Canada and the United States in cooperation and consultation with state and provincial governments, Tribal governments, First Nations, Métis, municipal governments, and watershed management agencies.

- Highlights of these efforts are described below in the Domestic Actions and Achievements section.

Priority for Science: Assess coastal environments, with a binational focus on coastal wetlands through the Great Lakes Coastal Wetland Monitoring Program (U.S. lead) and the Canadian Coastal Baseline Habitat Survey (Canada lead), to support protection and restoration efforts and other actions that increase resiliency of native species and their coastal habitat.

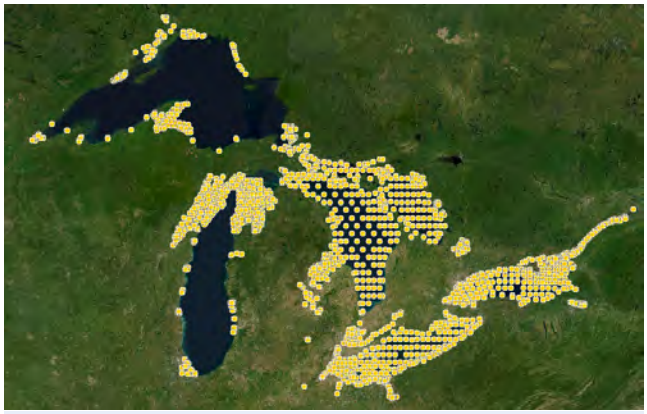
- The United States led the assessment of coastal wetlands through the Great Lakes Coastal Wetland Monitoring Program (CWMP), a collaboration between the EPA's Great Lakes National Program Office, Environment and Climate Change Canada, academic partners, and Birds Canada. Using standardized procedures, the CWMP uses a comprehensive approach to assess and support management of major coastal wetlands throughout the Great Lakes basin. More than 80 species of fish rely directly on coastal wetland habitat at some point in their life cycle and over 50 fish species are solely dependent on coastal wetlands for the entirety of their life cycle. Many fish species, such as northern pike, yellow perch, walleye and bowfin, use coastal wetlands for spawning and nursery habitat. Monitoring of birds, amphibians, fish, macroinvertebrates, plant communities, and water quality occurred annually at a subset of coastal wetland sites.
- Canada and Ontario completed a Baseline Coastal Habitat Survey encompassing over 8,500 kilometers of shoreline and more than one million hectares within the Canadian portion of the Great Lakes coastal margin including coastal wetlands, tributaries, shorelands, and the upland system. The results establish a benchmark of coastal habitat extent, condition, function, and level of protection, and the rich data source helps resource managers identify place-based conservation needs, goals, and action. In 2023, the CWA hosted a four-day webinar series with over 450 conservation practitioners to showcase the findings, encourage the use of online spatial data, and promote collaborative conservation efforts.
- Building on the Baseline Coastal Habitat Survey, Canada developed a standardized methodology to report on coastal wetland extent and change over time by hydrogeomorphic type and plant community for the Canadian portion of the Great Lakes. Additionally, a systematic framework to spatially analyze the ecological significance of coastal habitat, the degree of land use pressure, and the level of protection was completed for 60 Great Lakes coastal units to focus conservation, protection, and restoration efforts strategically.



Friends of the Shiawassee National Wildlife Refuge. Credit: Kenneth Bailey.

Coastal ecological significance for the two-kilometer margin of the Canadian portion of the Great Lakes Basin. Credit: CWA.

- The Great Lakes Coastal Assembly worked with U.S. and Canadian partners to develop and implement a coastal wetland framework to advance coastal wetland conservation efforts. Beginning with Lake Erie, USFWS, the National Oceanic and Atmospheric Administration (NOAA) and partners completed a 20-year retrospective analysis of coastal wetland change in areal extent by vegetation community and hydrogeomorphic type under varying water levels.



Great Lakes Acoustic Telemetry Observation System map depicting ongoing receiver deployments. Credit: Great Lakes Acoustic Telemetry Observation System.

Other Binational Accomplishments

Canada and the United States continued to assess fish populations, their recovery and use of Great lakes habitats through the Great Lakes Acoustic Telemetry Observation System. This collaborative effort by academic and government partners involved deploying and maintaining acoustic receivers and studying the seasonal movement, behavior, habitat use, and survival of fish with implanted transmitters. This information helps fisheries managers in decision-making to ensure sustainable fisheries and restoring crucial habitats.

DOMESTIC ACTIONS AND ACHIEVEMENTS

In addition to the actions taken to achieve the binational priorities for science and action, the United States and Canada pursued various domestic projects supporting Annex 7 (Habitat and Species).

Blanding's turtle, a Michigan Species of Greatest Conservation Need that benefits from GLRI-funded habitat restoration. Credit: USFWS.

United States

Restoring large-scale habitats

- **Targeted habitat restoration in Michigan.** The Grand Traverse Regional Land Conservancy, Michigan Department of Natural Resources, and other partners, in collaboration with the U.S. Fish & Wildlife Service's Coastal Program and Great Lakes Restoration Initiative, restored more than 250 acres of wetland and riparian habitats on the Petobego State Game Area and the Skegemog Lake Wildlife Area in Michigan. The restoration improved

the overall quality of the larger conservation area, which spans 3,400 acres of coastal habitats. The conservation of high-quality habitats in this region supports 25 State Species of Greatest Conservation Need, such as the pickerel frog and Blanding's turtle.

Previously undocumented Federally listed Pitchers Thistle on island in Lake Huron. Credit: Nick Thiesen, Huron Pines.

Previously undocumented Federally listed Pitchers Thistle on island in Lake Huron. Credit: Nick Thiesen, Huron Pines.

- **Protection of High-Quality Forest Habitat along Lake Superior Shoreline.** Through a GLRI grant administered by the USDA Forest Service, a 226-acre parcel of land along Lake Superior's shore was conserved as the Keweenaw North Shore/Gratiot Community Forest. The community forest provides five public access sites, and encompasses coastal wetlands, old-growth forests, and portions of the Gratiot River that provide native trout habitat. Other species within the area include Canada lynx, grey wolf, northern long-eared bat, tricolored bat, rufa red knot, and monarch butterfly.

Wetland restoration

- **Reconnecting one thousand acres of habitat.** The U.S. Fish & Wildlife Service's National Wildlife Refuge continued an ongoing wetland restoration project at the Shiawassee National Wildlife Refuge to reconnect over 1,000 acres of floodplain wetlands (recently converted from agricultural land) to the adjacent Shiawassee River for the first time in more than a century. Through critical partnerships with groups like Ducks Unlimited, the reconnection work has allowed fish to use shallow floodplains for spawning and nursery habitat and has promoted the establishment of wetland vegetation important to other wildlife species. An additional phase of this project restored 100 acres and reconnected 80 acres to the Shiawassee River. Overall, this project has impacted 2,632 acres at Shiawassee National Wildlife Refuge.
- **Restoring natural flow and connectivity.** A regional partnership between NOAA Fisheries and the Great Lakes Commission, Audubon, NYDEC, and Ducks Unlimited improved habitat for fish and wildlife at Lakeview Wildlife Management Area in New York. This project utilized "channeling and potholing," a wetland enhancement technique to restore 180 acres of coastal wetlands, create 5,000 linear feet of 8-foot-wide channels, and improve 7 acres of open water habitat. This work improved the hydrology, water depths, amount of open water, and habitat connectivity, allowing access to shallow water areas for spawning and nursery habitat for fish and breeding habitat for migrating birds.
- **Coastal Wetland revitalized on Ohio's Lake Erie Shoreline.** USACE partnered with the City of Port Clinton, OH and the GLRI to restore 12 acres of

coastal wetland habitat in Lake Erie's Western Basin. The wetland in Port Clinton contributes habitat connectivity to two major bird migration flyways – the Atlantic and Mississippi, while improving biodiversity for a multitude of aquatic species. Restoration work included treating invasive phragmites and planting native wetland species, as well as constructing microhabitat with small scale channel excavation. Partners including the Ohio Environmental Protection Agency, Ohio Division of Natural Resources, Ohio Lake Erie Commission, USFWS, and Great Lakes Fishery Commission contributed to this success.

USACE contractors performing native planting surveys. Credit: USACE.

- **Indiana Dunes National Park continues restoring the Great Marsh wetland.** This wetland provides valuable wildlife habitat as well as a filter for storm-water and melting snow, removing pollutants and potentially dangerous bacteria such as *E. coli* from water before it enters Lake Michigan. Since 2022, 400 more acres of wetland have been restored or maintained, bringing the total restored area since 1999 to 1,100 acres.
- **Reusing dredged sediment for wetland reconstruction.** Following navigation channel dredging in Sandusky, Ohio, the USACE placed 140,000 cubic yards of sediment into containment. Once the sediment settles, it will be used for in-water wetland reconstruction. These restored wetlands will enhance wildlife, waterfowl, and fisheries habitat in Sandusky Bay, while simultaneously also improving nearshore water quality.

Restoring habitat connectivity.

- **Supporting Aquatic Organism Passage and River Reconnection.** The Michigan Department of Natural Resources, Michigan-based nonprofit Conservation Resource Alliance, the Great Lakes Restoration Initiative, and the U.S. Fish & Wildlife Service collaborated to restore 53 miles of free-flowing habitat in the Maple River watershed, which possesses some of the state's highest densities of brook trout. GLRI funds recently supported work to improve fish passage at three road crossings: Maple-Robinson Road, Mackinac-Petoskey Trail, and Douglas Lake Road. By removing dams and redesigning road crossings, aquatic access throughout the system has been increased, improving the resiliency of the resident brook trout.
- **Restoring recreational fishing opportunities.** Michigan's Alpena Fish and Wildlife Conservation Office has reconnected 96 miles of high-quality brook trout habitat in the Upper Black River. Restoration work resulted in 18 upgraded road crossings and the complete removal of two dams. Fish passage and habitat was further strengthened with the enhancement of in-stream and riparian habitat, including riffle habitat enhancements, riparian forest management, and large woody debris placement.
- **Restoring fish passage for native brook trout along Wisconsin's South Shore of Lake Superior.** The Wisconsin DNR, in partnership with the NOAA Fisheries Office of Habitat Conservation and the Great Lakes Fisheries Commission, and supported by the Great Lakes Restoration Initiative, removed a culvert and an abandoned railroad embankment impeding migratory fish passage in Nebagamon Creek, Lake Superior. The project restored natural hydrologic conditions for fish passage and sediment transport, improving both population resilience and water quality.

- **Brook Trout Reserves.** Brook Trout Reserves are preservations for certain streams in preparation to protect the highest-quality habitat in warming scenarios. Wisconsin DNR Brook Trout Reserves effects are underway in the Upper Peshtigo River with partners in Wisconsin's Lake Michigan watershed.
- **Partnership-based approach to aquatic habitat restoration.** In Cadillac, Michigan, Trout Unlimited, Wexford County Road Commission, the Forest Service and partners are tackling watershed-scale restoration. By replacing bridges and expanding undersized culverts into larger "stream simulation" culverts, natural stream flows and fish passage is restored. The partnership has completed all 12 aquatic organism passage restoration projects within the Hinton Creek watershed, fully reconnecting the mainstem with its fish-bearing tributaries.
- **Restoring Powderhorn Lake.** Efforts by the Forest Preserves of Cook County and Illinois DNR successfully reconnected Powderhorn Lake, a 50-acre freshwater lake, with Wolf Lake, a 950-acre freshwater lake. Restoration required adding a half-mile connection aboveground with creeks and underground with pipes large enough to pass fish and turtles. Fish and wildlife are now benefiting from over 100 added acres of diverse marsh habitat, the ability to move between lakes, and the presence of revitalized fish nursery habitat. Additionally, neighboring urban communities will see reduced flooding, better water quality, and more green space.

Post-restoration aerial photo of restored connection to Wolf Lake, immediately downstream of Powderhorn Lake. Credit: NOAA Fisheries.

- **Indigenous Partnerships and Native Species Restoration.** The Little Traverse Bay Bands of Odawa Indians and USFWS collaborated to conduct on-the-ground conservation, restoration, and monitoring of federally endangered piping plover on High Island in Lake Michigan. The High Island spit is designated as a critical habitat for endangered piping plovers and provides a suitable habitat for threatened plants such as Pitcher's thistle. Seven pairs were found nesting in 2024, contributing to the record number of 81 nesting pairs in the Great Lakes, the most since the piping plover was listed as endangered in the Great Lakes in 1985.

Great Lakes piping plover chick. Credit: USFWS.

Targeted species restoration

- **Record Piping Plover Pair Numbers.** Each season, GLRI supports work to locate and identify each critically endangered Great Lakes Piping plover pair and nest, put protections around nests, and monitor each for the full breeding season. With this dedicated effort, monitors can increase nest success, quickly identify abandoned nests if they fail, and then rescue eggs that can be raised in captivity to help supplement the population. With support from university partners, each Great Lakes Piping plover is banded, which has increased our knowledge of the species and improved management outcomes. In 2024, a record 81 pairs of Great Lakes piping plovers were discovered and protected in the basin.
- **Tree planting to counter the Emerald Ash Borer.** The Emerald Ash Borer (EAB) is an invasive insect

that decimates ash trees, killing nearly all the mature trees in areas of infestation. Lucas County was the first place in Ohio where EAB was found. As a result of EAB and the historic loss of forests, just 12 percent of Lucas County's land area remains forested. In the spring of 2023, Metroparks Toledo, in partnership with the City of Toledo and with Great Lakes Restoration Initiative funding through the U.S. Forest Service, planted over 4,000 trees to address forest loss due to EAB. The plantings established a matrix of native hardwood species well-suited to floodplains and not susceptible to EAB.

- **Collaborative Great Lakes Manoomin (Wild Rice) Project.** Funded through the GLRI, the Great Lakes Manoomin Project focuses on protecting, monitoring, and restoring wild rice and its habitat in the northern Great Lakes basins. It is collaboratively executed by NOAA's Office for Coastal Management, Tribal Nations, and other partners. The first two completed project phases in Lake Superior and Lakes Michigan-Huron are described in a story map highlighting the cultural-ecological significance of manoomin. The third and final project phase began in 2024, which further supports wild rice population recovery by developing system resilience indicators for wild rice.
- Native Mussel Recovery. Several projects are supporting native mussel recovery, including:
  - From 2022–2025, Cuyahoga Valley National Park, with funding from the National Park Foundation advanced freshwater mussel restoration in the Cuyahoga River. This effort has included habitat modeling, monitoring, and preparation for reintroduction, laying the groundwork for a science-based, adaptive management approach. In Fall 2025, the first cohort of 658 two-year-old fatmucket mussels was stocked at five sites, marking a major milestone in restoring a keystone species that improves water quality and supports aquatic life.
  - Indiana Dunes National Park implemented several conservation strategies that have proved effective at restoring freshwater mussels to the east branch of the Little Calumet River. Several hundred adult mussels representing five species were translocated from connected drainages and successfully reintroduced to the park. Additionally, the park has invested in the development of facilities and methods for propagating mussels using *in vitro* and *in vivo* techniques. Several thousand mussels representing six species have been propagated and reared with the earliest tag and release dates scheduled for the summer of 2026.
  - NPS, USGS, NOAA, and academic partners are implementing invasive mussel control efforts aimed at restoring native whitefish spawning habitats at priority sites in Lake Michigan (Sleeping Bear Dunes) and Lake Huron (Thunder Bay).
- **Release of federally endangered butterflies.** In partnership with the Great Lakes Restoration Initiative, the Minnesota Zoo, Haddad Lab at the University of Michigan, the John Ball Zoo, and other partners, the U.S. Fish and Wildlife Service is working to release and restore wild Poweshiek skipperling butterfly populations. Although once widespread and abundant throughout the U.S. Midwest, this species now remains only in a single Michigan county. Efforts to captively rear and breed the butterflies resulted in the release of over 1,400 butterflies into Michigan prairies in 2024, which followed releases of more than 600 butterflies between 2022 and 2023. The wild populations of this butterfly are anticipated to increase in abundance and distribution due to sustained releases and expanding zoo support programs.

Poweshiek skipperling sipping nectar. Credit: Vince Cavalieri, USFWS.

- **Supporting delisting of federally listed American hart's-tongue fern.** The U.S. Fish & Wildlife Service worked with many partners and the Great Lakes Restoration Initiative to deliver conservation efforts focused on the federally listed American hart's-tongue fern. These efforts, including propagation and reintroduction initiatives at key sites, habitat management, invasive species control, and site monitoring, have boosted the recovery of the fern - which is now positioned for potential delisting.
- **Supporting recovery of federally listed Dwarf Lake Iris.** Collaborating with the Great Lakes Restoration Initiative and partners across the Great Lakes region, the U.S. Fish & Wildlife Service has worked to recover the federally threatened dwarf lake iris, found only in the Great Lakes region. Through extensive and successful public outreach, monitoring, and habitat management – including tailored action plans for several dwarf lake iris sites – the species is being considered for delisting.

Canada

- **Assessing habitats and species.** Canada and Ontario have led assessments of the status of fish populations and habitat in several Areas of Concern, including Hamilton Harbour, Toronto and Region, and the St Clair-Detroit River system. This multi-agency effort provided critical insights into fish population and habitat trends. In addition, fish community and habitat surveys were undertaken to support future assessments of fish populations and habitats in the Toronto and Region Area of Concern. These surveys, conducted in similar habitat types across Lake Ontario, were complemented by the deployment of data loggers to characterize thermal and oxygen profiles and time series that are essential for assessing the dynamics of different ecotypes, including wetlands, embayments, river mouths, and the open coast.
- **Lower trophic surveys.**
  - Canada completed lower trophic surveys for Lake Huron and Lake Ontario. These surveys included a spring and summer whole-lake assessment of plankton food web composition, biomass, and primary productivity to support studies of larval fish recruitment and populations of forage fishes by binational partners.
  - To support fisheries management during a period of declining offshore nutrient concentrations, Canada and Ontario continued to maintain thermistor buoys and conduct sampling of plankton, water quality parameters, and forage fish diets at long-term monitoring stations located in Hamilton Harbour, western Lake Ontario, and in the eastern Kingston Basin.
- **Coastal wetland resilience.**
  - In 2024, CWA's Great Lakes Freshwater Ecosystem Initiative supported and promoted local-level action to enhance water quality, ecosystem health, and the resilience of coastal wetlands experiencing stress due to climate risks and impacts, including supporting:
    - The Essex Region Conservation Authority to restore the structure, diversity, hydrologic connectivity, and water quality within the 115-hectare Hillman Marsh (Leamington, Ontario), which involved modeling to optimize the design and construction of a new engineered and nature-based barrier feature to protect the marsh from climate extremes.

An eroding barrier beach that once protected Hillman Marsh on Lake Erie. Credit: Wayne King.

    - McMaster University in developing and validating a scientific approach to classify the resilience of coastal wetlands to climate change in Georgian Bay, which can serve as a screening tool for environmental agencies and municipalities to identify wetlands that require mitigation and protection from human

development because of their value as climate refugia.

  - The Central Lake Ontario Conservation Authority to enhance and create new wetlands, reconnect aquatic habitat, and model and design a new barrier feature to protect the Lynde Shores wetland ecosystem (Whitby, Ontario) from future water level extremes and storm events.

  — Natural Resources Canada's Two Billion Trees program supported and complimented the work of the Central Lake Ontario Conservation Authority by the planting of 3,500 trees in the Lynde Shores Conservation Area to further protect the natural heritage features and functions of the wetland ecosystem.

- **Coastal wetland conservation.** The Ontario Ministry of the Environment, Conservation and Parks continued to work with conservation organizations, municipalities and Indigenous communities to protect, restore, and enhance wetlands in priority Great Lakes watersheds and to improve water quality as part of the Wetlands Conservation Partner Program. Sixteen conservation organizations and five municipalities were supported to enhance water quality, mitigate excess stormwater flow, preserve and increase habitats for endangered species, help prevent flooding, build climate change resiliency, and increase economic activity. These 21 organizations completed over 225 wetland restoration and enhancement projects benefiting over 760 hectares (1880 acres) of wetlands across Ontario. Since its launch in 2020, the 5-year program supported in total over 590 projects covering over 4,000 hectares (9,900 acres) of wetlands in the Great Lakes watershed and connecting waterways.

- **Conserving and protecting species at risk from disappearing from the Great Lakes region.**

  — Between 2023 and 2025, ECCC's Habitat Stewardship Program for Species at Risk supported 60 projects within the Great Lakes region. Collectively, these projects enhanced approximately 660 hectares of habitat and protected more than 430 hectares through the enrollment of private landowners in tax incentive programs and through partial-interest land securement.

  — The Canada Nature Fund for Aquatic Species at Risk supported multi-species, place-based, and threat-based stewardship actions that recover and protect aquatic species at risk and improve water quality within the Great Lakes watershed. Over 2023 to 2024, the program funded over $1.4 million across nine projects supporting aquatic species at risk in the Great Lakes Basin. Projects in and around the Great Lakes and contributing watersheds restored wetlands, enhanced riparian habitat, increased awareness about conservation needs, and promoted stewardship at the community level.

  — Canada's Species at Risk Partnerships on Agricultural Lands Program supported the Ontario Soil and Crop Improvement Association to collaborate with farmers to implement beneficial management practices that supported the recovery of species at risk through initiatives such as modified grazing, forage harvest management, and the creation of wildlife habitat on marginal lands. In 2023-24, the program supported the creation of 54 hectares of wildlife habitat and the implementation of enhanced management practices for species at risk on an additional 710 hectares.

  — The Species at Risk Partnerships on Agricultural Lands Program also supported Bird Ecology and Conservation Ontario's project to collaborate with farmers to implement beneficial stewardship practices such as delayed haying, delayed livestock grazing, leaving fields fallow, avoiding nests during hay harvest, and raising awareness of species-at-risk in Ontario.

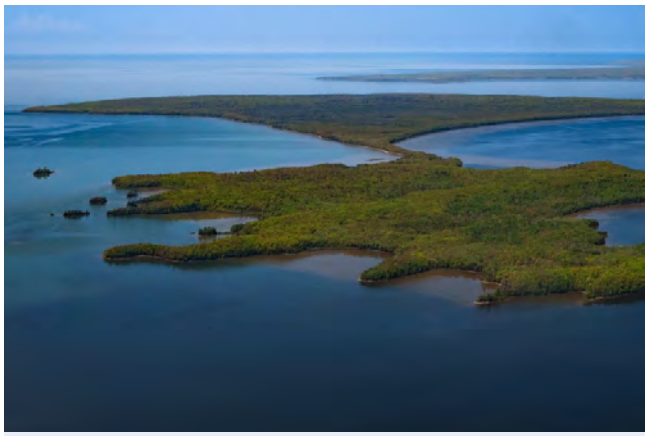
- **Native species protection and restoration efforts.**

  — The Ontario Ministry of Natural Resources (MNR) continued to work with national and binational partners to protect and restore native species across the Great Lakes. Long-term efforts for native species like Lake Trout and Atlantic Salmon appear to be succeeding. By late 2024, Lake Trout in Lake Superior were declared restored after more than 30 years of effort. Wild Lake Trout reproduction targets

in the main basin of Lake Huron continue to be met. Lake Erie has seen wild juvenile Lake Trout reproduction for the first time in over 60 years. In Lake Ontario, increasing numbers of adult Atlantic Salmon returns, signal success in binational reintroduction efforts. MNR supported the binational restoration plans through annual stocking of 80,000 Lake Trout into Lake Erie and 1,000,000 into Lake Huron. The nearshore fish community and Walleye populations were assessed in the major tributaries of Georgian Bay and the North Channel. This crucial information is used to develop restoration and management plans for Walleye in the Canadian waters of Lake Huron.

  - Mapping of habitat and modeling key habitat characteristics for native migratory species continued in four major Canadian Lake Erie tributaries to identify opportunities for protection or restoration. The MNR also facilitated the trapping and transfer of American Eel around the Moses Saunders Dam by working with commercial fishers and Ontario Power Generation. This effort helps to protect Lake Ontario's Eel populations by aiding this species' unique spawning migration to the Atlantic Ocean.
  - The MNR also actively supported and participated in binational work to address declining populations of Coregonids (e.g., whitefish and cisco) and Lake Sturgeon across the Great Lakes Basin.

- **Landscape Level Habitat Protection.** The Government of Canada made an unprecedented commitment to protect 25 percent of Canada's land and oceans by 2025, and 30 percent protection by 2030. The Nature Smart Climate Solutions Fund supported over 20 Conservation Authorities and Land Trusts to deliver nature-based solutions to address climate change impacts, including protecting and restoring wetlands, grasslands, and riparian areas, as well as enhanced land management practices to increase carbon sequestration. Overall, the program conserved over 3500 hectares of conservation lands in perpetuity and restored over 100 hectares of priority habitat for carbon sequestration and biodiversity.



Batchewana Island is now protected with support from the Nature Smart Climate Solutions Fund.

- **Expanding protected and conserved areas.** The Canada Nature Fund and the Ontario Greenlands Conservation Partnership expanded the network of protected and conserved areas by working with the Nature Conservancy of Canada, Ducks Unlimited Canada, and Wildlife Habitat Canada on behalf of local and regional land trusts. Examples of these large habitat conservation projects include: 67.5 hectares at Turkey Point, Lake Erie; 50 hectares of forest and wetlands in Essex County, at Upper Cedar Creek in Harrow and Hillman Sand Hills near Leamington; 40 additional hectares protected on Cockburn Island, Georgian Bay; 750 hectares of lands and waters on Manitoulin Island, Lake Huron; 190 hectares on Lake Superior's Black Bay Peninsula, near Thunder Bay.
- **Restoring critical habitat.**
  - Canada is implementing its national Framework to Identify Fish Habitat Restoration Priorities (2023), which encourages information sharing and use of resources to target restoration activities for maximum benefit to fish habitat. As part of this initiative, Indigenous groups, industry sectors, non-governmental organizations, academics, and provincial government agencies were engaged to identify fish habitat restoration priorities in the lower Great Lakes watersheds.
  - Canada's Enhanced Nature Legacy facilitated stewardship and restoration, landscape and management planning, research, monitoring, analysis, and documenting biodiversity in

UNESCO biosphere reserves. The fund is supporting efforts in:

  - The Long Point Walsingham Forest Priority Place, where local partners are treating Phragmites, monitoring endangered species, reducing wildlife road mortality and protecting over 3,200 hectares (7900 acres) of habitat, directly or indirectly benefiting over 80 species at risk.
  - The Georgian Bay Biosphere Region Community Nominated Priority Place (Maamwi Anjiakiziwin), where actions such as collecting data on best management practices implemented by six municipalities for road maintenance and use, holding Truth and Reconciliation training sessions, targeting youth training sessions, and planning, research, and engagement to improve stewardship and protection of priority habitat.

- **Working toward ecosystem resilience.** In 2023, Parks Canada and the Nature Conservancy of Canada launched the Government of Canada's Landscape Resiliency Program for enhanced protection of up to 30,000 hectares of land and water located near existing parks across Canada, including the Great Lakes at locations such as Point Pelee in Lake Erie, the Bruce Peninsula in Lake Huron, and Thousand Islands in the St. Lawrence River.
- **Indigenous Partnerships.**
  - Canada's Indigenous Partnerships Initiative supported over 25 Indigenous-led stewardship actions that benefited species at risk in the Great Lakes region. Actions included ecological monitoring, habitat restoration and/or enhancement, and engaging youth and the public in awareness and capacity building for Indigenous-led conservation projects. With continued support from the Canada Nature Fund, the Initiative has supported 14 projects to conduct scientific surveys, gather traditional knowledge to inform stewardship actions, and to remove invasive species.
  - As part of Canada's commitment to conserve 30 percent of the country's lands and waters by 2030, Canada provided support to work towards the future protection of the Shawanaga First Nation Indigenous Protected and Conserved Area on Shawanaga Island (protecting 1,020 hectares) and, in collaboration with Ontario, the Georgian Bay Biosphere Reserve, and the Georgian Bay Land Trust.

Annex 8: Groundwater

Canadian and U.S. governmental agencies continue to actively manage contaminated groundwater sites and issues in the Great Lakes watershed. Cooperation between local, state, provincial, and federal agencies has continued to improve understanding of groundwater's influence on surface water quality and ecosystem health. Over the last three years, the Groundwater Annex facilitated communication among members from local, state, provincial, and federal agencies on a variety of groundwater-quality topics. Both countries also conducted research to study groundwater contaminant sources and the dynamic interaction between the groundwater system and surface waters, to further understand and prevent risks to Great Lakes water quality.

Key Achievements

- Facilitated communication among members from local, state, provincial, and federal agencies on a variety of groundwater-quality issues relevant to Canada and the U.S.
- Member agencies of the Groundwater Annex Subcommittee supported and performed multiple research projects investigating a wide variety of groundwater contaminants that could pose a threat to the Great Lakes.
- Gathered and analyzed groundwater data for the 2025 State of the Great Lakes (SOGL) groundwater quality sub-indicator report.
- Published the groundwater science report entitled *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: An Updated Status Report* (2024).

Purpose and Overview

The purpose of Annex 8 (Groundwater) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to coordinate groundwater science and management actions.

Groundwater is an important component of the water entering the Great Lakes, either through direct groundwater discharges into the Great Lakes or indirect discharges into surface waters, like rivers and wetlands, that eventually flow into the lakes. Clean groundwater assists in maintaining healthy aquatic and surrounding terrestrial ecosystems. Groundwater also stabilizes water temperatures in stream, wetland, and coastal areas.

The Groundwater Annex focuses on increasing the understanding of how groundwater influences Great Lakes water quality and ecosystem health.

Orange staining at the edge of this stream indicates a discharge area of groundwater with elevated dissolved iron concentrations, as part of an ECCC study into potential impacts from historic landfills. Credit: James Roy, ECCC.

ANNEX IMPLEMENTATION

The implementation of commitments under Annex 8 (Groundwater) is co-led by Environment and Climate Change Canada (ECCC) and the U.S. Geological Survey (USGS) supported by the Annex 8 Subcommittee, which includes members from ECCC; Ontario Ministry of the Environment, Conservation and Parks (MECP); Toronto and Region Conservation Authority; Upper Thames River Conservation Authority; Indiana Department of Environmental Management; Michigan Department of Environment, Great Lakes, and Energy; Minnesota Department of Health; New York State Department of Environmental Conservation (NYDEC); Ohio Department of Natural Resources; Ohio Environmental Protection Agency; U.S. Environmental Protection Agency; USGS.

A monitoring well at the edge of a historic landfill in Ontario that was sampled for the presence of a variety of emerging contaminants, including per- and polyfluoroalkyl substances (PFAS). Credit: James Roy, ECCC.

Binational Actions and Achievements

Priority for Science: Conduct research to identify and understand point and non-point sources of pollution that impact the Great Lakes due to transport via groundwater.

In Canada, ECCC carries out groundwater research on potential impacts from contaminants to waters of the Great Lakes basin with funding supported by the Freshwater Action Plan and often in collaboration with academic researchers and/or Ontario MECP. Ontario MECP also supports similar research through the Canada-Ontario Agreement (COA) funding to academic researchers and a large collaborative field study lead by Natural Resources Canada was recently initiated to target groundwater contamination. In the United States, groundwater research has been conducted by USGS with support from the Great Lakes Restoration Initiative, state, or local funding.

- Groundwater projects with relation to Great Lakes water quality are mentioned in the following tables.

A team of ECCC scientists and Western University professors and students are using radon detectors with nearshore lake water sampling to map out areas of higher groundwater discharge along the northern shore of Lake Ontario. Credit: Kayla Bruce, ECCC.

Table 1. Studies initiated prior to 2022 (completed or near-completion).

- River reach-scale impacts from road salt-contaminated groundwater on benthic ecosystems, groundwater discharge effects on stream chloride concentrations, and potential influences of high-chloride groundwater on metal mobilization from streambed sediments (ECCC in collaboration with Western University).
- Year-round dynamics of chloride concentrations across eight urban streams in Hamilton region, with a focus on base flow periods and aquatic life exposure periods (ECCC in collaboration with Toronto Metropolitan University).
- Relationship between direct groundwater discharge to the northern shore of western Lake Ontario and its associated contaminant loadings (including road salts) using publicly gathered data and numerical models (The Oak Ridges Moraine Groundwater Program with funding from COA-MECP).
- Relative contribution of groundwater and associated preferential pathways in transporting road salt to surface waters in the Great Lakes, focusing on the Western Lake Ontario basin, by monitoring multiple sites over two hydrologic cycles, analyzing groundwater-surface water interactions, seasonal chloride trends, and the effects of land use and geology (University of Guelph; COA-MECP-funded).
- Factors influencing the transport (primarily via groundwater pathways) of contaminants from onsite wastewater treatment (septic) systems to watershed tributaries of Lake Erie and Lake Simcoe, using artificial sweeteners and microbial markers as human wastewater tracers, including development of a geospatial tool to predict phosphorus loading from septic systems (Western University, with funding from COA-MECP, and in collaboration with ECCC).
- Role of groundwater in the delivery of nutrients to agricultural streams in the Thames watershed, and the potential effects of groundwater phosphorus inputs on stream ecology and how riparian areas may mitigate these nutrients inputs (Western University, with funding from COA-MECP, and in collaboration with ECCC).
- Long-term phosphorus loading via groundwater from a coastal community with decommissioned septic systems using numerical modeling (ECCC in collaboration with Western University).
- Development of a decision tree framework to estimate the number of potential sources of per- and polyfluoroalkyl substance (PFAS) contamination to groundwater in Ontario based on land-use activities and to enable the creation of a risk-based inventory of PFAS-contaminated sites, supported by an interactive map (Royal Military College of Canada, with funding from COA-MECP).
- Assessing the potential for groundwater transport of contaminants to Lake Superior using hydrogeologic setting and estimated water budgets (USGS Lake Superior Cooperative Science and Monitoring Initiative (CSMI) study.
- Potential influence of groundwater on water quality of nearshore Lake Huron and assessing the role of groundwater transporting nitrate and chloride to the Lake (USGS Lake Huron CSMI study building on the previous work done for Lake Superior).

Sampling a groundwater spring for measurement of microplastic transport in groundwater in an area of urban karst (limestone/dolostone caves and cracks). Credit: James Roy, ECCC.

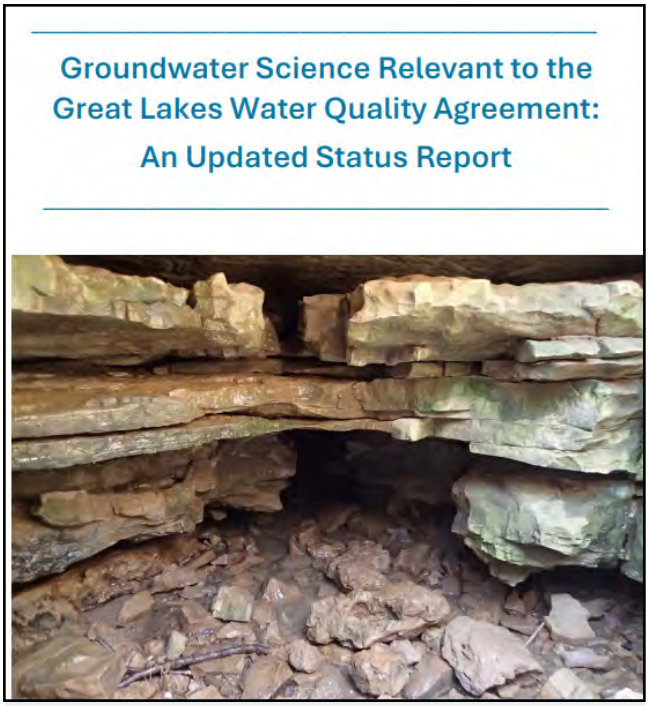
Table 2. Studies more recently initiated and on-going.

- Understanding groundwater-surface water interactions and quantifying nutrient transport through the groundwater system into the creek in the Norfolk sand plain system (lower Whitmans Creek watershed, Lake Erie basin) (University of Guelph, with funding from COA-MECP; initiated spring 2023).
- Examining the movement of nitrogen and phosphorus between groundwater and surface water and characterizing the ecosystem services provided by the hyporheic zone of the stream that flows into Lake Huron. This was performed in a clay dominated agricultural watershed at an integrated monitoring site in the southern Lake Huron basin (University of Guelph with funding from COA-MECP).
- Identifying areas of concern for direct discharge of road salt from groundwater to nearshore areas of Western Lake Ontario (Ontario side) by leveraging existing field data and modeling results and collecting new field data (Western University, with funding from COA-MECP, in collaboration with ECCC; initiated spring 2024).
- Investigating septic system wastewater effluent inputs to Great Lakes watersheds, focusing on effluent inputs via drains that intercept shallow groundwaters, or through direct pipe connections, and examining several emerging organic contaminants, anti-microbial resistance, and microplastics (Western University in collaboration with ECCC).
- Presence of ultra-short-chain PFAS in groundwater and groundwater-fed streams with impacts from a variety of sources (starting first with landfill leachate) (ECCC led in collaboration with Western University).
- Groundwater flow and contamination in the lower part of the Grand River watershed in southern Ontario (~2000 km2), with the Six Nations of the Grand River and Mississaugas of the Credit First Nations communities, including assessment of groundwater contaminant impacts to surface waters in the region and potential impacts from the region's abandoned oil and gas wells (Natural Resources Canada / Geological Survey of Canada, in cooperation with ECCC, OGS, MECP and MNR and Grand River Conservation Authority; initiated 2024).
- Determining if a novel treatment technology (UV/sulfite/iodide system), which effectively reduced PFAS contamination at a laboratory bench scale, will be effective with field groundwater from selected facilities within the Great Lakes basin (Royal Military College, with funding from COA-MECP; initiated spring 2024).

ECCC scientists sampling groundwater discharging into a shallow pond as part of an investigation into ecological exposure to groundwater impacted by mixtures of legacy and emerging contaminants. Credit: Kayla Bruce, ECCC.

Priority for Action (carried over from 2022): Update the 2016 binational groundwater science report entitled *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: A Status Report*, to reflect new knowledge on groundwater in the Great Lakes region, including an assessment of the geographic distribution of known and potential sources of groundwater contaminants relevant to Great Lakes water quality.

- Canada and the U.S. published *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: An Updated Status Report (2024)*. The 2024 publication updates the original 2016 report, assesses groundwater science progress, and identifies new and ongoing science needs.



Cover page of the Groundwater Science Relevant to the Great Lakes Water Quality Agreement: An Updated Status Report.

Other Binational Accomplishments

In 2024, ECCC, USGS, and MECP groundwater subject matter experts contributed to producing the SOGL groundwater quality sub-indicator report, which will be published in the SOGL Report 2025 (see Annex 10: Science for more information).

Domestic Actions and Achievements

Canada and the United States also implemented various domestic projects that also support Annex 8 (Groundwater), complementing efforts to achieve binational science and action priorities.

Canada and Ontario

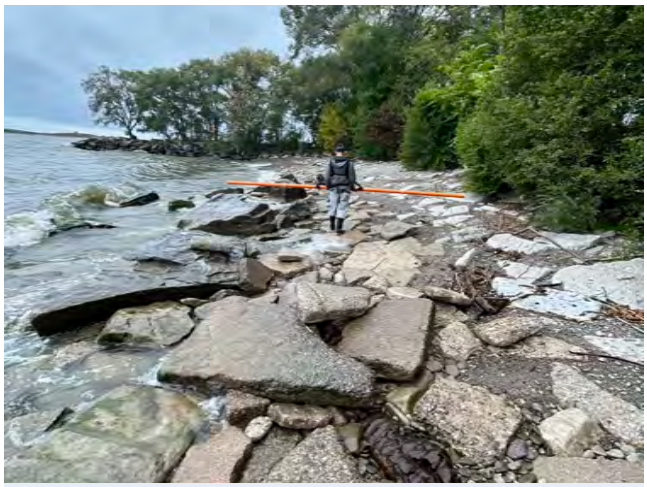
The Groundwater Quality Annex of the 2021 COA commits the governments of Canada and Ontario to continue their focus on research on groundwater's influences and impacts on Great Lakes water quality and ecosystem health and on identifying priority areas for action. Specific groundwater-related activities not included in the previous list of studies are described below.

Groundwater modeling and groundwater-surface water interaction.

- In Spring 2023, MECP funded a project to map and ground-truth groundwater discharge / baseflow dynamics at a representative, high priority sub-watershed within the Lake Erie basin, and to optimize field monitoring methods and data collection strategies to support the quantification of groundwater and contaminant contributions to surface water systems using conventional and emerging field investigation techniques, hydrologic models and artificial intelligence.
- Through the Canada1Water program, NRCan and collaborators have delivered key data and analyses on groundwater and groundwater-surface water interactions in the Great Lakes Basin, including:
  - Fully-harmonised datasets to support regional-scale groundwater–surface-water modelling for the Great Lakes Basin (Canada-U.S.), built on a simplified seven-layer map hydrostratigraphic framework; and
  - Data on water storage changes (snow, surface water, soil, groundwater) for each of the five Great Lakes basins, derived from numerical model and a 20-year series of Gravity Recovery and Climate Experiment satellite data.

Research on groundwater-surface water interaction and climate change impact.

- MECP is supporting research on groundwater-surface water interactions and climate change impacts in sub-watersheds in the northern Lake Huron and Lake Superior basins with Nipissing University and Lakehead University, respectively. These studies use data collected from two integrated water and climate change monitoring stations that are part of a network of seven sites established in 2012.



Using electromagnetic geophysics to investigate road salt contaminated groundwater that might be discharging to Lake Ontario in the Greater Toronto Area, Ontario; a collaborative study by Western University (MECP funding) and ECCC. Credit: Kayla Bruce, ECCC.

United States

- **Monitoring.** Groundwater levels and groundwater quality are monitored in the U.S. Great Lakes states by local, state, and federal agencies. For example, in New York, the USGS is coordinating with NYDEC to monitor a statewide network of groundwater observation wells that provides real-time groundwater elevation data, which are used in concert with other data to make drought-related decisions. In Minnesota, a network of over 270 wells is sampled for 100 different chemicals, including nutrients, major ions, volatile organic com- pounds, and trace metals. Data from field-measured parameters, including pH, specific conductance, dissolved oxygen concentration, and temperature, also are collected (Minnesota Pollution Control Agency groundwater monitoring). The State of Ohio monitors over 200 wells for ambient groundwater quality including wells on the Lake Erie islands (Ohio Environmental Protection Agency Ground Water Characterization Program) primarily to provide data and information to protect drinking water supplies.
- **Nutrients in Groundwater.** USGS continues to work with the Wisconsin Department of Natural Resources and researchers at the University of Wisconsin–Madison to develop a Nitrate Decision Support Tool. This statewide tool combines GIS and well data with a Machine Learning model of groundwater age and nitrate leaching estimates; the tool estimates the concentration of nitrate at specified wells over time and forecasts how changing nutrient leaching below the land surface could affect concentrations. An important feature of the tool includes its ability to incorporate model uncertainty into estimates of time delays between management actions and improved concentration at receptor wells.
- **Data Infrastructure.** The State of Michigan has invested in an internal upgrade of water-resources data, including groundwater data, to provide a comprehensive database that spans agencies and allows improved access to groundwater data. A complementary cooperative project with Michigan State University and USGS to develop a Michigan Hydrologic Framework seeks to bring together external data sources and provide a mechanism for stakeholders to provide water-resources data to the state to support decision making.
- **Economic Studies.** Michigan Department of Environment, Great Lakes, and Energy awarded a grant in March 2021 to Michigan State University's Institute of Water Research to conduct a 2-year economic study of Michigan's use of institutional controls for managing groundwater contamination. The research team will use case studies to better understand the long-term implications, risks, and costs of using institutional controls and other restrictive actions, such as limiting the use of an aquifer when managing risks associated with groundwater that has become unusable due to contamination. They will also develop a framework to guide future decision-making. This work will clarify how Michigan currently manages contaminated groundwater and will inform decisions about future uses of institutional controls.

Annex 9: Climate Change Impacts

Canadian and U.S. governmental agencies continue to collect meteorologic, hydrologic and environmental information for use by regional and local project planners. In addition, agencies and researchers are also developing analytic tools and studies for resource managers, local communities, and other decision-makers. Over the last three years, governmental agencies have facilitated communications and shared information on environmental conditions to support the development of resilient infrastructure and restoration projects.

Key Achievements

- Supported the 2025 Great Lakes Modeling Workshop.to enhance regional modeling coordination and collaboration. The workshop convened modelers, model users and academics from the Great Lakes region to share new research findings, highlight data resources and tools, set priorities and goals, and develop recommendations to improve lake modeling and meteorologic projections.
- Continued to deliver quarterly and annual summaries on basin-wide lake surface and air temperature changes, precipitation, ice cover, and water levels.
- Continued to host webinars to share and discuss Great Lakes research, tools and strategies.

Purpose and Overview

The purpose of Annex 9 (Climate Change Impacts) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) was established to support the Agreement's broader objectives to foster collaboration in monitoring and forecasting the effects of environmental conditions on Great Lakes water quality. Annex 9 also facilitates the exchange of critical information between researchers, resource managers, and project planners.

Precipitation regimes, air and water temperatures, ice cover, and water levels have significant effects on Great Lakes communities. Improved understanding and predictions of these environmental conditions is essential for resilient development and management of Great Lakes communities and ecosystem.

Rising waters in Lake Ontario led to localized flooding on Centre Island (Toronto Islands). Credit: Steven_Kriemadis @ iStock.

ANNEX IMPLEMENTATION

The implementation of this Annex is supported by an Annex 9 Subcommittee, co-led by U.S. National Oceanic and Atmospheric Administration (NOAA) and Canada Water Agency (CWA). Members of the subcommittee include the Great Lakes Indian Fish and Wildlife Commission; Michigan Department of Environment, Great Lakes, and Energy (EGLE); Ohio Lake Erie Commission; U.S. Army Corps of Engineers (USACE); U.S. Bureau of Indian Affairs; U.S. Department of Agriculture (USDA); U.S. Environmental Protection Agency (USEPA); Wisconsin Department of Natural Resources; Environment and Climate Change Canada; Chiefs of Ontario; Fisheries and Oceans Canada; Métis Nation of Ontario; Natural Resources Canada; Ontario Ministry of Natural Resources; Ontario Ministry of the Environment, Conservation and Parks; Parks Canada.

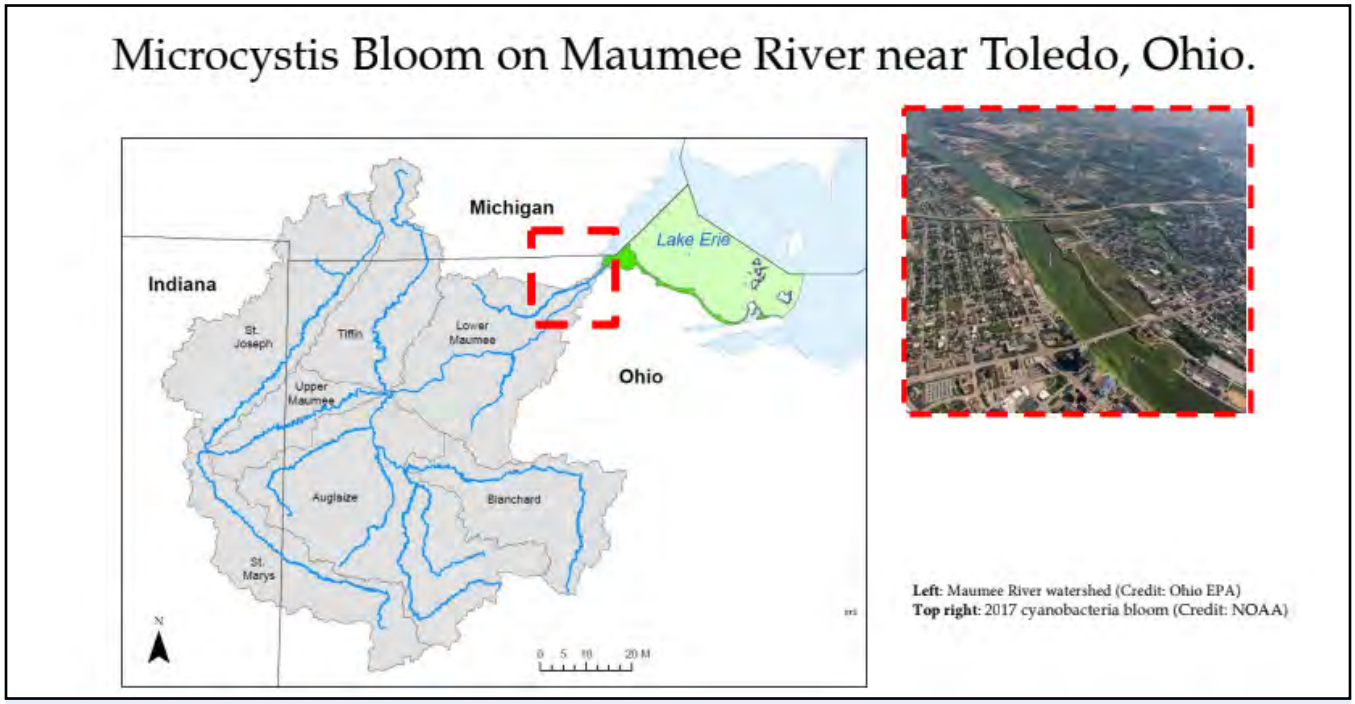
Binational Actions and Achievements

Priority for Action: Foster and enhance knowledge exchange and discussions on Great Lakes climate projections, integrated lake modeling, and downscaling approaches for Great Lakes resource managers.

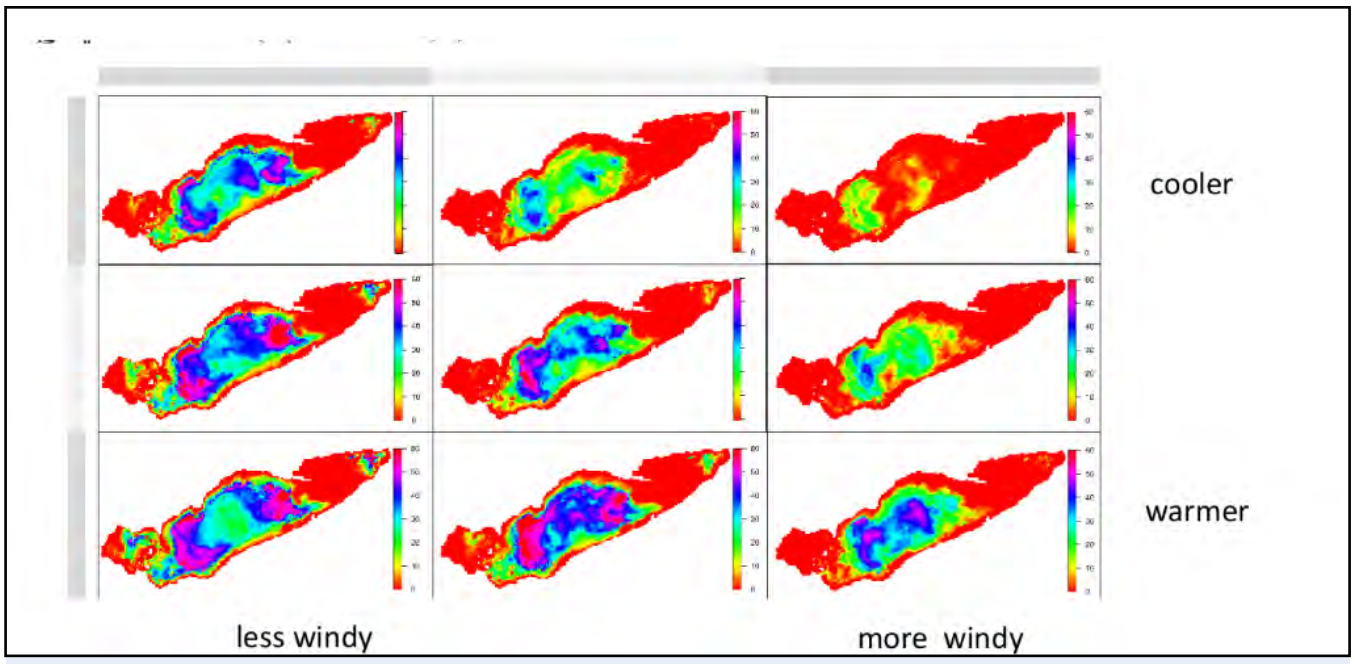
- **2025 Great Lakes Modelling Workshop.** In June of 2025, NOAA and the Canada Water Agency supported a third binational Great Lakes Modeling Workshop, led by the Great Lakes Integrated Sciences and Assessments (GLISA). The workshop assembled subject matter experts to discuss progress, challenges, and collaborative paths to advance Great Lakes modeling. Workshop topics included data management and access, understanding current vulnerabilities, and recommended next steps.

2025 Great Lakes Modelling Workshop. Participation from modeling communities and users across the U.S. and Canada with over 35 participating organizations.

Day 1 of the workshop focused on lake modeling – highlights presented below.

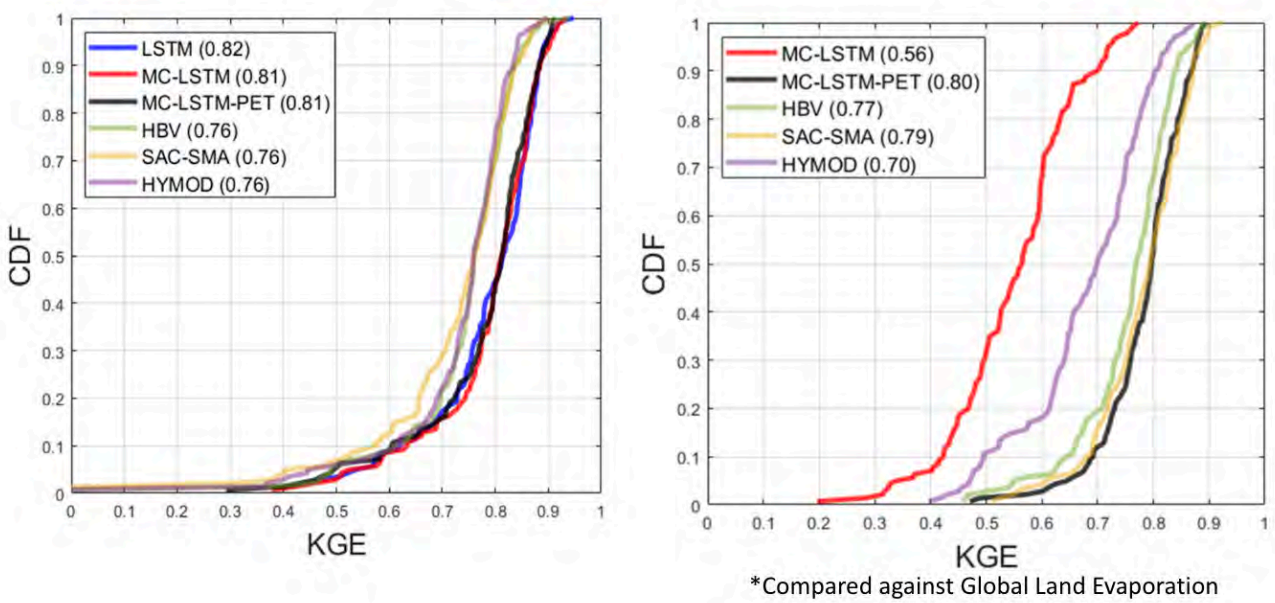


Ongoing Lake Modelling Research: Understanding harmful algal-bloom forming microcystis on Maumee River near Toledo, Ohio. Credit: Dr. Andrew Gronewold, University of Michigan.

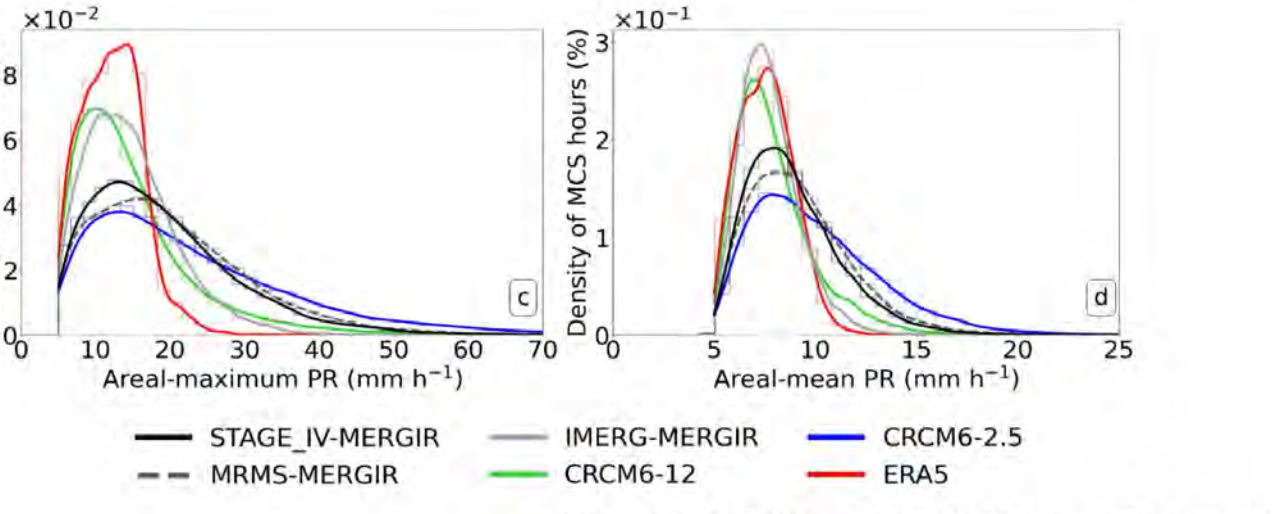


Annual duration of hypoxic conditions in Lake Erie's central basin depend on lake surface temperature and wind intensity. Images represent simulations of dissolved oxygen (mg/L) using the ELCOM-CAEDYM model; the center image shows average conditions, with wind increasing left to right and temperature increasing top to bottom. Credit: Dr. Philippe Van Cappellen, University of Waterloo.

Day 2 of the workshop focused on regional modeling – highlights presented below.



Comparison and performance of hydrological process-based models (HBV, SAC-SMA, and HYMOD) versus deep learning (DL) models (LSTM, MC-LSTM, and MC-LST-PET) in predicting historical streamflow (left) and evapotranspiration (right) on freshwater systems based on cumulative distribution function (CDF) vs Kling-Gupta Efficiency (KGE) with rightmost profiles showing enhanced performance. Credit: Dr. Scott Steinschneider, Cornell University.



Université du Québec à Montréal (UQAM) updates on the Canadian Regional Climate Model Version 6 (CRCM6)-Global Environmental Multiscale (GEM) model simulations at 2.5 km (CRCM6-2.5) and 12km (CRCM6-12) resolutions. The data shows the density of Mesoscale Convective Systems (MCS) vs Areal-maximum precipitation rate (left) and density of MCS vs areal mean precipitation rate (right). Data in both plots show that the CRCM6-2.5 (blue) is relatively close to the radar based MRMS-MERGIR product (gray dash). An important result in understanding basin precipitation. Credit: Dr. Alejandro Di Luca, UQAM.

Table 1. Webinar Series

- A Resource for Historical Climate Data, Information, and Monitoring (Beth Hall, The Midwestern Regional Climate Center, Purdue University, September 29, 2023).
- Canada's First National Adaptation Strategy (Vincent Loiselle, ECCC, November 17, 2023).
- Examining Present and Future Climate over the Great Lakes Region Across Model Configurations (Jiali Wang, Argonne National Laboratory, and TC Charkraborty, Pacific Northwest National Laboratory, February 16, 2024).
- Exploring Great Lakes Water Budget Components Using the Canadian Regional Climate Model (CRCM versions 5 and 6) (Biljana Music, Ouranos, and Alejandro Di Luca, UQAM, June 14, 2024).
- Development of the Next Generation of Regional Climate Change Projections for the Great Lakes Basin (Michael Notaro, Nelson Institute for Environmental Studies Center for Climatic Research, University of Wisconsin-Madison, September 13, 2024).
- Housing, Infrastructure and Communities Canada and Climate Insight: Climate Toolkit for Housing and Infrastructure (Devin Causley, Infrastructure and Communities Canada, and Sheri Young, International Council for Local Environmental Initiatives Canada, Climate Insight, January 24, 2025).
- Investigating Surface and Subsurface Warming in the Laurentian Great Lakes: Historical Changes and Future Climate Projections (1979 - 2100) (David Cannon, Cooperative Institute for Great Lakes Research, September 26, 2025).

- **Webinar Series.** Over this reporting period, the Annex Webinar Series continued. The webinar series enhances coordination and knowledge exchange between experts, stakeholders, resource managers, and the public on programs conducted within the Great Lakes basin. The webinars for the 2023-2025 period included topics varying from information updates and modeling initiatives across the U.S. and Canada (see Table 1).

Priority for Action: Produce and share climate information of relevance to the Agreement with the Great Lakes community, including regularly issuing the binational *Quarterly Climate Impacts and Outlook report* and the *Annual Climate Trends and Impacts Summary for the Great Lakes Basin*.

- Great Lakes Outlooks continue to be produced and provide overviews of seasonal weather and water level conditions, and an outlook for the upcoming quarter.
- The Annual Summaries were produced by agencies and organizations including NOAA's Great Lakes Environmental Research Laboratory, ECCC, the Midwest Regional Climate Center, and the GLISA partnership (see Climate Change Impacts Documents – Binational.net for the Annual Summaries and Outlooks).
- The Annex Subcommittee supported the development of the *State of the Great Lakes 2025 Report* in relation to four sub-indicators that report on surface water temperatures, ice cover, annual precipitation amounts and water levels in the Great Lakes. These binational sub-indicators are authored by experts from NOAA, USACE, ECCC, and the University of Minnesota Duluth to share information on how shifts in weather may be acting as a Great Lakes ecosystem stressor.

Priority for Science: In collaboration with Annex 2, enhance Lakewide Action and Management Plans (LAMP) by including current climate trends and best available information of projected climate change and impacts.

- The Annex Subcommittee, with support from GLISA, provided information and review for the development of the Lake Erie Lakewide Action and Management Plan.
- The Annex Subcommittee, through its contribution to the 2025 State of the Great Lakes Report,

developed information (lake ice, lake surface temperature, and water levels) for use in the Lakewide Action and Management Plans.

Large ice formations on frozen Lake Superior. Credit: LIKE HE @ iStock.

Other Binational Accomplishments

- **Assessing coastal wetland conditions and trends.** The Great Lakes Coastal Assembly, made up of more than 25 organizations across federal, state, provincial, Tribal, NGO, and academic sectors, prepared a variety of resources to assess coastal wetland conditions and trends.
- **Expanded capacity for long-term monitoring of the Great Lakes Evaporation Network.** In 2023, the number of Great Lakes Evaporation Network (GLEN) fixed Eddy Covariance sites for monitoring air-lake fluxes of heat and energy expanded from 6 to 7 stations with several sites now also monitoring carbon dioxide flux. One site at Granite Island is providing near-real time data, http://umbs-dashboard.umbs.lsa.umich.edu/GILS-Met/index.html. The GLEN Network, co-sponsored by NOAA and ECCC, include partners from the University of Michigan, University of Colorado at Boulder, ECCC, and NOAA's Great Lakes Environmental Research Lab.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, Canada and the United States pursued a variety of domestic projects that also support the Climate Change Annex.

United States

Stressor impacts and adaptation

- The Great Lakes Coastal Resiliency Study (GLCRS), initiated in June 2023, is a regional initiative of the eight Great Lakes States, working in collaboration with the Corps of Engineers, NOAA, USGS, Federal Emergency Management Agency and the EPA. The major tasks include basin-wide analysis of coastal risks that will help researchers investigate the range of possible future water level and ice conditions. The GLCRS will investigate opportunities to improve resilience within both the built and natural coastal environments. The GLCRS will result in a plan that identifies vulnerable areas and recommends measures to increase resilience.
- EGLE released the 2024 Michigan Healthy Climate Plan Annual Report, which highlights the implementation of the 2023 clean energy laws, investments in impactful efforts, and resilience strategies to drive public service work across Michigan communities.
- In 2023, the NOAA launched the Providers Academy to build capacity among providers (e.g., **datasets, strategies and scenarios).**

Modeling and monitoring

- **Improving Water Level Forecasting.** NOAA enhanced Great Lakes water level forecasts, extending the forecast horizon from six months to a year. This funding is being used to improve the accuracy and lead time of these forecasts, which are crucial for various sectors like commerce, recreation, and safety. The project will be managed by the Cooperative Institute for Great Lakes Research at the University of Michigan. The improved forecasts will be integrated into operational systems, such as those used by USACE.

- **NOAA Great Lakes Changing, Ecosystems, and Fisheries Initiative.** The NOAA Changing, Ecosystems, and Fisheries Initiative will establish a nation-wide decision support system inclusive of the Great Lakes to provide resource managers, fishing communities, ocean industries and other decision makers with information, tools, and advice to increase resilience to ocean conditions. This cross-NOAA effort will build decision support systems in all U.S. marine regions and the Great Lakes to better ensure resource managers, local communities, and other decision-makers have the information they need to prepare for and adapt to conditions. The decision support systems will provide early warnings and forecasts of future ecosystem conditions, to understand opportunities and risks, as well as strategies for increasing community, economic, and fisheries resilience.
- **Long-term data assimilative, temperature and currents database.** This project began in 2018 and continued through 2025 funded through the Great Lakes Restoration Initiative (GLRI). The goal of the project is to create a long-term temperature and currents database for lakes Erie and Michigan by assimilating data collected from the Synthesis, Observations and Response network, moorings and gliders into a Great Lakes forecast model. The combined data-model approach offers the most accurate three-dimensional temperature and currents reanalysis and simulations to support long term monitoring and management and restoration efforts in the Great Lakes region. Once completed, this long-term data-assimilative reanalysis will allow decision makers and coastal managers to evaluate various planning and restoration scenarios.

Meetings and Conferences

- EGLE held the Michigan Healthy Climate Conference on April 22-23, 2025, in Detroit, Michigan. The Conference drew nearly 1,000 people from all over Michigan and beyond representing local, state, and Tribal governments, universities, nonprofits etc. Attendees presented key components of the "Road to 2030". The Road to 2030 plan highlights decarbonizing maritime and lake dependent transportation, preventing aquatic invasive species, safeguarding Great Lakes fisheries, high resolution mapping of the Great Lakes lakebeds by 2030, and other critical activities.

Community-based data and portals

- **The Freeze Date Tool.** The publicly available Freeze Date Tool, developed by the USDA and Purdue University, provides historical freeze date information across regions of the Great Lakes basin and includes trends, decades, and growing season data, for other counties in the north-central and northeastern United States. The tool helps users understand freeze date patterns and potential changes over time, aiding in agricultural planning and decision-making.
- **Climate and Hazard Mitigation Planning (CHaMP) Tool v2.0.** CHaMP, co-produced by NOAA, provides users with a single point of access to county-, state- and region-specific historical hazard data and projected information. Organized around hazard themes, the tool displays metrics, hazard data, and hazard impacts in a visual format with downloadable data visualizations and tables that are accompanied by explanatory text.

Canada

Modeling, tools, resources, and analysis to improve understanding of changing climate and weather, and their effects

- The Government of Canada and the Government of Ontario make available to the public regularly updated climate and weather variables, such as wind, temperature, precipitation, evaporation, wave height, water temperature, ice cover and Great Lakes water levels. The Climate Trends and Variation Bulletin provides temperature summaries of the past season or year, presenting it in a historical context to show how recent conditions deviate from the long-term average. Ontario also shares Ontario-specific, high resolution regional climate projections.
- Natural Resources Canada's Canada in a Changing Climate is a national assessment process of how and why Canada's climate is changing; the impacts of these changes on our communities, health, environment, and economy; and how we are adapting across the country including in the Great Lakes Basin. The second foundational science assessment, Canada's Changing Climate 2026, is nearing completion. This report will be a comprehensive assessment of how Canada's climate

has changed, the causes of these changes, and what changes are projected for the future.

- The Government of Canada, in partnership with academia and industry, developed Canada1Water, the first-ever continental-scale model of Canada's complete water cycle which allows for integrated groundwater and surface water simulations to the end of the 21st century. This work includes transboundary watersheds shared by Canada and the United States. The Canada1Water Phase 1 Research and Development Report was released in 2024.
- As part of the government of Canada's National Adaptation Strategy, ECCC is creating hydrologic climate change scenarios for Canada and the transboundary region that involves setting up hydrological models and verifying them with historical data and then running them with various climate change sequences for the future. This project will result in both future hydroclimate data to be available to researchers and the public, but part of the project is also to develop methods for event attribution of flooding and droughts.
- By January 2025, 56 Flood Hazard Identification and Mapping projects continue to be implemented in Ontario including within the Great Lakes Basin. These projects are implemented in partnership between the Government of Canada, Ontario Ministry of Natural Resources and local partners and are significantly increasing flood mapping coverage along with information available for dissemination to the public.

Rainstorm in Toronto, Lake Ontario. Credit: Orchidpoet @ iStock.

Climate change communication and engagement

- The Métis Nation of Ontario (MNO) hosted a Virtual Great Lakes Climate Change Forum in February, 2025. The Forum provided Métis citizens the opportunity to connect with members of the MNO Environment and Climate Change staff, and the MNO Great Lakes Advisory Group in meaningful discussions on the far-reaching impacts of climate change. The Forum also included presentations by MNO's Environment and Climate Change Team on climate change effects on the Great Lakes, along with researchers from both York University and Fisheries and Oceans Canada on the impacts of increased ice melt to ecosystem health and climate change impacts on aquatic invasive species.

Climate change adaptation, resilience, and vulnerabilities efforts

- CWA's Great Lakes Freshwater Ecosystem Initiative combines science and action to address environmental challenges affecting Great Lakes' water quality and ecosystem health by supporting local projects. Many projects funded in 2024-25 will help communities adapt to climate change.
- Recognizing that coastal communities in Canada face more frequent and extreme climate events, Natural Resources Canada leads the Climate-Resilient Coastal Communities Program (2023- 2028). The program co-funds 21 integrated regional-scale pilot projects on Canada's three marine coasts – Atlantic, Pacific, and North – and in the Great Lakes-St. Lawrence region and the CoastAdapt toolkit. Funding was awarded to projects that are enhancing the climate resilience of coastal communities and businesses, developing and coordinating innovative adaptation actions to reduce climate change risks, working collaboratively on systems-based adaptation approaches, and developing coastal resilience guidance.
- Projects receiving funding as of 2025 in the Great Lakes area include vulnerability assessments, adaptation and resilience plans/toolkits, and pilot adaptation projects. The Climate Insight toolkit is one example of a funded project.

Annex 10: Science

Over the last 3 years Canada and the United States have continued monitoring to assess water quality and aquatic ecosystem health, guide restoration actions, and measure progress in Great Lakes protection and restoration. A comprehensive State of the Great Lakes Report was developed that assesses the overall health of the Great Lakes using a suite of ecosystem indicators. Work continued to identify ways that Traditional Ecological Knowledge (TEK) can help Annexes implement actions to assess, protect and restore the Great Lakes.

Key Achievements

- Released the *State of the Great Lakes 2025* (SOGL) report.
- Implemented the Cooperative Science and Monitoring Initiative (CSMI), which included:
  - planning and implementing field years in Lake Ontario (2023), Lake Erie (2024), and Lake Michigan (2025); and
  - developing CSMI synthesis reports for Lake Michigan (2020 CSMI), Lake Superior (2021 CSMI), Lake Huron (2022 CSMI), and Lake Ontario (2023 CSMI). CSMI results were also highlighted at the 2023, 2024 and 2025 International Association for Great Lakes Research annual conferences.
- The U.S. Caucus of the TEK Task Team assisted the Annex 2 Lake Partnerships with increasing the involvement of knowledge holders and TEK topic areas in the CSMI priorities setting process.

Purpose and Overview

The purpose of Annex 10 (Science) of the Great Lakes Water Quality Agreement (Agreement or GLWQA) is to enhance the coordination, integration, synthesis, and assessment of science activities. Science, including monitoring, surveillance, observation, research, and modeling, may be supplemented by other bodies of knowledge, such as TEK to support effective decision-making and action.

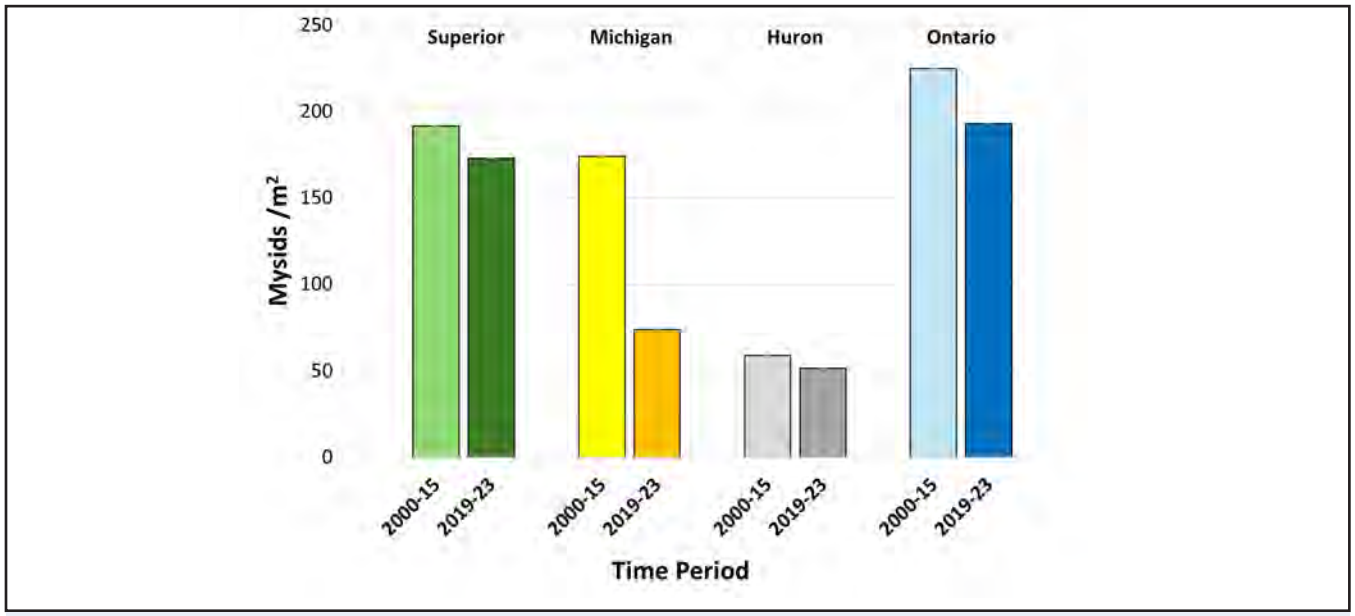
ANNEX IMPLEMENTATION

Implementation of the commitments within Annex 10 (Science) were co-led by Environment and Climate Change Canada (ECCC) and the U.S. Environmental Protection Agency (EPA), supported by an Annex 10 Subcommittee with members from Canada Water Agency (CWA); Chiefs of Ontario; ECCC; Essex Region Conservation Authority; Fisheries and Oceans Canada (DFO); Métis Nation of Ontario; Ontario Ministry of Natural Resources (MNR); Ontario Ministry of the Environment, Conservation and Parks (MECP); Natural Resources Canada; Town of Ajax; Great Lakes Indian Fish and Wildlife Commission; Indiana Department of Environmental Management; Little Traverse Bay Bands of Odawa Indians; Michigan Department of Environment, Great Lakes and Energy; Ohio Environmental Protection Agency; Ohio Lake Erie Commission; EPA; U.S. Geological Survey (USGS); U.S. National Oceanic and Atmospheric Administration (NOAA); U.S. National Park Service (NPS); U.S. Fish and Wildlife Service; Keweenaw Bay Indian Community; Wisconsin Department of Natural Resources (WDNR). Great Lakes experts from universities and other organizations also partnered to support the implementation of Annex 10 during the field year.

Binational Actions and Achievements

Priority for Action: Issue the State of the Great Lakes 2025 Report.

- Canada and the United States continue to maintain a suite of comprehensive, science-based ecosystem indicators to assess the state of the Great Lakes, anticipate emerging threats, and measure progress in relation to the GLWQA's General and Specific Objectives.
- For the 2025 reporting year, 42 sub-indicators were used to support and assess nine indicators aligned to the nine General Objectives of the GLWQA (see page x in the Introduction).
- Development of the sub-indicator reports involved more than 200 government and non-government scientists and experts who contributed to analyzing and reviewing available data. SOGL 2025 includes the consensus reached by these scientists and experts on the sub-indicator assessments.



Temporal comparison of *Mysis* population densities in the Great Lakes. With the exception of Lake Michigan which is assessed as 'Poor', *Mysis* population density in the Great Lakes is in 'Good' condition. Lake Erie *Mysis* density is not included in this figure due to scale (a small population inhabits the deep waters of the Eastern Basin, but density is typically <1 *Mysis*/m2 and would be hard to visualize on this figure).

A new *Mysis* sub-indicator was included in the SOGL 2025 reporting cycle. This native zooplankton species is an important component of the Great Lakes food web. Their abundances have increased in importance for fish diets after the decline in *Diporeia* populations.

A *Mysis*, typically 1-2 cm in length. Credit: NOAA Great Lakes Environmental Research Laboratory (GLERL).

- The SOGL 2025 report will be released on binational.net to provide an opportunity for the public to review the report and findings in advance of discussions at the 2026 Great Lakes Public Forum.

Priority for Action: In collaboration with Tribes, First Nations and Métis, increase understanding and consideration of Traditional Ecological Knowledge, including by updating, as appropriate, the Guidance Document on Traditional Ecological Knowledge Pursuant to the Great Lakes Water Quality Agreement.

- The U.S. TEK Caucus assisted the Annex 2 Lake Partnerships with increasing the involvement of knowledge holders and TEK topic areas in the CSMI priorities setting process.
- Through CWA's Great Lakes Freshwater Ecosystem Initiative and other domestic mechanisms (further discussed below under Domestic Actions and Achievements), Canada is supporting First Nations and Métis in participating in activities related to the GLWQA including participating in the Science Annex Subcommittees and other Annex Subcommittees, as well as TEK efforts.

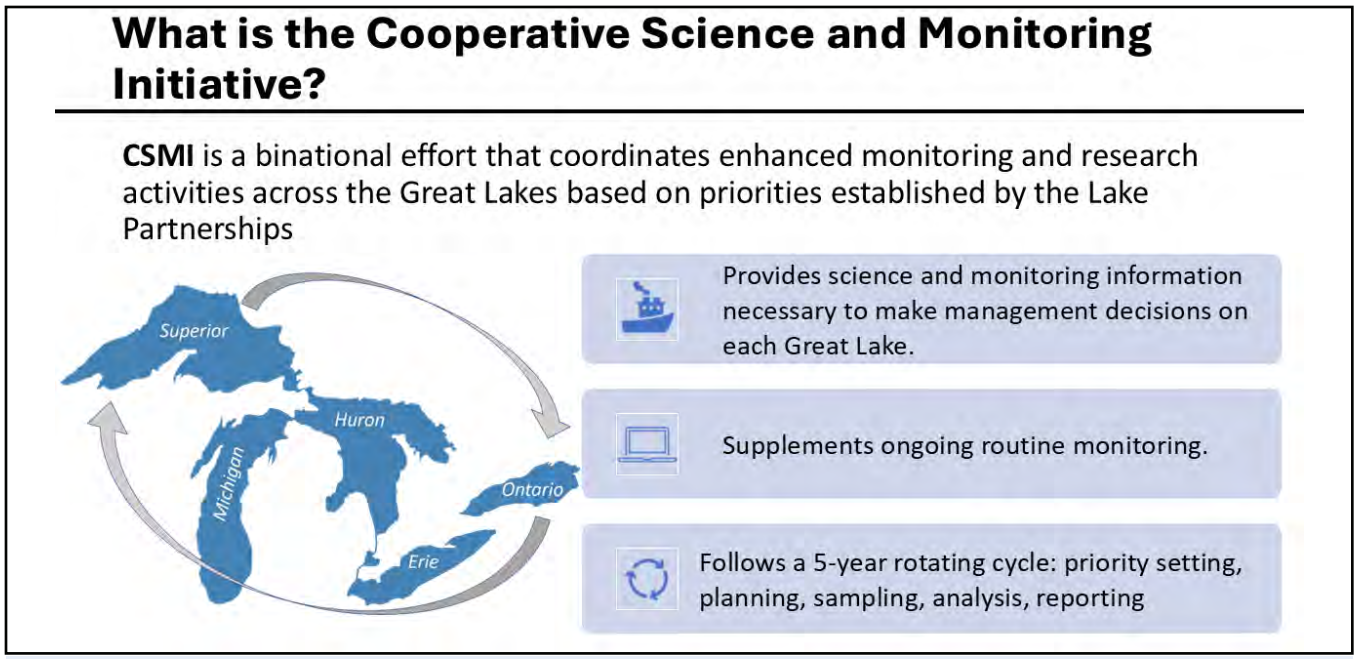
Priority for Science: Implement the binational Cooperative Science and Monitoring Initiative to coordinate planning, delivery and reporting of science in relation to the specific priorities identified through the Lakewide Management process. (Lake Ontario 2023, Lake Erie 2024, Lake Michigan 2025).

- Canada and the United States implemented the CSMI, in which each year, science and monitoring activities are coordinated binationally in one of the five Great Lakes to address the science priorities identified by the Lake Partnerships under Annex 2 (Lakewide Management).
- Ongoing Canadian and U.S. long-term monitoring programs for contaminants, water quality, nutrients, lower food web, prey fish, and fish communities help address overarching science priorities for each lake.
- The CSMI Task Team coordinated planning and implementation activities for Lake Ontario, Lake Erie and Lake Michigan intensive field years. In addition, the CSMI Task Team continued to engage with the Annex 2 Lake Partnerships to provide updates and information regarding CSMI activities, as needed. Below is an account of CSMI Task Team activities undertaken in 2023-2025 for each of these lakes.

Lake Ontario 2023 CSMI Intensive Field Year.

Multi-agency Coordinated Efforts

- Multi-agency collaborations between USGS, New York State Department of Environmental Conservation (NYDEC), and MNR continued annual prey fish population assessments (including Alewife, Deepwater Sculpin, Round Goby, Rainbow Smelt, and others).
- Multiple U.S. federal agencies (EPA Great Lakes National Program Office (GLNPO), EPA Office of Research and Development (ORD), NOAA GLERL,



Credit: EPA

USGS) and partners (DFO, Cornell University, SUNY Buffalo State University) conducted coordinated sampling to address the Lake Ontario Partnership's CSMI priorities that included the assessment of lower food web health, quagga mussel colonization extent, Lake Ontario's open water food web structure changes, and characterization of contaminant movement (e.g., mercury and PFAS movement up the food web in to fish).

Canada-led Efforts

- ECCC and MECP long term contaminant monitoring programs examined the spatial distribution of persistent bio-accumulative and/or toxic chemicals in the waters and sediments of Lake Ontario and assessed concentrations of legacy contaminants and chemicals of emerging concern in the Lake Ontario food web including prey fish, Lake Trout, Herring gulls, Double crested cormorants and Snapping turtles.
- ECCC and MECP conducted regular monitoring of select tributaries on the north shore of Lake Ontario to derive nutrient loading estimates.
- ECCC, MECP and DFO conducted coordinated monitoring of water quality in the offshore and targeted nearshore regions of Lake Ontario to assess nutrient and lower trophic level status.
- ECCC and MECP continued to monitor *Cladophora* in the nearshore waters Lake Ontario to determine the extent and drivers of benthic algal growth (e.g., nutrients, light, dreissenid mussels, etc.).
- DFO conducted coordinated sampling with partners to assess the status of zooplankton communities and measured primary production to estimate secondary production of zooplankton and mysid populations.
- DFO, MNR and partners conducted acoustic tagging of Lake Trout to assess spawning habitat use.
- MECP and ECCC continued the *Cladophora* sentinel assessment to support growth modelling in eastern Lake Erie.
- MECP and partnering agencies collected year-round and event-based data from Western basin Lake Ontario tributaries.
- MECP conducted a Lake Ontario Western Basin Nearshore Intensive Water Quality study and collected sediment, water, benthic invertebrates, phytoplankton and zooplankton samples from MECP nearshore monitoring network stations to identify temporal and spatial trends.

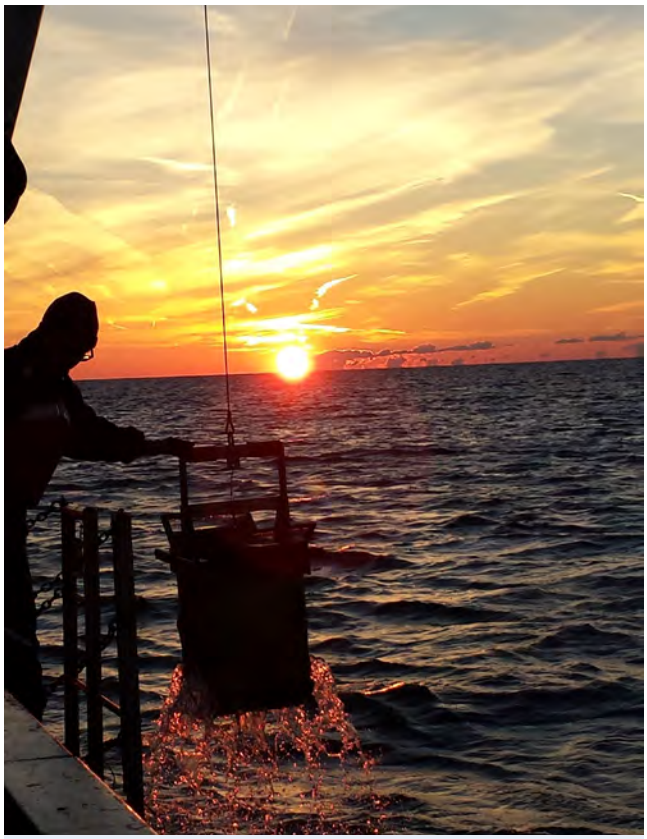
U.S.-led Efforts

- USGS and the New York State Department of Environmental Conservation conducted the Lake Ontario Nearshore Nutrient and Contaminant Study building on prior nutrient studies conducted during the 2008, 2013, and 2018 CSMIs. The 2023 study sampled nutrients, algal biomass and toxins, trace metals, organic compounds, and contaminants of emerging concern to characterize conditions in tributaries, embayments, open waters and nearshore areas. The same partners also continuously monitored quality in two embayments using sensors, enabling the calculation of daily primary production.
- Two projects carried out by U.S. federal (USGS, U.S. Fish and Wildlife Service (USFWS)) and state partners (NYDEC) studied Lake Trout spawning behavior in Lake Ontario and assessed spawning habitat distribution and use lakewide. Results are guiding research and restoration aimed at restoring a self-sustaining Lake Trout population in Lake Ontario.

Lake Erie 2024 CSMI Intensive Field Year

Canadian-led Efforts

- ECCC and MECP long term contaminant monitoring programs examined the spatial distribution of persistent bio-accumulative and/or toxic chemicals in the waters and sediments of Lake Erie and assessed concentrations of legacy contaminants and chemicals of emerging concern in the Lake Erie food web including prey fish and Lake Trout.
- ECCC, MECP and DFO conducted coordinated monitoring of water quality in the offshore and targeted nearshore regions of Lake Erie to assess nutrient and lower trophic level status. MECP continued its ongoing Great Lakes nearshore monitoring program consisting of sediment, water, benthos, phytoplankton and zooplankton sampling, thermal and optical profiles of the water column, physical characterization of the lake bottom and deployed two nearshore buoys in Lake Erie to measure dissolved oxygen, algal blooms, water temperature, and currents.
- ECCC and MECP continued to monitor *Cladophora* in the nearshore waters of eastern Lake Erie to determine the extent and drivers of benthic algal growth (e.g., nutrients, light, dreissenid mussels, etc.).
- ECCC and MECP conducted ongoing long-term connecting channel, tributary and stream water quality monitoring in Ontario to report on the current status and identify temporal and spatial trends, as part of ongoing Canadian work that aims to monitor trends of nutrients and contaminants between and through the Great Lakes.
- MECP undertook watershed modeling studies to develop a phosphorus loss (loading) model for the entire Canadian Lake Erie basin to assess the impact of several land use and land management scenarios on phosphorus loads. MECP also assessed Stormwater Management practices responsible for the phosphorus contribution in an urban sub-watershed from different diffuse source areas to identify the effectiveness of stormwater management low impact developments for the runoff water quality.
- DFO conducted an assessment of the base of the food web including estimates of primary productivity and bacterial growth in addition to microscope based assessments of the phytoplankton, zooplankton and microbial communities with an emphasis on the source and fate of nutrients, harmful algal blooms and eutrophication, hypoxia extent and impact, species susceptibility to habitat changes, trophic transfer of lower food web to higher food web, and expansion of food web models to integrate phytoplankton, zooplankton and microbial loop.
- MECP sampled the nearshore waters of Lake Erie, Lake St Clair, St Clair River and Detroit River to identify temporal and spatial trends in sediment and water quality (nutrients, organics, metals, phytoplankton, and zooplankton) and benthic community composition.
- MNR undertook a larval fish survey of west and west-central basin of Lake Erie. The information from this survey is being used to identify critical spawning areas in the lake and model larval dispersal for key fish species, like Walleye, Yellow Perch and Lake Whitefish.



Lake Erie Sediment Monitoring Program onboard the CCGS LIMNOS depicting ECCC staff collecting a mini-boxcore. Credit: ECCC/Research Support Section.

U.S.-led Efforts

- EPA-GLNPO, EPA-ORD, NOAA and their partners (Cornell University, SUNY Buffalo State University) investigated Lake Erie's lower food web health and quagga mussel colonization extent.
- To better understand the drivers of hypoxia in the central basin of Lake Erie, NOAA deployed sediment traps and collected sediment cores. Data are being used to predict the response of oxygen depletion and hypoxia to changes in phosphorus loading, organic matter deposition and decomposition, and other in-lake changes.
- To improve understanding of bloom drivers in the western basin of Lake Erie, USGS and the EPA ORD studied the contribution of direct phosphorus release from the sediment and resuspension of sediment and potential seeding of cyanobacteria from the sediment into the water column.
- USGS, USFWS and partners (University of Toledo, Toledo Zoo) conducted a study of juvenile Lake Sturgeon habitat use by tracking fish for a year after stocking in the Maumee River to fill a key gap in our understanding of sturgeon life history in Lake Erie.
- USGS and MI DNR tagged adult northern pike to identify and characterize spawning habitat in Lake St. Clair; this information will be used to protect and enhance native pike populations.
- A study by USGS and Ohio DNR analyzed catches of age-0 and age-1 fish to see how factors such as lake level, ice cover, precipitation, wind, and waves play a role in fish recruitment in the Western Basin of Lake Erie.
- Another study by USGS, Ohio DNR, and Michigan DNR studied the diet preference of walleye in their first year of life in western Lake Erie, providing insights on how diets have shifted after the establishment of invasive species and how diets impact growth and survival.
- To better understand and improve management of beach health, studies by USGS and MI EGLE monitored beaches for *E. coli* as well as additional variables including other pathogens, algal toxins, genetic markers, and benthic algae.

Lake Michigan 2025-2026 CSMI Intensive Field Year.

- USGS, USFWS, NOAA, and the Little Traverse Bay Band of Odawa Indians conducted coordinated monitoring to investigate bottlenecks that limit survival of larval lake whitefish. Using beach seines and small vessels, they sampled larval lake whitefish across sites with differing primary production and dreissenid mussel densities to identify the factors that have led to declining whitefish health.
- EPA GLNPO, NOAA, USGS and partners at SUNY Buffalo State University conducted a whole-lake benthic survey to track spatial and temporal changes in the total benthic community, including *Diporeia* and dreissenid mussels. They also assessed mussel body condition and reproductive status, to better understand mussel population dynamics in the lake.
- A project by USACE and the EPA GLNPO assessed the ecological benefits of historic sediment mound

placements in Lake Michigan, focusing on their role in supporting the lower food web and fish populations.

- USGS, EPA, USACE and the WDNR conducted monitoring to assess factors impacting the formation of harmful algal blooms in Green Bay. Sampling was conducted at multiple sites in the Lake Winnebago – Fox River – Green Bay system starting in early spring to improve our understanding of seasonal and upstream influences on HAB development.
- USGS completed sampling using new approaches to evaluate winter distribution and behavior of the invasive Round Goby, and their potential for egg predation on coregonines and deepwater sculpins.
- Collaborating with Tribal partners (Grand Traverse Band of Ottawa and Chippewa Indians, Little River Band of Ottawa Indians, Little Traverse Band of Odawa Indians), USGS conducted high resolution mapping of Tribal priority reefs for conservation and management of lake whitefish.
- USGS and the EPA ORD sampled transects to determine mercury concentrations and sources change and impact bioaccumulation in the food web across a range of nearshore to offshore habitats in Lake Michigan.
- NOAA, EPA ORD, and USGS sampled invasive mussels across Lake Michigan for PFAS contamination.

Other Binational Accomplishments

- Binational efforts are underway to understand the conditions that lead to *Cladophora* growth throughout the Great Lakes. During the *Cladophora* growth season, USGS, ECCC and MECP scientists and divers collected samples in lakes Michigan, Huron, Erie, and Ontario to examine the influence of nutrient concentrations and invasive mussels on *Cladophora* growth. ECCC, with support from MECP, developed and implemented field and laboratory protocols to assess benthic conditions. These are consistent with other binational agencies and include metrics to assess *Cladophora* and dreissenid mussel status, such as abundance, density, size distribution, and tissue phosphorus content in the eastern basin of Lake Erie and nearshore waters of Lake Ontario and Lake Huron. USGS team collected sentinel site data at transects in Lakes Michigan, Huron, Erie, and Ontario. This broad-scale, logistically complex effort is made possible with the help of multiple agency partners, including the EPA, NPS, ECCC, and state agencies. This data was used to develop the *Cladophora* assessment for the 2025 State of the Great Lakes report.
- These broad-scale studies are also leveraged for targeted research on *Cladophora* biology. Collaborations with universities yielded additional investigations to help managers understand the microbial ecology of *Cladophora* (i.e., how microbes interact with the algae to encourage *Cladophora* growth). USGS published data on the taxonomic composition of benthic algal communities; refined algorithms for benthic algae detection in autonomous underwater vehicle imagery; and is working to integrate algal observations from sentinel site, autonomous underwater vehicle transect, and satellite remote sensing scales.
- The field data will be used to populate models that can help to develop *Cladophora* management strategies to address *Cladophora* impacts. USGS, ECCC and MECP also deploy instrumented benthic frames to collect data necessary to develop and integrate nearshore and lakewide hydrodynamic and water quality models for developing *Cladophora* response to tributary nutrient inputs.
- Results were used to inform the GLWQA Nutrients Annex Subcommittee's assessment of whether current science is sufficient to warrant development of binational phosphorus load and *Cladophora* targets to meet the GLWQA Nutrients Annex Lake Ecosystem Objectives for the eastern basin of Lake Erie.
- During spring 2024, coordination between the EPA and ECCC facilitated the completion of planned monitoring activities despite delays in vessel repairs for the Canadian Coast Guard's coastal research and survey vessel, Limnos. Thanks to this binational partnership, ECCC personnel were able to join the EPA's research vessel, the Lake Guardian, to collaboratively collect samples from Lakes Erie and Superior for nutrients, major ions, metals and organic contaminants in the spring season.

- During the 2024 intensive field year for Lake Ontario, both U.S. and Canadian agencies completed lower food webs sampling as part of the Lake Ontario Lower Food Web Assessment. Scientists at the EPA, DFO, and academic partners will combine datasets from sampling efforts and collaborate to enhance our understanding of changes to the lower food web.

Domestic Actions and Achievements

In addition to the actions taken to achieve the binational priorities for science and action, Canada and the United States implemented a variety of domestic projects that also support Annex 10 (Science) commitments.

Canada

- **ECCC Monitoring.** When the Limnos was returned to service in late May 2024, ECCC completed a whole lake spring water quality survey from ECCC long-term stations in Lake Superior, and completed summer cruises on Lakes Superior, Huron/Georgian Bay, and Erie.

CCGS LIMNOS in Sarnia, Ontario, following an Upper Lakes Water Quality and Monitoring Program. Credit: ECCC/Research Support Section.

- To coincide with the CSMI field year on Lake Erie, ECCC completed lake-wide sediment collections for contaminant analyses (supporting Annex 3, Chemicals Management Plan priority chemicals, and State of the Great Lakes reporting on sediment quality status); and conducted benthic invertebrate community assessments, as part of the CWA's Great Lakes Freshwater Ecosystem Initiative, to evaluate nearshore habitat quality assessments (supporting Annex 2).
- In 2024, high-frequency water quality data from seven ECCC sensor-based monitoring stations and one water quality buoy went live on Great Lakes Observing System-Seagull. Real-time data is now available from two stations in the St. Clair River, two stations in the Niagara River, one station at the outlet of Lake Ontario (Wolfe Island), and tributary monitoring stations in the Thames and Sydenham Rivers. The western basin Lake Erie buoy (near Leamington Ontario) measures standard water quality parameters and those associated with harmful algal blooms (Chlorophyll-a, Phycocyanin, Colored Dissolved Organic Matter, etc.).

ECCC Diver performing pump wand maintenance at an ECCC Water Quality Monitoring and Surveillance in-situ sampling station in the Niagara River. Credit: ECCC/Research Support Section.

- **Great Lakes Freshwater Ecosystem Initiative (GLFEI).** CWA's GLFEI targets the most significant environmental challenges affecting Great Lakes water quality and ecosystem health by delivering on Canada's commitments under the GLWQA. To assist in achieving this goal, the GLFEI supports actions by others to restore Areas of Concern (AOC); prevent toxic and nuisance algae; restore and protect critically important coastal areas, including wetlands; reduce releases of harmful chemicals; and support community-based science. Over Fiscal Years 2023 to 2025, Canada's GLFEI funding supported numerous science-focused projects, such as:
  - Monitoring nutrient and bacterial Contamination in Chedoke and Red Hill Creek Watersheds, which flow into Cootes Paradise and the Hamilton Harbour AOC through water sampling, water quality analysis, and collaborating with the City of Hamilton and technical experts to share data and insights.
  - Tracking and assessing fish habitat use and movement patterns using acoustic telemetry at important locations across the Toronto waterfront to assess the rehabilitation of fish habitat and populations in the Toronto and Region AOC following the implementation of habitat restoration efforts.
  - Investigating how water-level changes impact coastal wetlands in Georgian Bay through a cost-effective method to assess and classify wetland vulnerability, produce maps of vulnerable wetlands and share the data with conservation groups to prioritize conservation efforts.
  - Combining data from sources across the Rouge River watershed in order to expand and connect watershed datasets with datasets from nearshore waters, which will identify priority sub-watersheds and coastal areas in need of restoration and protection actions to reduce stress on nearshore waters.
  - Investigating how mercury behaves in Lake Erie's nearshore during *Cladophora* algae blooms by working with community partners and improving ongoing monitoring efforts leading up to peak bloom periods.
  - Supporting Indigenous stewardship and monitoring to protect the Great Lakes.
  - Collecting community-based science data in various parts of the Great Lakes basin on water quality, nearshore ecosystem health and climate adaptation and resilience. The data collected is supporting research and decision-making, filling data gaps, and engaging volunteers and raising awareness of Great Lakes issues. Community-based science data informs some SOGL sub-indicators and will support future reporting.

ECCC staff working onboard the CCGL GOOSE III conducting vibracore sampling near the Randle Reef Remediation Project, Hamilton Harbour Area of Concern. Credit: ECCC/Research Support Section.

- **GLFEI-supported Indigenous led science and actions.** Between 2023 and 2025, Canada's GLFEI funding supported First Nations and Métis internal capacity building, participation in Great Lakes governance, stewardship, and monitoring to address locally significant issues. This work included:
  - Supporting First Nations' participation and involvement in decision-making related to Areas of Concern (e.g., status of specific Beneficial Use Impairments, advancing specific management strategies, remedial actions and projects, and community engagement).
  - Implementing Best Management Practices (e.g., cover crops, riparian buffers) to reduce phosphorus loads from reaching Lake Erie and transferring knowledge to Indigenous youth to ensure long-term sustainability of the project results.

— Strengthening Indigenous participation in Great Lakes science and the application of Traditional Ecological Knowledge, governance, and stewardship through multi-year funding agreements with Métis Nation of Ontario, Chiefs of Ontario, and Anishinabek Nation. The funding agreements include innovative provisions for Chiefs of Ontario and Anishinabek Nation to manage the distribution of funds to First Nations for on-the-ground projects that will focus on Great Lakes science and stewardship.

United States

- During the 2023-2025 field seasons, the EPA Research Vessel Lake Guardian traveled over 30,000 nautical miles across all 5 Great Lakes conducting long-duration, long range surveys in the open waters of the Great Lakes to fulfill EPA's statutory obligations in the Clean Water Act to monitor water quality. The Lake Guardian surveys help to (1) support an over 40-year record of water quality and biological data in all five Great Lakes; (2) assess the impacts to the lower food web from invasive species like quagga mussels; (3) inform fisheries management; (4) measure concentrations of contaminants in Great Lakes water, sediment and biota; and (5) assess the prevalence of HABs and hypoxia.
- **Understanding how Lake Winnebago and the Fox River Harmful Algal Blooms (HABs) impact Green Bay water quality.** USGS scientists monitored water quality and the composition of cyanobacterial algal blooms throughout Lake Winnebago, Fox River, and Green Bay (Lake Michigan) in Wisconsin to determine if algal blooms in Lake Winnebago are moving downstream and contributing to cyanobacterial blooms in Green Bay. The preliminary results indicate that distinct blooms form throughout the Lake Winnebago-Fox River-Green Bay corridor during the summer months, with unique influences at different locations. This helps resource managers understand drivers of HABs in Green Bay and informs best management approaches for addressing the blooms.
- **New High-Resolution Land Cover Data Available for the Great Lakes Region** NOAA's Coastal Change Analysis Program enhanced the resolution of land cover products in the Great Lakes region to a 1-meter resolution. These land cover data products are available on NOAA's Digital Coast, including impervious surfaces, tree canopy, wetland classification, and water features. These new high-resolution land cover data sets support a wide range of applications in Great Lakes communities, including flood inundation modeling, stormwater management, nature-based solutions, urban forestry, and more.

An algal bloom within a lock on the Fox River, Wisconsin, August 2024. Credit: Luke Loken, USGS.

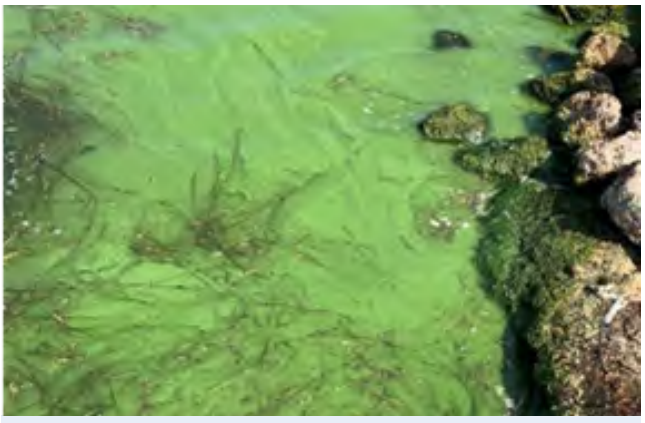
- **Tracking *Mysis* population trends across the Great Lakes: U.S.** EPA GLNPO cooperators at Cornell University recently published a study that summarized trends in *Mysis* populations across the Great Lakes over the previous two decades. *Mysis* densities and growth rates were correlated with indicators of food availability (i.e., chlorophyll and zooplankton) indicating that population trends are largely driven by processes occurring at the base of the aquatic food web. The study used *Mysis* data from USGS, NOAA, and DFO long-term monitoring programs, as well as GLNPO's Great Lakes Biology Monitoring Program, the only program that consistently monitors *Mysis* in all five Great Lakes.

Mysis sampling at night aboard the Research Vessel Lake Guardian. Credit: EPA.

- **USGS Published Updated Interactive Water Quality Dashboard for Great Lakes Tributaries.** The United States Geological Survey has released an update of their interactive water quality dashboard for 24 major U.S. tributaries of the Great Lakes. The dashboard provides map and graphical displays of status and trends in water quality variables for the period 2011 to 2023, including phosphorus, nitrogen, chloride, and suspended sediment. This information is being used to evaluate ongoing progress of nutrient reduction efforts and will be updated as information becomes available.
- **New Dashboard for Collaborative Great Lakes Benthic Habitat Mapping Project.** The new U.S. Great Lakes Collaborative Benthic Habitat Mapping Common Operating Dashboard tool shows the current status of high-resolution bathymetry data, validation data collection, and benthic habitat mapping for the nearshore waters of the Great Lakes Basin. Bathymetry data is the measurement of water depths and provides essential information for protecting the region's vital freshwater resources and aquatic habitat, identifying critical underwater infrastructure, and improving navigational safety.
- **Sand Point Phytoremediation and Stabilization project.** Keweenaw Bay Indian Community's project in collaboration with USFS and MTU began in 2025 at Sand Point. With funding from the Bipartisan Infrastructure Law and GLRI, the project will plant willows and poplars on Sand Point. Poplar and Willow trees are used because of their ability to take up heavy metals, which are present in the stamp sand of Sand Point.
- **Mapping Millions of Acres of Great Lakes wetlands.** In 2024, USFWS National Wetlands Inventory (NWI) successfully mapped more than 3 million acres of wetlands in Western Lake Erie, including the Lower Maumee River. Great Lakes wetlands are important because they protect and improve water quality, provide fish and wildlife habitats, and store floodwaters. Wetland maps are shared with the public through the NWI online wetland mapping tool. These maps are used extensively by resource managers and private property owners to plan wetland restoration projects and inform bird migration assessments.

The USFWS National Wetlands Inventory generates critical information for resource managers regarding locations and types of Great Lakes wetlands (above) to inform restoration and protection of important ecosystems. Credit: USFWS.

- **Monitoring Harmful Algal Blooms in Muskegon Lake Using Aerial Imagery.** In 2024, NOAA's Great Lakes Environmental Research Laboratory, in partnership with the Cooperative Institute for Great Lakes Research, monitored cyanobacteria Harmful Algal Blooms in Lake Muskegon using high resolution imagery (1 meter scale) taken from aircraft flyovers. Planes with hyperspectral cameras captured images of the lake twice a month during the bloom season. Images were used to alert drinking water managers and other stakeholders of the location, size, and movement of the cyanobacteria bloom. This information helps inform resource and drinking water managers.



HABs in Muskegon Lake can cause unsafe conditions for recreation activities like swimming and boating. Credit: Bopaiah Biddanda.

Conclusion

Through the Great Lakes Water Quality Agreement, Canada and the United States continue to demonstrate a shared commitment to restoring and protecting the chemical, physical, and biological integrity of the waters of the Great Lakes.

The collaborative actions described in this report reflect significant progress made under each of the Agreement's annexes and highlight the strength of binational partnerships across all levels of government, Indigenous Peoples, and local communities.

While challenges remain, the sustained dedication of Great Lakes partners provides a strong foundation for continued progress.

Building on the science, innovation, and cooperation fostered through the member agencies of the Great Lakes Executive Committee, Canada and the United States will continue to advance toward achieving the objectives of the water quality Agreement to help ensure the Great Lakes remain a healthy, resilient, and valued resource for future generations.