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2016 Progress Report of the Parties

U.S. spelling is used throughout this report except when referring to Canadian titles. Units are provided in both metric and U.S. customary units.

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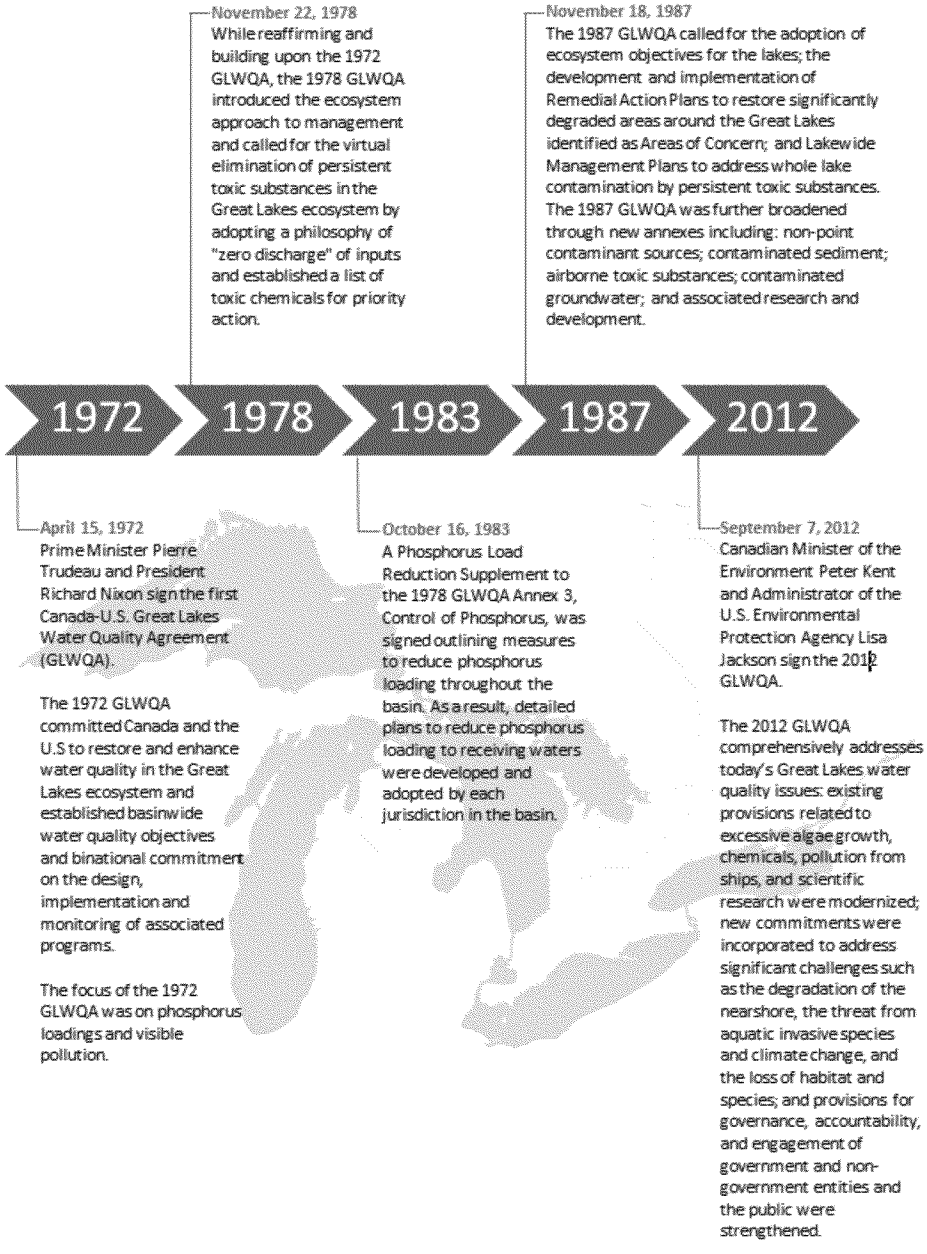
INTRODUCTION

The purpose of the 2012 Great Lakes Water Quality Agreement ("GLWQA" or "Agreement") is to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes. This Agreement between Canada and the United States (the "Parties") was first signed in 1972 and subsequently amended in 1983, 1987 and 2012. (See Figure 1 for a history of the Agreement over the years.)

Figure 1 – The history of the Great Lakes Water Quality Agreement



The 2016 Progress Report of the Parties is the first report produced pursuant to Article 5 of the 2012 GLWQA - "Consultation, Management and Review". The Report summarizes key actions taken by Canada and the United States toward meeting the commitments set forth in the Articles and Annexes of the Agreement during the 2013 to 2016 time period.

REPORTING AGAINST KEY COMMITMENTS FROM ARTICLES

Article 3: "The Parties shall publicly report, in the Progress Report of the Parties, State of the Great Lakes Report and Lakewide Action and Management Plans, on the progress in achieving the General Objectives, Lake Ecosystem Objectives and Substance Objectives."

- **General Objectives:** The 2012 GLWQA requires that Canada and the United States continue to maintain comprehensive, science-based ecosystem indicators to assess the state of the Great Lakes. As outlined in the Science Annex Chapter of this Progress Report of the Parties, the suite of indicators resulting from the State of the Lakes Ecosystem Conference (SOLEC) process (which began in 1994) was updated by the Parties to better assess and report against the General Objectives of the 2012 GLWQA. Information on the state of the Great Lakes will be presented at the Great Lakes Public Forum in October, 2016. A final State of the Great Lakes report will be available in 2017. The Parties will continue to refine indicators over time.

- **Lake Ecosystem Objectives and Substance Objectives:** The 2012 GLWQA calls for the development of lake-specific ecosystem objectives, to serve as a benchmark against which to assess status and trends in ecosystem health. The development of draft Lake Ecosystem Objectives for Lake Erie are in development.

Article 5: "The Parties hereby establish a Great Lakes Executive Committee to help coordinate, implement, review and report on programs, practices and measures undertaken to achieve the purpose of this Agreement: …"

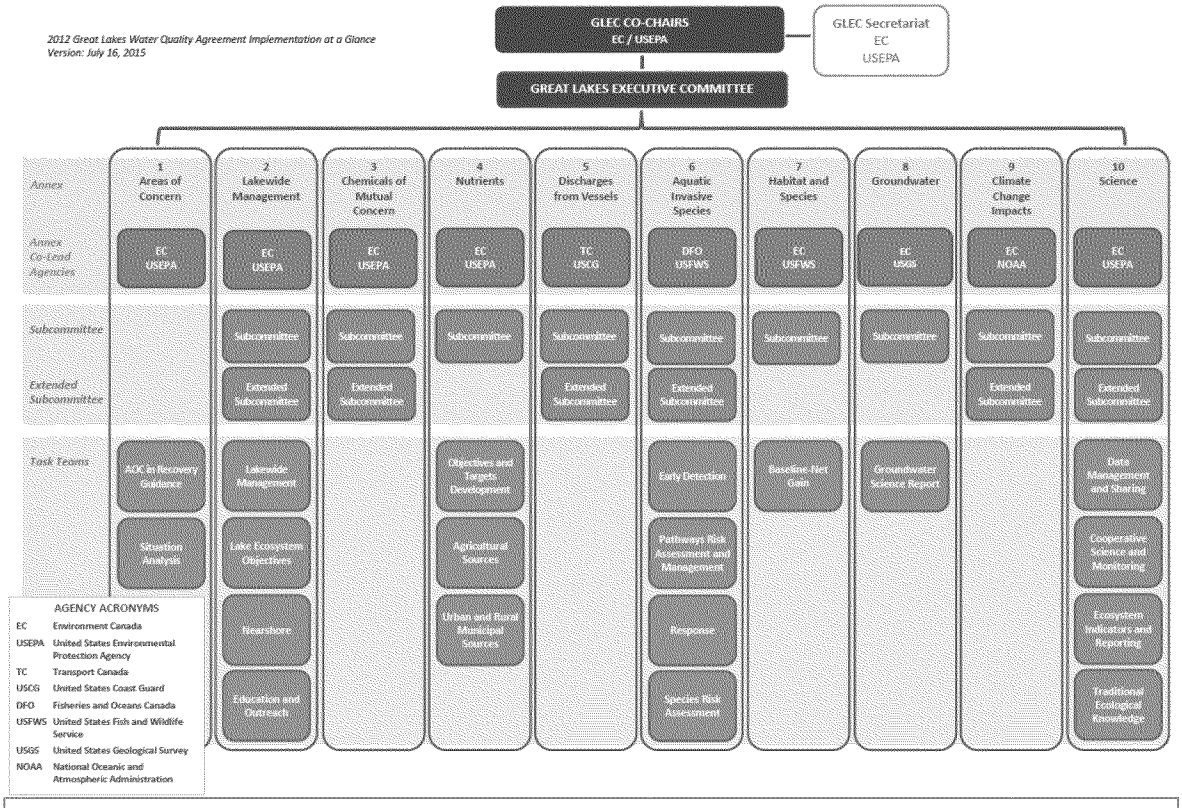
- A Great Lakes Executive Committee (GLEC) was established (with an expanded membership) to replace the former Binational Executive Committee established under the 1987 GLWQA. The GLEC includes senior-level representatives from the Canadian and U.S. Governments, state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, and other local public agencies. An inaugural meeting of the GLEC was held on December 5-6, 2012 in Toronto, Ontario. The GLEC has met biannually since then, alternating meeting locations between Chicago, Illinois, and Toronto, Ontario. Summaries of the past GLEC meetings are available at binational.net (http://binational.net/category/mtg-ru/).

- The GLEC meetings provide a forum where GLEC members can get updates from the two Parties on GLWQA implementation and also provide the Parties with advice and updates on their own GLWQA-related activities. The meetings have been instrumental in coordinating the activities of a number of departments, agencies, organizations and peoples represented in the GLEC membership. In addition, Canada and the United States have held these meetings as open meetings, attracting a large attendance from a number of observers including the Province of Quebec, the International Joint Commission, the Great Lakes Commission, the Great Lakes Fishery Commission, environmental non-governmental organizations, and members of the interested public – all of which have provided significant contributions and advice to the GLEC.

- A formal subcommittee structure has also been established to engage GLEC member organizations and others in working binationally to plan and implement actions to achieve commitments for each of the ten issue areas (Annexes) identified in the 2012 GLWQA (see Figure 2). These annex-specific subcommittees are co-led by one representative from each country. A significant amount of work

has been undertaken by each Annex Subcommittee over the first three years of the implementation of the 2012 GLWQA; this work will be discussed in subsequent Annex chapters.

Figure 2 – 2012 Great Lakes Water Quality Agreement Implementation at a Glance
[Source: http://binational.net/wp-content/uploads/2014/06/GLWQA-Subcommittees-and-Task-Teams-Chart-16Jul2015-web.pdf]



The Subcommittee, consisting of representatives from GLEC member agencies and organizations, assists the Annex Co-Leads in coordinating and undertaking activities in support of meeting commitments of the Annexes.

An Extended Subcommittee, consisting of representatives from GLEC member agencies and organizations and other entities, advises and provides guidance to the Annex Co-Leads and Subcommittee.

A Task Team, consisting of representatives from GLEC member agencies and organizations and others entities, may be established to perform specific tasks required to meet Annex commitments.

[!]

[!]

Article 5: "… the Parties to discuss and receive Public comments on the state of the lakes and binational priorities for science and action to inform future priorities and actions;"

"… the Parties shall establish, in consultation with the Great Lakes Executive Committee, binational priorities for science and action to address current and future threats to the quality of the Water of the Great Lakes, not later than six months after each Great Lakes Public Forum. The priorities shall be established based on an evaluation of the state of the Great Lakes and input received during the Great Lakes Public Forum and recommendations of the Commission;"

"…the Parties shall establish priorities, in consultation with the Great Lakes Executive Committee, for each Annex sub-committee to ensure the effective implementation of this Agreement. The Parties shall regularly update those priorities;"

- Canada and the Unites States presented binational priorities for science and action for public input at the 2013 Great Lakes Public Forum on September 9-10, 2013. These priorities are key action and science-oriented activities that are intended to focus the work planned under each of the GLWQA issue Annexes for the three-year GLWQA management cycles. Following the 2013 Great Lakes Public Forum, Canada and the United States solicited public input on the materials presented at the Forum (including the presentation of binational priorities for science and action) via a post-Forum written comment period. The 2014-2016 binational priorities for science and action were subsequently finalized and posted on binational.net (www.binational.net/2014/03/20/psa-pasa-2014) in March 2014.

- The binational priorities for science and action for 2017-2019 will be presented at the 2016 Great Lakes Public Forum for public input.

- Annex Co-Leads report on the activities and priorities of their Annex Subcommittees at each GLEC meeting. The GLEC meeting provides an opportunity for the Annex Co-Leads to discuss and seek input on their activities and priorities with a diverse group of GLEC members and observers. The GLEC Co-Chairs, who represent Canada and the United States, ultimately provide the direction on these activities and priorities to ensure the effective overall implementation of the 2012 GLWQA.

Article 5: "… the Parties shall convene, with the Commission, a Great Lakes Public Forum within one year of entry into force of this Agreement, and every three years after the first Forum."

- Canada and the Unites States held the first Great Lakes Public Forum on September 9-10, 2013 during the 2013 *Great Lakes Week*. Holding the first Great Lakes Public Forum during *Great Lakes Week* allowed Canada and the United States to take advantage of the many environmentalists, scientists, academics, government representatives, elected officials, tribal members and business leaders participating in that event, which featured an expanded week of events, conferences, meetings and networking on issues related to the Great Lakes.

- The 2013 Great Lakes Public Forum provided an opportunity for Canada and the United States to take stock of the overall health of the Great Lakes, and to celebrate the clean-up of several environmental areas of concern and other environmental accomplishments in the Great Lakes. The Forum specifically provided an opportunity for the Parties to discuss and seek public comment on the state of the lakes and binational priorities for science and action. Comments from the public were received by in-person and webinar participants, as well as through a written comment period.

- The 2013 Great Lakes Public Forum also provided an opportunity for the International Joint Commission to discuss the Parties' progress reporting and the Commission's assessment of progress. Further information on the Forum, including the agenda, and other materials are available at binational.net (www.binational.net/2013/10/01/great-lakes-public-forum-2013).

- The second Great Lakes Public Forum will be held on October 4-6, 2016 in Toronto, Canada.

Article 5: "… the Parties shall convene a Great Lakes Summit in conjunction with the Great Lakes Public Forum…"

- The Parties held a Great Lakes Summit on September 11, 2013, marking the first time that Canada and the United States convened a meeting with all of the Great Lakes-related commissions (the Great Lakes Commission, the Great Lakes Fishery Commission and the International Joint Commission) to promote coordination and increased effectiveness in the environmental management of the Great Lakes. Topics of discussion included the missions, roles and responsibilities of the Commissions in relation to the GLWQA; collaboration between the Commissions and Canada and the United States on Lakewide Action and Management Plans; coordination of the science and monitoring undertaken by Canada, the United States and the Commissions; and use of emerging tools and gap analyses in addressing excessive nutrient levels in Lake Erie.

- In addition to holding these formal Summit meetings, Canada and the United States have increased their engagement with the Commissions by: 1) holding meetings in conjunction with the biannual GLEC meetings; 2) holding other *ad hoc* meetings to discuss GLWQA-related issues; 3) by increasing communication between Commissions and the Lakewide Management Annex Co-Leads via periodic conference calls; and, 4) granting Commission participation or observation on all of the Annex Subcommittees.

- A 2016 Great Lakes Summit will occur during the October, 2016 Great Lakes Public Forum to continue the successful dialogue between Canada and the United States and the Commissions.

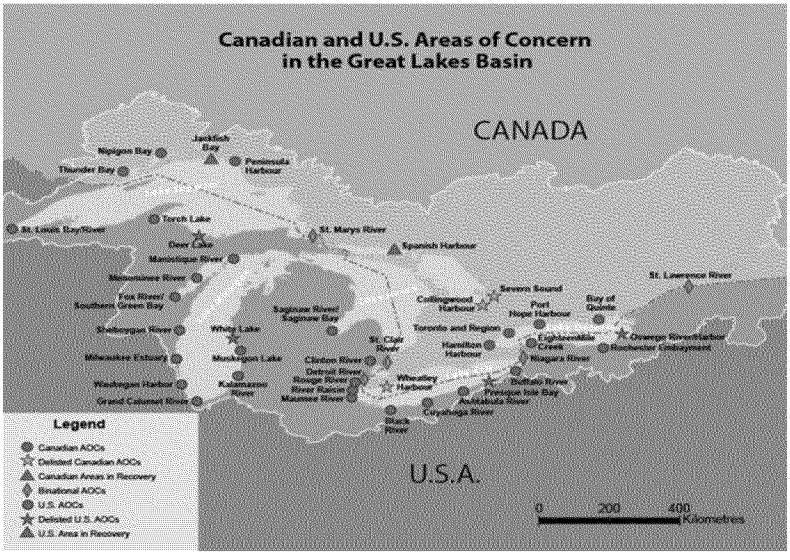
Article 6: "the Parties shall notify each other, through the Great Lakes Executive Committee, of planned activities that could lead to a pollution incident or that could have a significant cumulative impact on the Waters of the Great Lakes …"

- Canada and the United States have implemented notification procedures to identify notifications, pursuant to Article 6(c), of planned activities that could lead to a pollution incident or that could have a significant cumulative impact on the Waters of the Great Lakes. Proposed notifications are solicited from GLEC members and observers on a quarterly basis. Information of the notifications conveyed by one country to the other is available at http://binational.net/2015/05/06/notifications/.

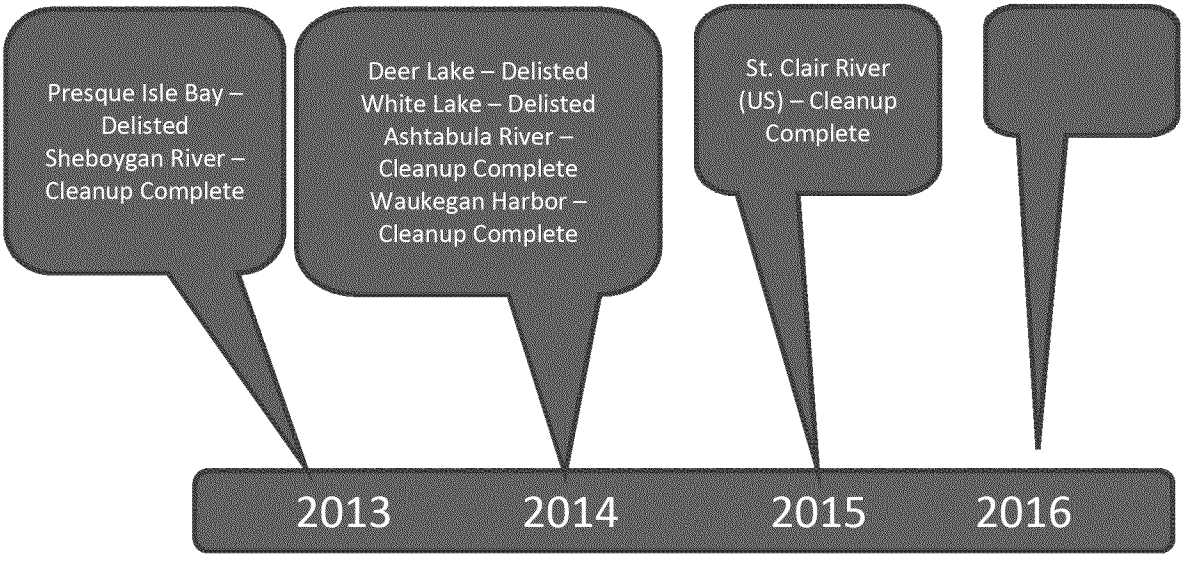
AREAS OF CONCERN ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

In the Areas of Concern Annex of the 2012 GLWQA, Canada and the United States reaffirmed their commitment to restore beneficial environmental uses at Areas of Concern (AOCs), through the development and implementation of Remedial Action Plans. Canada and the United States previously designated 43 AOCs, which are geographic areas where significant environmental impairment occurred as a result of human activities at the local level.



PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annex is co-led by Environment and Climate Change Canada and the United States Environmental

Protection Agency.

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

For both Canada and the United States, the AOC program is a mature one and efforts to restore these 43 areas have been underway for over 25 years. Working with provincial, state and local governments and community members and stakeholders, Canada and the United States have made progress in restoring beneficial uses through the implementation of Remedial Action Plans. Momentum has been building, and both sides are removing beneficial use impairments at an increasing rate. Canada and the United States also share information on approaches to AOC remediation on an ongoing basis in order to support work towards the delisting of AOCs.

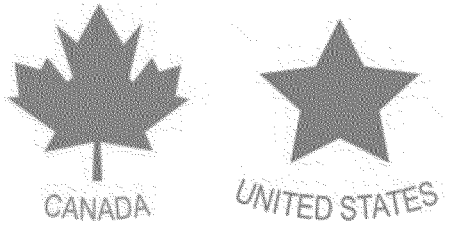
Develop AOC guidance documents to provide additional knowledge and tools to enhance and advance the restoration and delisting of AOCs

- In October 2015, a binational task team completed a document that provides guidance on the process, principles, challenges and roles and responsibilities for designating an AOC as an AOC in Recovery

Develop practices or mechanisms (such as RAP reports, lessons learned, or beneficial use impairments information) for sharing information among AOC communities and the broader public

- In April 2015, a second binational task team completed a Situation Analysis on how the AOC program is currently being implemented in the two countries, including a review and comparison of agency roles and practices, stakeholder engagement, status and processes for addressing impairments, and recommendations for enhancing program delivery.

DOMESTIC ACTIONS TAKEN



Taking an ecosystem approach and partnering with other governments, organizations and individuals, both Canada and the United States investigated environmental problems and the causes within in each AOC during the early years of the AOC program. As the name implies, Remedial Action Plans that were developed identify the corrective measures and programs needed to restore the beneficial uses and enhance water quality and ecosystem health in AOCs. Monitoring is also carried out to track environmental recovery and to assess the current status of beneficial use impairments (BUIs). The following tables show the status of BUIs in each AOC; the actions completed or initiated since 2013 for each AOC, and the remaining actions required for the removal of the AOC designation (known as delisting).

2016 PROGRESS REPORT OF THE PARTIES

ANNEX 1: AREAS OF CONCERN

2016 Status of Beneficial Use Impairments in the Canadian Great Lakes Areas of Concern

		Restrictions on fish & wildlife consumption	Tainting of fish & wildlife flavour	Degradation fish & wildlife populations	Eutrophication or other	Bird deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions on drinking water consumption, or taste and odour problems	Beach closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phytoplankton and zooplankton populations	Loss of fish & wildlife habitat	Original Total	Total Removed	Remaining Total
Thunder Bay	ON												2014			8	1	7
Nipigon Bay	ON		1995	2016	1995		2016	1995	2016			2016			2016		8	0
Jackfish Bay	ON				2010	2010		1998								8	3	5
Peninsula Harbour	ON				2012			2012								6	2	4
St. Marys River	ON					2016										10	2	9
Spanish Harbour	ON			1999		1999					1999		1999	1999	1999	9	6	3
Severn Sound	ON	2002		2002				2002	2002			2002			2002	6	6	0
Collingwood Harbour	ON	1994		1994		1994	1994	1994	1994		1994	1994		1994	1994	10	10	0
St. Clair River	ON		2011									2016	2012			9	3	6
Detroit River	ON		2014							2011	2016	2016	2011			12	5	7
Wheatley Harbour	ON	2010		2010			2010	2010	2010						2010	6	6	0
Niagara River	ON				2009	2009		1998								9	3	6
Hamilton Harbour	ON															9	0	9
Toronto and Region	ON				2011	2011	2016	2016								10	4	6
Port Hope Harbour	ON															1	0	1
Bay of Quinte	ON															10	0	10
St. Lawrence River	ON		1997			2007	2007	2007		1997		1997	1997			12	7	5
Original Total		14	4	15	8	8	15	17	10	4	11	12	5	3	16	135		
Total Removed		3	4	5	5	7	5	9	4	2	3	6	5	2	5		66	
Remaining Total		11	0	10	3	1	10	8	6	2	8	6	0	1	11			78

BUI Removed BUI Impaired

BUIs by Fiscal Year

Updated 1/29/16

AOC	State	Restriction on fish & wildlife consumption	Tainting of fish & wildlife flavor	Degraded fish & wildlife populations	Fish tumor or other deformities	Bird & 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 zooplankton	Loss of fish and wildlife habitat	Original Total	Total Removed	Remaining Total
Waukegan Harbor	IL							2014			2011				2013	6	3	3
Grand Calumet River	IN									2012			2011			14	2	12
Clinton River	MI															8	0	8
Deer Lake	MI	2014				2011			2011							3	3	0
Detroit River	MI		2013							2011						11	2	9
Kalamazoo River	MI										2011	2012				8	2	6
Manistique River	MI						2007				2010				2008	5	3	2
Muskegon Lake	MI	2013						2011		2013	2015					9	4	5
River Raisin	MI			2015					2013		2013	2012			2015	9	5	4
Rouge River	MI															9	0	9
Saginaw River & Bay	MI		2008							2008					2014	12	3	9
Torch Lake	MI				2007											3	1	2
White Lake	MI	2013		2014			2012	2011	2012	2014		2014			2014	8	8	0
St. Clair River	MI/ON		2010				2015	2011				2012	2012			10	5	5
St. Marys River	MI/ON					2014						2014				10	2	8
Menominee River	MI/WI										2011					6	1	5
Buffalo River	NY															9	0	9
Eighteenmile Creek	NY															5	0	5
Oswego River	NY	2006		2006					2006						2006	4	4	0
Rochester Embayment	NY				2015					2011			2011			14	3	11
Niagara River	NY/ON															7	0	7
St. Lawrence River	NY/ON													2015		7	1	6
Ashtabula River	OH	2014		2014											2014	6	3	3
Black River	OH															9	0	9
Cuyahoga River	OH															9	0	9
Maumee River	OH												2015			10	1	9
Presque Isle	PA				2013			2007								2	2	0
Fox River/ S Green Bay	WI															13	0	13
Milwaukee Estuary	WI															11	0	11
Sheboygan River	WI							2015								9	1	8
St. Louis River & Bay	WI/MN											2014				9	1	8
Original Total		30	7	25	18	17	27	27	18	8	20	19	4	8	27	255		
Total Removed		5	3	4	3	2	3	6	3	6	6	6	4	1	7		60	
Remaining Total		25	4	21	15	15	24	21	14	2	14	13	0	7	20			195

BUI Removed BUI Impaired

EPA-R5-2017-000200000743

Canadian Areas of Concern – Status of Actions

AOC	Sediment Cleanup / Remediation	Habitat Restoration	Municipal / industrial WW treatment	Non-point-source pollution mgmt.	Studies/ Investigations	BUI Evaluation/ Assessment	Monitoring	Year all remediation and restoration actions were or will be completed	AOC Weblink
Thunder Bay									
Nipigon Bay								2018	
Jackfish Bay									
Peninsula Harbour								2019	
St. Marys River									
Spanish Harbour									
St. Clair River									
Detroit River									
Niagara River								2019	
Hamilton Harbour									
Toronto Region									
Port Hope									
Bay of Quinte								2019	
St. Lawrence River (Cornwall)								2019	

These Canadian AOCs are delisted: Collingwood Harbour (1994), Severn Sound (2003), and Wheatley Harbour (2010)

All Actions Completed | Some Actions Completed; Future Actions Required | Future Action Required | Action to be Determined

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U. S. Areas of Concern – Status of Actions

Updated 2/19/16

AOC	State	Sediment Remediation	Habitat Restoration	Hydrologic Controls/Diversions Implemented	Safe Drinking Water Provided	Engineering Design	Studies/Investigations	Other Regulatory Action	BUI Evaluation/Assessment	Year all remediation and restoration actions were or will be completed	AOC Weblink
Waukegan Harbor	IL									2014	
Grand Calumet River	IN									2020+	
Clinton River	MI									2017	
Deer Lake	MI									Delisted 2014	http://www.epa.gov/deer-lake-aoc
Detroit River	MI										
Kalamazoo River	MI									2020+	
Manistique River	MI										
Muskegon Lake	MI										
River Raisin	MI									2016	
Rouge River	MI										
Saginaw River & Bay	MI										
Torch Lake	MI										
White Lake	MI									Delisted 2014	
St. Clair River	MI/ON									2015	
St. Marys River	MI/ON									2016	
Menominee River	MI/WI									2016	
Buffalo River	NY									2016	
Eighteenmile Creek	NY										
Oswego River	NY										
Rochester Embayment	NY										
Niagara River	NY/ON										
St. Lawrence River	NY/ON										
Ashtabula River	OH									2013	
Black River	OH									2016	http://www.epa.gov/black-river-aoc
Cuyahoga River	OH										
Maumee River	OH										
Presque Isle	PA									Delisted 2013	
Fox River/ S Green Bay	WI									2020+	
Milwaukee Estuary	WI									2020+	
Sheboygan River	WI									2013	
St. Louis River & Bay	WI/MN									2020+	

All Actions Completed

Some Actions Completed; Future Actions Required

Future Action Required

Action to be Determined

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LAKEWIDE MANAGEMENT ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

In the Lakewide Management Annex of the 2012 GLWQA, Canada and the United States committed to establishing Lake Ecosystem Objectives, developing and implementing binational strategies, and issuing Lakewide Action and Management Plans (LAMPs) and annual reports. Further, the Annex expressly required Canada and the United States to develop a Nearshore Framework by 2016. On [insert date posted], 2016, Canada and the United States issued a draft Nearshore Framework for public comment.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS

2012	2013	2014	2015	2016
• Established Lakewide Management Annex Subcommittee. • Published Lakewide Action and Management Plan (LAMP) Annual Reports. • Identified Lake Ontario Cooperative Science and Monitoring Initiative (CSMI) priorities.	• Finalized Lake Erie Biodiversity Conservation Strategy and Lake Erie CSMI priorities. • Published LAMP Annual Reports. • Identified Lake Michigan CSMI priorities.	• Identified Lake Superior CSMI priorities. • Published LAMP Annual Reports. • Confirmed LAMP/CSMI reporting rotational schedule. • Developed Lake Ecosystem Objectives guidance document. • Outreach and Engagement task team report drafted	• Published Lake Superior Biodiversity Conservation Strategy. • Identified Lake Huron CSMI priorities. • Published LAMP Annual Reports. • Completed Lake Partnership governance framework. • Completed template for LAMP report. • Engaged in consultation on draft Lake Superior LAMP. • Drafted Nearshore Framework. • Conducted outreach and engagement webinars on a basin-wide basis and for each of the individual lakes. • Initiated update of Lake Ontario LAMP	• Posted draft Nearshore Framework for public comment. • Published Lake Superior LAMP. • Formed Outreach and Engagement subcommittees for each Lake Partnership. • Published LAMP Annual Reports.

			Biodiversity Conservation Strategy Implementation Strategy.	

This Annexes' implementation is supported by the Lakewide Management Annex Subcommittee, co-led by Environment and Climate Change Canada and the United States Environmental Protection Agency. Organizations on the subcommittee include: [insert logos]

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

The Parties shall document and coordinate management actions through the development of Lakewide Action and Management Plans (LAMP) for each Great Lake.

- Having confirmed the Lakewide Action and Management Plan (LAMP) reporting rotational schedule in 2014, Canada and the United States undertook the development of the first LAMP under the 2012 GLWQA for Lake Superior. An extended period of public and agency review on the draft LAMP was undertaken.

- The Lake Superior Partnership drew upon foundational documents, including the Lake Superior Biodiversity Conservation Strategy, previously prepared with the help of many interested stakeholders.

- The Partnership assessed Lake Superior and found the lake to be in generally good condition.

- Threats to the ecosystem include chemical contaminants, aquatic invasive species, climate change, habitat destruction, and reduced habitat connectivity between the open lake and the tributaries.

- To address these threats, the 2016 LAMP identifies management actions that will help protect and restore the Lake Superior ecosystem. In addition, the Lake Superior Partnership committed to a number of projects over the next five-year period. Best efforts will be made to implement these projects (subject to available resources) through the cooperation and coordination among Lake Superior Partnership agencies.

- The LAMP also includes current science priorities for the 2016 Lake Superior Cooperative Science and Monitoring Initiative (CSMI).

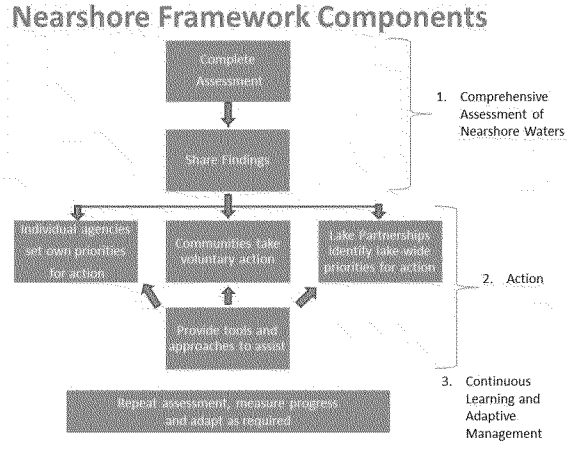
By 2016, develop an integrated nearshore framework which will, when implemented, provide an overall assessment of the state of the nearshore Waters of the Great Lakes, identify nearshore areas of high ecological value and those that are or may become subject to stress, determine cumulative effects and threats and establish priorities for action.

- At numerous places along the 10,000 mile Great Lakes coastline, nearshore conditions in the lakes have become degraded due to a variety of human-induced, climate induced, and invasive species-induced stressors.

- Canada and the United States undertook a three-year process to engage a wide range of people and organizations throughout the Great Lakes basin to develop the Nearshore Framework. The Framework was developed for the use of the government agencies that comprise the Lake Partnerships charged with developing and implementing LAMPs for each Great Lake, with significant input and participation from a variety of non-governmental stakeholders. The Nearshore Framework is a commitment made by the Parties to:
    - provide a comprehensive assessment of nearshore waters;
    - share the information from the assessment;
    - identify areas requiring protection, restoration or prevention activities; and
    - identify impairment causes and the agencies responsible for addressing them.

- The responsible agencies can then factor these findings into their priority setting processes and engage and empower communities to create collaborative approaches to addressing the identified issues and take action. Canada and the United States will provide tools and approaches to assist in these collaborative efforts.

The Great Lakes Nearshore Framework



Establish Lake Ecosystem Objectives for each Great Lake, including its connecting river systems, as a benchmark against which to assess status and trends in water quality and lake ecosystem health.

- Using direction from the 2012 GLWQA, Canada and the United States developed a guidance document for the development of Lake Ecosystem Objectives (LEOs) and a framework which links the LEOs to the Agreement's General Objectives, as well as the State of the Great Lakes Indicators.

- The guidance suggests that LEOs should:
    - be practical and attainable or achievable within a 20-year timeframe;
    - provide sufficient direction for implementing LAMP actions;
    - have support from the agencies that implement the programs used to achieve the objective;

- be based on sound, readily available data, so they can be reported on every five years; and
- taken together, be a comprehensive suite which addresses each 2012 GLWQA General Objective and lake stressor.

- A binational team was formed to draft, using the guidance, a suite of LEOs for Lake Erie.

- LEOs for the other lakes will be developed during the next reporting cycle.

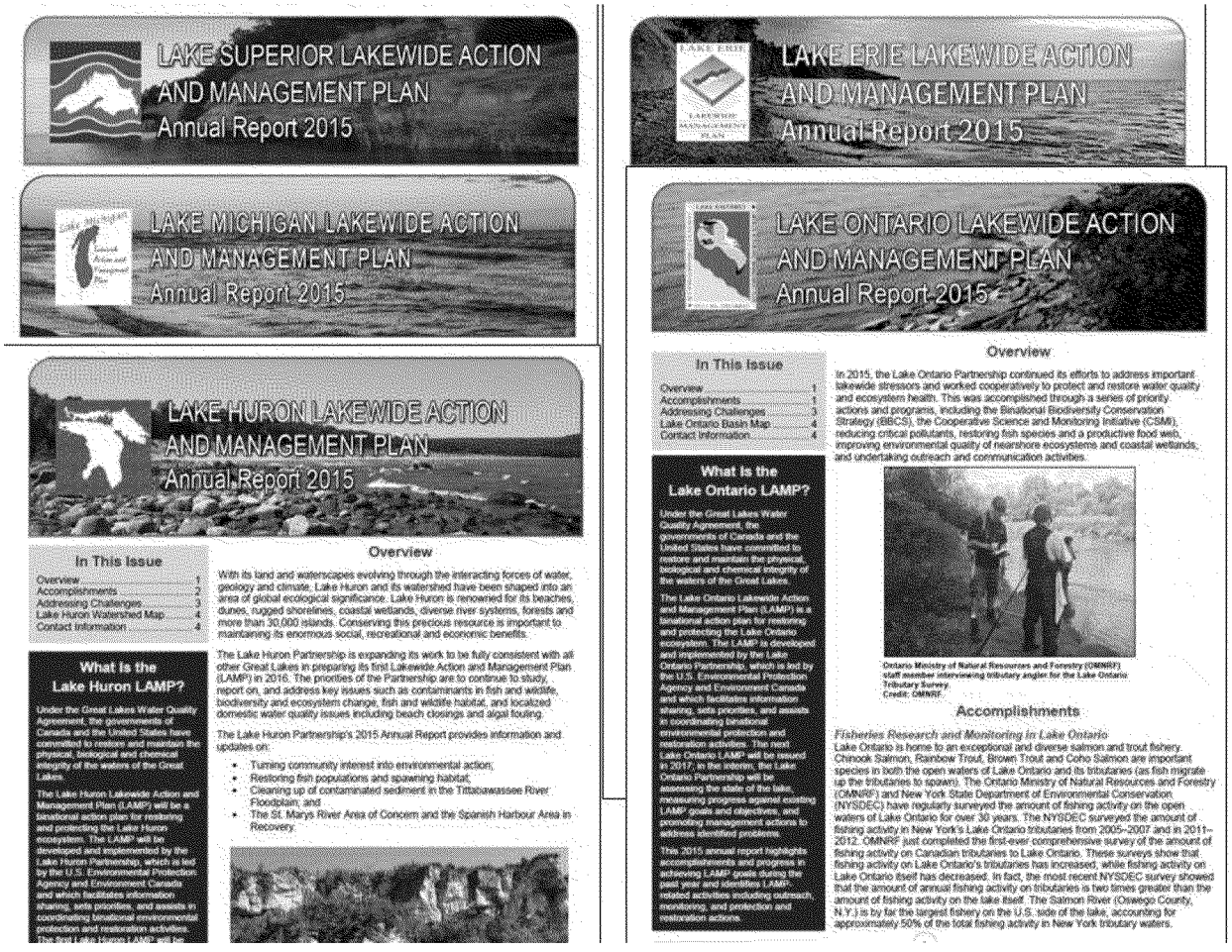
The Parties, in cooperation and consultation with State and Provincial Governments, Tribal Governments, First Nations, Métis, Municipal Governments, watershed management agencies, other local public agencies, and the Public, shall undertake the lakewide management actions.

- Canada and the United States have undertaken outreach and engagement activities through the work of the Lake Partnerships and the Annex Subcommittee.

- Recommendations and lessons learned were articulated in the Lakewide Management Annex Outreach and Engagement Task Team report in 2014.

- In 2015, eight webinars involving over 800 participants were held to update the basin-wide and individual lake stakeholder communities about progress under the Lakewide Management Annex, and to discuss possible approaches to outreach and engagement. Outreach and Engagement sub-committees were formed under each Lake Partnership to develop and implement an outreach and engagement strategy for each lake.

- LAMP Annual reports were issued to provide an overview of accomplishments and challenges facing each lake.



CHEMICALS OF MUTUAL CONCERN ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

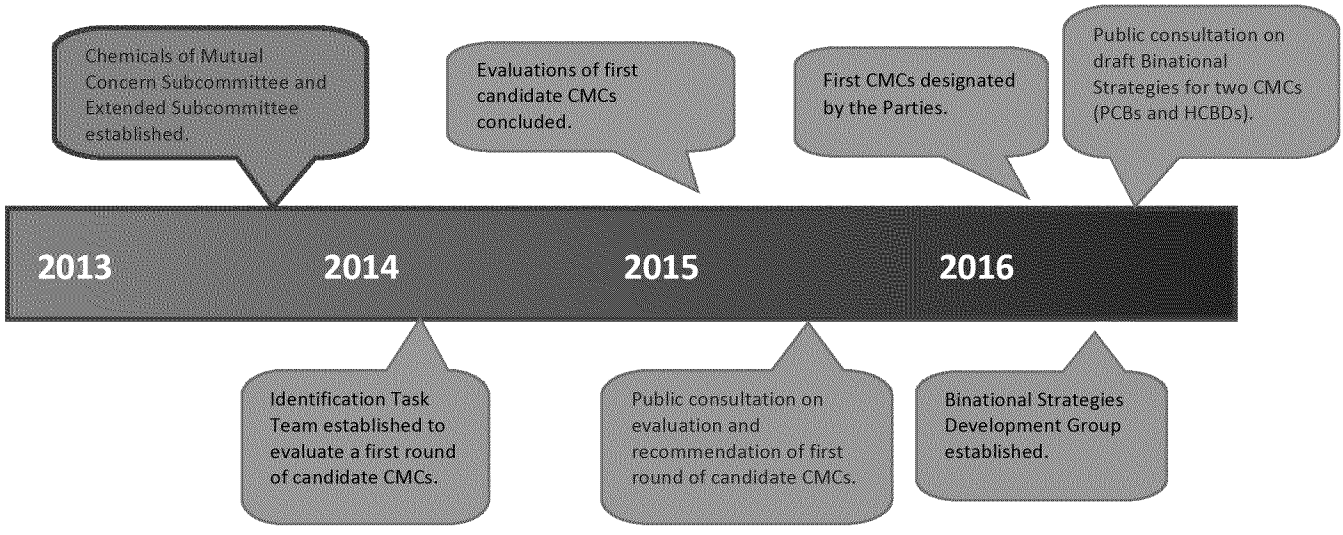
Due to the high population density and concentration of industrial activity in the Great Lakes region, as well as long-range atmospheric transport and deposition from out-of-basin sources, chemical pollution has long been a serious concern in the Great Lakes basin. As such, addressing the threats posed to the Great Lakes by chemicals in the environment has been a priority of Canada and the United States since the late 1970's. Toxic chemicals in the Great Lakes environment can harm aquatic ecosystems and negatively impact habitats and biodiversity. Some chemicals are also persistent and can bioaccumulate in the food web, potentially exposing humans through fish consumption.

The purpose of the Chemicals of Mutual Concern Annex is to contribute to the achievement of the general and specific objectives of the Agreement by protecting human health and the environment through cooperative and coordinated measures to reduce anthropogenic releases of chemicals of mutual concern (CMCs) into the waters of the Great Lakes.

Under the Annex, the Parties have committed to identify CMCs on an ongoing basis and to take specific actions for CMCs, including the development of binational strategies, which may include pollution

prevention, control and reduction actions as well as research, monitoring and/or surveillance activities.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS



The implementation of this Annex is supported by the Chemicals of Mutual Concern Annex Subcommittee, co-led by Environment and Climate Change Canada (ECCC) and the United States Environmental Protection Agency (EPA), and supported by an Extended Subcommittee with representation from non-government organizations and industry. Organizations on the Subcommittee include: [the Ontario Ministry of Environment and Climate Change (OMOECC), the Indiana Department of Environmental Management (IDEM), the Minnesota Department of Health (MDH), Wisconsin Department of Natural Resources (WDNR) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) - insert logos]

ACTIONS TAKEN FOR KEY COMMITMENTS

The Parties shall identify chemicals of mutual concern that originate from anthropogenic sources. The Parties shall mutually determine those chemicals that are potentially harmful to human health or the environment by:

1. **establishing and implementing a process by which the Great Lakes Executive Committee may recommend CMCs to the Parties. The recommendation shall include a review of available scientific information supporting the recommendation; and**

2. **considering recommendations of the Great Lakes Executive Committee and jointly designate chemicals as chemicals of mutual concern for the purposes of the Agreement.**

Binational Actions Taken

- A series of criteria, the *Binational Considerations*, were developed to evaluate candidate CMCs. Using these criteria, a first round of candidate CMCs were evaluated, with detailed reports for eight candidate CMCs posted to binational.net for public input ([insert link]). Taking into consideration

the information in the reports and input provided by the Chemicals of Mutual Concern Subcommittee, Extended Subcommittee, the Great Lakes Executive Committee and the public, on XXX, Canada and the United States designated the following eight chemicals as the first CMCs under the 2012 GLWQA:

1. Mercury;
2. Polychlorinated biphenyls (PCBs);
3. Perfluorooctanoic acid (PFOA),
4. Perfluorooctane sulfonate (PFOS),
5. Long-chain perfluorinated carboxylic acids (LC-PFCAs);
6. Polybrominated diphenyl ethers (PBDEs)
7. Hexabromocyclododecane (HBCD); and
8. Short-chain chlorinated paraffins (SCCPs)

- As a means to foster enhanced stakeholder engagement, the Parties created a process by which stakeholders, including non-government organizations, industry, academia and the public, can propose specific chemicals for consideration as potential candidate CMCs. A support document for the external nominations process is available on binational.net [insert link], which describes the information to be submitted by stakeholders in support of a nomination.

The Parties, in cooperation and consultation with State and Provincial Governments, Tribal Governments, First Nations, Métis, Municipal Governments, watershed management agencies, other local public agencies, and the Public, shall target these Chemicals of Mutual Concern for action by:

1. **preparing binational strategies for chemicals of mutual concern, which may include research, monitoring, surveillance and pollution prevention and control provisions;**

2. **coordinating the development and application of domestic water quality standards, objectives, criteria and guidelines [for CMCs]…**

Binational Actions Taken

- Draft *Binational Strategies* for two CMCs, Polychlorinated Biphenyls (PCBs) and Hexabromocyclododecane (HBCD) are being developed. Stakeholders, including the public, will contribute to the development binational strategies via specific input and review opportunities.
- These Binational Strategies may include research, monitoring, surveillance and pollution prevention and control actions for the governments of Canada and the United States and other levels of government, as well as non-government stakeholders, to consider in addressing data gaps and reducing the anthropogenic release of CMCs into the waters of the Great Lakes.
- The development of *Binational Strategies* for the remaining CMCs will subsequently be initiated and will take into account any lessons-learned while developing the first two *Binational Strategies*.
- Existing relevant Canadian and United States environmental quality guidelines for CMCs from federal and state or provincial governments are being compiled and will be made available on binational.net as Binational Strategies are developed. These guidelines are used to provide a measure of environmental progress, for example, through the State of the Great Lakes indicator

reporting. They may also be used to evaluate progress towards implementation and the effectiveness of *Binational Strategies* for CMCs.

The Parties, in cooperation and consultation with State and Provincial Governments, Tribal Governments, First Nations, Métis, Municipal Governments, watershed management agencies, other local public agencies, and the Public, shall coordinate on science priorities, research, surveillance and monitoring activities, as appropriate, including:

1. **identifying and assessing the occurrence, sources, transport and impact of chemicals of mutual concern, including spatial and temporal trends in the atmosphere, in aquatic biota, wildlife water, and sediments;**

2. **coordinate research, monitoring, and surveillance activities as a means to provide early warning for chemicals that could become chemicals of mutual concern;**

Binational Actions Taken

- Through venues such as the Cooperative Science and Monitoring Initiative under the Science Annex, monitoring of CMCs in relevant environmental media of the Great Lakes is being pursued in a collaborative and coordinated manner, whenever possible.

- This monitoring of CMCs not only supports the commitments of the Chemicals of Mutual Concern Annex, but is also critical for the development of the triennial State of the Great Lakes Indicators report, in which levels of these chemicals in the Great Lakes are reported.

- Both Parties have comprehensive national monitoring and surveillance programs, as well as regional, Great Lakes-specific programs and activities, which evaluate a broad suite of chemicals, including more recent chemicals of potential concern (e.g., organic flame retardants and perfluorinated chemicals).

Domestic Actions Taken

- The Government of Canada continues to assess and manage the risks posed by chemicals through the national Chemicals Management Plan. Under the Chemicals Management Plan, approximately 2,740 substances have been assessed, and 363 substances or groups of substances have been concluded to be toxic. For these toxic substances, 76 final risk management instruments covering 325 substances or groups of substances have been developed, and additional risk management instruments are being developed.

- All designated CMCs are listed under the Schedule 1 – List of Toxic Substances of the *Canadian Environmental Protection Act, 1999*. As such, all CMCs are subject to federal risk management in Canada, for example through the *Polychlorinated Biphenyl Regulations* and the *Prohibition of Certain Toxic Substance Regulations*. Additionally, Environment and Climate Change Canada has developed federal environmental quality guidelines or supported the development of federal-provincial guidelines, for many of the first CMCs.

- Furthermore, Canada is Party to many Multilateral Environmental Agreements aimed at globally addressing environmental and human health impacts of chemicals, some of which include the CMCs. Examples of relevant Multilateral Environmental Agreements include the Minamata Convention on Mercury and the Stockholm Convention on Persistent Organic Pollutants.

- Environment and Climate Change Canada also delivers a number of foundational water quality monitoring and surveillance activities in the Great Lakes watershed, including the Great Lakes Surveillance Program and the Great Lakes Fish Contaminant and Sediment Monitoring and Surveillance Programs, through which CMCs will continue to be monitored in the Great Lakes.

UNITED STATES

- The EPA delivers a number of foundational water quality monitoring and surveillance activities in the Great Lakes watershed, including the Great Lakes Fish Monitoring and Surveillance Program and the International Atmospheric Deposition Network.
- The EPA also has funded, and continues to fund, research on the presence, effects, and trends of emerging chemicals, including CMCs, in a variety of media through the Great Lakes Restoration Initiative and its partners. As a result of the identification of hexabromocyclododecane (HBCD) as a CMC, it has been added to the routine monitoring program of the Environmental Protection Agency's Great Lakes Fish Monitoring and Surveillance Program. These activities provide data and information to regulatory offices within the Environmental Protection Agency for consideration and incorporation into decision making processes.

- In the United States, CMCs are regulated under a combination of multiple federal, state and local statutes and regulations, depending on the source, use and release of the respective CMC. The Environmental Protection Agency generally addresses CMCs through the Toxic Substances Control Act, which seeks to address the human health and environmental impacts of chemicals in industrial use within the Great Lakes basin through a combination of voluntary and regulatory risk management activities. However, these risk management actions are taken at a national level, focusing on specific substances and their specific uses in commerce.

- As implementation of Chemicals of Mutual Concern Annex proceeds toward the development of Binational Strategies and ensuing actions, the U.S. will seek to more closely align its actions at the federal, state and local levels, to better support CMC-oriented actions that are specific to the Great Lakes basin, as appropriate.

NUTRIENTS ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

In the Nutrients Annex of the 2012 GLWQA, Canada and the United States commit to coordinating binational actions to manage phosphorus loadings and concentrations in the Waters of the Great Lakes. The Nutrients Annex requires Canada and the United States to establish phosphorus load reduction targets, allocated by country for the nearshore and open waters of Lake Erie, by 2016. Domestic Action Plans to achieve the Lake Erie targets must be developed by 2018.

On February 22, 2016, Canada and the United States adopted new phosphorus reduction targets for Lake Erie, and are now working to develop Domestic Action Plans to meet the 2018 deadline.

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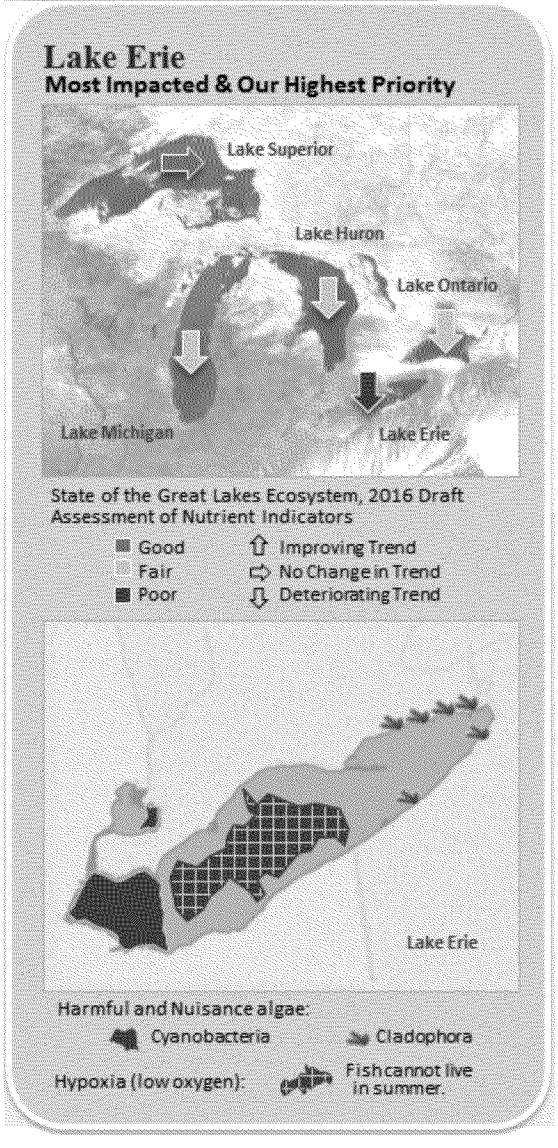
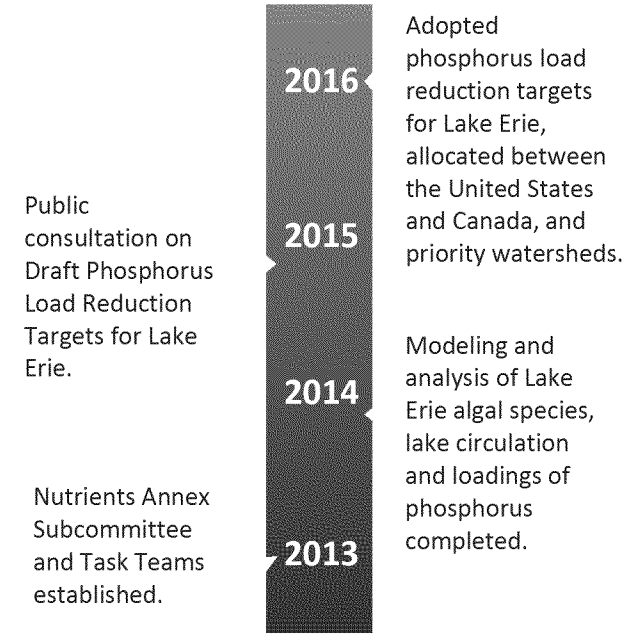


PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annexes' implementation is supported by the Nutrients Annex Subcommittee, co-led by Environment Canada and the U.S. Environmental Protection Agency. Organizations on the subcommittee include:

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

By 2016, develop binational substance objectives for phosphorus concentrations, loading targets, and loading allocations for Lake Erie.

- Following a robust binational science-based process and extensive public consultation, Canada and the United States adopted the following phosphorus reduction targets for Lake Erie on February 22, 2016 [reference table]. Further science and analysis is needed to establish targets that will minimize impacts from nuisance algae in the eastern basin of Lake Erie.

Lake Ecosystem Objectives (as outlined in the 2012 GLWQA Annex 4 Section B)	Western Basin of Lake Erie	Central Basin of Lake Erie
Minimize the extent of hypoxic zones associated with excessive phosphorus loading, particularly in Lake Erie's central basin.	40 percent reduction from 2008 levels in total phosphorus entering the western and central basins of Lake Erie to achieve an annual load of 6000 Metric Tons to the central basin. This amounts to a reduction from Canada and the United States of 212 Metric Tons and 3,316 Metric Tons, respectively.	

Maintain algal species consistent with healthy aquatic ecosystems in the Nearshore.	40 percent reduction in spring total and soluble reactive phosphorus loads from the following watersheds where localized algae is a problem: Thames River – Canada Maumee River – United States River Raisin – United States Portage River – United States Toussaint Creek – United States Leamington Tributaries – Canada	Sandusky River – United States Huron River, Ohio – United States
Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.	40 percent reduction in spring total and soluble reactive phosphorus loads from the Maumee River (United States). This equates to a target spring load of 860 Metric Tons total phosphorus and 186 Metric Tons soluble reactive phosphorus.	Not Applicable

By 2018, develop binational phosphorus reduction strategies and domestic action plans to meet the objectives for phosphorus concentrations and loading targets in Lake Erie.

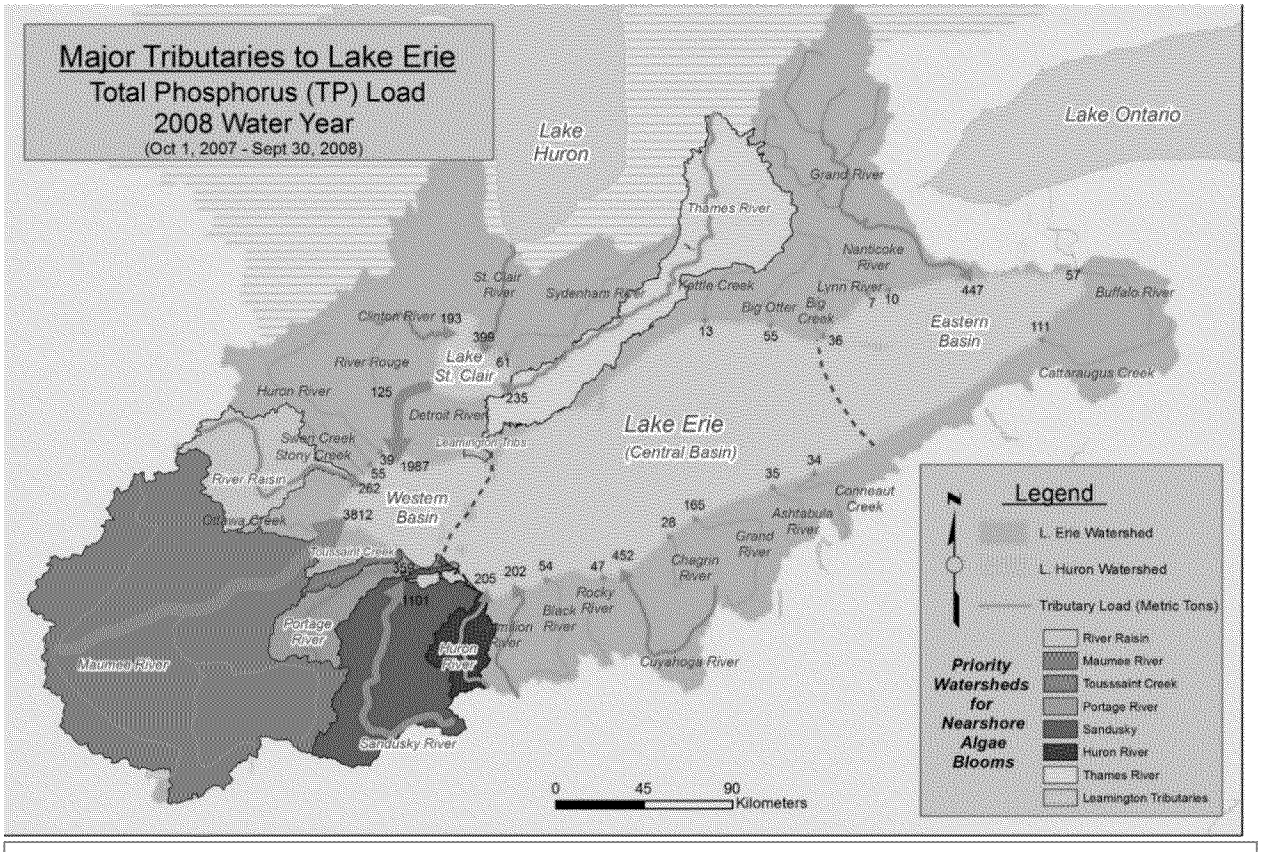
- Canada and the United States are working with multiple partner agencies, Tribes, First Nations, Métis, and stakeholders to develop a binational phosphorous reduction strategy and Domestic Action Plans. These plans will identify the actions required to meet the agreed to load reduction targets. Stakeholders are being engaged during the development process, and the draft plans will be available for further consultation in 2017.

Assess, develop, and implement programs to reduce phosphorus loadings from urban, rural, industrial and agricultural sources. This will include proven best management practices, along with new approaches and technologies.

- Ongoing efforts to limit excess phosphorus loading to the Great Lakes – through detergent bans, optimizing sewage treatment, and implementing best management practices on agricultural lands – must continue and be enhanced with better targeting and adoption. Work is underway to evaluate the existing programs in Canada and the United States, identify opportunities to maximize our phosphorus reduction efforts, and propose new programs or approaches to manage phosphorus loadings from municipal and agricultural point and nonpoint sources.

Identify priority watersheds that contribute significantly to local algae development, and develop and implement management plans to achieve phosphorus load reduction targets and controls.

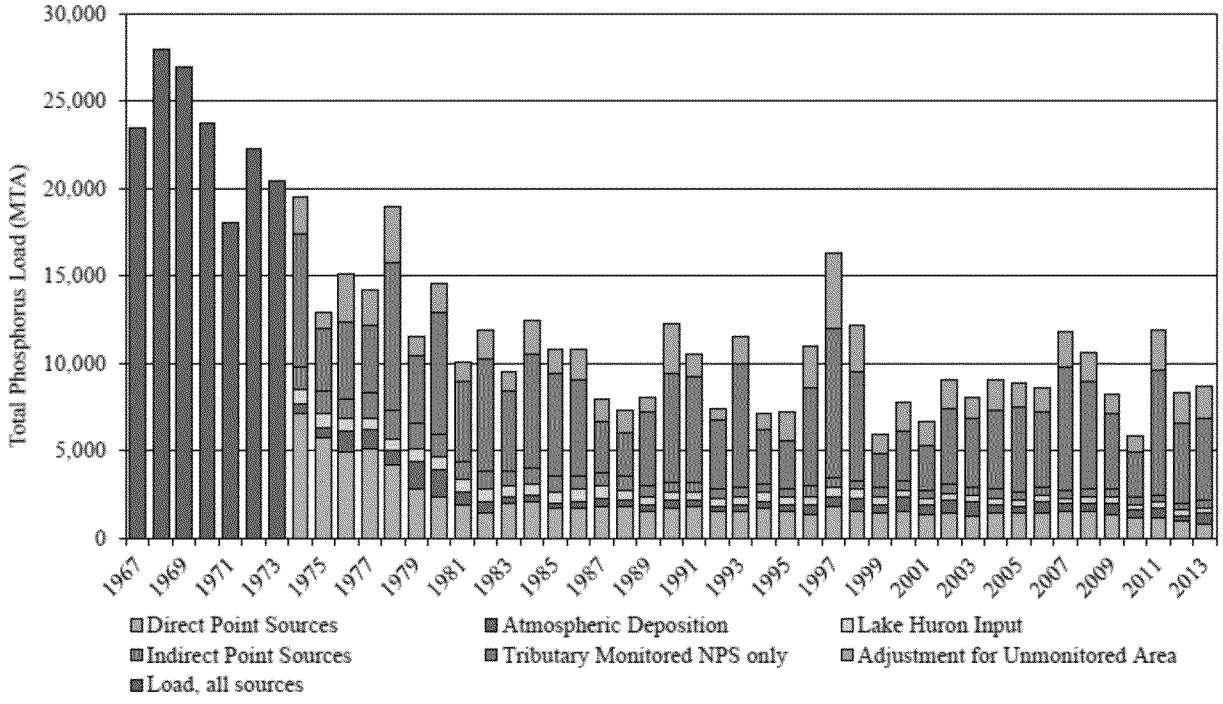
- Canada and the United States identified eight priority watersheds – two in Canada and six in the United States – for phosphorus control to address algal blooms occurring in the nearshore waters of Lake Erie [reference figure].



2008 Baseline Phosphorus loads for major tributaries to Lake Erie and the priority watersheds for nearshore blooms. Domestic action plans will further prioritize watershed implementation efforts to meet the new phosphorus load reduction goals.

Undertake and share research, monitoring and modeling necessary to establish, report on and assess the management of phosphorus and other nutrients and improve the understanding of relevant issues associated with nutrients and excessive algal blooms.

- Canada and the United States engaged several scientific experts in the development of the new phosphorus loading targets for Lake Erie, and are currently developing an approach to monitoring and tracking progress towards the new targets. The following priorities for research, monitoring and modeling have been identified:
  - Monitoring of Total Phosphorus and Dissolved Reactive Phosphorus loads;
  - Research on factors that contribute to Harmful Algal Bloom toxin production;
  - Better understanding of internal Phosphorus loads;
  - Factors controlling the growth of Cladophora; and
  - Improvement of ecosystem models to understand the relationship between external, internal Phosphorus loads and algal blooms.



Total phosphorus loads to Lake Erie by source type, 1967 – 2013.

- As shown in the above chart [reference figure], under the previous 1987 GLWQA targets, Canada and the United States tracked phosphorus loads and sources on a whole-lake basis. The new targets for Lake Erie are refined to specific locations, forms of phosphorus, and time of year. Going forward, tracking and assessments related to these new targets will need refinement and it will be critical that sufficient data are collected to evaluate implementation efforts and the Lake's response over time as part of an ongoing, science-based adaptive management approach.

DOMESTIC ACTIONS TAKEN

- In Canada, actions are being taken to manage phosphorus loads to Lake Erie through urban and rural point and non-point initiatives including ongoing infrastructure and agricultural stewardship programs. To further improve the effectiveness of current and future phosphorus management in Lake Erie, Canada and Ontario, along with their partners and stakeholders are working to review and where necessary implement changes to the existing program, policy and legislative phosphorus management frameworks. Canada's 2016 Federal Budget allocated $3.1 million in 2016 to 2017 to Environment and Climate Change Canada to continue to improve nearshore water and ecosystem

health by reducing phosphorus and the resulting algae in Lake Erie. With these resources, the focus will shift from setting phosphorus targets to achieving them, including developing a domestic action plan, and monitoring and reporting on progress.

- The United States has several permitting and funding programs to reduce phosphorus loadings from municipal, industrial and agricultural sources. For example, state environmental and agricultural programs establish discharge limits and comprehensive nutrient management plans to manage nutrient pollution. Since 2008, $314 million in Farm Bill funding has supported conservation activities on 2.5 million acres of private land throughout the Great Lakes region. In recent years, over 410 nutrient reduction projects have been implemented in the Maumee River watershed with Great Lakes Restoration Initiative (GLRI) and Nonpoint Source Program funds. A new United States Department of Agriculture Natural Resources Conservation Service initiative launched in 2016 will help landowners reduce phosphorus runoff from farms by more than 640,000 pounds each year by effectively doubling the acres under conservation in the Western basin over the course of the three-year investment.

DISCHARGES FROM VESSELS ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

The Discharges from Vessels Annex of the 2012 GLWQA commits the responsible authorities in Canada and the United States (who are identified in the annex) to prevent and control vessel discharges that are harmful to the waters of the Great Lakes.

Vessel discharges of concern under the 2012 GLWQA are the following:

a. Oil and hazardous Polluting Substances;
b. Garbage;
c. Wastewater and Sewage;
d. Biofouling;
e. Antifouling Systems; and
f. Ballast Water.

Under the 1987 GLWQA, biennial reports to the International Joint Commission from the responsible Canadian and the United States agencies consistently indicated that potential discharges of oil and hazardous substances, garbage, wastewater, ballast water and sewage from vessels are well regulated and that sufficient reception facilities are available to receive discharges ashore. These potential discharges continue to be well regulated and reception facilities to received discharges ashore are remain sufficient during the reporting period in this Progress Report of the Parties as Canada's and the United States' enforcement of their respective domestic regulatory regimes and applicable international conventions has reduced the risk of vessel discharges of concern. Continued prevention and reduction of threat of impact to the waters of the Great Lakes from all vessel discharges will continue to be the goal for the responsible authorities.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS

Discharges from Vessels Annex Subcommittee established.

Engagement efforts:

- Annual Meetings of Responsible Authorities to support implementation of the Annex;
- Public and stakeholder outreach at the Great Lakes Waterway Conferences;
- Specified stakeholder engagement under the Canadian Marine Advisory Council; and
- Coordination with the Aquatic Invasive Species Annex Subcommittee as needed.

This Annexes' implementation is supported by the Discharges from Vessels Annex Subcommittee, co-led by Transport Canada and the United States Coast Guard. Organizations on the subcommittee include: [Insert logos]

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

Oil and Hazardous Substances

- Transport Canada and the United States Coast Guard have a compatible and effective port and flag state regulatory regime[1] in place with respect to preventing the discharge of oil or hazardous substances on the Great Lakes from vessels and maritime transportation-related facilities that transfer oil or hazardous substances in bulk.

  In response to the possibility of the maritime transportation of crude or other heavy oils on the Great Lakes, Canadian and United States governments created a working group on Maritime Transportation of Hydrocarbons and their by-products. This multi-agency group, chaired by the Transport Canada and the United States Coast Guard, serves as a binational forum to facilitate discussions regarding maritime shipments of hydrocarbons and their by-products (defined initially as crude oil and associated bulk liquids) and address any concerns that may arise in a coherent and

[1] Canada's vessels inspection program is divided into two regimes: the domestic one is known as Flag State Control and the international, as Port State Control. More information about Canada's Flag State Control can be found at https://www.tc.gc.ca/eng/marinesafety/oep-inspection-psc-menu-1120.htm and more information about Canada's Port State Control can be found at https://www.tc.gc.ca/eng/marinesafety/dvro-fsc-menu-1741.htm.

consistent manner. The initial focus of this work is on freshwater, including the Great Lakes and its tributaries, and the St. Lawrence River and Seaway. A phased workplan has been developed and will focus on areas of mutual interest in preparedness, response, liability, and compensation.

[Place holder for 2-3 graphs with vessel & facility oil discharges statistics]

Garbage

- The illegal discharge of Garbage from commercial vessels in the Great Lakes continues to be a rare event. For the Great Lakes and the coasts, the majority of marine debris entering the water comes from shore side sources.

- No enforcement events for violations of the International Convention for the Prevention of Pollution from Ships Annex V (MARPOL V) or other garbage-related incidents were reported.

Reception Facilities for Garbage

- Both Parties indicate there are sufficient and adequate MARPOL V reception facilities on the Great Lakes. There has not been a validated report of an inadequate reception facility on the Great Lakes since 2006.

Wastewater and Sewage

- Several Great Lakes states have established "no discharge zones" of sewage in their respective waters in accordance with the United States Clean Water Act. Since Marine Sanitation Devices on most vessels are designed for continuous operations, it has been reported that some vessels with no or insufficient holding tanks have been forced to divert untreated sewage or treated effluent to ballast tanks to remain in compliance. Both Canada and the United States are in agreement that ballast tanks are not an appropriate place to store sewage – treated or untreated.

Antifouling Systems

- Both have regulations or policies in place implementing the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (IAFS), which ensures anti-fouling paint applied to vessels is free of tributyltin. Anti-fouling paint containing tributyltin is not available for sale on either side of the border. Both countries issue IAFS certificates to their flag state vessels and incorporate the IAFS in their respective Port State Control enforcement programs.

Ballast Water

- The risk of the introduction of aquatic invasive species (AIS) to the Great Lakes via ballast water discharges from vessels arriving from outside of Canada's Exclusive Economic Zones[2] has been

[2] In relation to the Great Lakes, the Exclusive Economic Zones stretches 200 nautical miles from Atlantic coast and

substantially reduced. Because of compatible ballast water exchange regulations between Canada and the United States and stringent binational enforcement, no new AIS attributable to the ballast water of these ships has been reported in the Great Lakes since 2006. For the past several years, the Ballast Water Working Group[3] has examined 100% of these vessels. During these ballast management exams, 100% of the vessels' ballast tanks are examined to ensure the tanks were fully exchanged or sufficiently flushed with sea water. Vessels that did not exchange their ballast water or flush their ballast tanks were required to either retain the ballast water and residuals onboard, treat the ballast water in an environmentally sound and approved manner, or return to sea to conduct a ballast water exchange. Vessels that were unable to exchange their ballast water or residuals and that were required to retain them onboard received a verification exam during their outbound transit prior to exiting the Seaway. Ballast Water Working Group verification efforts indicated that there was no non-compliant ballast water discharged in the Great Lakes. Ballast Water Working Group annual reports for the past three years can be accessed at:

- http://www.greatlakes-seaway.com/en/pdf/2014_BW_Rpt_EN.pdf
- http://www.greatlakes-seaway.com/en/pdf/2013_BW_Rpt_EN.pdf
- http://www.greatlakes-seaway.com/en/pdf/2012_BW_Rpt_EN.pdf

- Significant work is underway to move the current exchange-based programs to binationally compatible technology-based regimes that will require treatment of all ballast water to a common discharge standard and address the risk of spreading organisms. As agreed in the 2012 GLWQA, both Parties are taking into account, as appropriate, the standards set forth in the International *Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (the "BWM Convention") and its associated guidance. Canada has acceded to the BWM Convention while the United States Environmental Protection Agency, the United States Coast Guard, and the American Great Lakes States have established requirements under the *National Invasive Species Act* and the *Clean Water Act.* While there are differences between these approaches, the United States and Canada continue to work closely together – including bilaterally through annual meetings of the responsible authorities outlined in the Discharges from Vessels Annex and at the International Maritime Organization – towards maintaining compatible, fair, practicable and environmentally protective ballast water requirements in both countries.

Biofouling

Both Canada and the United States have participated in the development of the International Maritime Organization's *2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*.

DOMESTIC ACTIONS TAKEN

includes the Gulf of St. Lawrence.

[3] The Ballast Water Working Group is comprised of representatives from the United States Coast Guard, the U.S. Saint Lawrence Seaway Development Corporation, Transport Canada, and the Canadian St. Lawrence Seaway Management Corporation. Created in 2006, the group's mandate is to develop, enhance, and coordinate binational compliance and enforcement efforts to reduce the introduction of aquatic invasive species by transoceanic ships via ballast water and residuals.

CANADA

Ballast Water

- Were the BWM Convention to enter into force now, technical and regional compatibility factors would pose challenges to ships operating primarily on the Great Lakes-St. Lawrence Seaway system. As this Convention has not yet entered into force, Canada will continue to monitor these challenges and is considering options in case these challenges persist upon the Convention's entry into force. Canada remains committed to the Convention and will continue to work with the United States and other stakeholders towards compatible, fair, practicable and environmentally protective Great Lakes requirements meeting Canada's international obligations.

- Canada also continues to actively conduct ballast water research applicable to the Great Lakes. Results of a recent national risk assessment indicated that the ballast water transported by Great Lakes ships poses a high risk for spreading aquatic invasive species between ports in Canada and the United States when compared with the ballast water transported by international vessels (which are subject to regulations in both countries focused on lowering the risk of introductions from foreign ports). Further detail on this and other research projects conducted in Canada can be found in the publications listed in the annex to this report.

UNITED STATES

Oil and Hazardous Substances

- The tank barge ARGO carrying 4,762 barrels (~200K gal) of petroleum product – believed to be benzol and/or a light petroleum variant – sank in western Lake Erie during a storm in 1937. National Oceanic and Atmospheric Administration's *Remediation of Underwater Legacy Environmental Threats* report determined ARGO to be the most significant potential environmental hazard of all Great Lakes shipwrecks.

- On August 28, 2015, Cleveland Underwater Explorers (CLUE) discovered the barge ARGO approximately nine miles east of Kelleys Island and two miles south of the international border with Canada in approximately 13 meters of water. On September 8, 2015, CLUE notified the United States Coast Guard of the discovery.

- As a result of a suspected minor discharge of product from the barge, a notification under Article VI

(c) of the GLWQA was made to the Parties' Secretariats on October 24, 2015.

- Soon after the notification, a Unified Command consisting of the Ohio Environmental Protection Agency and the United States Coast Guard was established. Assisting agencies include United States Environmental Protection Agency, Ohio Department of Natural Resources, National Oceanic and Atmospheric Administration, Ohio Emergency Management Agency, Canadian Coast Guard, and Environment and Climate Change Canada.

- Over the following six weeks, the Unified Command oversaw the survey of the tank barge and preparations for the hot-tapping and removal of the product from the cargo tanks. When the operation was completed, several thousand gallons of a benzene-type hazardous substance was removed from two of the barge's tanks.

Ballast Water

- The United States Coast Guard continues to implement its 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. Five independent laboratories are in the process of testing 18 systems for type approval[4]. Numerous additional vendors have filed a Letter of Intent to begin type approval testing.

- Additionally, the Coast Guard currently has issued 56 interim Alternative Management System determinations for ballast water treatment systems and the Coast Guard expects type approval applications from several of these manufacturers. These designations are intended as a bridging strategy to allow for the use of Ballast Water treatment systems that are type-approved by foreign administrations in accordance with the International Maritime Organization Ballast Water Management Convention of 2004.

- The first four ballast water management systems (BWMSs) type approval applications submitted to the Coast Guard proposed using an alternative test method of determining the efficacy of the ultraviolet BWMSs. A subsequent Coast Guard review concluded that the alternative test method was not equivalent because it does not measure the efficacy of the BWMSs to the required performance standard required by the regulations and the BWMSs were not approved.

[4] Type Approval is the primary process for equipment and materials to receive United States Coast Guard approval. See http://www.uscg.mil/hq/cg5/cg5214/eqpt_approval.asp for further information.

AQUATIC INVASIVE SPECIES ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

Aquatic invasive species (AIS) have historically caused significant impacts to the Great Lakes Basin Ecosystem (Ecosystem), and the economies and social constructs that the ecosystem supports. The 2012 Great Lakes Water Quality Agreement (GLWQA) recognizes the need to address AIS issues, and commits Canada and the United States to: preventing the introduction of AIS; controlling or reducing the spread of existing AIS; and eradicating, where feasible, existing AIS with the Ecosystem. Canada and the United States continue to minimize risk of Asian carps and other species invading the Great Lakes by a combination of risk assessment and risk management. Since 2012, no new AIS are known to have become established in the Great Lakes.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS

This annex is being implemented by the Aquatic Invasive Species Subcommittee, co-led by Fisheries and Oceans Canada and the United States Fish and Wildlife Service. Organizations on the subcommittee include: [use logos from Fisheries and Oceans Canada, U.S. Fish and Wildlife Service, 1854 Treaty Authority, Canadian Aquatic Invasive Species Network, Chippewa-Ottawa Resource Authority, First Nation / Metis – Chiefs of Ontario, Great Lakes Indian Fish and Wildlife Commission, Great Lakes Commission, Great Lakes Fishery Commission, Great Lakes St. Lawrence Cities Initiative, Michigan Department of Environmental Quality, Minnesota Department of Natural Resources, New York Department of Environmental Conservation, Ohio Department of Natural Resources, Ontario Federation of Anglers and Hunters, Ontario Ministry of Natural Resources, Ontario Invasive Species Centre, The Nature Conservancy, U.S. Environmental Protection Agency, and U.S. National Oceanographic and Atmospheric Administration.

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

By 2015, develop and implement an AIS early detection and rapid response initiative.

- An AIS early detection and rapid response initiative was developed and is being implemented by Canada and the United States as a part of a number of strategies being applied to prevent the introduction and spread of AIS. The initiative includes several components to ensure Canada and the United States have the necessary tools to detect invaders early on, and undertake any rapid response activities to eradicate the population or to reduce further its spread:
    - An "AIS species watch list" of those species of the highest priority of risk of invading the Great Lakes.
    - A list of priority locations to undertake surveillance for the potential introduction of species on the "AIS species watch list";
    - Protocols for monitoring and surveillance methodologies (such as environmental DNA sampling and sampling using gears that collect fishes and bottom-dwelling invertebrates) so that a potential invader is promptly observed and reported;
    - The sharing of relevant information amongst the responsible departments and agencies to ensure prompt detection of invaders and prompt actions to respond to them; and
    - The coordination of plans and preparations for any response actions necessary to prevent the establishment of newly detected AIS.

- A detailed account of the achievements, to date, under the initiative is available at www.binational.net (http://binational.net/2015/02/23/ais-early-detection/).

Conduct risk assessments on AIS species and pathways for their entry into the Great Lakes.

- Efforts have begun to plan more efficient sharing, among Great Lakes jurisdictions and their partners, of species risk assessment results.
- A binational effort, to assess risks relating to Grass Carp establishment and ecological impacts in the Great Lakes, will soon be completed and published. Based on this analysis, the socioeconomic impacts of Grass Carp will be projected and these results published in the near future.
- Following completion of the Grass Carp ecological risk assessment, a binational risk assessment for Black Carp will be developed beginning in early 2016.
- Pathway risk analyses have been conducted, which are supporting management efforts to prevent the introduction and spread of AIS.
    - Historically, an average of one non-native species was found to be established in the Great Lakes about every 8 months. Most of those introductions resulted from ballast water discharge. No ballast-mediated introductions, and no additional introductions from other pathways, have resulted in establishment of a nonnative species since 2006. Thus, the risk of all pathways, including and especially ballast, has been reduced.
- A risk analysis of illegal trade and transport into Great Lakes jurisdictions was completed and a report of these findings was delivered to the Great Lakes Fishery Commission's Law Enforcement Committee. The report recommends risk management efforts to address the unacceptable risks documented for regulated (state, provincial, and federal) species in the internet, live bait, live food, aquaculture, private pond/lake stocking, water garden, aquarium/pet, and cultural release pathways. The AIS Subcommittee will continue to work with the Law Enforcement Committee to

address risk management needs described in the risk analysis report.

- In the United States, pathway risk reduction of AIS transport in recreational boats is being pursued. A partnership with government and industry is working toward objectives of developing new U.S recreational boat design standards for building new "AIS-Safe Boats" and U.S. standards for AIS removal from existing recreational boats.
- In Canada, the National Recreational Boating Risk Assessment is being conducted.

Other outreach and engagement undertaken in support of meeting various annex commitments.

- An inventory, of outreach activities conducted by Great Lakes agencies and their partners was completed, which will help guide future efforts to enhance existing outreach programs and help guide development of additional programs designed to focus on human-mediated pathway risks not effectively addressed by existing outreach programs.
- [Input from Gavin]

DOMESTIC ACTIONS TAKEN

[Placeholder for CDN input]

Conduct risk assessments on AIS species and pathways for their entry into the Great Lakes.

- Approximately 160 non-native species risk assessments were conducted by the United States, and have been posted on www.fws.gov (http://www.fws.gov/fisheries/ANS/species_erss_reports.html), with additional species risk assessments to be undertaken and posted. Climate matches for these species a show degree of establishment risk in the Great Lakes basin, if those species are introduced in numbers large enough to establish self-sustaining populations.
- The risk of barge shipping-related transport of fishes, within the Chicago Area Waterway System, was evaluated, and the resulting report delivered to the Asian Carp Regional Coordinating Committee.

Conduct research to develop and test AIS detection, containment, and control technologies.

- Work was initiated on the development and testing of a near-real-time environmental DNA (eDNA) surveillance tool in order to support Law Enforcement efforts relating to illegal transport of Asian carp species into Great Lakes jurisdictions.
- The use carbon dioxide as an environmentally sound approach to help contain Asian carps in the Mississippi River system was tested. Results show promise of this containment technology at reducing the risk of Asian carps spread
- Work was initiated on the development and testing of a system to deliver a piscicide (Antymicin), into waters containing Bighead and Silver Carps, so that non-target environmental impacts are not significant. This technology could be used to reduce populations in the Chicago Area Waterway System and Illinois River, to minimize risk of establishment in the Great Lakes.

Assessment of the potential impacts of climate change on AIS.

- A climate change projection tool was developed that can project the AIS climate niche, within the Great Lakes basin, under climate change scenarios published by the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/) in the years 2050 and 2070.

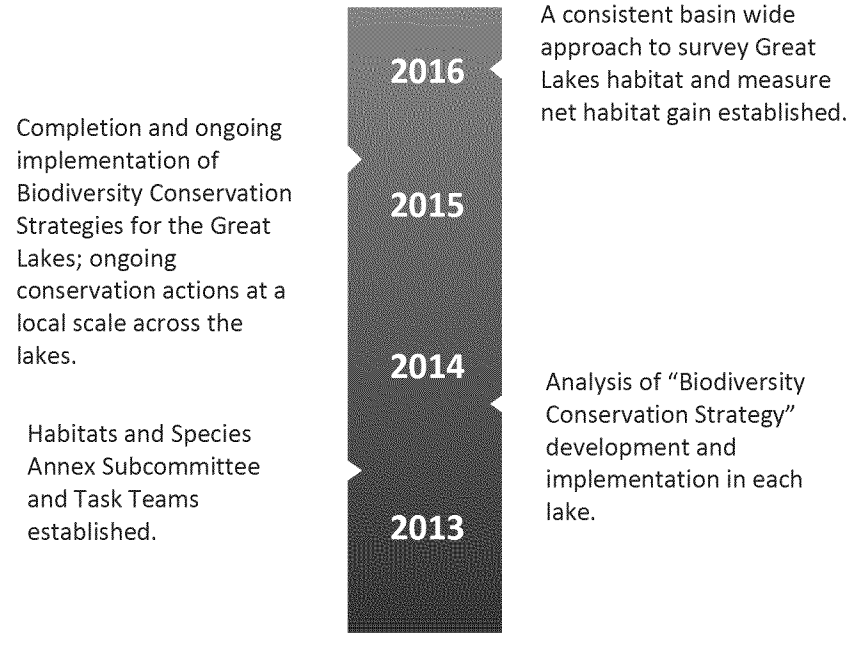
HABITATS AND SPECIES ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

In the Habitat and Species Annex of the 2012 GLWQA, Canada and the United States commit to conserving, protecting, maintaining, restoring and enhancing the resilience of native species and their habitats, as well as supporting essential ecosystem services in the basin.

The Habitats and Species Annex requires Canada and the United States to implement several commitments to address the health of Great Lakes habitats and species, including: 1) conducting a baseline survey against which to establish a target of net habitat gain and to measure future progress; 2) completing the development and implementing lakewide species conservation plans; 3) assessing gaps in current programs and initiatives, facilitating and strengthening both binational and domestic programs; and 4) increasing awareness of habitat and species and methods to conserve, protect and enhance their resilience.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annexes' implementation is supported by the Habitat and Species Annex Subcommittee, co-led by Environment and Climate Change Canada and the United States Fish and Wildlife Service. Organizations on the subcommittee include: [insert logos]

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

By 2015, complete the binational Biodiversity Conservation Strategies for all lakes, including connecting channels.

Begin implementation of priority actions identified in the Biodiversity Conservation Strategies through existing programs and agreements.

- Lakewide habitat and species protection and restoration conservation strategies, also called Biodiversity Conservation Strategies (Strategies), were developed for all five of the Great Lakes as of February 12, 2015. The Strategies assess the status and threats to lakewide biodiversity and recommend conservation priorities for native species and their habitats. The Executive Summaries are available on binational.net (www.binational.net/2015/02/23/habitat-and-species-strategies).

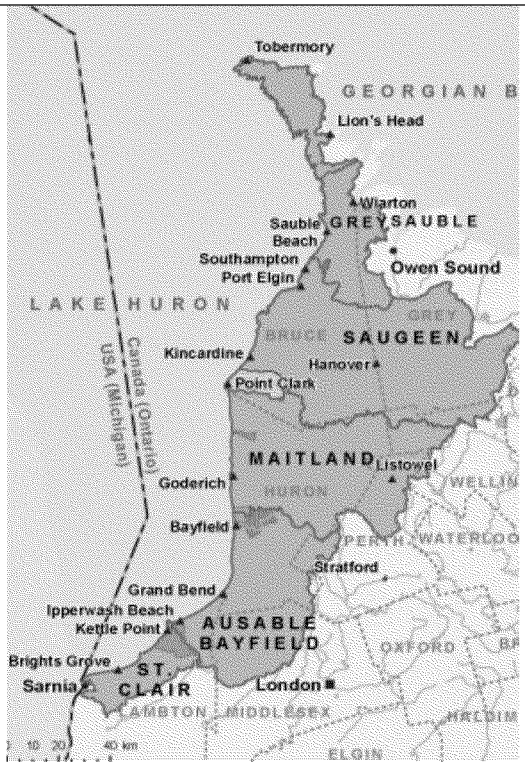
- Each Strategy is a product of extensive collaboration among lakewide regional and local stakeholders. They serve as a tool to foster and guide a shared implementation of priority conservation actions among federal, state, provincial, tribal, academic, municipal and watershed management agency representatives. Across the lakes there is strong support for the adaptive management approach in the planning, application and implementation of the Strategies.

- The Lake Superior Partnership is currently in the process of preparing watershed-level plans to further guide and support implementation of the recently released Strategy at a local level. The Lake Ontario Partnership used the broader Lake Ontario Biodiversity Strategy to produce an implementation plan to focus on and implement priority actions within the 2012 GLWQA mandate. Other Lake Partnerships are identifying regional (or watershed based) biodiversity objectives and outlining the specific actions required to address these issues on a more manageable scale.

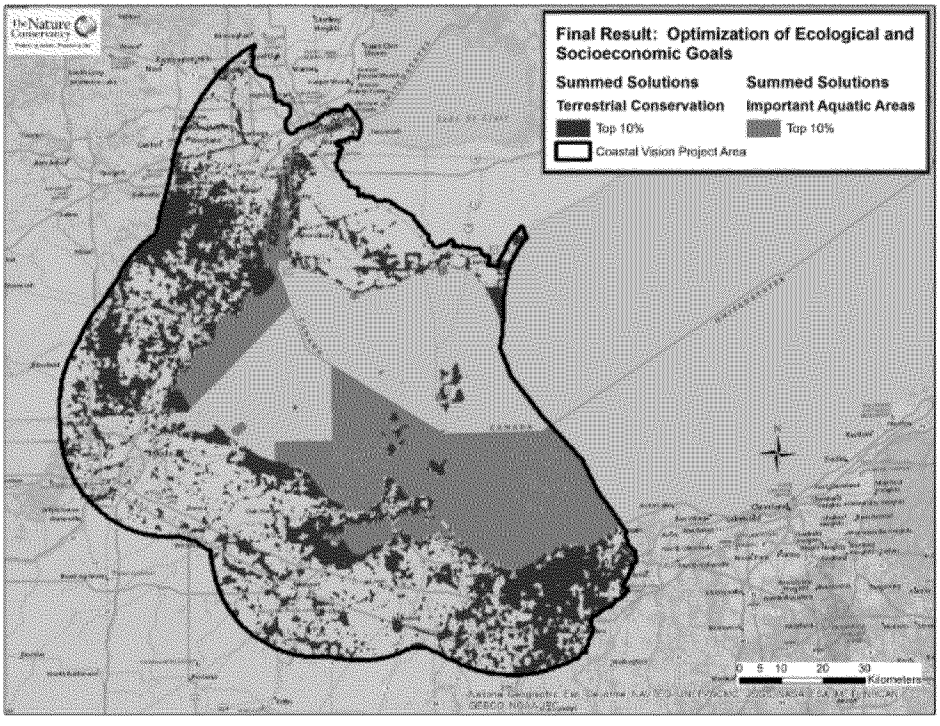
Begin implementation of priority actions identified in the Biodiversity Conservation Strategies through existing programs and agreements.

- The table below [reference table] illustrates several examples of how the Strategies are being used in each lake basin to inform and implement priority conservation actions.

Lake Huron: Healthy Lake Huron Healthy Lake Huron is a team of dedicated environmental professionals who coordinate actions aimed at improving overall water quality along the southeast shores of Lake Huron. They are taking actions to address the issue of non-point source pollution, which has been identified as a critical threat in their Biodiversity Conservation Strategy.	

	 Membership of the Healthy Lake Huron group (www.healthylakehuron.ca)
Lake Superior: Superior Streams The Lake Superior Biodiversity Conservation Strategy classified dams and barriers as a high threat to meeting biodiversity targets. As a preliminary step in addressing this threat a team of specialists using geospatial technology from Lakehead University in Ontario is leading an effort to compile the relevant data and develop a decision support tool to aid in decision-making on the matter.	 The Black Sturgeon Dam on the Black Sturgeon River, Ontario (Photo Credit: Ontario Ministry of Natural Resources)

Lake Ontario: Bloater Fish Stocking In Lake Ontario, the Lake Partnership identified the restoration of native preyfish species as a priority for implementation of the Biodiversity Conservation Strategy and the Canadian and United States agencies initiated a program to reintroduce bloater to the lake in 2012. The program is ongoing, and nearly 62,000 bloaters were released in November, 2015.	 Dale Hanson from the Green Bay Fish and Wildlife Conservation Office assists with bloat egg collection (Photo Credit: United States Fish and Wildlife Service)
Lake Michigan: Lake Herring Restoration Restoration of the native Lake Herring is a priority identified in the Lake Michigan Biodiversity Conservation Strategy. To help restore the species to its historical status as a primary prey fish in Lake Michigan, the Little Traverse Bay Bands of Odawa Indians released nearly 50,000 summer fingerling and 8,000 fall fingerling into Little Traverse Bay, Michigan, in 2014. The Little Traverse Bay Bands of Odawa Indians is currently evaluating the success of the fingerling releases.	 Lake Herring (Photo Credit: United States Environmental Protection Agency)

Lake Erie: Western Basin Conservation Vision Targets and goals from the Lake Erie Biodiversity Conservation Strategy were used in the development of a regional implementation plan called the Western Basin Conservation Vision. This plan identifies and maps areas to focus local conservation investments to meet regional conservation goals.	 Final Results of the Optimization of Ecological and Socioeconomic Goals (http://nature.ly/WLEcoastalvision)

"…conduct a baseline survey of the existing habitat against which to establish a Great Lakes Basin Ecosystem target of net habitat gain and measure future progress…"

- An approach to measure baseline conditions of habitat and monitor change over time was developed with support from engaging experts and partners around the lakes through a series of binational workshops, meetings and webinars. This approach is built upon existing Great Lakes monitoring programs and emphasizes the use of remotely sensed information for maximum data coverage. The physical characteristics of the lakes will be used to map habitat types and the condition of the habitat will then be assessed. The baseline survey will be conducted on a reoccurring basis to track changes in the ecosystem over time and monitor progress. The approach will undergo further refinement and implementation will follow.

- This effort also supports the other Habitats and Species Annex 2014-2016 binational priorities for science to investigate tools and techniques that can assist with priority identification, and explore ways to incorporate the concepts of resilience, adaptive management and climate change adaptation strategies into efforts to conserve and protect native species and their habitat.

DOMESTIC ACTIONS TAKEN

CANADA

- Canada has multiple existing federal and provincial programs which contribute to the ongoing goals of the Habitats and Species Annex, including programs run by Parks Canada, Environment and Climate Change Canada's Wildlife Service and the Ontario Ministry of Natural Resources and Forestry. In addition, there are many non-governmental partners making significant contributions to habitat and species conservation, including the Nature Conservancy of Canada, Conservation Ontario and the many individual Conservation Authorities in the province, the Ontario Federation of Anglers and Hunters, Ducks Unlimited, and Stewardship Councils.

UNITED STATES

- In the United States, multiple federal and state agencies, as well as local and regional conservation entities, non-governmental organizations, and myriad conservation partners conduct a wide range of activities related to fish and wildlife and habitat. Many of these activities support directly or indirectly goals and priorities of Habitats and Species Annex. In addition to base-funded activities conducted by federal agencies, the Great Lakes Restoration Initiative (GLRI) has boosted funding in recent years to supplement agency budgets to allow them to pursue high priority conservation and restoration needs throughout the Great Lakes Basin, including fish and wildlife habitat. Federal agencies conduct GLRI-funded activities themselves and also provide GLRI funds to other partners to conduct activities identified in the GLRI Action Plan II, which expressly references the broad goals and commitments in the 2012 GLWQA.

GROUNDWATER ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

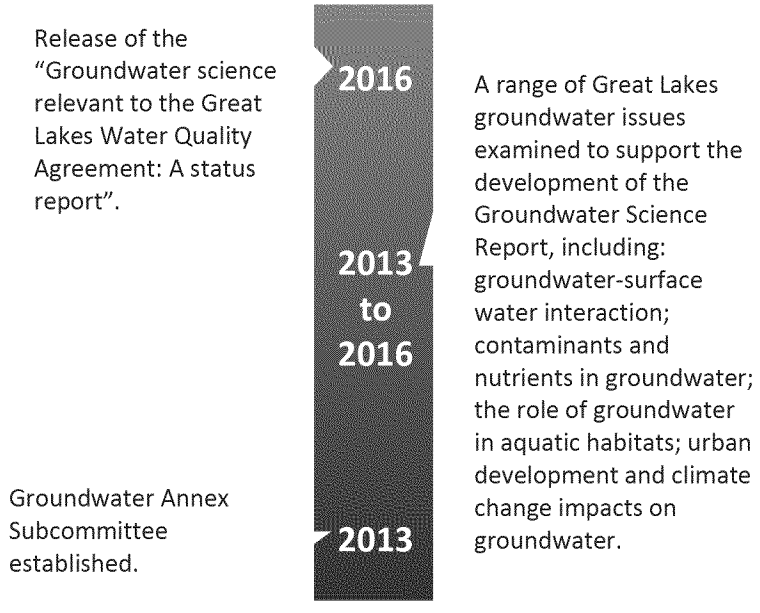
OVERVIEW

The Groundwater Annex of the 2012 GLWQA recognizes the interconnection between groundwater and the Waters of the Great lakes. Understanding the extent of the impact that groundwater has on the chemical, physical and biological integrity of the Great Lakes is important for the long-term protection of the Great Lakes.

It is for this reason that the Groundwater Annex commits Canada and the United States to coordinate scientific assessments of groundwater to better understand how groundwater affects surface water quality and quantity; and also commits Canada and the United States to coordinate groundwater management actions to protect and manage groundwater-related stresses affecting the Waters of the Great Lakes.

As a first step, Canada and the United States released an initial report on the relevant and available groundwater science in XX, 2016.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS



[Possibly include image of cover page of GW Science Report.]

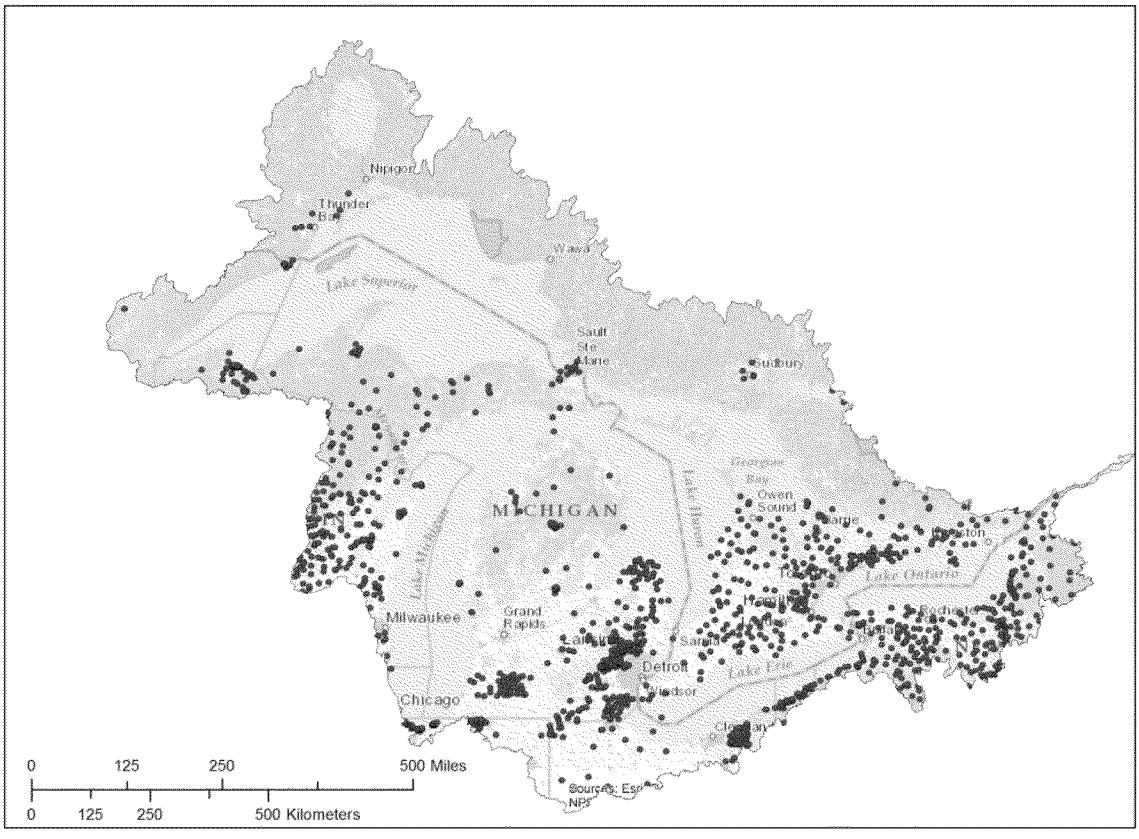


Figure x - Locations of monitoring wells in the Great Lakes Basin with publicly available water quality analyses

The implementation of this Annex is supported by the Groundwater Annex Subcommittee, co-led by Environment Canada and the U.S. Geological Survey. Organizations on the subcommittee include:

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

Within two years of entry into force of this Agreement, publish an initial report on the relevant and available groundwater science.

Identify groundwater impacts on the chemical, physical and biological integrity of the Waters of the Great Lakes; analyze contaminants, including nutrients in groundwater, derived from both point and non-point sources impacting the Waters of the Great Lakes; assess information gaps and science needs related to groundwater to protect the quality of the Waters of the Great Lakes; and analyze other factors, such as climate change, that individually or cumulatively affect groundwater's impact on the quality of the Waters of the Great Lakes.

- An initial report on the relevant and available Great Lakes groundwater science was

published and released for public comment on December 3, 2015. The report titled, "Groundwater science relevant to the Great Lakes Water Quality Agreement: A status report", available on http://binational.net/2015/12/03/groundwater-science/, provides the current state of science on groundwater and its relation to Great Lakes water quality by examining various issues such as: 1) the importance of groundwater-surface water interaction and interconnection; 2) contaminants and excessive nutrients in groundwater; 3) the influence of groundwater in providing aquatic habitats with a focus on Great Lakes nearshore areas, streams, and wetlands; and 4) the influence of urban development and climate change on groundwater quantity and quality. The Report also summarizes the major science gaps and needs. This report provides a better basis and understanding of the issue of groundwater in the Great Lakes and its influence on the quality of the Waters of the Great Lakes; helps assess whether groundwater improves or adversely impacts Great Lakes water quality; and supports future groundwater science and management actions.

Identify priorities for science activities and actions for groundwater management, protection, and remediation, to achieve the General and Specific Objectives of this Agreement; and

Coordinate binational groundwater activities under the GLWQA with domestic groundwater programs to assess, protect and manage groundwater impacting the waters of the Great Lakes.

- Information from the Groundwater Science Report, including the science gaps and needs, will be used to draft the 2017-2019 Binational Groundwater Priorities for Science and Action, which will be presented for public input at the Great Lakes Public Forum in October, 2016.

- Discussions with other Annex Subcommittees will soon be undertaken to inform these 2017-2019 Binational Priorities; to determine if there needs to be a focus on coordinating specific binational groundwater activities; and to determine the need for surveillance of groundwater quality for priority areas.

DOMESTIC ACTIONS TAKEN

CANADA

Assess information gaps and science needs related to groundwater to protect the quality of Waters of the Great Lakes.

- In March 2015, the Ontario Geological Survey and Geological Survey of Canada hosted a Groundwater Geoscience Knowledge GAP Analysis session for southern Ontario clients. Session participants identified 30 individual groundwater geoscience knowledge gaps which include: i) communications, ii) standards and protocols, iii) water quality and geochemistry, iv) surface and groundwater interaction, v) geology and hydrogeology, vi) climate change and vii) data management and dissemination.

Identify groundwater impacts on the chemical, physical and biological integrity of the Waters of the Great Lakes.

- The Ontario Geological Survey continues to develop an improved understanding of provincial groundwater resources that establishes the data and information needed to assess the impacts of groundwater on the Waters of the Great Lakes. In particular, the ambient groundwater geochemistry project has created a water quality database that is being evaluated for potential use in the development of a groundwater indicator under the guidance of the Science Annex Subcommittee.

- Environment and Climate Change Canada is currently assessing the role of groundwater as a source of nutrients (phosphorus and reactive nitrogen) to surface waters of Southeastern Georgian Bay and the Nottawasaga River. This work is being supported by the Lake Simcoe / Southeastern Georgian Bay Clean-up Fund.

UNITED STATES

Identify groundwater impacts on the chemical, physical and biological integrity of the Waters of the Great Lakes.

- The U.S. Geological Survey is continuing studies of selected areas of the Great Lakes basin to evaluate the effects of land use and flow path on groundwater quality which, in turn, impact the Waters of the Great Lakes as groundwater interacts with surface water.

- The State of Michigan has developed a water withdrawal assessment tool that evaluates the effect of large water withdrawals, including groundwater, on fish habitat in streams. The assessment tool has been used in Michigan for several years and is being evaluated by a few other Great Lakes states for possible implementation. Understanding the effects of groundwater withdrawal on stream habitat is an important consideration under the 2012 GLWQA.

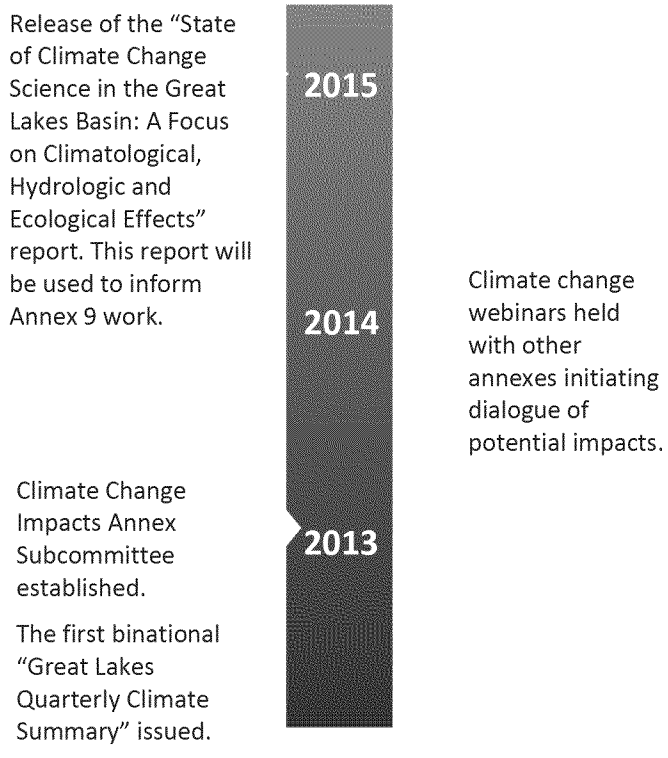
- [Placeholder: the "new" project by The Ohio State University (Audrey Sawyer) funded by the Ohio Sea Grant on "Quantifying the effects of surface water-groundwater interaction on dissolved phosphorus loads to Lake Erie."]

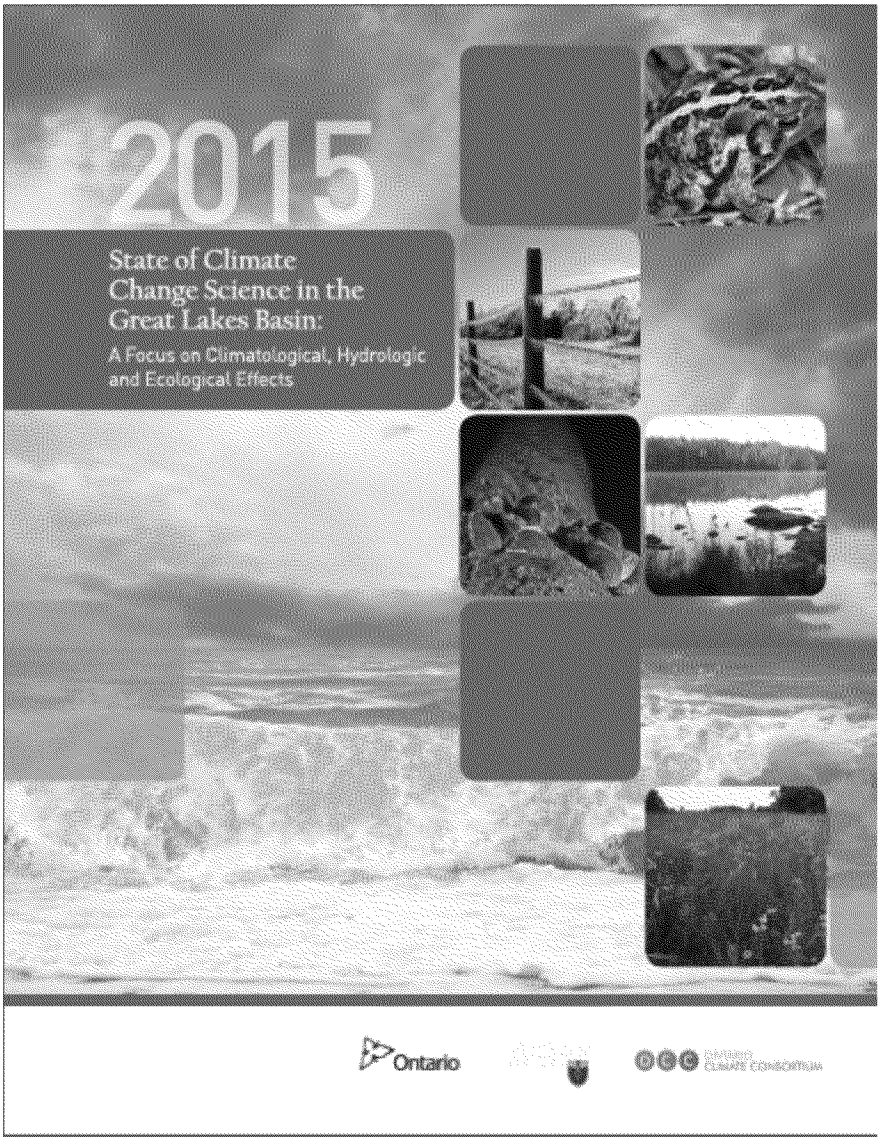
CLIMATE CHANGE IMPACTS ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

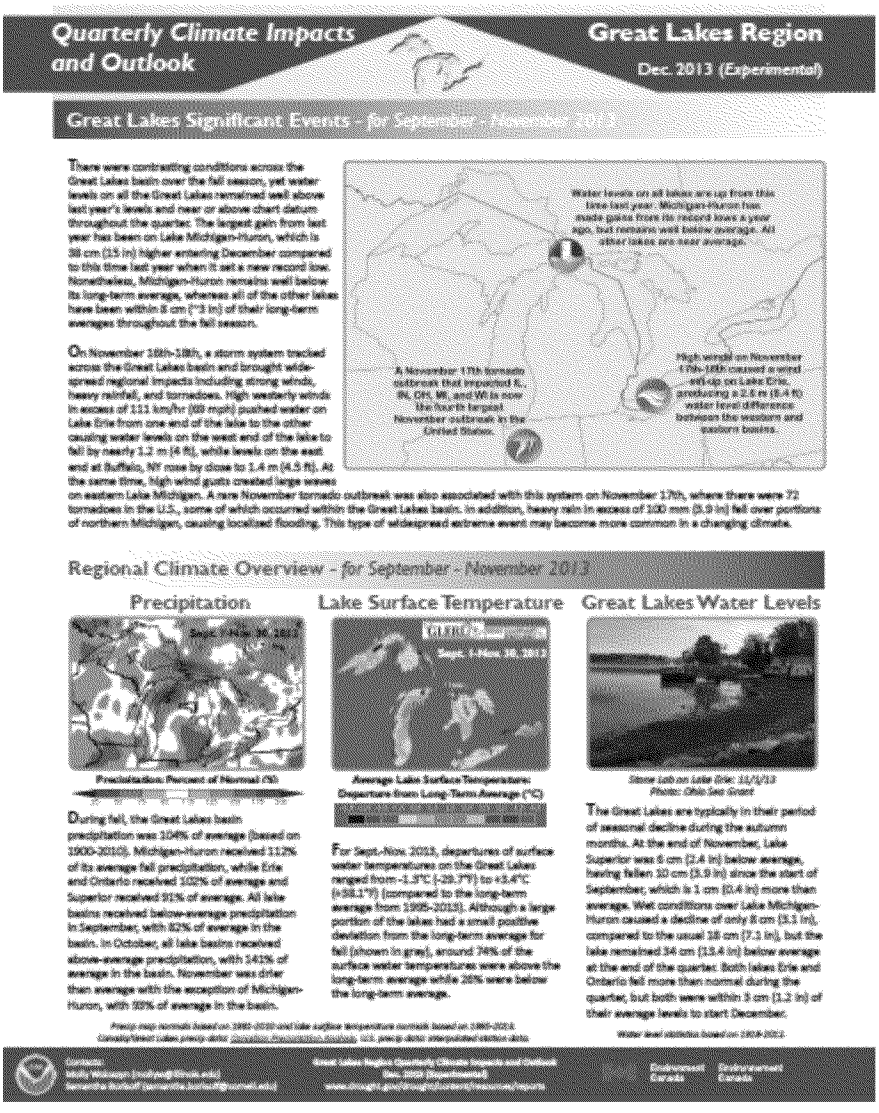
OVERVIEW

Recognizing that climate change has an impact on the quality of Waters of the Great Lakes, Canada and the United States incorporated a new annex in the 2012 GLWQA to address this issue, through which both governments commit to coordinate efforts to identify, quantify, understand, and predict the climate change impacts on the water quality of the Great Lakes and to share information broadly with Great Lakes resource managers to proactively address those impacts. A key activity of this annex in the first three years was a synthesis of available science on the observed and projected impacts of climate change in the Great Lakes Basin.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS




2015
State of Climate Change Science in the Great Lakes Basin:
A Focus on Climatological, Hydrologic and Ecological Effects
Ontario



This Annexes' implementation is supported by the Climate Change Impacts Annex Subcommittee, co-led by Environment and Climate Change Canada and the National Oceanic and Atmospheric Administration. Organizations on the subcommittee include: [insert logos]

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

Coordinate binational climate change science activities (including monitoring, modeling and analysis) to quantify, understand, and share information that Great Lakes resource managers need to address climate change impacts on the quality of the Waters of the Great Lakes and to achieve the objectives of this Agreement.

- In June 2013, Canada and the United States initiated the development of the first

binational quarterly newsletter focusing on climate impacts and outlooks for the Great Lakes region. The Great Lakes Climate Quarterly issues (www.binational.net/category/a9/qcio-btsc) provide a quick and easy-to-understand binational overview of the latest season's weather and water level conditions, weather and water level-related impacts, and an outlook for the upcoming quarter. These Great Lakes Climate Quarterlies are produced by Canadian and United States experts for use by managers and practitioners at federal, state, provincial, regional, and local scales as well as stakeholders and the general public.

- A series of webinars were conducted in 2014 to present information on the best available peer-reviewed climate change science in the Great Lakes to Annex Subcommittees, as well as other interested parties such as the Council for Great Lakes Industries. Webinars were provided specifically to: 1) enhance broad understanding of climate information; 2) to discuss the type of climate change information required by other Annex Subcommittees to support their activities; 3) to help focus the work of the Climate Change Impacts Annex Subcommittee in providing more tailored climate change information.

- In December 2015, a "State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrologic and Ecological Effects" report was released, which synthesizes the state of climate change impacts in the Great Lakes basin and identifies key knowledge gaps. The Executive Summary and further information is available at [insert binational.net link]. The 2015 State of Climate Change Science in the Great Lakes Basin report, and the companion database of all the literature reviewed for the report, were developed by the Ontario Climate Consortium, the Ontario Ministry of Natural Resources and Forestry, and McMaster University, with support from Department of Fisheries and Oceans Canada and Environment and Climate Change Canada, and in consultation with Climate Change Impacts Annex Subcommittee. The report supports various commitments under the Climate Change Impacts Annex and will be used for further discussions with Annex Co-Leads and their Subcommittees and inform future work of the Climate Change Impacts Annex Subcommittee.

Enhance monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

- A growing ensemble of in situ measurements – including offshore eddy flux towers, buoy-based sensors, and vessel-based platforms – are being deployed through an ongoing binational collaboration known as the Great Lakes Evaporation Network. The Network is helping to reduce uncertainties in the Great Lakes water balance, providing a more robust basis for short- and long-term projections of [...], and filling a significant gap in measurements, including evaporation and water temperatures, and related meteorological data. The Network is supported through a consortium of researchers from Environment and Climate Change Canada and the National Oceanic and Atmospheric Administration, the University of Michigan, Northern Michigan University, the University of Colorado, Limno-Tech and the Great Lakes Observing System.

DOMESTIC ACTIONS TAKEN

CANADA

Develop and improve regional scale climate models to predict climate change in the Great Lakes Basin Ecosystem at appropriate temporal and spatial scales.

Link the projected climate change outputs from the regional models to chemical, physical, biological models that are specific to the Great Lakes to better understand and predict the climate change impacts on the quality of the Waters of the Great Lakes.

- Canada continues to support the development of coupled atmospheric-land-ocean models for the Great Lakes-St. Lawrence River system that can be integrated with Regional Climate models to evaluate the hydrometeorological impacts of climate change.

- A coordinated evaluation of the impacts of climate change on the levels and flows of the St. Lawrence River from 1961-2100 is being undertaken through a collaborative of agencies including Fisheries and Oceans Canada, Hydro-Quebec, Centre of Water Expertise of Quebec, OURANOS and Environment and Climate Change Canada. Climate change will modify the flow of water into the St. Lawrence River (from Lake Ontario, the Ottawa River, and tributaries) and the level of the Great Lakes. These two factors will lead to changes in both the average and extreme levels in the St. Lawrence River. The anticipated impacts include erosion or deposition along the river banks, navigation impacts, and impacts to drinking water intakes. A major focus of this project is improving the analyses of the routing of Ottawa River flows so that Great Lakes and St. Lawrence River models can be linked.

Enhance monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

- Environment and Climate Change Canada collects data from a network of approximately 1300 surface weather and climate observing sites across the country. These sites include weather stations owned by Environment and Climate Change Canada, NAV CANADA, National Defence, along with volunteer climate stations. The majority of these sites are automated observing platforms which report year round, 7 days a week, 24 hours a day. The Water Survey of Canada is the national authority responsible for the collection, interpretation and dissemination of standardized water resource data and information in Canada. In partnership with the Province of Ontario, the Water Survey of Canada operates approximately 440 active hydrometric gauges in the Canadian portion of the Great Lakes-St. Lawrence River Basin. The Science and Technology Branch of Environment and Climate Change Canada supports the operation of three evaporation stations at Stannard Rock on Lake Superior, Long Point on Lake Erie and Simcoe Island on Lake Ontario as part of the Great Lakes Evaporation Network.

- Multiple methods and estimates of Great Lakes runoff are now available from various federal agencies in Canada and the United States and a comprehensive evaluation and coordination

of runoff estimates is necessary. The Great Lakes Runoff Inter-comparison Project was initiated as a binational collaboration aimed at assessing a variety of models currently used (or that could readily be adapted) to simulate basin-scale runoff to the Great Lakes. The Great Lakes Runoff Inter-comparison Project for Lake Ontario was initiated by Environment and Climate Change Canadian in 2013. The project compared different hydrologic models in their ability to estimate Lake Ontario's direct incoming runoff. The results highlight the different models' weaknesses and strengths, in order to assess which model to use as a function of the targeted application and experiment settings, with the more general goal to improve Lake Ontario's runoff simulation by identifying and fixing some of the model weaknesses.

Develop and improve analytical tools to understand and predict the impacts, and risks to, and the vulnerabilities of, the quality of the Waters of the Great Lakes from anticipated climate change impacts.

- The Canadian Precipitation Analysis is an operational near real-time gridded precipitation product from Environment and Climate Change Canada available since April 2011 for North America. The Canadian Precipitation Analysis is highly regarded due to its unique capability of capturing some of the precipitation features that are specific to the Great Lakes-St. Lawrence River region, in particular the effects that the lakes have on the precipitation patterns, something that is very difficult to measure? with the existing precipitation gauging network. A project was initiated in 2015 to provide the foundation for extending the Canadian Precipitation Analysis back to 1983.

UNITED STATES

Develop and improve regional scale climate models to predict climate change in the Great Lakes Basin Ecosystem at appropriate temporal and spatial scales.

Link the projected climate change outputs from the regional models to chemical, physical, biological models that are specific to the Great Lakes to better understand and predict the climate change impacts on the quality of the Waters of the Great Lakes.

- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab (GLERL) brought together several different modeling and observational approaches to study climate change in the Great Lakes basin. The modeling activity consisted of further development and application, specifically for our lake-dominated region, of three coupled atmosphere-lake-land regional climate models: the Coupled Hydrosphere-Atmosphere Research Model (CHARM, based on the Regional Atmospheric Modeling System, RAMS) at the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory, the Regional Climate Model version 4 (RegCM4) at the University of Wisconsin, and the Weather Research and Forecasting Model (WRF) at the University of Maryland; along with development and testing of a version of the Finite Volume Coastal Ocean Model (FVCOM) with enhancements for

simulation of ice (FVCOM-Ice) and lower trophic level ecology in the form of a nutrient-phytoplankton-zooplankton-detritus (NPZD) model component.

Enhance monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

- In 2013, the Lake Superior National Estuarine Research Reserve established a new Sentinel Site located in Pokegama Bay, Lake Superior. With funding support from the National Oceanic and Atmospheric Administration, this Sentinel Site included weather/meteorological station, water quality sonde, surface elevation tables, permanent vegetation transects, geodetic vertical referencing benchmarks, and an acoustic doppler current profiler installation. This site is now recording monthly water quality sampling for nutrients and chlorophyll. The primary goal is to understand sediment movement and the consequence of sediment movement to marsh sustainably under the expectation of the increased frequency and intensity of storm events.

- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab has been exploring the relationships between ice cover, lake thermal structure, and regional climate for over 30 years through development, maintenance, and analysis of historical model simulations and observations of ice cover, surface water temperature, and other variables. Weekly ice cover imaging products produced by the Canadian Ice Service started in 1973. Beginning in 1989, the United States National Ice Center produced Great Lakes ice cover charts that combined both Canadian and United States agency satellite imagery. These products are available at the Great Lakes Environmental Research Lab through the Coastwatch program (www.coastwatch.glerl.noaa.gov), a nationwide National Oceanic and Atmospheric Administration program within which the Great Lakes Environmental Research Lab functions as the Great Lakes regional node.

- Currently, there is year-round monitoring infrastructure dedicated to understanding off-shore processes that impact Great Lakes ecosystem health. Beginning in Fiscal Year 2015, the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab (with funding support from the National Oceanic and Atmospheric Administration's Coastal Storms Program) is seeking to fill these data gaps through a two-phased approach. First, the team will deploy and manage data from vessel- and buoy-based sensors to improve understanding of over-water meteorology, evaporation, and water temperature in the Great Lakes. Second, the project will also focus on data analysis, system validation, and model assimilation to improve access to and understanding of the acquired data.

Develop and improve analytical tools to understand and predict the impacts, and risks to, and the vulnerabilities of, the quality of the Waters of the Great Lakes from anticipated climate change impacts.

- The National Oceanic and Atmospheric Administration's Office for Coastal Management developed and released the Lake Level Viewer (www.coast.noaa.gov/llv) for the United States portion of the Great Lakes basin in 2014. This tool helps users visualize lake level changes that range from six feet above to six feet below historical long-term average water levels in the Great Lakes,

along with potential shoreline and coastal impacts. Communities can use this information to determine what preparations make the most sense in planning for water level change scenarios. Preparations might include zoning restrictions, infrastructure improvements, and habitat conservation. As a result of this work and product delivery, Digital Elevation Models for each lake basin and the associated topographic and bathymetric data are now available on The National Oceanic and Atmospheric Administration's Digital Coast (https://coast.noaa.gov/digitalcoast/).

- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab developed and released a basin wide Water Level Dashboard in 2014 (www.glerl.noaa.gov/data/dashboard/GLHCD.html). The Dashboard is a dynamic graphical interface for visualizing projected, measured, and reconstructed surface water elevations on the earth's largest lakes. This interface also reflects relationships between hydrology, climate, and water level fluctuations in the Great Lakes.

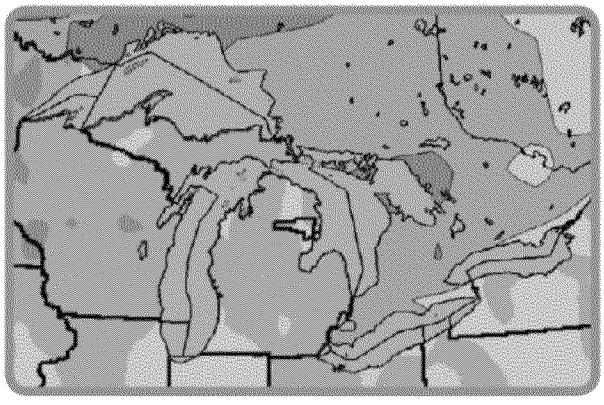
Coordinate binational climate change science activities (including monitoring, modeling and analysis) to quantify, understand, and share information that Great Lakes resource managers need to address climate change impacts on the quality of the Waters of the Great Lakes and to achieve the objectives of this Agreement.

- The National Oceanic and Atmospheric Administration's National Center for Environmental Information produces an annual "State of the Climate" report (www.ncdc.noaa.gov/sotc). This report provides a collection of monthly summaries recapping climate-related occurrences on both a global and national scale.

- The National Park Service released a Climate Change Scenario Planning Workshop Summary. This report summarizes outcomes from a two - day scenario workshop for Apostle Islands National Lakeshore, Wisconsin. The primary objective of the session was to help senior leadership make management and planning decisions based on up - to - date climate science and assessments of future uncertainty. The session was also designed to assess the effectiveness of using regional - level climate science to craft local scenarios; and to provide an opportunity for participants to better understand how scenarios can be used.

Possible graphics:

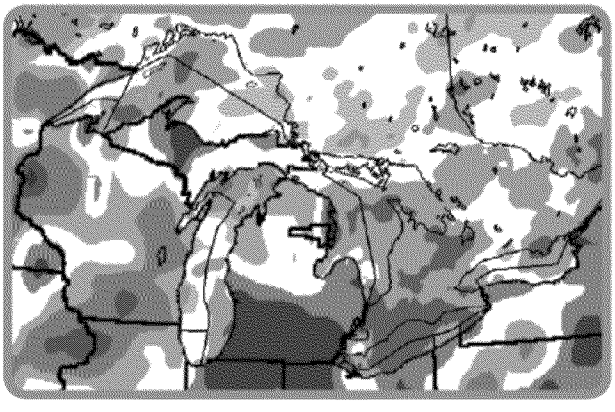
Sources: GL Climate Outlook – Fall 2015



Sept-Nov 2015 Air Temp: Departure from Normal

°C -5 -4 -3 -2 -1 -0.5 0.5 1 2 3 4 5

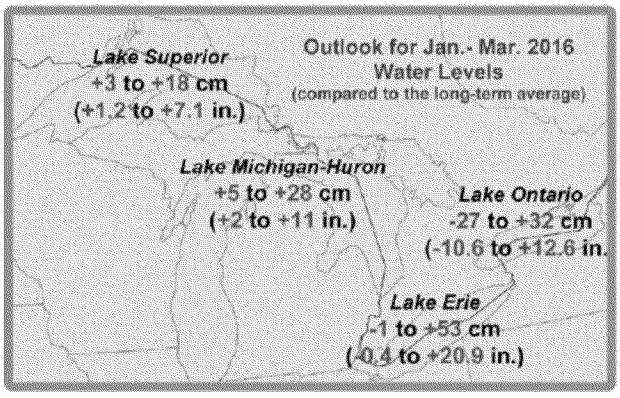
°F -9 -7.2 -5.4 -3.6 -1.8 -0.9 0.9 1.8 3.6 5.4 7.2 9



Sept-Nov 2015 Precip: Percent of Normal (%)

25 50 75 90 110 125 150 175 200

Lake Level Outlook



Potential range for water levels for Jan-Mar 2016 compared to the long-term average (1918-2014).

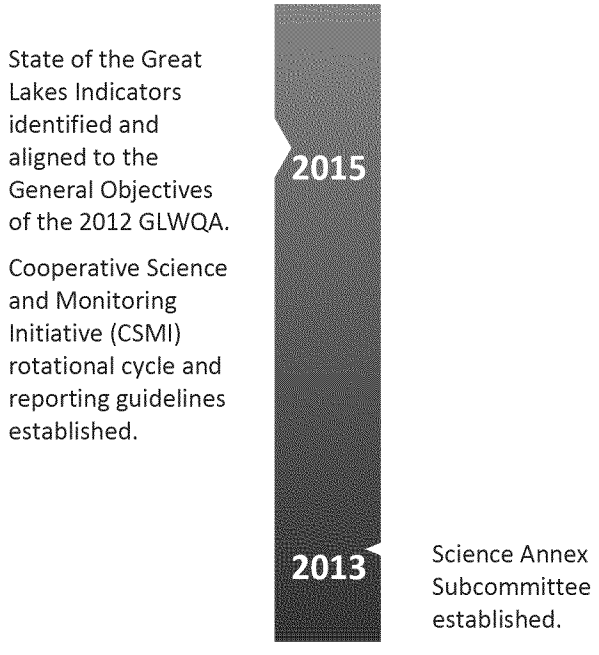
SCIENCE ANNEX
PROGRESS REPORT OF THE PARTIES CHAPTER

OVERVIEW

The 2012 GLWQA recognizes that the effective implementation of management decisions, policies and programs needs to be based on the best available science, research and knowledge. Throughout the 2012 GLWQA, specific science-based commitments are captured in various Annexes . The Science Annex of the 2012 GLWQA commits Canada and the United States to enhancing the coordination, integration, synthesis, and assessment of science activities across all Annexes of the Agreement.

Key activities of the Science Annex in the first three years of the implementation of the 2012 GLWQA included establishing a suite of indicators to assess the ecosystem conditions of the Great Lakes; and strengthening the Cooperative Science and Monitoring Initiative to ensure binational coordination of Great Lakes priority science and research activities.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annexes' implementation is supported by the Science Annex Subcommittee, co-led by Environment Canada and the United States Environmental Protection Agency. Organizations on the subcommittee include: [insert logos]

BINATIONAL ACTIONS TAKEN FOR KEY COMMITMENTS

The Parties shall establish and maintain comprehensive, science-based ecosystem indicators to assess

the state of the Great Lakes, to anticipate emerging threats and to measure progress in relation to achievement of the General and Specific Objectives of this Agreement. The indicators shall be periodically reviewed and updated as necessary.

The Parties shall also issue, every three years, a State of the Great Lakes Report to the Commission and the Public, describing basin-wide environmental trends and lake-specific conditions using ecosystem indicators established by the Parties.

- In January of 2015, Canada and the United States confirmed the suite of indicators for use in assessing the ecosystem conditions of the Great Lakes. This suite was established based on Great Lakes indicator work (previously known as SOLEC) that began in 1994.

- The indicator suite includes nine indicators, one for each of the General Objectives of the 2012 GLWQA. The nine indicators are supported by 43 sub-indicators [reference Figure].

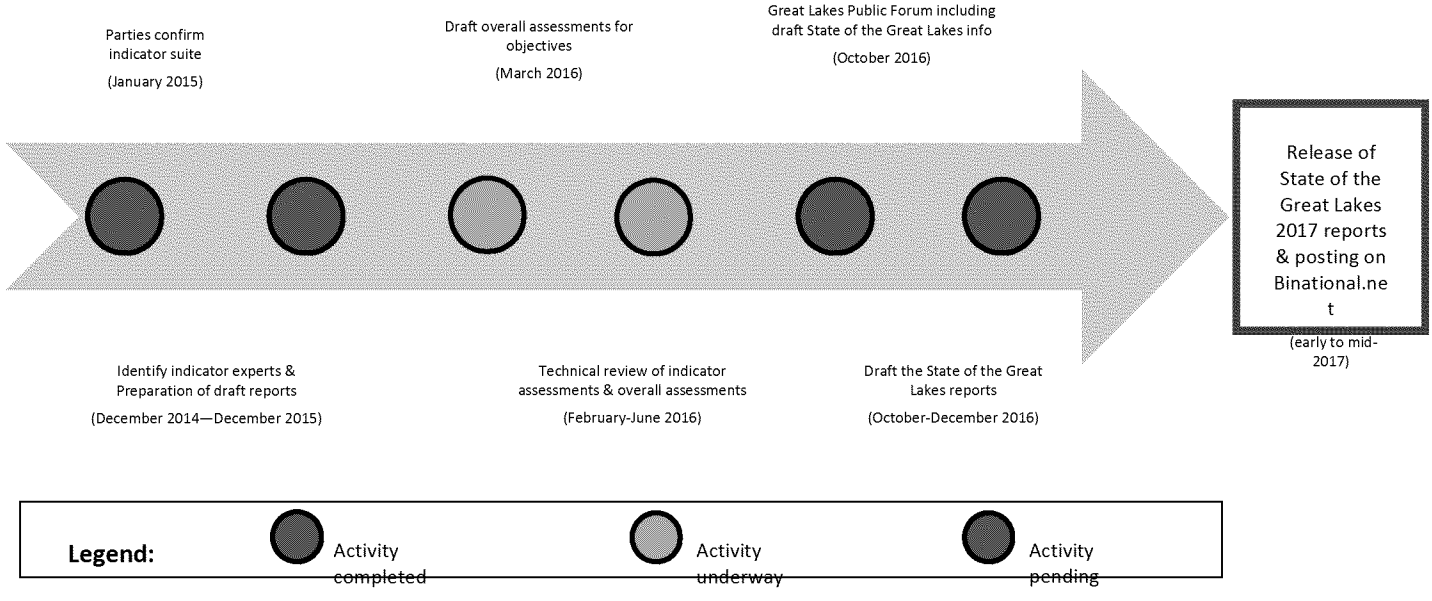
- Over 100 Great Lakes experts have been engaged in reporting against these indicators, representing federal, provincial, state and local governments, as well as academia and non-governmental organizations.

- Draft indicator information will be presented at the Great Lakes Public Forum in October, 2016 for public comment. Following the Forum, the State of the Great Lakes reports, describing basin-wide and lake-specific environmental trends and conditions using the ecosystem indicators, will be released in the spring of 2017 [reference Figure].

Indicators & Sub-Indicators for Assessing the State of the Great Lakes

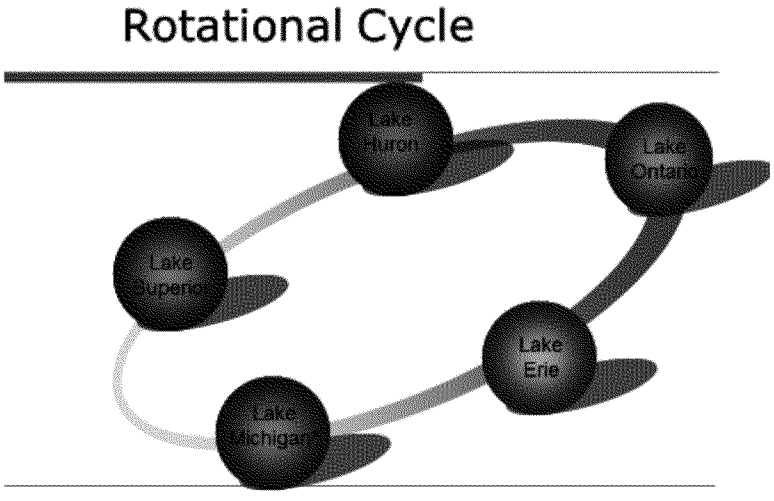
1. Drinking Water
2. Beaches
3. Fish Consumption
4. Toxic Chemicals
   - Toxic Chemical Concentrations (open water)
   - Toxic Chemicals In Great Lakes Whole Fish
   - Toxic Chemicals In Great Lakes Herring Gull Eggs
   - Toxic Chemicals in Sediment
   - Atmospheric Deposition of Toxic Chemicals
   - Water Quality in Tributaries
5. Habitat & Species
   - Coastal Wetland Invertebrates
   - Coastal Wetland Fish
   - Coastal Wetland Plants
   - Coastal Wetland Amphibians
   - Coastal Wetland Birds
   - Coastal Wetlands: Extent and Composition
   - Aquatic Habitat Connectivity
   - Fish Eating and Colonial Nesting Waterbirds
   - Phytoplankton (open water)
   - Zooplankton (open water)
   - Benthos (open water)
   - Diporeia (open water)
   - Preyfish (open water)
   - Lake Trout
   - Walleye
   - Lake Sturgeon
6. Nutrients & Algae
   - Nutrients in Lakes (open water)
   - Harmful Algal Blooms
   - Cladophora
7. Invasive Species
   - Aquatic Invasive Species
   - Sea Lamprey
   - Dreissenid Mussels
   - Terrestrial Invasive Species
8. Groundwater
9. Watershed & Climate Impacts
   - Water Levels
   - Surface Water Temperature
   - Ice Cover
   - Precipitation Events
   - Baseflow due to Groundwater
   - Watershed Stressors
   - Forest Cover
   - Land Cover
   - Tributary Flashiness
   - Hardened Shorelines
   - Human Populations

2017 State of the Great Lakes Report timeline



In addition to ongoing science and monitoring activities that are routinely carried out by the Parties and other government and non-government entities, the Parties shall implement a cooperative science and monitoring initiative for each of the Great Lakes on a five-year rotational basis. The Parties shall focus monitoring activities on the science priorities identified through the Lakewide Management Process. The Parties will coordinate these activities across government and non-government organizations.

- The Cooperative Science and Monitoring Initiative (CSMI) was developed under the 1987 GLWQA as the result of a need to binationally coordinate science to provide information supporting management decisions for the Great Lakes. Monitoring and research activities in the Great Lakes basin are coordinated with an emphasis on enhanced monitoring and research field activities on one of the Great Lakes per year, on a five year rotating cycle [reference figure].



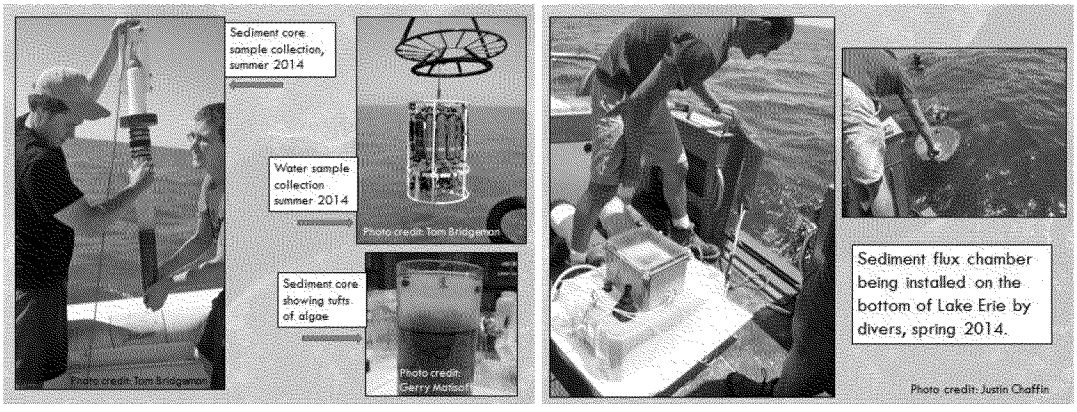
- For the 2012 GLWQA, Canada and the United States established the following multi-step CSMI process for each Great Lake: 1) identification of science and monitoring needs; 2) planning; 3) coordinated monitoring (field years); 4) laboratory analysis; 5) data analysis and reporting; and, 6) final report and communicating out.

- Examples of cooperative science performed in response to the needs of LAMP workgroups include:
    - 2013 Lake Ontario – assessment of the lower food web and projects across federal and state agencies addressing nutrient loadings and nearshore to offshore movement of nutrients;
    - 2014 Lake Erie – projects including an assessment of Dreissenid mussel populations, nutrient loadings from rivers and western basin sediments and a phosphorus mass balance model for the western and central basin;
    - 2015 Lake Michigan – projects addressing nutrient and contaminant loads to and contaminants in the lake, investigation of the movement of nutrients and energy nearshore to offshore supporting fisheries.

[Possible images to use. This image looks lot better than the EC one but would need rights to use.]
Source: https://rvlakeguardian.wordpress.com/2014/07/29/whats-living-along-the-bottom-of-lake-erie/]

Source: https://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=F9A91157-1&printfullpage=true

[Can something like this be put together for CSMI that is recent?]
Source: http://lakeerie.ohio.gov/GLRI/CSMI.aspx]



Facilitate information management and sharing to improve knowledge, accessibility and exchange of relevant Great Lakes information.

- The Science Annex Subcommittee are also examining data and information management and sharing efforts that will best support implementation of the commitments throughout the 2012 GLWQA. An initial examination was undertaken to understand the needs of all annex subcommittees as to their needs for data and information management and sharing. Based on this information and discussions at the Great Lakes Executive Committee meetings, the Science Annex Subcommittee will be examining existing Great Lakes-related distributed data and information access systems and platforms and their application to a specific pilot project on a priority area such as the Lake Erie phosphorus and/or nearshore issue.

Identify science priorities, taking into account recommendations of the Commission.

Undertake a review of available scientific information to inform management actions and policy development.

- The Science Annex Subcommittee coordinated and assisted in the development of the 2014-2016 binational priorities for science amongst the other annexes. As called for in Article 5 of the 2012 GLWQA, these priorities, along with the priorities for action, were posted onto binational.net (www.binational.net/2014/03/20/psa-pasa-2014) in March 2014.

- In support of the development of nutrient objectives for controlling nuisance *Cladophora* in the Great Lakes, the Science Annex Subcommittee held a binational workshop on January 28-26, 2016 to determine the state of knowledge of *Cladophora* from the perspectives of the entire Great Lakes basin, from that of individual lakes, and with respect to areas within each lake where *Cladophora* is perceived to be a significant local problem. The findings of the workshop will help guide a strategy for proposing nutrient reduction targets that will control *Cladophora*.

DOMESTIC ACTIONS TAKEN

CANADA

Identify science priorities, taking into account recommendations of the Commission.

- In March 2013, a Canadian workshop was organized to support identifying possible science priorities that Canada could put forward for first three years under the 2012 GLWQA, pursuant to the development of the binational priorities for science called for in Article 5 of the 2012 GLWQA.

- [Placeholder: GLNI science story]

  Within Environment and Climate Change Canada, two Great Lakes Science Days have been held in an effort to share information on priorities, progress and emerging issues, and also to encourage continued collaboration between Great Lakes scientists, researchers and program teams within the department

- [Placeholder: Include some Provincial activities? i.e. science work under GL Protection Act or GL Strategy]

UNITED STATES

[Link a key commitment from annex if relevant / delete this box]

[Insert any relevant US domestic actions related to annexes' commitments – can be very brief or deleted if not needed or may want to consider adding domestic science-related story as a "boxed" item.]