Wetlands in the Great Lakes

Prepared by the Great Lakes Water Quality Board

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The cover photo is of the beautiful Pelee Marsh in the Point Pelee National Park in Canada.

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1.0 EXECUTIVE SUMMARY

The International Joint Commission (IJC) has documented the need for healthy, vital wetlands supporting water quality and diverse aquatic and terrestrial communities in the Great Lakes basin. Yet, both the total land area and the overall quality of Great Lakes wetlands continue to decline (USEPA, 2014; State of Ontario Biodiversity Report, 2010). This trend is reflective of substantial wetland losses throughout the U.S. and Canada.

Recognizing the continued loss of wetland habitat, the U.S. and Canadian governments chose to augment existing wetland conservation policies/approaches and provide additional protections by committing to a goal of "net habitat gain" in the 2012 Great Lakes Water Quality Agreement (GLWQA). This goal has yet to be realized.

Accordingly, IJC funded this project to:

- Summarize the most important challenges to protecting and enhancing wetlands to set the context of the project;
- Identify examples where wetland conservation and protection policies and programs have led to benefits to water quality and ecosystem health, including supporting and increasing wetland habitat and function;
- Identify and summarize the tools, approaches, and authorities specific to wetland conservation and management with respect to the jurisdictions in the Great Lakes basin and identify where gaps to supporting healthy and productive wetlands exist; and
- Provide considerations and/or recommendations on how governments can make progress on the target of "net habitat gain" in the Great Lakes.

Focused on both inland and coastal wetlands of the Great Lakes Basin, the goals of this project were to:

- *Summarize the key current challenges to protecting and enhancing wetlands to set the context of the project;*
- *Identify examples where wetland conservation and protection policies and programs have led to benefits to water quality and ecosystem health, including supporting and increasing wetland habitat and function;*
- *Identify and summarize the tools, approaches, and authorities specific to wetland conservation and management with respect to the jurisdictions in the Great Lakes basin and identify where gaps to supporting healthy and productive wetlands exist; and*
- *Provide considerations and/or recommendations on how governments can make progress on the target of net habitat gain in the Great Lakes.*

This report identifies the following top-five stressors to Great Lakes wetlands:

- Water-level regulation;
- Commercial and non-commercial land development;
- Pollutant loadings including nutrient overloading;
- Invasive species; and,
- Climate change.

A detailed scan of wetlands related laws in 11 jurisdictions –comprising of the federal governments of the United States and Canada, the province of Ontario, and eight Great Lakes states—is presented in this report. On the U.S. side, the Clean Water Act and the National Environmental Policy Act, establish the regulatory frameworks that promote the protection of wetlands. Along with enforcement of these laws, other programs and policies have also been established in each of the Great Lakes states.

Canada also maintains an extensive regulatory program for wetlands protection. Its federal policy is comprehensive with nine guiding principles, seven objectives, and seven strategies that seek to accomplish the overarching goal of no net loss of wetland function. The province of Ontario has similar comprehensive goals that focus on improved inventory/mapping, creating a no net loss policy, and careful assessment protocols for wetlands evaluations.

While each of the jurisdiction have established very similar goals, there are variation in the details of the regulations, and their enforcement. This causes uneven levels of wetland protection.

Best Practices can provide appropriate wetlands protection supplemented by incentive programs that lead to wetlands enhancement and restoration. These practices and how they interface with the jurisdictional non-uniformities are presented below:

Best Practices for Regulatory Frameworks:
Most wetland policies in the basin were developed more than a decade ago and research, conditions, and the inventory of wetland areas have changed significantly since that time. Accordingly, these programs can be strengthened by:

This report follows the definition of "net habitat gain" contained in Great Lakes Nearshore Framework (2016), which describes it as doing one or more of the following:

1. *A spatial increase in "priority habitats" for communities of native fish and wildlife species;*
2. *Improvement in habitat condition and functionality of habitat types from severely degraded and not functional to degraded but functional and then to high quality and highly functional; and,*
3. *Maintaining the condition of high quality habitat.*

- Implementing practices that use latest science and technology. For example, Ontario's wetland conservation strategy's focus on improving wetland inventory and mapping, as well as improving wetland evaluation are excellent starting points for the entire Basin
- Creating basin-wide, uniform definition of wetlands to ensure comprehensive protection for wetlands throughout the Basin. This protection framework will need to recognize the varying hydrologic regimes for all the wetland types in the basin to cover all habitat types
- Eliminating variations in regulatory frameworks in jurisdictions across the Basin. These include:
  - Protection framework for geographically isolated wetlands currently not included in federal protections;
  - Delineation criteria across the basin;
  - In-lieu fee program templates to generate funds for restoration of lost wetland functions statewide;
  - Permit activity tracking frameworks; and
  - Establishing Anti-degradation standards as well as water quality

standards for wetlands that keep net habitat gain as its primary objective.

Best Practices for Addressing Key Stressors to Wetlands:
These include:

- Continued implementation and monitoring of IJC's 2015 Lake Ontario Plan for water-level regulation
- Strong laws that directly address commercial and non-commercial developments on or near wetlands
- Citizen-based partnerships supporting regulatory frameworks to solve the challenge of nutrient overload in the Basin
- Public, private, and citizen driven programs that focus on preventing the spread of terrestrial and aquatic invasive species
- Adaptive management techniques for all stressors to focus resources on successful, cost effective solutions that are resilient to climate change

Best Practices for Funding Frameworks that Recognize and Institutionalize the Financial Values of Wetland Preservation: Moody's investor service recently warned cities that they will face downgrades in their credit rating unless they plan carefully for climate change. This will incentivize public entities to invest in infrastructure upgrades and wetlands related restoration. Accordingly, Great Lakes communities would benefit from:

- A uniform basin-wide standard for mitigation ratios
- A uniform compensatory scheme that also allows for in-lieu fees and other financial payments
- Municipal wetland preservation programs that lessen the flooding impacts that communities are experiencing while protecting/restoring/creating resilient wetlands.

Best Practices presented here-in can be categorized in the following groups:

1. *Promoting uniform regulatory frameworks on both sides of the border;*
2. *Targeting key stressors;*
3. *Creating funding frameworks that are similar; and*
4. *Creating incentive frameworks, and*
5. *Engaging indigenous peoples early and often.*

Last but not the least, for wetlands that still are pristine or are unique, practice "an ounce of prevention is worth a pound of cure".

Best Practices for Incentive Frameworks:
Incentivizing private owners to preserve wetlands on their property has yielded improvements in conservation in the past. The public investment in these programs have been insufficient to increase the wetland areas at scale. Additionally, these programs should be reassessed and altered to realign incentives with the best available science and policies. To build public support for these programs, effective outreach should be established to build trust between private partners and the public. These public/private coalition can build a basin-wide incentive framework to improve and expand the successful programs of the past. A path forward could include:

- A public outreach program giving landowners information on how to effectively manage wetlands on their property
- An expansion of the U.S. Farm Bill which spends nearly $30 billion towards a variety of conservation efforts (not all are focused on wetlands). Some have argued that the existing process to seek assistance is onerous. By addressing these challenges, it can be even more effective in conserving and restoring

wetlands that currently fall outside of the regulatory programs.

Best Practices for Indigenous People Participation:

Interviews were conducted with indigenous people and a variety of experts and the lake-wide management plan (LaMP) program was repeatedly cited as a good framework to engage diverse parties, including the indigenous people. Its techniques and methodology could be replicated in other smaller, more focuses policy programs on both sides of the border. Accordingly, an improved Great Lakes focused wetlands programs could:

- Emulate the LaMP engagement strategy in wetland policy formulation and deployment
- Engage indigenous people early and consider ways to more effectively integrate traditional knowledge into wetland management decisions
- Lower barriers to restoration when using native plants

Finally, lessons from Kakagon Slough in United States and Long Point National Wildlife Area in Canada are worthy of emphasis, because, as one interviewee stated, “an ounce of prevention is worth a pound of cure”.

The technical support for these observations is presented in the following sections, organized as follows: Chapter 2 presents an overview of the stressors to wetlands in the Great Lakes. This is followed by Chapter 3 showcasing comparison and analyses of wetland laws and policies on both sides of the international border that form the foundation of Great Lakes wetlands protection. Chapter 4 discusses the best practices that could lead to overall net habitat gain. Chapter 5 summarizes findings from an extensive survey for the wetlands experts in both countries. Finally, Chapter 6 presents an overall analysis and recommends a pathway to habitat gain.

2.0 GREAT LAKES WETLANDS

2.1 WETLANDS IN THE GREAT LAKES

The Great Lakes region's people, economy, and culture are inextricably linked to the health of its wetlands. Water quality, including nutrient and sediment sequestration, are directly tied to the value of wetlands, providing benefits ranging from wildlife and fish habitat to its use and value as a source for food and medicine. There are economic benefits to healthy wetlands in the form of recreation and tourism, cultural and spiritual significance, for climate change mitigation, and erosion reduction and flood mitigation. Throughout the Great Lakes, the numerous benefits of wetlands are well known, and yet, various stressors continue to threaten each of these well-known benefits.

Various wetland types influence species composition and wetland diversity. Differing wetlands provide different ecological functions and values based on their aquatic environments, vegetation, shoreline configurations, water-level fluctuations, bedrock geology, hydrologic connectivity, and climate.

The wetlands of the Great Lakes basin are broadly categorized as either coastal or inland based on their hydrologic source and connection to the lake. Both categories and their distinguishing functions are discussed in Appendix A. This project scope assessed both types of Great Lakes wetlands.

2.2 WETLAND ECOSYSTEMS – A DYNAMIC CHALLANGE

Wetlands, with fluctuating water levels and nutrient-rich soils, are some of the most productive ecosystems in the world. It is estimated that up to one third of Great Lakes primary productivity occurs in coastal wetlands ("Importance of Great Lakes Coastal Wetlands," 2017). Great Lakes wetlands exist as ecotones between purely aquatic and purely terrestrial environments, and provide habitat for a tremendous diversity of biota, including hundreds of plant, fish, bird, reptile, amphibian, mammal, and invertebrate species.

In the United States, over 50 percent of Great Lakes wetlands have been lost to several stressors that have, and continue to, threaten the delicate ecosystem and way of life (USEPA, 2014).

In Canada, the 2010 State of Ontario's Biodiversity report indicated that 69 percent or 1.9 mil hectares (4.7 mil acres) of wetlands had been lost by 1982 and an additional 70,854 hectares (175,804 acres) or 3.5 percent were lost by 2002.

Over 40 species of fish alone utilize the Great Lakes wetlands for some part of their life cycle (Jude & Pappas, 1992). Some fish use wetlands only for spawning, while some remain in the wetlands all year, as the vegetation provides good cover from predators. Additionally, wetlands are home to many invertebrates, which are a good food source for fish and other animal communities. Animals, such as birds and mammals, rely heavily on wetlands during migration and breeding.

Notable activities and stressors that contribute to wetland loss include water-level regulation, commercial and non-commercial development, shoreline alteration and development, pollution, invasive species, and climate change.

2.3 STRESSORS TO GREAT LAKES WETLANDS

In the United States, over 50 percent of Great Lakes wetlands have been lost to several stressors that have, and continue to, threaten the delicate ecosystem and way of life (USEPA, 2014). In some areas, especially the lower Great Lakes basin, it is even more noticeable with more than 95 percent of wetlands lost ("Wetland Habitat," n.d.). Similarly, in Canada, there's similar supporting data. For example, the 2010 State of Ontario's Biodiversity report indicated that 69 percent or 1.9 mil hectares of wetlands (4.7 mil acres) had been lost by 1982, and an additional 70,854 hectares (175,084 acres) or 3.5 percent were lost by 2002.

Notable activities and stressors that lead to wetland loss include the following:

Water-level Regulation

Water-level fluctuation is an important ecological process that modifies wetland ecosystems. The natural fluctuations in water level support the wetland ecosystem. However, lake levels are often regulated for lakeshore property owners, shipping and boating industries, and hydropower, to the detriment of natural wetlands.

Stable water levels affect soil chemistry and decrease plant and animal diversity because some species are more adaptable to soil chemistry changes than others. Regulated water levels also limit or dampen high and low levels needed to maintain a diverse vegetation community. Additionally, in areas that are not flooded, invasive species are likely to dominate the plant and animal populations because frequent flooding of upland areas is an effective invasive species control mechanism (EPA, 2006; Wilcox, 2004).

As an example of how water-level regulation can negatively affect coastal wetlands, man intervened in Lake Ontario's water levels with the operation of the St. Lawrence Seaway in about 1960. Prior, fluctuations during the 20th century ranged about 6.5 ft. Once regulation began, the range reduced slightly during 1960–76, but low water-supply (from the upper lakes) conditions in the mid-1960s and high supplies in the mid-1970s, maintained much of the range. After 1973, regulation reduced the range to about 4.4 ft. The lack of alternating flooded and dewatered conditions, especially the absence of low lake levels, resulted in extensive stands of cattail establishing at the expense of other plant community types, mostly the sedge/grass community at upper elevations in the wetlands (Wilcox, 2005).

It is estimated that up to one third of Great Lakes primary productivity occurs in coastal wetlands ("Importance of Great Lakes Coastal Wetlands," 2017).

Recognizing the impact of the constrained water-level range, a new water-level regulation plan for Lake Ontario (Plan, 2014) was implemented in January 2017 that seeks to restore some of the natural fluctuations (IJC, 2014).

Commercial and Non-commercial Development

Large areas of wetlands are lost because the land has been drained for agricultural use or because fill material has been deposited to

As an example, the lack of alternating flooded and dewatered conditions in Lake Ontario, resulted in establishment of extensive stands of cattail at the expense of other plant community types, mostly the sedge/grass community at upper elevations in the wetlands. A new regulation plan for Lake Ontario (Plan 2014) has now been implemented that seeks to restore some of the natural fluctuations (IJC 2014).

support development. To accommodate development, a variety of practices affect the hydrology that supports a healthy wetland, including shoreline modification, dike or dam construction, and road construction near wetlands.

Shorelines are often modified to reduce flooding or erosion and to facilitate shipping traffic often through the construction of break-walls or retaining walls. Although these structures reduce erosion, they also reduce the sediment delivery that replaces sediments transported naturally along the shoreline and on barriers that protect wetlands from lake processes. Additionally, these structures can redirect and often amplify wave action leading to additional erosion. Dredging to create harbors and channels also eliminates wetland habitat and increases erosion (Albert, 2005; Wilcox, 2005).

Dike and dam construction negatively impact wetlands by interrupting the natural hydrology that supplies water to wetlands. Additionally, water quality is reduced when wetlands are isolated from their water sources. When a dike is constructed, the wetland is isolated from the lake or other water source. Similarly, dams disrupt water flow and sediment transport. Diking and damming also create physical barriers for many species which disrupts the habitat by preventing free access to the water source.

Road construction and other major physical alterations near wetlands interrupt the flow of water and stress the wetland habitat. Many roadways along the shoreline cross wetlands, which both disrupts water flow and increases sediment deposition. These deposits can also provide habitat that support invasive species, further harming the ecosystem. Roadway by-products can also contaminate wetlands and change the soil and water chemistry, disrupting plant and animal habitat.

Shoreline modification, dike or dam construction, and road construction near wetlands are key development challenges impacting wetlands. In addition, wetlands have also been lost because the water has been drained for agricultural use or because fill material has been used for development.

Filling, ditching, and draining land is used to convert wetlands for land development use, crop production, or for extractive industries. Ninety-five percent of the wetlands converted to uplands between the mid-1970s to the mid-1980s was due to agriculture or other land uses (Dahl & Johnson, 1991).

Pollution

Excessive pollutant loadings can exceed a wetland's ability to capture and/or sequester these pollutants. Although wetlands help improve water quality, excess pollutants inhibit their ability to do so. Some examples of pollutants in wetlands are excess nutrients from urban and agricultural runoff, sewage discharges, turbidity from boats, and toxic substances from abandoned industrial parcels. Small changes in water quality can change plant and animal

Pollutants in wetlands are excess nutrients from urban and agricultural runoff, sewage discharges, turbidity from boats, and toxic substances from landfills. Small changes in water quality can change plant and animal communities, as some species are more adaptive to water quality changes than others. Algal blooms, produced due to high nutrient levels, can reduce light for plant and animal species that need it for survival.

If there is a common theme of a single challenge across the Great Lakes, it is the presence of invasive species such as Phragmites australis. The basin has spent a lot of resources to come up with a solution, and it still is omnipresent.

communities, as some species are more adaptive than others.

High nutrient levels can cause algal blooms within a wetland, particularly in barrier-protected wetlands that have little or no connection with a lake. Algal blooms can reduce light for plant and animal species that need it for survival (Wilcox, 2005). Additionally, when algae decay, dissolved oxygen decreases, causing more species to die. Unfortunately, some invasive species, such as *Phragmites,* thrive in these nutrient-rich environments and limit the growth of native species even further. Some methane-producing microorganisms also thrive in low oxygen conditions, so lower oxygen levels lead to higher methane emissions (Tanner et al., 1997).

High temperatures and levels of turbidity also affect plant and animal diversity in a similar way to high nutrient levels. Changing water temperatures affect the growing season, an advantage for species able to adapt quickly. Like algae, high turbidity limits light, which is disruptive to species that photosynthesize or rely on sight for feeding.

Invasive Species

Introducing non-native species into wetland habitats can severely harm wetland habitat, as they compete with native species for food and habitat. Humans often are responsible for their introduction, either by intentional release, escape from cultured populations, travel through canals, etc. And, once established, and can be extremely difficult and costly to remove.

Examples of widespread invasive species in the Great Lakes wetlands include the common reed (*Phragmites australis*) and the common carp (*Cyprinus carpio*) ("Invasive Species," n.d.). Common reed grows very densely, outcompeting native vegetation. The common carp is a fish that spreads very quickly and harms other fish populations by eating a large amount of the available food or disturbing habitat.

Climate Change

Climate change has become a major stressor to Great Lakes wetlands, as it affects water levels, solar radiation, weather patterns, and air and water temperature. Climate change is expected to result in further loss of wetlands and species diversity.

Both prolonged dry and wet periods prevent natural water fluctuations necessary for a healthy wetland habitat. Water temperature can affect chemical and biological reactions, such as plant decay. Changes in weather patterns, air temperature, and solar radiation also influence the water chemical composition, as well as the growing season for plant species. An important consideration for climate adaptation with respect to wetlands would be to ensure wetlands are able to migrate with changing water levels and limit the encroachment of non-compatible land uses.

Wetlands account for approximately 30 percent of global methane emissions currently, and this is likely to increase over time (Paudel, Mahowald, Hess, Meng, & Riley, 2016). As stated in the *Pollution*

Climate change related variability are already making significant changes to the Great Lakes ecosystem. Adaptation measures are now being studied, deployed, and monitored in many parts of the basin.

section, low oxygen conditions and high temperatures accelerate decay and reduces oxygen levels, further impairing the environment, which also, in turn, increases methane generation. This methane is a greenhouse gas that exacerbates the impacts of climate change, driving even lower oxygen conditions and higher temperatures (Zhang et al., 2017).

2.4 ECONOMIC BENEFITS OF WETLANDS

Wetlands provide an incredible variety of benefits, but often overlooked is the vast economic impact they can. Economists have developed frameworks to convert the values ecosystems generate into dollars and cents. These frameworks attempt to monetize wetland benefits either by computing the actual value of the services offered through direct measurement and estimation or by inferring, from the behavior of the surrounding community, to what value people place on the wetlands. Wetland scientists and regulators must use their best judgment based on the available information and the ecosystem being examined to choose the appropriate assessment method.

Ontario's Wetland Conservation Strategy (2014) indicates that in southern Ontario, acting as natural infrastructure, wetlands produce at least $14 billion in economic benefits each year for Ontarians (Troy and Bagstad, 2009).

A study of the economic value of protecting and restoring Great Lakes ecosystems (Marbek, 2010) found the benefits people received (e.g., recreational value, clean water filtration, biodiversity habitat, etc.) were 13 to 35 times greater than the protection or restoration project costs, depending on location. Furthermore, a recent study that examined the financial cost of a major flood event in urban and rural areas, found that leaving wetlands intact on the landscape can reduce the financial costs of floods by up to 38 percent (Moudrak, Hutter and Feltmate, 2017).

Ontario's Wetland Conservation Strategy (2014) indicates that in southern Ontario, acting as natural infrastructure, wetlands produce at least $14 billion in economic benefits each year for Ontarians (Troy and Bagstad, 2009).

A study in Saginaw Bay estimated that the average per acre present value of wetlands is as high as $2,421 per acre ($981 per hectare) (Whitehead et al., 2009). This paper details a contingent valuation study that attempted to capture the value that citizens put on their local wetlands, either through their choices or through their own willingness to pay for access.

Similarly, an analysis carried out on the U.S. Army Corps of Engineers' section 404 mitigation program[1] attempted to quantify benefits based on available literature values (Adusumilli, 2015). The analysis developed annual values for recreational fishing, bird hunting, bird watching, water quality protection, water supply protection, commercial fishing, and flood control for all mitigation wetlands within the United States. Throughout the whole United States, the annual average benefit is estimated to be nearly $3 billion from these specific types of wetlands (Whitehead et al., 2006). Between the Great Lakes states, mitigation wetlands provide annual benefits more than $600 million, with an average annual benefit per acre exceeding $100,000 ($40,500 per hectare). These values only cover mitigation wetlands, but a similar analysis examining

[1] Mitigation wetlands are wetlands that have been constructed to offset the negative impacts from human activities that have changed or degraded wetland areas

the average value for all wetlands shows an annual value of $10,000 dollars per acre ($4,050 per hectare). This wide variation is emblematic of the difficulty scientists encounter when trying to place a value on ecosystem services, but simultaneously illustrates how much value wetlands provide.

No net loss typically refers to the goal of balancing unavoidable wetland losses from development with wetland restoration so that there is no overall loss of wetland function on the landscape.

To achieve a goal of no net loss, mitigation sequences are used that comprise of steps such as:

1. *Taking measures to prevent impacts from occurring in the first place, for instance by changing or adjusting the development project's location and/or the scope, nature and timing of its activities;*
2. *Minimizing measures to reduce the duration, intensity and/or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible;*
3. *Mitigating measures to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/or minimized; and*
4. *Compensating (offset) measures to compensate for any residual significant, adverse impacts that cannot be avoided, minimized and/or rehabilitated or restored.*

Inland Wetlands in Cottage County

3.0 JURISDICTIONAL SUMMARY

3.1 KEY JURISDICTIONS IN THE GREAT LAKES BASIN

In the Great Lakes basin, wetlands regulations vary across political boundaries that include 11 jurisdictions - two countries, eight U.S. states, and one Canadian province. In addition, many local units of government also have regulations that protect wetlands.

Each of these jurisdictions has its own policy framework and priorities. A review of these 11 jurisdictions reveals a variety of similar but differing programs that provide wetlands with varying levels of protection while allowing for flexibility to tailor policies and programs to different landscapes, demographics, resource users, conservation partners, etc.

It is important to note that conserving biodiversity within the five Great Lakes and along their shorelines is a long-held goal on both sides of the border. Each lake has had a Biodiversity Conservation Strategy developed to help identify priority areas for conservation and assess the current health of the lakes (Nature Conservancy, (n.d.)). These documents along with the Lakewide Action and Management Plan provide essential guidance for restoration, conservation, and management activities within each Lake (Great Lakes and St. Lawrence Cities Initiative, (n.d.)).

In this Chapter, the major jurisdictional approaches to wetlands regulations are discussed. There is also a brief discussion on the establishment of these frameworks.

3.2 REVIEW OF WETLAND RELATED LAWS AND REGULATIONS WITHIN THE 11 JURISDICTIONS

3.2.1 UNITED STATES FEDERAL REGULATIONS AND LAWS

In the United States, wetland laws were established in a manner sensitive to the federal objective for wetlands protections while recognizing states' rights and the rights of individual property owners. The federal government retains substantial power over natural resources but can only exert its authority under specific circumstances. The federal jurisdiction over navigable waters (regulated under Section 10 of the Rivers and Harbors Act) and Waters of the U.S. (i.e. navigable waters, lakes, ponds, small streams, ditches, and adjacent wetlands) is summarized in Table 3.1 below However, federal law generally does not regulate isolated wetlands on private property. Thus, several states have regulatory frameworks that increase wetland protection.

A key federal law, is the National Environmental Policy Act (NEPA) of 1969, which promotes environmental protection. The NEPA process allows federal agencies to undertake environmental review of federal actions and federally funded projects. The NEPA process informs decision makers and the public of the potential environmental effects of proposed actions by a federal agency or project receiving federal funds and the alternatives considered.

The Clean Water Act (CWA) of 1972 (as amended in 1987) establishes the basic structure for regulating discharges of pollutants into the Waters of the U.S and regulating quality of standards for surface waters. The primary mechanism of the CWA for wetland protection is through Section 404 and Section 401. Section 404 of

the CWA regulates the discharge of dredge or fill material into Waters of the U.S. (which includes wetlands). Section 401 - Water Quality Certification (WQC) is typically administered by each state and certifies that activities regulated under Section 404 do not violate state water quality standards. State water quality standards are generally established by states and included in their legislation.

The U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (USEPA) administer the CWA Section 404 and share enforcement authority. The USACE issue three levels of permits: Nationwide Permits and Regional General Permits, which authorize activities that are similar in nature and cause only minimal impacts to aquatic resources, including wetlands, and individual permits that are required for all other activities under USACE jurisdiction.

Section 404(f) of the CWA provides a description of activities exempt from the permitting requirements including:

- Farming, silviculture and ranching activities;
- Emergency maintenance activities;
- Construction and maintenance of farm ponds, stock ponds, or irrigation ditches or the maintenance of drainage ditches
- Construction of temporary sedimentation basins;
- Any activity with respect to which a State has an approved program under section 208(b)(4) of the CWA which meets the requirements of sections 208(b)(4) (B) and (C); and
- Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment.

CWA and NEPA provide good frameworks for wetland protection in the United States. Ways to further ensure that wetlands are looked after could seek to further broaden the definition of the "waters" of the United States, as well as eliminating the broad exemptions that currently exist.

While the wetlands regulations form the foundation for wetlands protection in the United States, other federal laws also support wetlands protection and/or restoration. Many only apply to federally funded projects while others ensure that other regulatory programs consider wetlands protection and/or restoration. Table 3.1 provides a brief description of the related federal laws and the interface with wetlands programs.

Table 3.1 Wetland Regulations in the United States [(Thomas et. al., 2005); (Environmental Law Institute, 2006, 2007-a-b, 2008)]

Law	Administering Agency	Details
National Environmental Policy Act of 1969 (NEPA)	Multiple	Projects on federal land or projects receiving federal funding, require review under NEPA.
Clean Water Act (CWA), Section 404 [Permits for Discharges of Dredged or Fill Material into Waters of the United States (33 CFR Part 320-332), Compensatory Mitigation for Losses of Aquatic Resources (33 CFR Part 332)]. Section 401	Multiple	Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Section 401 provides a mechanism for State Certification of Water Quality for Section 404 permits.

Law	Administering Agency	Details
(Water Quality Certification (WQC)		
Comprehensive Environmental Response Compensation and Liability Act (Superfund) (P.L. 96-510) (1980)	AFA	Establishes liability of the U.S. Government for damages to natural resources over which the U.S. has sovereign rights.
Coastal Barriers Resources Act (P.L. 96-348) (1982)	NOAA	Designates various undeveloped coastal barrier islands for inclusion in the Coastal Barrier Resources System. Designated areas are ineligible for Federal financial assistance that may aid development.
Coastal Zone Management Act (P.L. 92-583) (1972)	NOAA	Provides Federal funding for wetlands programs in most coastal States, including the preparation of coastal zone management plans.
Estuary Protection Act	DOI	Authorized the study and inventory of estuaries, and the Great Lakes, and provided for management of designated estuaries between DOI and the States.
National Flood Insurance Program	FEMA	Unintentionally encourages development in flood plains, which contain wetlands, by providing low-cost Federal Insurance.
Federal Water Project Recreation Act (P.L. 89-72) (1965)	DOI, Corps	Recreation and fish and wildlife enhancement must be considered by Federal water projects. Authorizes Federal funds for acquiring land for waterfowl refuges.
Fish and Wildlife Coordination Act of 1956	DOI	Authorizes the development and distribution of fish and wildlife information and the development of policies and procedures relating to fish and wildlife.
Migratory Bird Conservation Act (45 Stat. 1222) (1929)	FWS	Established a commission to approve the acquisition of migratory bird habitat.
National Wildlife Refuge Acts (numerous acts)	FWS	Numerous statutes establish refuges, many of which contain significant wetland acreage.
Ramsar Convention (Treaty), adopted 1973, enforced from 1975	FWS	Maintains a list of wetlands of international importance and encourages the wise use of wetlands.
Watershed Protection and Flood Prevention Act (68 Stat. 666) (1954)	FWS, NRCS	Authorizes the FWS to investigate wildlife conservation on NRCS small watershed projects.
Wild and Scenic Rivers Act, (P.L. 90-542) (1968)	DOI, USDA	Protects designated river segments from damming and other alterations without a permit.
Wilderness Act of 1964 (78 Stat. 890)	DOI, USDA	Requires a review of Federal lands for inclusion in the National Wilderness Preservation System.
Endangered Species Act of 1973 (P.L. 93-205)	FWS	Provides for the designation and protection of wildlife, fish, and plant species that are in danger of extinction.
*Executive Order 11990, Protection of Wetlands (1977)	AFA	Requires Federal agencies to minimize impacts of Federal activities on wetlands.
*Executive Order 11988, Protection of Floodplains (1977)	FWS AFA	Requires Federal agencies to minimize impacts of Federal activities on flood plains.
Executive Order 12580, Superfund Implementation (1987)	DOI	Directs DOI to develop rules for assessing damages under CERCLA (Comprehensive Environmental Response Compensation and Liabilities Act) as a natural resources trustee.
Federal Noxious Weed Act (P.L. 93-629) (1975)	DOI, USDA, DOE, DOD	Authorizes controlling the spread of noxious weeds on Federal lands.
Federal Power Act (41 Stat. 1063) (1920)	FERC	FERC will cooperate with other Federal agencies in assessing proposed power projects, such as dams. FERC must consider protection of fish and wildlife resources.

Law	Administering Agency	Details
Fish and Wildlife Coordination Act (1965) (P.L. 89-72)	FWS	Requires Federal agencies to consult with FWS before issuing permits for most water-resource projects.
Food, Agriculture, Conservation, and Trade Act of 1990 (P.L. 101-624)	NRCS	Wetland Reserve Program purchases perpetual nondevelopment easements on farmed wetlands. Subsidizes restoration of croplands to wetlands.
Food Security Act of 1985 (*Swampbuster*) (P.L. 99-198)	ASCS, FWS	"Swampbuster" program suspends agricultural subsidies for farmers who convert wetlands to agriculture.
	FHA	Conservation Easements program allows FHA to eliminate some farm debts in exchange for long-term easements that protect wetlands and other areas.
National Wildlife Refuge System Administration Act of 1966 (P.L. 89-669)	DOI	Provides the guidelines for managing National Wildlife Refuges.
Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646).	FWS, USCG, EPA, USACE, NOAA	Created a Federal program to prevent and control the spread of species that are aquatic nuisances.
Oil Pollution Act of 1990 (P.L. 101-380)	DOE, DOI, NOAA	Enhanced the response to oil spills and required natural resource damage assessments.
Tax Deductions for Conservation Easements (Section 6 of P.L. 96-541)	IRS	Allows taxpayers to take a deduction for a qualified real property interest contributed to a conservation organization for conservation purposes.
U.S. Tax Code Reform Act of 1986 (P.L. 99-514)	IRS	Eliminates incentives for clearing land. Deductible conservation expenditures must be consistent with wetlands protection. Capital gains on converted wetlands treated as income.
Water Resources Development Act of 1976, 1986, 1988, 1990, (P.L.'s 94-587, 99-662, 100-676, 101-640)	USACE	States that future mitigation plans for Federal water projects should include "in kind" mitigation for bottom-land hardwood forests

3.2.2 CANADIAN FEDERAL LAWS FOR WETLANDS

Canada has enacted federal policies and laws to address environmental protection, including wetlands. The primary legislation driving wetland protection is Federal Policy on Wetland Conservation. It is augmented by the Fisheries Act, the Canadian Environmental Assessment Act, the Canadian Wildlife Act, and the Migratory Bird Conservation Act (see Table 3.2). The federal policy relies on existing laws and processes to both inculcate wetland priorities into federal decision-making and lead by example [i.e., moving provincial efforts towards more comprehensive protection (Austen & Hanson, 2007)]. By enhancing specific wetland-related laws with a federal policy, Canada coordinates a more holistic response and creates an adaptable and comprehensive policy to protect wetlands.

The Canadian federal policy contains nine guiding principles, seven objectives, and seven strategies to accomplish its overarching goal. Canada envisions seven outcomes to reach this goal include:

1. Maintaining functions and values derived from wetlands throughout Canada.
2. No net loss of wetland functions on all federal lands and waters.
3. Enhancing and rehabilitating wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels.
4. Recognizing wetland functions in resource planning, management, and economic decision-making with regards

to all federal programs, policies, and activities.
5. Securing all Canadian wetlands of significance.
6. Recognizing sound, sustainable management practices in sectors, such as forestry and agriculture, that make positive contributions to wetland conservation, while also achieving wise use of wetland resources.
7. Utilizing wetlands in a manner that enhances prospects for their sustained and productive use by future generations.

Canadian policy contains a detailed set of actions to help achieve each of these goals (Federal policy on wetland conservation, 1991). Overall, the Canadian government is attempts to: 1) ensure that within the country there is no net loss of wetland function on any state or federal land or waters; 2) ensure there is no wetland loss in areas where losses have reached critical levels; and 3) ensure that there is no net loss of regionally significant wetlands.

Canadian wetland policy is comprehensive with nine guiding principles, seven objectives, and seven strategies to accomplish three overarching goals:

1. *Ensure that within the country there is no net loss of wetland function on any state or federal land or waters.*
2. *Ensure there is no wetland loss in areas where losses have reached critical levels.*
3. *There is no net loss of regionally significant wetlands.*

Table 3.2 Wetland Laws in Canada

Program	Administering Agency	Effect
Canadian Fisheries Act (R.S.C., 1985, c. F-14)	Department of Fisheries and Oceans Canada	Offers blanket protections for waterways that support commercial, recreational, or sport fish species. The act protects these habitats from physical and chemical alterations that may impact fish species (Legal Backgrounder Fisheries Act, 2013).
Canadian Environmental Protection Act, (S.C. 1999, c. 33)	Environment and Climate Change Canada	Protects wetlands and many other habitats from pollution and ensures that overall environmental quality is not degraded. It applies the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific uncertainty cannot be used as a reason for postponing cost-effective measures to prevent environmental degradation and promotes and reinforces enforceable pollution prevention approaches (Climate Change Canada, 2017a-c)
Navigable Water Protection Act, (R.S.C., 1985, c. N-22)		Protects wetlands classified as “navigable waters” from alteration (Government of Canada, 1985).
Migratory Birds Convention Act, (S.C. 1994, c. 22)		Protects wetlands that serve as habitat for migratory bird species (Climate Change Canada, 2017a-c).

Program	Administering Agency	Effect
Canada Wildlife Act (R.S.C., 1985, c. W-9)		Permits agreements to purchase and conserve valuable lands that support important species (Climate Change Canada, 2017).
Species at Risk Act (S.C. 2002, c. 29)		Protects a wide variety of species that are at risk or threatened and protects their habitats (Assessment of Potential Wetlands Effects, 2014).
Canadian Environmental Assessment Act (S.C. 2012, c. 19, s. 52)	Canadian Environmental Assessment Agency	Provides guidance and standards for how the impacts to wetlands or other habitats will be assessed (Environmental Assessment Agency, 2016).

Similarities between the United States and Canadian framework include: 1) avoidance of loss when possible; 2) minimization of the extent of unavoidable losses; and 3) compensation through mitigation or other mechanism for unavoidable losses. However, as of 2007, the Canadian government had not developed wetland compensatory mitigation guidelines (Austen, E., & Hanson, A. (2007), which leaves development of compensatory mitigation frameworks to non-profits and provinces.

3.2.3 CANADIAN PROVINCIAL REGULATIONS

The Canadian province of Ontario borders all but one of the Great Lakes. Ontario is subject to Canada's federal wetland laws and it has a province-wide strategy as well as numerous laws and ordinances to protect wetlands.

Ontario's wetland conservation strategy for 2017-2030

This provincial strategy is a framework to guide wetland conservation across the province (Ontario Ministry of Natural Resources and Forestry, 2017, also see Table 3.3). The strategy includes vision, goals, outcomes, and a series of actions that the government will undertake by 2030. Three of these actions have been prioritized above all others and are detailed below:

1. Improving Ontario's Wetland Inventory and Mapping: The strategy offers the following suggestions for how the province's wetland inventory could be improved:
   - Ensure mapping procedures are up-to-date, consistent, and use the best technologies available.
   - Improve monitoring of wetland extent and align monitoring with policy targets and reviews.
   - Incorporate climate change considerations and evaluate data from partners and indigenous communities.
2. Creating No Net Loss Policy: The strategy proposes development of a wetland offsetting policy as an option to prevent the net loss of Ontario's wetlands. The following key considerations are identified:
   - The program should not relax any current wetlands protections.
   - The program should work with existing permitting and other frameworks.
   - Clearly articulate wetland functions, offsetting eligibility, and offsetting levels.
   - Establish distances and proximities acceptable for offsets.
   - Ensure wetland losses and gains do not generate an unbalanced distribution of wetland habitats.

- Finally, create policy structures and timelines that support and define implementation.

Ontario's 2017-2030 Wetland Strategy seeks to directly address the impact on wetlands in the Province. Priority goals include better inventory/mapping, a clear no-net loss policy, and a path to improve and restore existing wetlands.

Table 3.3 Ontario's Wetland Regulations in Ontario (Wetland Conservation in Ontario: A Discussion Paper, (n.d.); Ontario Ministry of Natural Resources and Forestry, 2017)

Laws	Details
Planning Act; Provincial Policy Statement 2014; Niagara Escarpment Planning and Development Act & Plan; Oak Ridges Moraine Conservation Act, 2001 & Plan; Greenbelt Act, 2005 & Plan; Lake Simcoe Protection Act, 2008 & Plan; Conservation Authorities Act Regulations; Renewable Energy Approvals Regulation (under the Environmental Protection Act); Crown Forest Sustainability Act, 1994; Forest Management Guides	The Ontario government's wetland conservation framework is composed of legislation, regulations, policies, guidelines, and agreements and includes grant and incentive programs and strategic partnerships. The wetland policy in Ontario is comprised of over 20 different pieces of legislation administered and/or implemented by five provincial Ministries, two federal Ministries, a provincial agency (Niagara Escarpment Commission), 36 conservation authorities and 444 municipalities. Eight policy instruments (see regulatory citation) prohibit certain activities in wetlands and/or protect wetlands from development.

3. Improving Wetlands Evaluation: For over 30 years, Ontario has evaluated and rated their wetlands in order to rank them relative to one another. A review of the methods used to evaluate wetlands will allow the province to explore:
   - How to incorporate advances in technology and scientific understanding.
   - Reconsider which values should be evaluated in light of new knowledge and priorities.
   - Improve guidance for incorporating local and traditional ecological knowledge and involving indigenous communities in decision making.

This new strategy will enable to build on past successes in wetland conservation.

3.2.4 STATE-SPECIFIC REGULATIONS IN THE UNITED STATES

In the United States, in addition to the CWA and other federal statutes, many regulatory programs provide environmental regulation to protect natural resources, including wetlands. The regulatory framework for wetland protection at the state level is summarized below and in Table 3.4.

State of Minnesota

In Minnesota, the USACE regulates discharge of dredged of fill material into Waters of the U.S. under Section 404 of the CWA and the Minnesota Pollution Control Agency (MPCA) administers Section 401 CWA. Two additional state programs regulate activities affecting water resources, including wetlands. The Wetland Conservation Act, which regulates most activities affecting wetlands, is administered by local government unites (i.e. counties, townships, cities, watershed districts, watershed management organizations, or state agencies (on state-owned land) and enforced by the MN Board of Water & Soil Resources. The Minnesota Department of Natural Resources (MDNR) regulates activities below the ordinary high-water mark in specially-designated public waters (i.e. designated as "public waters" and

"public water wetlands" in the Public Water Inventory Maps) through the Public Waters Work Permit Program.

Exemptions under the Wetland Conservation Act and the Public Waters Permit Program include a number of agricultural activities, construction of roads to construct silvicultural activities, as well as riprap, debris removal, seasonal docks, respectively. Mitigation for all federal jurisdictional wetlands is conducted by the USACE. Compensatory mitigation is required for unavoidable wetland impacts under all state regulatory programs.

State of Wisconsin

In Wisconsin, USACE Section 404 nationwide permits are replaced by Statewide General Permits that authorize discharge of fill materials to Waters of the U.S. Under this regulatory framework, the State implements a three-tier system of authorization based on the projected level of environmental impact, which includes exemptions, general permits, and individual permits (for activities that do not fit the general category). The Wisconsin Department of Natural Resources (WI DNR) issues Section 401 WQC for permits granted by USACE. WI DNR also requires WQC for wetlands determined to be a no navigable, intrastate, and isolated. Local municipalities may also regulate wetlands in shorelands and wetlands in the shoreland zone. Mitigation for all federal jurisdictional wetlands is conducted by the USACE. The WI DNR requires compensatory mitigation for unavoidable wetland loses for all individual permits; requirements can be met through mitigation banking, in-lie fee programs, or wetland creation. The replacement ratio is a minimum of 1.5:1 provided that the impacted wetland is not a protected class.

State of Illinois

In Illinois, the USACE regulates discharge of dredged of fill material into Waters of the U.S. under Section 404 of the CWA and the Illinois Environmental Protection Agency (IEPA) administers Section 401 CWA, which is the primary regulatory program involving private lands. The Interagency Wetland Policy Act (IWPA) authorizes Illinois Department of Natural Resources/Office of Water Resources (IDNR) to regulate state-funded projects and activities that impact state wetlands. In addition, local municipalities can also regulate wetlands that are not under the jurisdiction of the USACE, IDNR, or IEPA. Mitigation for all federal jurisdictional wetlands is conducted by the USACE. Illinois does have a no net loss law for regulated wetland activities; the IWPA and establishes guidelines for compensatory mitigation for unavoidable wetland loses Adverse wetland impacts are compensated by a ratio applied to the size of impact and location of compensation relative to the impacted wetland, ratios vary between 1:1 and 1:5.5.

State of Indiana

In Indiana, the USACE regulates discharge of dredged of fill material into Waters of the U.S. under Section 404 of the CWA and the Indiana Department of Environmental Quality (IDEM) administers Section 401 CWA. The Indiana Isolated Wetlands Law (IC 13-18-22 and Indiana Administrative Code 1&) establishes the state's permitting program of state regulated wetlands, which is administered by IDEM. The Lake Preservation Act (LPA) and the Flood Control Act (FCA) provide further regulation over public freshwater lakes, including wetlands within the lake's legal shoreline and within the floodway, which often encompasses wetlands and streams. Exemptions from IDEM permitting under the State Law include all those listed under Section 404(f), discharges in a *de minimis* amount, wetland activity at a surface coal mine for which IDEM has minimization plans, and activities within "exempt isolated wetlands." Mitigation for all federal jurisdictional

wetlands is conducted by the USACE. IDEM requires compensatory mitigation for unavoidable wetland impacts greater than 0.1 acre (0.04 hectares). The rations of compensatory mitigation are calculated based on the class of wetland being impacted. The goal of mitigation is not to incur loss of wetland functions.

State of Michigan

The Michigan Department of Environmental Quality (MDEQ) administers the Section 404 program in accordance to the Natural Resources Environmental Protection Act (NREPA). Federal oversight is retained for major discharges and the USACE retains jurisdiction over traditionally navigable waters, including the Great Lakes, connecting channels, and other waters connected to the Great Lakes. The MDEQ regulates wetlands that are 5-acres (2.023 hectares) or greater in area; contiguous (directly adjacent to) to an inland lake, pond, or stream; within 500 feet (152.4 meters) of an inland lake, pond, or stream; or within 1,000 feet (304.8 meters) of a Great Lake, Lake Saint Clair, Saint Mary's River, Saint Clair River, or Detroit River. Local municipalities add additional protection to wetland resources and may include those isolated wetlands that do not meet the MDEQ criteria. Exemptions from MDEQ permitting under State Law include multiple activities including certain agricultural activities, construction of temporary forestry/mining roads; maintenance or improvements of public roads; maintenance, repair, or operation of utilities, among others. MDEQ requires compensatory mitigation for unavoidable wetland impacts greater than 1/3 acre (.0135 hectares). The ratios of compensatory mitigation are calculated based on the wetland type being impacted and vary from 1.5:1 to 5:1; a 10:1 is required for wetland preservation.

State of Ohio

In Ohio, the USACE regulates discharge of dredged of fill material into Waters of the U.S. under Section 404 of the CWA and the Ohio Environmental Protection Agency (OEPA) administers Section 401 CWA. Ohio Administrative Code, 3745-1-50_54 provides protection for wetlands via anti-degradation rules and rules that establish minimum water quality criteria. The State Isolated Wetland Law provides regulates discharges of fill to isolated wetlands not regulated under the CWA based on three levels of review, which are dictated by the wetland category (i.e. Category 1, 2, and 3 in increasing order of quality) being impacted. Compensatory mitigation for unavoidable wetland losses is outlined for each of the three wetland categories defined in the Isolated Wetlands Law and the State's water quality standards. Ohio's mitigation rules comply with federal standards for CWA regulated wetlands, but for isolated wetlands the mitigation ratios also permit purchase of credits from mitigation banks.

State of Pennsylvania

Pennsylvania operates under a Section 404 State Programmatic General Permit (PASPGP) which authorizes discharge of dredge and fill material that result in direct or indirect impacts to 1.0 acre (0.405 hectares) or less of Waters of the U.S., including USACE jurisdictional wetlands. The PASPGP is administered by the State and eliminates federal/state duplication. Activities not regulated by Section 404 CWA or Section 10 River's and Harbors Act are permitted through state general permits and correspond to activities regulated under Dam Safety and Encroachment Act. Pennsylvania's regulatory program relies on several laws and statutes which allow regulation of 'exceptional value wetlands.' Compensatory wetland mitigation for unavoidable wetland losses includes mitigation banks, in-lieu fee, and wetland creation.

State of New York

The USACE regulates discharge of dredged of fill material into Waters of the U.S. under Section 404 of the CWA and the New York Department of Conservation (NY DEC) issues WQC for projects requiring a federal permit; however, Section 401 WQC is not the main process for wetland protection in the state. The NY DEC is the primary regulatory agency that manages and protects wetlands in the state of NY under multiple state law statutes. The Adirondack Park Agency (APA) oversees wetlands within boundaries of Adirondack Park (i.e. a six million acre or two and a half million hectares) patchwork of public and private land protected under state law). NYS DEC regulates activities affecting wetlands that are greater than 12.4 acres in size and those less than 12.4 acres if they are deemed of "unusual importance." The regulated areas include wetlands and a protective buffer extending 100 feet (30.48 meters) landward of the wetland. Jurisdiction over wetlands that are less than 12.4 acres (5.02 hectares) in size and not of "unusual importance" is up to the discretion of local governments. APA regulates activities affecting wetlands greater than one acre in size or located adjacent to a body of water, including a permanent stream, with which there is free interchange of water at the surface, in which case there is no size limitation. Compensatory mitigation for unavoidable wetland impacts is provided though a framework and guiding principles for decision making related to wetland regulation and enforcement; rations of 1:1 are desirable.

Table 3.4 A Scan of Wetlands Regulations Across Great Lakes States in the United States (Thomas et. al, 2005; Environmental Law Institute, 2006, 2007, 2008)

State level regulations	Summary
Minnesota	
Minnesota Statute Chapter 103G. - Waters of the State; 103G.245 - Work in Public Waters; Minnesota Rules Chapter 6115, Public Water Resources. Wetland Conservation Act (1991). Minnesota Administrative Rules Chapter 8420, Wetland Conservation.	USACE has jurisdiction over Waters of the U.S. and MPCA issues Section 401 WQC. The state regulatory program includes the Wetland Conservation Act administered by local units of government and the Public Waters Permit Program administered by MNDNR.
Michigan	
Natural Resources Environmental Protection Act (NREPA). Part 303 Wetlands Protection, R 281.921-281.925; Part 323, Shorelands Protection and Management, R 281.21-281.26	Michigan administers the CWA Section 404 program, with federal oversight retailed for major discharges. The USACE retains jurisdiction over traditionally navigable waters, including the Great Lakes, connecting channels and other waters connected to the Great Lakes (including wetlands). Isolated wetlands that are not regulated by MDEQ are often regulated by local municipalities.
Wisconsin	

State level regulations	Summary
WQC [WI Stat. Ann. Ss 227.11(2)(a), 281.11, 281.12(1) and 283.001. Admin. Code chs. NR 299 and 103], Physical Alteration of Waterways [WI Stat. Ann. ch. 30, 31. Admin. Code chs. NR 300-353]; Narrative Water Quality Standards for Wetlands (Chapter NR 103, WI Admin. Code)]; Shoreland Zoning, Shoreland Wetland Zoning and Floodplain Zoning (WI Stat. Ann. Sections 144.26, 59.971, 62.63 and 61.351; Admin. Code. ch. 115, 116, 1170]. 2001 Wisconsin Act 6 (as amended)	USACE has jurisdiction over Waters of the U.S., but Nationwide permits are replaced by Statewide General Permits. THE WI DNR issues WQC for Section 404 Permits and for wetlands determined to be not navigable, interstate, and isolated. The WI DNR implements a three-tier regulatory system that includes exceptions, general permits and individual permits.
Illinois	
Interagency Wetland Policy Act of 1989 (20 ILCS 830); 17 Adm. Code, Part 1090 (Implementation Procedures for the Interagency Wetlands Policy Act).	USACE has jurisdiction over Waters of the U.S. and IEPA issues Section 401 WQC, as the primary mechanism for wetland protection in private land. The IDNR regulates state-funded projects and activities that impact state wetlands. Local municipalities may also regulate wetlands that are not under jurisdiction of USACE, IEPA, or IDNR.
Indiana	
Indiana's State Isolated Wetlands law (Indiana Code 13-18-22) and 327 Indiana Administrative Code 17	USACE has jurisdiction over Waters of the U.S. and IDEM issues Section 401 WQC. IDEM administers the state's regulatory program, which regulates isolated wetlands.
Pennsylvania	
Dam Safety and Encroachments Act; Dam Safety and Waterway Management Rules and Regulations (Title 25, Pennsylvania Code, Chapter 105). State Programmatic General Permit (PASPGP)	A Programmatic General Permit from the USACE authorizes discharges to Waters of the U.S. Activities not regulated by Section 404 or Section 10 are permitted through general permits. PA DEP issue Section WQC.
New York	
Freshwater Wetlands outside of Adirondack Park (NY ECL Article 24, Title 7); Freshwater Wetlands within the Adirondack Park (NY ECL Article 24, Title 8; NY ECL Article 27); Freshwater wetlands subject to local control (NY ECL Article 24, Title 5); Tidal Wetlands (NY ECL Article 5); Wetlands Adjacent to State's Navigable Waters (NY ECL Article 15, Title 5)	USACE has jurisdiction over Waters of the U.S. and NY DEC issues Section 401 WQC. The primary regulatory agency is the NY DEC. The APA also oversees wetland regulation within boundaries of the Adirondack Park.
Ohio	
CWA Section 401, Water Quality Certification. Ohio Isolated Wetland Law, Ohio Revised Code 6111.02 through 6111.028	USACE has jurisdiction over Waters of the U.S. and OEPA issues Section 401 WQC. OEPA administers the state's regulatory program, which regulates isolated wetlands.

3.2.5 BINATIONAL AGREEMENTS

To address the international issues associated with wetland protection, the United States and Canada have engaged in several binational agreements that help to protect valuable wetlands and water resources. Agreements also exist among global community members to recognize particularly significant wetlands that are unique. These agreements may not have the force of law, but often serve to help coordinate responses and actions.

Great Lakes Water Quality Agreement and Boundary Waters Treaty

The Great Lakes Water Quality Agreement (GLWQA) and Boundary Waters Treaty are the oldest and most important agreements between the United States and Canada; through the GLWQA and Boundary Waters Treaty, both countries commit to restore and protect the waters of the Great Lakes. The Boundary Waters Treaty established the IJC who administers the GLWQA and pursues the common good of both countries as an independent and objective advisor to both governments. One of the General Objectives of the GLWQA (Article 3) is to support healthy and productive wetlands and other habitats to sustain resilient populations of native species. Specifically, Annex 7 - Habitat and Species seeks to achieve these objectives by implementation of programs and measures that contribute to the recovery of populations of species at risk, restoration of degraded native habitat and species, and a net gain in habitat (GLWQA 2012). These protections help to focus efforts on both sides of the Great Lakes to help preserve the precious regional resources, including wetlands.

Lake Ontario and St Lawrence River Plan 2014

The IJC developed the Lake Ontario and St. Lawrence River Plan (2014 Plan) to address the restricted variability water levels in Lake Ontario. The previous regulation plan had been in place for more than a half century, Plan 1958D with deviations (Plan 1958DD), and had unnaturally compressed water levels and harmed coastal ecosystems on Lake Ontario and the upper St. Lawrence River. These impacts were not understood when the previous plan was approved, but it is now widely recognized that ecosystem needs must be considered along with interests from other sectors such as economics and industry sector. Accordingly, the IJC reviewed an extensive range of alternative regulation plans through 16 years of scientific study, public engagement, dialogue with basin governments and careful consideration of all water uses and affected interests in Canada and the United States.

Lake Ontario and St Lawrence River Plan of 2014 is an IJC initiative that addresses the issue of artificially compressed water levels and harmed coastal ecosystems on Lake Ontario and the upper St. Lawrence River. The plan allows for a larger variability in water-levels which should help wetlands in the Great Lakes Basin.

The Lake Ontario and St. Lawrence River Plan allows more natural water levels while minimizing impacts to other interests. For example, compared to 1958DD, the increase in the maximum Lake Ontario level under 2014 Plan is six centimeters (2.4 inches). This water-level issue isolates nearby wetlands to the point of drought and damage. The plan also attempts to balance reconnecting these wetlands against the potential damage to residential properties from extremely high or extremely low water-levels.

3.3 POLICIES AND PROGRAMS THAT MAY AFFECT WETLANDS

In Canada, lack of wetland compensatory mitigation guidelines (Austen, E., & Hanson,

A. (2007) leaves development of compensatory mitigation frameworks to non-profits and provinces, which may mean uneven policies and implementation frameworks.

In the United States, while laws that expressly protect wetlands act as they are intended, there are ways that other laws can unintentionally but negatively impact wetlands even though all impacts need a careful NEPA analyses. Typically, these impacts arise when: a) certain land uses are determined to have values that exceed the value of the otherwise protected wetland, or b) they provide incentives even if wetlands are destroyed. For example, a great deal of progress could be made by reducing agricultural incentives when a negative impact on wetlands is produced.

Examples of U.S. laws at the federal level are presented in Table 3.5.

Table 3.5 U.S. Laws that May Affect Wetlands (Wetland Management and Research Wetland Protection Legislation. (n.d.))

Law	Administering Agency	Effects
Federal-Highway Act of 1968	DOT	Highway construction can affect wetlands at every stage. Wetlands are often prime sites for highways.
Federal Crop Insurance	USDA	Indirectly encourages farmers to place frequently inundated areas, including wetlands, into production.
Federal Livestock Grazing	USFS, BLM	Overgrazing promotes the loss of riparian habitat.
Flood Control Act of 1944 (P.L. 78-534)	USACE	Authorized various flood-control projects resulting in wetland destruction.
National Flood Insurance Program	FEMA	Unintentionally encourages development in flood plains, which contain wetlands, by providing low-cost Federal Insurance.
Payment-in-Kind (PIK) Program	USDA	Indirectly encourages farmers to place previously unfarmed areas, including wetlands, into production.
Small Reclamation Projects Acts of 1956 (70 Stat. 1044)	DOI	Encourages State and local participation in small western reclamation projects, which can destroy riparian habitat.
Surface Mining Control and Reclamation Act (P.L. 95-87), (1977)	DOI	Establishes a program for regulating surface mining and reclaiming coal-mined lands, including wetlands, under the Office of Surface Mining, Reclamation, and Enforcement
Surface Transportation Revenue Act of 1991(P.L. 102-240)	DOT	Transportation projects directly and indirectly destroy wetlands.
U.S. Tax Code	IRS	Encourages farmers to drain and clear wetlands through tax deductions and credits for development activities.
Water Resources Development Act of 1976, 1986, 1988, 1990 (P.L.'s 94-587, 99-662, 100-676, 101-640)	USACE	Water development projects directly and indirectly destroy wetlands

3.4 JURISDICTIONS IMPLEMENTING ADAPTIVE MANAGEMENT PRINCIPLES

Collaborative, integrated adaptive management offers an approach that helps address the uncertainties of an evolving future associated with climate change and the potential for extreme water levels and associated impacts. Adaptive management is a structured, iterative process for continually improving management results by learning from the outcomes of previous policies and practices.

In the context of wetlands and *at the scale* of the 11 jurisdictions defined in this report, the Project Team was unable to locate any definitive adaptive management *projects* being implemented in any of the jurisdictions across the Great Lakes. The only adaptive management plans found were related to a) IJC's own efforts related to water-level guidelines; and b) an adaptive management framework for *Phragmites* that is led by the Great Lakes Phragmites Collaborative.

At more local levels, several adaptive management projects are currently underway. This includes an initiative by the Stewardship Network that is addressing Phragmites in coastal wetlands. Efforts are also underway in Rondeau Provincial Park in Canada. However, none of these efforts have undergone rigorous evaluations to present a conclusive commentary.

3.5 MATRIX SUMMARIZING THE FINDINGS FROM JURISIDICTIONAL ANALYSES INCLUDING BENEFICIAL AND DETRIMENTAL POLICIES

Regulation remains the cornerstone of protecting wetlands. However, to achieve the goal of net habitat gain in the Great Lakes, additional efforts and additional incentives are required. The previous sections illustrate the regulatory approaches the various jurisdictions have taken to protect wetlands in the Great Lakes. Table 3.8 presents a comparison of the applicable regulations in the 8 U.S. states and how their approaches differ from one another. This represents a comparison of more than 70% of the regulatory bodies in the Basin and provides valuable insights into how wetland protections can be improved.

The Great Lakes states have taken different approaches to wetlands. These jurisdictions have differing definitions of wetlands, differing policies as to what riggers

Table 3.6 Comparison Matrix of U.S. State Environmental Laws (Environmental Law Institute, 2008)

JURISDICTION	U.S State Permitting authority in Coastal and Freshwater Wetlands	Authority to Permit Geographically Isolated Wetlands	Wetland Permit Tracking System	Wetland Specific Water Quality Standards (WQ Criteria, Designated Uses, Anti-Degradation Policy)	Wetland Monitoring Programs	Wetland Restoration Goals?
Michigan	Yes	Yes	Yes	Yes	No	Yes
Wisconsin	No	Yes	Yes	Yes	Yes	No
Illinois	No	Limited	Yes	Yes	No	No
Indiana	No	Yes	No	No	No	No
Minnesota	Yes	No	Yes	Yes	Yes	Yes
Pennsylvania	Yes	No	Yes	No	No	Yes
New York	Yes	No	Yes	No	No	No
Ohio	No	Yes	No	Yes	Yes	Yes

regulation, and differing enforcement approaches. The following examples demonstrate how these differences affect wetlands protection:

- Only Michigan, Minnesota, Pennsylvania and New York have wetland permitting authorities in coastal and freshwater wetlands;
- Only Michigan, Wisconsin, Indiana, and Ohio have authority to permit geographically isolated wetlands;
- Indiana and Ohio have no wetland permit tracking systems in place;
- Indiana, New York, and Pennsylvania issue Section 401 WQC, thus they do have tools to manage water quality standards and antidegradation rules.
- Various states have differing methods of implementing these standards within their status. Anti-degradation rules are in Section 404 permitting rules/statutes. In Michigan these Water Quality Standards are imbedded in NEPA under state rules and parts.
- Michigan, Illinois, Indiana, Pennsylvania, and New York have no wetland monitoring programs in place; and
- Wisconsin, Illinois, Indiana, and New York have no state-wide wetlands restoration goals in place.

As a binational organization, the IJC can and should promote more uniform laws to protect wetlands. While the analyses presented thus far in this section focusses on United States, similar challenges can be found in Canadian regulations. to improve wetlands control across the basin, the IJC could consider:

- Protection framework for geographically isolated wetlands currently not included in federal protections;
- Uniform delineation criteria applicable across the basin;
- Uniform in-lieu fee program templates to generate funds for restoration of lost wetland functions statewide;
- Open and spatially explicit permit activity tracking frameworks; and

Anti-degradation standards as well as water quality standards for wetlands that keep net habitat gain as its primary objective.

4.0 IDENTIFICATION OF BEST PRACTICES

4.1 BEST PRACTICES FOR KEY STRESSORS TO THE WETLANDS ECOSYSTEM

To provide protections for wetlands and ensure their health and integrity in the future, the five major stressors on the Great Lakes must be addressed. These stressors, including water level regulation, commercial and non-commercial development, pollution (especially nutrient pollution), invasive species, and climate change have the potential to inflict tremendous harm on wetland resources throughout the Great Lakes.

4.1.1 WATER-LEVEL REGULATION

One of the greatest concerns associated with Great Lakes is whether water levels in the basin that are subject to artificial controls will be able to mimic the natural variability that is key to so many habitats. IJC's 2014 Lake Ontario Plan described earlier in this report represents a practice that has produced the effects intended and helped alleviate the concerns around water level regulation in the Great Lakes. Any future concerns around other lakes should emulate this successful effort.

4.1.2 COMMERCIAL AND NON-COMMERCIAL DEVELOPMENT

Jurisdictional regulations can help controlling development – particularly on private land - and ensuring that wetland areas are not being drained, ditched, or filled.

4.1.3 POLLUTION/NUTRIENT OVERLOADING

Pollution has a long and problematic history in the Great Lakes. One of the most effective programs for dealing with the legacy of environmental contamination has been the Areas of Concern (AOC) program. The Great Lakes were home to 43 areas of concern (Areas of Concern. (n.d.)) and has invested considerable time and effort into creating remedial action plans (RAPs) to address the long-term beneficial use impairments (BUIs) in these sites. As of 2018, seven of the 43 sites have been delisted and removed 56 of the 255 BUIs that were originally included in the program (Restoring the Great Lakes AOCs (2017, March 21)).

This progress happened due to well formulated public-private engagements that led to strategic frameworks on both sides of the borders, followed by resources allocated to accomplish goals related to use impairments and nutrient overload. These processes need to be emulated elsewhere in the basin.

4.1.4 INVASIVE SPECIES

Both countries have developed invasive species management activities and are trying to extirpate or at least control them. Some control programs have seen fairly successful – if costly – results like the Lamprey Eel. Others, like Asian Carp and *Phragmites*, threaten major changes to the entire ecosystem. These programs must be supported – and funded – if the wetland ecosystem can be expected to be sustainable.

4.1.5 CLIMATE CHANGE

Climate change in the Great Lakes presents a tremendous complicating factor for the basin. The basin is expected to experience increased rainfall volume over shorter periods of time, exacerbating the impact of these stressors on environmental systems (Dorgeville, M., et. al. 2014). To prepare and adapt to a changing climate, adaptive management frameworks are needed.

Example of a Few Best Practices in Ontario

1. *Conserving migratory bird habitats in the Great Lakes (source: Ontario's Great Lakes Strategy 2016 Progress Report): The Ontario Eastern Habitat Joint Venture (EHJV) is a collaborative partnership of government and non-government organizations in Ontario, working together to conserve wetlands and habitats that are important to waterfowl and other migratory birds. Since 1986, the Ontario EHJV and similar partnerships in other provinces have helped to implement habitat conservation programs that support continental waterfowl objectives identified under the North American Waterfowl Management Plan. Partners work across Ontario; however, the focus is often in areas of southern Ontario where loss of wetland habitat has been highest.*

   Between 2006 and 2014, Ontario Eastern Habitat Joint Venture partners invested over $58.3 million to conserve wetlands and associated habitat across Ontario; this resulted in the securement of 37,379 hectares (92,366 acres), the restoration of 12,217 hectares (3,007 acres) and the management of 46,023 hectares (113,725 acres)of wetland habitat.

2. *Developing land-use planning policies that protect our wetlands (sources: Ontario's Great Lakes Strategy 2016 Progress Report, Provincial Policy Statement, 2014, and A Wetland Conservation Strategy for Ontario 2017-2030): Ontario's Provincial Policy Statement provides policy direction on land-use planning decisions across the province including the Great Lakes Basin. Policies updated in 2014 prohibit development and site alteration in significant coastal wetlands and increase protection for all coastal wetlands in southern Ontario including the Lake Huron, Lake Erie and Lake Ontario watersheds. Currently Ontario is updating mapping of all coastal wetlands within the province by 2020. This new mapping will help municipalities implement the coastal wetland policies.*

3. *Controlling invasive species to restore coastal wetlands (Sources: A Wetland Conservation Strategy for Ontario 2017-2030, and Ontario Ministry of Natural Resources, Invasive Phragmites – Best Management Practices, Ontario Ministry of Natural Resources): Ontario has taken action to combat the ecological and economic threats that Phragmites poses to the natural environment. In 2016, the Ontario government regulated Phragmites as a restricted species under the Invasive Species Act, enabling new tools in the management of this invasive plant. The province also provides funding to the Invasive Species Centre and the Ontario Invasive Plant Council's Ontario Phragmites Working Group to coordinate research and management in the province to identify innovative solutions to address Phragmites and to help landowners, municipalities and conservation groups control this invasive plant. This has led to a pilot project at Long Point and Rondeau Bay to test the application of a herbicide in wetland areas to combat Phragmites. With positive results, this project is helping to demonstrate the effectiveness of controlling Phragmites in wetlands with the use of herbicides.*

4.2 INCENTIVE FRAMEWORK BEST PRACTICES

The success of the Great Lakes Restoration Initiative (GLRI) on the U.S. side demonstrates the need for sustained funding frameworks that yield results. Similar efforts are currently underway in Canada as well. A set of funding frameworks, by no means an exhaustive list, is presented in Table 4.1.

In addition, incentive-based frameworks can further greatly enhance wetland restoration. Among newer such tools include frameworks such as credit trading, mitigation banking, and storm water banks.

In what follows, a set of incentive-based frameworks in United States and Canada are described next.

4.2.1 UNITED STATES PROGRAMS: THE FARM BILL

In the United States, the "farm bill" is the primary agricultural and food policy framework of the federal government. The comprehensive omnibus bill is passed by U.S. Congress approximately every five years and deals with both agriculture and all other affairs under the purview of the U.S. Department of Agriculture (USDA).

The farm bill has a long history of supporting conservation actions, although the definition

Table 4.1 EXAMPLES OF INCENTIVE FRAMEWORKS

Jurisdiction	Policy	Characteristics	Source
Wisconsin	2011 Wisconsin Act 118	Requires certain applicants to mitigate for unavoidable adverse wetland impacts. Three types of compensatory mitigation options to satisfy requirements: wetland mitigation banking, in-lieu fee program, permittee responsible mitigation	https://dnr.wi.gov/topic/wetlands/mitigation/
Ontario	Great Lakes Guardian Community Fund	This policy provides up to $25,000 for restoration or remediation activities throughout Ontario's territory in the Great Lakes Basin.	https://www.ontario.ca/page/great-lakes-guardian-community-fund
USA and Canada	Great Lakes Restoration Initiative	The Great Lakes Restoration Initiative funds many different efforts including wetland restoration on a binational basis throughout the basin	https://www.glri.us/actionplan/pdfs/glri-action-plan-2.pdf
Ohio	Stream and Wetlands In-Lieu Fee Program Mitigation Program	Restores wetlands to offset environmental impacts from economic development.	https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/ohio/ohio-stream-and-wetland-in-lieu-fee-mitigation-program.xml

of conservation actions has changed through time (Stubbs, 2014; Stubbs, 2016). As recently as the 1970s, the bill regulated practices like tile drains and open drainage ditches under the Agricultural Conservation Program. Now widely recognized to be detrimental to wetlands, they were removed from accepted practices in the 1980s.

As conservation priorities evolve, the farm bill attempts to adapt. Conservation programs can help stem the tide of farm nutrients and waste runoff into streams, which has put drinking water, animal life and plant growth at risk, as well as created at dead zone in the Gulf of Mexico at the mouth of the Mississippi River where no living things grow. Conservation programs make up about 6 percent of the $500 billion federal farm bill.

The current bill enacted new programs and updated existing ones impacting wetland conservation and restoration, such as:

- Conservation Reserve Program (CRP): The largest program in the farm bill pays farmers to take environmentally sensitive land out of production — typically, that's land that is highly erodible — for 10 or 15 years, allowing it to return to its native status. The 2014 farm bill capped CRP land at 24 million acres or 9.7 million hectares (about the size of Indiana), and it's nearly full, at a cost of $1.8 billion due to low prices for soybean and corn. CRP payments are calculated by looking at average land rental rates. When those numbers are competitive with what farmers can make growing crops, more of them may turn to CRP.
- Environmental Quality Incentives Program (EQIP): If farmers want to add cover crops for better soil health or install irrigation systems that help prevent groundwater contamination, they can apply for funding to cover those costs through EQIP. Installing conservation systems through EQIP can be important for farmers that want to maintain the soil's long-term production quality. EQIP is highly competitive, and in 2016, it was paying for more than 36,000 different projects.
- Conservation Stewardship Program (CSP): Like EQIP, CSP funds projects that add to the sustainability of farmland. It also rewards farmers who are already using methods like adding riparian

At $30 Billion a year towards conservation, the United States Farm Bill is a big driver of conservation efforts across the country, including the Great Lakes basin. Its three biggest program are massive in scope, for example:

1. *The Conservation Reserve Program is fully subscribed at 24 mil acresor 9.7 mil hectares (about the size of Indiana).*
2. *The Environmental Quality Incentive Program was paying for 36,000 projects in 2016.*
3. *The Conservation Stewardship Program covered up to 10 mil acres or 4 mil hectares of land — about the size of Massachusetts and Connecticut combined.*

That said, continued focus on improving its effectiveness is needed, and the following are recommended for 2018 Farm Bill:

1. *Increase flexibility in program administration and maximize ecosystem services using targeted placement of easements and other restoration practices*
2. *Expand conservation technical assistance to promote successful practices*
3. *Strengthen methods that demonstrate conservation successes and support state certification programs*

buffers to reduce runoff or installing better drainage systems to protect water quality. The 2014 farm bill covers up to 10 million acres of land in CSP — about the size of Massachusetts and Connecticut combined.

- The Swampbuster Program: Swampbuster is a provision of the Food Security Act of 1985 (P.L. 99-198) that discourages the conversion of wetlands to cropland use. Producers converting a wetland area to cropland lose eligibility for several farm bill benefits. Benefits are lost from when water-levels are lowered to facilitate agricultural production until they have been restored.
- Farmable Wetland Program (FWP): FWP is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees. The Farm Services Agency (FSA) runs the program through the CRP with assistance from other government agencies and local conservation groups.
- Agricultural Conservation Easement Program (ACEP): This program rolled many past easement programs into one. One of the most significant discontinued programs was the Wetland Reserve Program. That program's goals of purchasing long-term easements from farmers and restoring wetlands have been continued through the wetland easement program under ACEP.

In the above, note that other common program names exist that consolidate efforts of multiple programs. For example, introduced in the 2014 farm bill, the Regional Conservation Partnership Program (RCPP) is a new program that consolidates several programs eliminated by the bill, using funds and authorities from existing conservation programs to coordinate conservation efforts across the programs and on a regional scale. The specific programs used by RCPP are: ACEP; EQIP; CSP; and the Healthy Forests Reserve Program.

The 2018 farm bill will likely include changes to the list of approved practices as more conservation techniques are developed, and the top three programs (CRP, EQIP, and CSP) could see minor changes in acreage or funding. Conservation programs have extensive support among law makers and the farming community and are expected to remain a high priority.

4.2.2 CANADIAN PROGRAMS

Canada's National Wetlands Conservation Fund

The National Wetlands Conservation Fund was established in 2014 and, even though it has been wound down in 2018, continues to fund 55 projects until their date of completion (Climate Change Canada, 2018). The fund expended nearly $25.5 million through March 2017 and was able to fund 198 projects to restore and enhance 342,600 hectares or 846,583 acres of wetland areas. Canada has now ended the National Wetland Conservation Fund. While the fund is no longer active, its legacy of providing funding for the protection and restoration of wetlands in Canada is a legacy to emulate.

Canada's Ecological Gifts Program

Canada's Ecological Gifts Program is available throughout the entire country as a method for private citizens to preserve important ecological areas while receiving compensation for their donation. The program accepts many kinds of habitats including wetlands and can accept fee-

simple gifts as well as easements and other methods of preservation. Since its beginnings in 1995 the program has accepted over 1260 ecological gifts valued at almost $1 billion Canadian encompassing over 180,000 hectares or 444,789 acres (Climate Change Canada, 2017a). The program offers landowners who donate tax reductions to help compensate them for their donations.

Wildlife Habitat Canada Grants
First started in 1985, the Wildlife Habitat Canada Grants provides funds for habitat conservation throughout all of Canada. In total the program has provided $50 million in funding while also leveraging $150 million of other funding from project partners (Conservation Grant Program. (n.d.)). The program has provided support for over 1,500 projects and is primarily funded through the required purchase of conservation stamps by Canadian Waterfowl hunters. The program prioritizes programs that address the North American Waterfowl Management Plan, impact local and regional habitats of importance, and especially activities under the Newfoundland and Labrador Murre Conservation Fund.

Great Lakes Guardian Community Fund
Supporting the Great Lakes Protection Act, the Great Lakes Guardian Community fund launched in 2012 and has awarded $7.5 million to community-based projects that protect water quality for human and ecological health, improve wetlands, beaches and coastal areas, and protect habitat and species. The program provides up to $25,000 but only in areas hydrologically connected to the Great Lakes or other key watersheds in the basin. The fund has supported over 375 projects throughout its existence and continues to provide vital support for grass roots efforts in Ontario. During the current year (2018) it has provided $1.8 million in support of 60 projects.

4.3 CASE-STUDIES OF WETLAND PROTECTION AND RESTORATION IN THE GREAT LAKES BASIN

The Great Lakes' diverse landscape is dotted with wetlands, which provide an incredibly rich tapestry of habitats and resources. In many places, wetlands have been isolated and protected. In others, especially wetlands located close to cities, they have been heavily impacted by human activities.

This section presents six case studies chosen by the advisory board. These include the following in the United States:

- Kakagon Bay and Bad River Sloughs
- Saginaw Bay
- St. Clair Delta

And the following in Canada:

- Long-point National Wildlife Area
- Eastern Georgian Bay
- Rondeau Provincial Park Wetland

Some of these case studies represent wetlands preserved through strict protections, while others represent areas where restoration programs have been implemented.

4.3.1 KAKAGON AND BAD RIVER SLOUGHS

Background
Kakagon and Bad River Sloughs are in northern Wisconsin on Lake Superior after the confluence of the White and Bad rivers and are some of the most pristine and productive habitats in the world. Covering almost 16,000 acres (64,749 hectares), the sloughs lie almost entirely on the tribal land of the Bad River Band of Lake Superior Chippewa Indians and access to the site is highly controlled.

The protected wetlands host a whole range of threatened species and are an outstanding testament to the Bad River Band of Lake Superior Chippewa's and their

project partners' efforts (Wisconsin Wetlands Association, n.d.; Bad River Watershed Association. n.d.). The wetlands cover tamarack swamps, emergent wetlands, and lagoons offering incredible habitat diversity in a concentrated area. These wetlands are a major habitat for migratory birds, including ovenbirds, sedge wrens, and northern harriers, while also supporting native plants and a thriving animal population. Threatened species, including Canadian lynx and Lake Sturgeon, make their home in this area.

This wetland area is also the largest ancient wild rice bed in western Lake Superior, and accordingly, its value is connected to this centuries-old traditional food source.

Work done to date

Funded by GLRI (2017), between 2010 and 2015, nearly 25 projects worth $4.8 million were completed to help restore this region. The broad support for preserving this wetland can be seen in the Annual Wetland Award received in 2015 from the Wisconsin Wetland Association for Bad River Band and their project partners continued work with water quality code and monitoring efforts in this area (Bad River Watershed Association. n.d.). Additionally, RAMSAR, the international wetland organization, has recognized the sloughs for their uniqueness and value and have placed these wetlands on their RAMSAR list of wetlands of international importance (The Ramsar Convention on Wetlands, 2012).

Best Practices

- First, and perhaps most importantly, the sloughs are a unique resource and the best practice is to protect it at all costs, as opposed to introduce active management practices.
- Located in Lake Superior watershed, it is remote and, thus, lake-level impacts and development are not likely to impact it any time soon.
- A key challenge for the sloughs is mining at the head of the watershed in the Penokee Hills that could release harmful contaminants that would seriously impact the wetlands functions and value.
- Deer over browsing threatens natural regeneration, and invasive species threaten some of the unique habitats that make up this valuable region. Efforts are in place to address them and need to continue to be funded.

Without continued vigilance and protection, these habitats will lose what makes them unique.

Key lessons learned from Kakagon and Bad River Sloughs include: good working relationship between Bad River Bank of Lake Superior Chippewa Indians and the Wisconsin Department of Natural Resources, carefully addressing mining interests in the region, and invasive species management.

Finally, noting this region's importance, "prevention is the best practice: is a great lesson for other areas.

4.3.2 SAGINAW BAY

Background

Located in central-east Michigan, Saginaw Bay watershed is 8,700 square miles (22,533 square kilometers) of agricultural productivity, industrialized urban area, and wetlands. Before European settlement, this

region had one of the most extensive wetland complexes in the entire Great Lakes watershed, and it still includes many important wetlands. In addition, the watershed contains over 175 inland lakes and 7,000 miles (11,265 kilometers) of rivers and streams, which provide very diverse habitat for many plant and animal species (Public Sector Consultants, 2012).

Work done to date

Since 1988, extensive work has gone into remediating the region. Extensive planning has already been done to develop strategies to stop further degradation of the watershed. As a large part of the watershed is also an area of concern, it has also availed significant federal investment through the GLRI. In addition, according to the goals outlined in the Saginaw River/Bay Area of Concern Restoration Plan, the region strives for a 60 percent permanent habitat protection goal. Per GLRI (2017), between 2010 and 2015, nearly 58 projects worth $24 million were undertaken to help restore this region.

Best Practices

- This region's biggest challenge is that it is a home to four major cities (Bay City, Flint, Midland, and Saginaw) that comprise 1.4 million people. Because of human activity, the complex honeycomb of rivers and waterways has been heavily altered and negatively impacted. Much of this is now being addressed via grants and other incentive frameworks. GLRI is a part of this solution, which has already resulted in removal of three beneficial use impairments, including loss of fish and wildlife habitat.
- Careful coordination with citizens and stakeholders to develop remedial action plans that contained priorities to restore the region.
- Nutrient pollution is a big problem for Saginaw Bay, and federal and state agencies are jointly working together to address the topic. This includes cutting-edge, water-quality trading projects and incentive-based frameworks for farmers.
- Finally, a large amount of money has been spent under various federal programs to remediate the region.

Best practices adopted in Saginaw region include a close coordination between stakeholders and regulatory agencies, careful planning and framework development, and availability of resources (GLRI, for example) to make changes happen.

As the region is very similar in nature to Western Lake Erie and Green Bay, a combination of practices adopted here can easily be replicated elsewhere in the Great Lakes basin.

4.3.3 ST. CLAIR DELTA

Background

At about 1,200 square miles (3,108 square kilometers) and 367 miles (591 kilometers) of rivers and streams, the St. Clair Delta is a large, shallow basin between the St. Clair and the Detroit rivers and is the largest wetland area in the Great Lakes. The Canadian portion of the St. Clair Delta is managed by the Walpole Island First Nations people. A majority of the watershed contributing to the delta is agricultural land ("Our River – Friends of the St. Clair River," n.d.).

The delta contains seven deep channels that enter Lake St. Clair, with a total average discharge of about 177,000 cubic feet (5012.1 cubic meters) per second (Thomas, Christensen, Szalinska, & Scarlat & 2006; Raphael & Jaworski, n.d.). Affected by this high discharge, as well as long- and short-term fluctuations of Lake St. Clair, the water levels create a unique wetland habitat in the St. Clair delta. (Raphael & Jaworski, n.d.).

The St. Clair delta ecosystem has been negatively affected by invasive species, industrial and agricultural pollution, and structural changes for shipping and flood control (EPA, 2005). These impacts were labeled beneficial use impairments (BUIs) (MDEQ Press Release Archives, 2017).

Work done to date

Both the Canadian and U.S. governments have done an exemplary job working at federal and state/provincial levels to develop remedial action plans and to implement the key priorities on both sides of the border. These priorities include remediation of contaminated sediment, extensive restoration projects, and elimination of sanitary sewer overflows and contaminant spills (EPA, 2005). Recent announcements indicated that with the completion of 12 habitat restoration projects that were funded by the GLRI, the region is no longer an area of concern (MDEQ Press Release Archives, 2017).

Best Practices

- Careful coordination with citizens and stakeholders to develop remedial action plans that contained priorities to restore the region.
- Implementing regulatory changes to address water-level fluctuations with the delta as the primary focus while keeping shipping and flood control as key objectives.
- Funding via opportunities, such as the GLRI, to implement priorities identified in the plans. As of 2017, this has resulted in the removal of eight out of nine beneficial use impairments on the U.S. side. Progress is equally impressive on the Canadian side and as of 2017, only two beneficial use impairments remain and are undergoing a re-designation process. Draft assessment reports for the outstanding three beneficial uses are being drafted.
- Significant work is still being done to address *Phragmites* in the region.

Best practices adopted in St Clair delta are similar to Saginaw region and include a close coordination between stakeholders and regulatory agencies, careful planning and framework development, and availability of resources (GLRI, for example) to make changes happen.

St Clair delta is also a great example of a binational area of importance that is close to meeting its environmental goals.

4.3.4 LONG POINT NATIONAL WILDLIFE AREA

Background

Long Point National Wildlife Area (NWA) is situated on Long Point, a sandy peninsula located in Port Rowan, Ontario, on the north shore of Lake Erie. Established in 1978, it is Ontario's largest NWA, covering 3,284 ha. Located along the Atlantic Flyway, the area is one of the most important staging grounds on the continent for waterfowl. Hundreds of thousands of migrating birds pass through Long Point every spring and fall, not to mention the more than 300 different migratory bird species that visit the peninsula.

In 1986, part of the Long Point NWA was designated as a RAMSAR site, acknowledging it as a wetland of international importance. Bird Life International has also recognized the NWA as an internationally-significant Important Bird Area ("Long Point," n.d.). Long Point is vital to wildlife in the area for its range of habitats, including marshes, open shoreline, and woodlands ("Long Point National Wildlife Area," 2017). It is home to "1,384 species of plants, 370 species of birds, 102 species of fish, 46 species of mammals, 34

species of amphibians and reptiles, and 91 species of butterflies" ("Long Point," n.d.). Many national and provincially-identified endangered species have been observed in the Long Point NWA. It is particularly important for bird species, as 75 percent of migratory birds in Ontario pass through the NWA ("Long Point National Wildlife Area," 2017).

Work done to date

One of the major threats to this important landscape comes from *Phragmites* and other invasive species. The risk of losing this landscape has galvanized the local communities to take action, developing long-term management solutions to keep invasive species in check. These ongoing activities offer the best hope of protecting this landscape for future generations. ("Southern Norfolk Sand Plain Natural Area," n.d.; "Long Point – Source Protection Plan," n.d.).

Best Practices

- NWAs are protected and managed according to the Wildlife Area Regulations under the Canada Wildlife Act. The primary purpose of NWAs is the protection and conservation of wildlife and their habitat. For this purpose, and according to the legislation, Environment and Climate Change Canada can prohibit all activities in a NWA that could interfere with the conservation of wildlife. Consequently, most NWAs are not accessible to the public and all activities are prohibited. Careful stewardship of the Canadian government has been key to the region's good health.

Long Point National Wildlife Area is a good example of an important region that is protected and managed well according to a set of wildlife area regulations. Careful stewardship of the Canadian government has been key to the region's good health. In addition to its rich history of private conservation by hunters and now conservation groups, Phragmites threat has galvanized the local population.

4.3.5 EASTERN GEORGIAN BAY

Background

Georgian Bay is a section of Lake Huron enclosed within Ontario. There are more than 3,700 coastal wetlands along the eastern coast of Georgian Bay (Fracz & Chow-Fraser, 2013). Due to its remoteness and the relatively light development pressure (mainly recreational), the region has not received as much attention as other areas in the lower Great Lakes.

Although wetlands in the region are generally in good condition, they face threats that include extreme or prolonged water-level variability, invasive species, water pollution, and increasing recreational and cottage development.

Work done to date

There have been many efforts to conserve the wetlands along eastern Georgian Bay as the bay provides habitat for many rare species. In 1929, the Georgian Bay Islands National Park was established to protect the southern portion of the bay. The area was then recognized as globally significant in 2004.

Extensive data documenting the conditions of the wetlands exists, which includes surveys starting as early as 1998 by the Chow-Fraser lab. The bay also contains two Important Bird Areas identified by Bird Life International. The Nature Conservancy Canada has worked with many partners, including Ontario Ministry of Natural Resources and Parks Canada, to protect wildlife habitat along the eastern coast of the bay ("Eastern Georgian Bay Coast Natural Area," n.d.).

More recently, the Government of Canada has built a $29 million Lake Simcoe/South-eastern Georgina Bay clean-up fund over the five-year period between 2012 – 2017. The fund was created to support projects that "improve scientific understanding of the watersheds for decision-making; rehabilitate priority habitats to restore the health of the aquatic ecosystem and the cold-water fishery; and/or reduce phosphorus from rural and urban sources" ("Lake Simcoe/south-eastern Georgian Bay clean-up fund," 2016). This fund will help to address the ongoing issues that threaten the wetlands of Georgian Bay.

Best Practices

- The Lake Simcoe/Southeastern Georgina Bay clean-up fund can serve as a good model for other locally-driven funds in the region.
- Agencies, such as Parks Canada, the Ontario Ministry of Natural Resources, and the Georgian Bay Land Trust, work with several large land conservancies in the region through innovative partnerships. This has resulted in protecting some of the most remarkable areas of the Eastern Georgian Bay Coast for future generations of people, as well as the security of wildlife who live here.
- Nutrient overloading is a key challenge here and practices being implemented hold promise elsewhere in the Great Lakes.

Best practices adopted in Eastern Georgian are multi-faceted. On one hand, it has good frameworks for public-private partnerships, and on the other, clearly set-aside clean-up funds to enable significant program and stewardship. Existing threats include extreme or prolonged water level variability, aquatic invasive species, and increasing recreational and cottage development.

- Water-level fluctuations and climate change could have significant impact on this area and need to be carefully monitored and addressed.
- Managing development also needs a careful overlay of regulations and practices that keep their focus on the wetlands of the region.

Best practices to emerge out on Rondeau Provincial Park focus on adaptive management aspects of invasive species control. The region has extensive and hard to eradicate Phragmites, and the processes developed here can be adapted elsewhere.

4.3.6 RONDEAU PROVINCIAL PARK WETLAND

Background

Rondeau Bay is enclosed on the west by mainland Ontario and to the east by a depositional spit of land. Rondeau Provincial Park protects some of the most pristine habitat left in Carolinian Canada. The park has been protected since 1894, making it the second oldest in the province of Ontario. Since the last glaciation, the land has gone through a full successional sequence from early, hardy species, like grasses, through to shade-tolerant sugar maples and American Beech (Marsh, 2006). This has resulted in tremendous diversity of habitats that have earned the site an Important Bird Area Designation from Bird Life International (Bird Life International, 2018).

The park is important for many species and supports significant populations (1 percent> of North American population or world population). The following species are present at these levels: Greater Scaup; Tundra Swan; Common Goldeneye; Ruddy Turnstone; and Forster's Tern.

In the past, some extremely vulnerable species, such as the Acadian Flycatcher and the King Rail, have also made the park home (Bird Life International, 2018).

Work done to date

Despite a long history of protection and efforts from provincial and federal authorities, the park still faces some significant threats. *Phragmites* has been making inroads into some of the wetlands in the area, and if protective actions aren't taken, this valuable habitat could be seriously impaired. To combat this risk, the Ontario *Phragmites* Working Group has created a control program to apply *Roundup* herbicide and control *Phragmites* throughout the reserve. The program has been in place since 2016 and will need to be continuously executed to control *Phragmites* populations effectively (Rondeau Bay *Phragmites* Control Program, n.d.).

Best Practices

The Ministry of Natural Resources and Forestry has recognized *Phragmites australis* as a significant threat to biodiversity and species at risk at Rondeau coastal marshes. Using currently available management tools, the ministry has been working with several partners to eradicate invasive *Phragmites* from these locations.

Efforts have been unsuccessful in controlling the spread of *Phragmites*, primarily due to the lack of a registered herbicide for use in Canadian wetlands. This remains an area that needs to be carefully monitored and reviewed in the near-term.

4.4 A SUMMARY OF IDENTIFIED TOOLS

This Chapter presented four sets of Best Practices/Tools on which Great Lakes Basin organizations could focus their efforts. These include:

1. Bringing the latest science and technology into protection and restoration of wetlands. For example, Ontario's wetland conservation strategy's focus on improving wetland inventory and mapping, as well as improving wetland evaluation are excellent starting points for regional efforts.
2. Addressing the most important stressors in the Great Lakes such as:
    a. IJC's 2015 Lake Ontario Plan for water-level regulation
    b. Laws to directly address commercial and non-commercial developments
    c. Citizen-based partnerships coupled with regulatory frameworks to reduce nutrient overloading in the Basin
    d. Preventing the spread of terrestrial and aquatic invasive species
    e. Utilizing adaptive management techniques to help direct resources to successful, cost-effective programs that also facilitate projects that are resilient to climate change
3. Eliminating gaps in regulatory frameworks in jurisdictions across the Basin.
4. Support and expand incentive-based programs that encourage wetland restoration/construction beyond regulatorily drove mitigation (for example the farm bill in the United States or various Canadian program described here-in).

And finally, the lessons learned from Kakagon Slough in United States and Long Point National Wildlife Area in Canada should be replicated in other watersheds. These protection-based programs are built on the assumption that" an ounce of prevention is worth a pound of cure".

5.0 A SURVEY OF WETLAND EXPERTS

5.1 WHY WAS IT NEEDED

A survey of experts was conducted to answer two questions:

- What are the key challenges to preserving and enhancing wetlands for the improvement of water quality and aquatic ecosystem health of the Great Lakes, including challenges to supporting a target of net habitat gain with respect to wetlands, and
- Where and what types of wetlands are at risk in the Great Lakes basin based on existing data and information?

Accordingly, the project team solicited input and information from over 50 parties across the Great Lakes basin, including experts from academia, federal resource managers, state agency resource managers at senior and mid-level positions, tribal resource managers, and leading non-governmental organizations in wetlands restoration and conservation. These experts are identified in Appendix B. The desired information was obtained using an online survey.

The survey comprised of 18 mostly multiple-choice questions, within the following categories:

- Locational information
- Assessment of threats to wetlands
- Impacts of wetlands laws, including protection versus restoration
- Barriers to wetland restoration
- Effectiveness of public engagement on the topic of wetlands
- Pathway to restoration of wetlands, such as which regulatory tools and management practices work well
- Additional comments/suggestions

Additionally, by choice, a respondent could provide contact information for the project team to follow up with questions. Otherwise, the survey remained anonymous.

Nearly 66 percent response rate was achieved for the online survey soliciting input from over 50 parties across the Great Lakes basin, including but not limited to, experts from academia, federal resource managers, state agency resource managers at senior and mid-level positions, tribal resource managers, and leading non-governmental organizations in wetlands restoration and conservation. Half of the respondents were from the U.S., while the other half were from Canada.

5.2 SURVEY PROCESS

On January 23, 2018, a total of 53 potential survey participants were contacted via email by the project team. A total of 35 responses were received; nearly 66 percent of the invited participants, of which nearly half worked in Canada. *SurveyMonkey* was used to host the online survey. The survey was kept "live" until January 30, 2018. A web link to access the survey was included in an email, which provided a brief project background and explained the survey's primary goals, in addition to expressing the importance of participation.

Potential respondents were allowed one week to access and complete the survey. Reminder emails were sent approximately three days after the initial invitation. Survey responses were tracked daily to identify any potential problems with responses.

A detailed analysis is presented in Appendix B. The following sections provide a highlighted summary pertinent to the two questions presented in Section 5.1 – 1) Key

challenges to preserving and enhancing wetlands, and, 2) location and types of wetlands at risk.

5.3 KEY CHALLENGES TO PRESERVING AND ENHANCING WETLANDS

The survey indicated the following key challenges to preserving and enhancing Great Lakes wetlands:

- **Biggest stressors to Great Lakes wetlands include climate change**: Respondents ranked the following as the top five stressors (Figure B.9, Appendix B):
  - Invasive species
  - Draining of wetlands
  - Conversion to impervious areas
  - Pollution
  - Climate change
- **So far as regulatory protection, some regions are better protected than the others:** When asked if wetland protection has become more stringent over the past decade, no clear conclusion could be discerned (Figure B.7, Appendix B), with nearly a third of respondents agreeing and another third unsure. On the other hand, one respondent cited the Ontario government's 2014 Provincial Policy Statement was more stringent in that it has increased protection for coastal wetlands in several ecoregions (5E, 6E, and 7E). This policy significantly expanded wetland protections by restricting development and site alteration from occurring unless no negative impacts can be demonstrated.
- **Regulatory requirements drive wetland restoration, but local laws were considered the weakest:** Respondents indicated that regulatory requirements are a key driver of wetland restoration in the Great Lakes basin. Community organizations and governmental entities play a key role in wetland restoration (Figure B.11, Appendix B). Based on the responses (Figure B.10, Appendix B), it appears experts thought that the local laws are the weakest in protecting Great Lakes wetlands. In addition, their enforcement was not considered adequate by nearly half of the respondents.

According to survey respondents, the top five stressors to wetlands include invasive species, wetland draining, conversion to impervious areas, pollution, and climate change.

- **Wetland law enforcement suffers from limited resources and capacity:** Respondents indicated that enforcement of existing wetlands laws is limited by both resources within the regulatory agencies and the political will toward enforcement (Figure B.11, Appendix B).
- **Lack of funding is one of the biggest barriers to wetland restoration**: Key barriers to wetland protection included lack of funding for regulatory enforcement and/or restoration efforts (81 percent agreeing) and lack of regulatory protection through existing regulation (55 percent agreeing) (Figure B.12, Appendix B).

Among things the respondents felt were going well, the following two stand out:

- **Public is informed and engaged**: Most of the respondents either agreed or strongly agreed that in their local area,

In their comments, respondents provided specific instances of key stressors identified previously: from emerald ash borer in Black ash swamps, to mining for bogs and riverine wetlands, to industrial activity in Thunder Bay.

On the other hand, respondents indicated that Lake Superior wetlands are pristine, and need to be kept as such.

the public is aware of the threats, is actively engaged, and there are leaders in their communities that keep the public informed of developments related to wetland threats and wetland restoration (Figure B.13, Appendix B).

- GLRI has been a great boost for wetlands restoration on the U.S. side: GLRI received multiple positive comments throughout the survey recognizing the positive impact of the GLRI on wetlands restoration.

5.4 WHERE AND WHAT TYPES OF WETLANDS ARE AT PARTICULAR RISK IN THE GREAT LAKES BASIN

Nearly 92 percent of the respondents identified wetlands in specific regions or parts of Great Lakes as particularly threatened (Figure B.3, Appendix B). A few substantive comments are presented below:

- Wetlands adjacent to or within urban/developed areas are heavily degraded.
- Dunes and swales are often exempted from regulation under Clean Water Act section 404 and, specifically, Michigan's dune regulations have weakened recently.
- Non-native species, lack of political support, and urban runoff are huge threats to wetlands.
- Black ash swamps face a threat from the emerald ash borer. Other peaty wetlands are converted to low-quality shrub swamps after continued human disturbance, especially forest harvest.
- Wetlands within the heavy agricultural regions are the most threatened by hydrologic alterations. These wetlands are typically exempted from regulatory protections. Agricultural activities are rarely regulated, and, as a result, there are very few buffers around wetlands. Additionally, the runoff is often diverted into channelized watercourses untreated, there are fewer trees and shade, the groundwater is often disrupted by agricultural drains/tiles and irrigation, and the wetland communities are highly fragmented on the landscape.
- Georgian Bay coastal wetlands are experiencing increased pressure due to the construction of lake-side cottages.
- Lake Erie wetlands suffer from agricultural practices, pesticide accumulations, and fertilizer runoff from tiled fields.
- Bogs are threatened by peat mining.
- Riverine wetlands in Northeastern Minnesota face negative pressures due to hard rock mining.
- Thunder Bay is threatened by industrial activity.
- Wet meadows and shoreline fens are being affected by no less than three ongoing impacts: reduced spring flood pulses, increased nutrients, and shoreline development for cottages.
- Lake Superior wetlands are not particularly threatened compared to the lower Great Lakes. However, they could use stronger emphasis on keeping them in their good state.

According to survey respondents, a key barrier to wetland restoration is a lack of funding.

When asked about their understanding of the level of protection provided to each wetland class, respondents indicated their belief that far more protection is provided to coastal wetlands than to riverine or inland wetlands (Figure B.4, Appendix B).

5.5 ADDITIONAL COMMENTS FROM RESPONDENTS RELATED TO WETLAND PROTECTION AND CONSERVATION IN THE GREAT LAKES

In addition to the answer to the questions presented in the survey, comments from a few respondents are presented below:

- More funding, like GLRI, is needed. Also, as state and federal agencies do much of the restoration work, they should receive most of the funding.
- Offsetting requirements (forced restoration) or conservation authorities are primary drivers for restoration of wetlands in the Great Lakes.
- Among the most important drivers for Great Lakes wetlands restoration are local recognition, interest, and cultural importance to protecting or restoring important resources for fish, wildlife, and human uses.
- Greater protection of high quality wetlands by states that own/manage large areas of these wetlands may be a successful strategy.
- Three issues that apply to nearly all wetlands.
    1. There is strong pressure to reduce natural changes in water-level within and among years. The importance of spring flood pulses, particularly those occasional years with particularly high and particularly low levels should not be altered to better support wetland health.
    2. Although eutrophication was particularly an issue in the 1970, there is a lot of local agricultural intensification, which is increasing nutrient inputs to wetlands. These inputs reduce biological diversity.
    3. Urbanization and real estate development on shorelines and in flood plains continues to be a serious problem. County planners seem content to reduce standards to the lowest possible level, even reducing protection for natural areas adjoining provincially significant wetlands.
- In addition, even though Ontario has identified Areas of Natural and Scientific Interest (ANSIs), “some U.S. counties have officially decreased protection for some wetlands. They stand by while one development after another degrades them. There seems to be a need for a strong message to planners that wetland area protection is a priority. Also, they need to understand that protection does not stop at the waterline—we need real, enforceable buffer zones.”
- Continue working with tribal governments on this shared issue.
- Restoration should not be confused with protection. Wetland quality is a critical component of assessment. Loss of function should be considered a form of wetland loss.
- More regional strategies and integrating decision making is needed.
- Common carp need to be added to the invasive species list.

6.0 OVERALL ANALYSES AND A PATH TO NET HABITAT GAIN IN GREAT LAKES BASIN WETLANDS

6.1 CONTRASTING THE JURISDICTIONS: GAP ANALYSES, NEGATIVE POLICIEIS, AND USE OF ADAPTIVE MANAGEMENT PRINCIPLES

It is apparent that wetlands are not regulated uniformly throughout the Basin. States and provinces augment the federal programs to fill the gaps in regulation/protection. But regulation alone will not lead to net habitat gain. To augment the regulatory program, a number of incentive programs have been used to encourage wetland restoration.

Ontario's wetland conservation strategy correctly identifies one of the most fundamental gaps in wetland protection: inadequate knowledge of wetland areal extent throughout the basin. Even though advanced spatial data analysis tools are now widely available, on both sides of the border the question remains, "Where are the wetlands and how much area do the cover?" The lack of detailed knowledge regarding the extent of wetlands limits the effectiveness of protection and restoration programs.

A consistent definition of wetlands would help assure that wetlands across the Basin are getting equivalent protection. Within U.S., the standard definition is defined in the USACE manual. This definition is also supplemented and expanded by state and regional programs which can result in varying standards being implemented. This level of regional variability seems unlikely to stem from fundamental characteristics of wetland habitats. The Great Lakes face basin-wide threats and effective solutions will rely on creating agreement on how best to define a wetland, how to assess them, and how to assure compliance with the regulations in place.

There is an inconsistency on how and when wetlands regulations are applicable. Choosing where and when regulations are applicable has resulted in isolated wetlands being excluded from protection in certain regions.

On both sides of the border wetlands are given federal protection, only to those wetlands that are associated with "navigable" waters. As a result, Ontario and the U.S. states have instituted additional, but varied, regulation. Only 3 of the 8 U.S. states extend protections to isolated wetlands which can include prairie potholes and other rare wetland areas. This gap in protection allows the continued loss of these important ecosystems.

Wetland integrity is also related to the chemistry of the waters in the wetland. However, only a limited number of jurisdictions have passed standards for water chemistry and other wetland characteristics. Creating tailored standards that support other existing water quality regulations would prevent the continue loss of high quality wetlands as happens when under regulated wetland areas "slip through protection cracks".

Finally, unintended impacts from U.S. laws unrelated to wetlands also have a detrimental impact on existing wetlands. This could be avoided if statutes and programs were revisited with a wetlands protection focus to avoid unintended consequences. These existing national laws create an incentive structure that allows

parties to unintentionally impacting wetlands, and thus encourage their degradation and/or destruction. Canada has specifically developed frameworks within their national wetland policy aimed at aligning the interests of various agencies.

The IJC can play an important role as a thought leader and coordinator for basin-wide responses to these recognizes weaknesses and gaps. Assembling and coalescing the successful programs into a toolkit of best practices for the various jurisdictions is a needed first step. By creating this tool-kit the IJC can help ensure that the various jurisdictions within the basin are ready to meet existing and future challenges or threats with a united front.

6.2 A PATH FORWARD - MEASURES TO IDNETIFY AND ELIMINATE GAPS, ELIMINATE UNINTENDED DETRIIMENTAL POLICIES, AND ENCOURAGE USE OF BEST PRACTICES

Comments from Great Lakes basin wetlands experts show that there are many positives to the existing frameworks of protecting and restoring wetlands (Table 6.1). Among the positives include the policy statements in Ontario that set a good goal for the province, development of the tribal water quality standards, accolades to the citizen science programs, and education/outreach efforts.

Table 6.1. Comments by Experts on Current Great Lakes Wetland Policies

Positive Policies	Negative Policies
Ability to regulate "Hazard Lands," including wetlands in Ontario	Chemical weed management overuse
100% tax relief for provincially significant wetlands In Ontario	Promotion of dikes and water-level control for invasive species control
Ordinances that protect tree, wildlife, wetland areas, and provide setbacks	Promotion of tile drainage
Education and Outreach Efforts	Weakening regulations and rules
Pre-application meetings for projects	Cutting back on enforcement budgets
Incorporate wetlands into parks	Lack of enforcement personnel
Enforcement of existing laws	Not expanding wetland definition to those impacted by variable water-levels
Agricultural BMPS	Agricultural subsidies
Endangered species exclusion activities	Voluntary regulatory programs
Provincial policy statement	Michigan drain code
Tribal water quality standards	Emphasis on mitigation rather than protection
Evaluate wetlands based on integrity and not function	Mitigation banking that is decoupled from impacted watershed
Compensatory programs that allow offsets and credits	Weak fisheries act
Citizen science programs	Regulation of water-levels
Incorporating traditional wetland uses into standards	
Wetland evaluations	
Canadian Federal Policy on Wetland Conservation	

The experts also suggested many ways to help the stakeholders be better stewards of their environment. These broad recommendations include new/updated policies, changes to practices, reassessing incentive frameworks, and better public engagement strategies. Experts (and indigenous people) agreed that the existing policies are under enforced. The enforcement agencies are under-staffed and under-funded. Ensuring that these organizations have adequate resources to enforce existing regulations is a required aspect for ensuring the future of wetlands.

The IJC may want to consider the following:

Recommendations for Regulatory Frameworks:

Most wetland policies in the basin were developed decades ago and research, conditions, and the inventory of wetland areas have improved significantly since that time. Accordingly, wetlands regulation would improve if the regulatory agencies would:

- Implement best practices that use latest science and technology regarding the welfare of wetlands. For example, Ontario's wetland conservation strategy's focus on improving wetland inventory and mapping, as well as improving wetland evaluation as a starting points for comprehensive regulation, enforcement, and protection.
- Create a unified basin-wide definition of wetlands to ensure wetlands enjoy equal yet comprehensive protection throughout the basin. This protection framework needs to recognize the varying hydrologic regimes for all the wetland types in the basin to cover all habitat types.
- Focus efforts to ensure uniformity in regulatory frameworks in jurisdictions across the Basin. These include:
    - Protection for geographically isolated wetlands currently excluded from federal protections
    - Uniform delineation criteria across the basin
    - Uniform in-lieu fee program templates to generate funds for restoration of lost wetland functions statewide
    - Open and spatially explicit permit activity tracking frameworks; and
    - Anti-degradation standards as well as water quality standards for wetlands that keep net habitat gain as its primary objective.

Recommendations for Addressing Key Stressors to Wetlands:

Continued improvement in wetlands protection requires international leadership, jurisdictional support, and citizen driven action. Some examples of best practices focused at addressing the specific stressors include:

- IJC's 2015 Lake Ontario Plan for water-level regulation.
- Local laws and ordinances to mitigate the environmental damage caused by commercial and non-commercial developments.
- Citizen-based partnerships supported by regulatory frameworks to address the growing challenge of nutrient overloading in the Basin.
- Continued focus on preventing the spread of terrestrial and aquatic invasive species at all levels of government.
- Effective use of adaptive management techniques to direct funding and support to the most effective programs that address all stressors but particularly climate change

Recommendations for Funding Frameworks:

Recognize and institutionalize the financial values of wetland preservation. Moody's investor service recently warned cities that they will face downgrades in their credit

rating unless they plan carefully for climate change. This will incentivize public entities to invest in infrastructure upgrades and wetlands related restoration. Accordingly, Great Lakes communities would benefit from:

- A uniform basin-wide standard for mitigation ratios
- A uniform compensatory scheme that also allows for in-lieu fees and other financial payments
- Develop municipal wetland preservation programs that lessen the flooding impacts that communities are experiencing while protecting/restoring/creating resilient wetlands.

Recommendations for Incentive Frameworks:

A path forward should include incentivizing private owners to preserve wetlands on their property. Effective outreach should be established to build trust between private partners and the public. These public/private coalition can build a basin-wide incentive framework to improve and expand the successful programs of the past. Specific steps could include:

- A public outreach program giving landowners information on how to effectively manage wetlands on their property
- An expansion of the U.S. Farm Bill which includes provisions to make wetlands a priority and assure that improvements have permanence. By addressing these challenges, it can be even more effective in conserving and restoring wetlands that currently fall outside of the regulatory programs.

Recommendations for Indigenous People Participation:

Lake-wide management plan (LaMP) program was repeatedly cited as a good framework and could be replicated in other smaller, more focuses policy programs on both sides of the border. Accordingly, an improved Great Lakes focused wetlands programs could:

- Emulate the LaMP engagement strategy in wetland policy formulation and deployment
- Engage indigenous people early and consider ways to more effectively integrate traditional knowledge into wetland management decisions
- Lower barriers to restoration when using native plants

Finally, lessons from Kakagon Slough in United States and Long Point National Wildlife Area in Canada are worthy of emphasis, because, as one interviewee stated, “an ounce of prevention is worth a pound of cure”.

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APPENDIX A:
TYPES AND FUNCTIONS OF WETLANDS

A.1 TYPES OF WETLANDS

Coastal wetlands of the Great Lakes can be placed into three categories: lacustrine, riverine, or barrier-protected wetlands (Albert et al., 2005, also see Table A.2):

- Lacustrine wetlands are directly controlled by the lake waters. They are affected by lake processes, such as water-level fluctuations, currents, and water surface freezing (Albert et al., 2005).
- Riverine wetlands are formed in rivers that either flow into or between the Great Lakes. Some riverine systems characteristics, such as water quality or sediment accumulation, are controlled by the waters that drain to the river. However, the wetlands are still affected by some coastal processes and Great Lakes water levels because the lakes can flood back into river mouths (Albert et al., 2005).
- Finally, barrier-protected wetlands were originally formed due to coastal processes, but have been separated by some barrier, such as a beach. If they are connected to the lake, the water-level is controlled by the lake. Otherwise, the water level is controlled by groundwater and surface drainage (Albert et al., 2003).

A.2 KEY FUNCTIONS OF WETLANDS

Great Lakes wetlands fill many important ecological roles that contribute to the health of the Great Lakes. Several are outlined below:

Shoreline Protection

Lacustrine wetlands serve as protection for Great Lakes' shorelines against waves and other lake processes that cause erosion. Vegetation roots stabilize the soil, preventing erosion. Erosion can cause damage to nearby infrastructure and lead to expensive repairs. Additionally, shoreline erosion in bays can lead to the need for costly dredging to allow boat access. For example, the U.S. Army Corps of Engineers, the agency responsible for dredging all federal channels and harbors in the Great Lakes basin on the U.S. side, removes about 4 million cubic yards of sediment from Great Lakes channels and harbors every year at a cost of about $20 million ("Dredging," n.d.).

Stormwater Storage & Groundwater Recharge

By their very nature, wetlands hold a very large amount of water, serving as flood mitigation for communities. Stormwater that is drained to wetlands is slowly released back into the floodplain. This storage reduces floods and, therefore, decrease erosion and sedimentation. Stormwater storage is especially important in developed areas where high levels of runoff and flooding can be detrimental to communities and the environment. Wetlands can provide much of this necessary storage. According to the Michigan Department of Natural Resources (MDNR), a one-acre wetland

Key functions of wetlands include shoreline protection, stormwater storage and flood mitigation, groundwater recharge, climate control, erosion reduction and nutrient cycling among others.

So far as water quantity retention abilities, according to Michigan Department of Natural Resources, a one-acre wetland flooded to a depth of one foot, can hold 330,000 gallons (1,249,186 liters) of water.

So far as water quality control abilities, according to EPA, Congaree Swamp in South Carolina removes the same amount of pollutants removed by a $5 million treatment plant

Table A.1 Types of Inland Wetlands (Albert, 2005; Wilcox, 2005; "Wetlands Classification and Types," 2017)

Type of Inland Wetland	Characteristics
Wet Meadows	Wet meadows occur in a variety of settings where the land surface is relatively flat, but they usually lack standing water much of the year. Instead, the high-water table produces a suitable level of saturation for the growth of wetland plant communities and development of characteristic wetland soils.
Prairie Potholes	Prairie potholes are a direct result of the glaciation that moved across the landscape leaving the land pockmarked with depressions that are periodically refilled by snowmelt and rainfall. Some smaller wetlands are seasonal, but deeper potholes can be perennial.
Vernal Pools	Vernal pools are shallow wetlands that are present in the spring and summer in depressions on the landscape that allow water to pool. Unlike prairie potholes, vernal pools are not of glacial origin and are instead the result of soil and topographic features.
Forested Swamps	Forested swamps in the Great Lakes are perpetually inundated areas that support tree species like willows and hemlocks. These wetlands are usually connected to a waterway that provides a slow but steady flow, which may dry up during particularly dry periods.
Bogs	Bogs represent one of the most unique wetland environments with extremely acidic soils and plants found in no other wetland type. Sphagnum moss is one of the primary drivers of bog formation, in some situations collecting and retaining relatively scarce rainwater and in others growing over water bodies and converting them into peat bogs. Under either condition, bogs primarily see water inflow coming from rainwater and not groundwater or overland flow.
Fens	Fens are also often found on peat, but the water source is primarily derived from inflow or groundwater sources. Fens are less acidic than bogs and support more diverse plant communities but retain some of the characteristics of bogs, including peat formation.

Table A.2 Types of Coastal Wetlands (Albert, 2005; Wilcox, 2005; "Wetlands Classification and Types," 2017)

Lacustrine Wetlands	
Types of Lacustrine Wetlands	Characteristics
Open Shoreline	Open shoreline wetlands are directly connected to the Great Lakes and have no protection against lake processes. There is very little organic sediment, and vegetation is limited.
Open Embayment	Open embayment wetlands are directly connected to the Great Lakes and have no barriers to wave action or lake-level changes. Plant communities in these wetlands are heavily influenced by wave action and the sandy soil types characteristic of the growth media.

Protected embayment	Protected embayment wetlands still share a direct connection with the lakes but are more deeply indented in the shoreline and are generally formed of more resilient substrates. This provides the plant communities with more protection from wind and waves, as well as allowing the accumulation of organic material from tributary water bodies.
Sand-Spit Embayments	Sand-spit embayment wetlands form because of sand movement along shorelines and the depositional patterns that create protected shoreline sections. Despite the shifting nature of sand-spits, these barriers can provide significant defenses against wind and wave action.
Riverine Wetlands	
Types of Riverine Wetlands	**Characteristics**
Channelside Wetlands	Channelside wetlands form along the side of streams and rivers and are subject to the strong currents and low accumulation of organic matter that come with swift flowing water. These wetlands are often very thin and cling to the margins of the waterway.
Streamside Embayments	Streamside embayments provide more protection than channelside wetlands but are still very susceptible to their parent waterway.
River Deltas	Delta systems are wetlands formed in river deltas made of alluvial materials and extend into the Great Lakes. These wetlands are rich with organic sediments and vegetation.
Drowned River Mouths	Drowned river-mouth systems are affected by the river water and the lake water. The amount that these wetlands are affected by the lake depends on the current water-levels and amount of recent precipitation. As they accumulate lots of organic sediment and are protected from erosion due to coastal processes, there is much opportunity for vegetation growth.
Connecting Channel	Connecting Channel systems refer to wetlands in the large connecting rivers between the Great Lakes. These systems typically are affected by strong water currents which prevents the accumulation of organic soil.
Barrier-Protected Wetlands	
Types of Barrier-Protected Wetlands	**Characteristics**
Dune and Swale Complexes	Swale Complex systems are wetlands that occur between sand spits or beach ridges and are often still connected to the lake. Many small swales are separated from the lake and become swamps with high amounts of organic sediments.
Tombolo	Tombolo wetlands form when sand spits connect the shoreline to a bedrock island within the lakes. The resulting structure offers leeward protection that permits the establishment of wetland plant communities.
Barrier Beach Lagoons	Barrier Beach Lagoon systems are wetlands that form behind a sand barrier and are very protected from coastal processes. If they are connected to the lake, the water-level is controlled by the lake. Otherwise, the water-level is controlled by groundwater and surface drainage.
Diked Wetlands	Diked wetlands are manmade constructions. Often, dikes are constructed to protect wetlands from human activity. When a dike is constructed for a wetland, the wetland is isolated from the lake activity.

Georgian Bay Wetlands

flooded to a depth of one foot can hold 330,000 gallons (1,249,186 liters) of water ("Wetland Habitat," n.d.).

Wetlands are inextricably bound to the fate of groundwater with the geological setting dictating what that relationship will be. In some formations, wetlands are fed by water being forced to the surface and represent the outflow of an artesian well system. In other formations, wetlands act as net contributors to the groundwater system. These recharging wetlands can have important impacts on the variability of groundwater levels and provide important conduits for water to enter aquifers (Mitsch and Gosselink, 2015).

Water Quality Control

Wetlands help to improve water quality by retaining nutrients, metals, sediments, and other pollutants, with its efficiency dependent upon its location and how long water stays in it. As many Great Lakes wetlands are connected to the lakes, these wetlands act as filters to pollutants that often would otherwise be deposited into the lakes or other water sources. The primary source of pollutants entering wetlands is from stormwater runoff, which can disrupt and damage the ecosystem.

Wetlands can perform some of the same functions as water treatment facilities. In the Lake Simcoe Watershed in Ontario, Ducks Unlimited and Environment Canada quantified the benefits generated by wetlands. Using the filtration costs for Sutton Water Pollution Control Plant as a basis, the study calculated that wetlands are providing over $292,000 in nutrient sequestration benefits annually (Pattison et al., 2016). Some wetlands, such as the Congaree Swamp in South Carolina, can provide services like the level of wastewater treatment plants. According to the EPA, the swamp removes the same amount of pollutants removed by a $5 million treatment plant (U.S. Environmental Protection Agency, 2006). Not surprisingly,

some communities use constructed wetlands as part of their water treatment systems (Vymazal, 2010).

Wetland Habitats

Great Lakes wetland habitats support an extremely broad range of species, including a large percentage of threatened or endangered species. According to MDNR, Michigan wetlands alone support about 1,150 native plant species and over 230 vertebrate wildlife species ("Wetland Habitat," n.d.). Many wetlands are very rich in nutrients, and the vegetation provides shelter and food, so fish and animal species can thrive. Some species live in wetlands their whole lives, whereas some use wetlands only at points in their life-cycles, such as during breeding.

The whooping crane is an example of a species that relies on Great Lakes wetlands. Wetlands provide everything the whooping cranes need for survival: ideal food sources, nesting and breeding habitat, and ideal places to stop during migration. Wetlands also provide some safety from predators, as some animals are not willing to travel into the water (Sonnenblick, Klosiewski, & Kienbaum, 2015).

Climate Control

Wetland influence on global climate control is a relatively new area of study. Ontario's Wetland Conservation Strategy (1991) mentioned that wetlands can play an important role in mitigating climate change by reducing greenhouse gas concentrations, regulating temperature, reducing the heat-island effect (the added heat that builds up in urban areas compared to nearby rural areas), slowing the impacts of droughts, and reducing flood and erosion risks and negative impacts on water quality. Forested wetlands and peatlands are especially important because they can store significant amounts of carbon.

Wetlands can play an important role in mitigating climate change by reducing greenhouse gas concentrations, regulating temperature, reducing the heat-island effect, slowing the impacts of droughts, and reducing flood and erosion risks and negative impacts on water quality.

A recent study examined carbon sequestration in both drained and restored wetlands at three sites across southern Ontario. The results of the study demonstrated that restored wetlands increase the amount of carbon stored in the landscape (Enanga et al. 2014).

More research is needed to further examine the benefits of restored wetlands in mitigating climate change.

APPENDIX B
WETLAND EXPERT SURVEY: LIST OF EXPERTS AND SURVEY FINDINGS

Table B.1 Experts invited for survey on Great Lakes basin wetlands

Name	Organization	Email
Dr. Denis Albert	Oregon State University	Dennis.Albert@oregonstate.edu
Dr. Pat Chow-Fraser	McMaster University	chowfras@mcmaster.ca
Dr. Nick Danz	University of Wisconsin - Superior	ndanz@uwsuper.edu
Dr. Sue Doka	Fisheries and Oceans Canada	Susan.Doka@dfo-mpo.gc.ca
Jennifer Dunn	NYDEC	Jennifer.Dunn@dec.ny.gov
Dr. Gordon Goldsborough	University of Manitoba	gordon.goldsborough@gmail.com
Greg Grabas	Environment and Climate Change Canada	greg.grabas@canada.ca
Dr. Paul Keddy	Independent Scholar	drpaulkeddy@gmail.com
Jon Midwood	Fisheries and Oceans Canada	Jon.Midwood@dfo-mpo.gc.ca
Linda Mortsch	University of Waterloo	ldmortsc@uwaterloo.ca
Tys Theijsmeijer	Royal Botanical Gardens	ttheysmeyer@rbg.ca
Dr. Don Uzarski	Central Michigan University	uzars1dg@cmich.edu
Owen Steele	Ducks Unlimited Canada	o_steele@ducks.ca
John Coluccy	Ducks Unlimited	jcoluccy@ducks.org
Kurt Kowalski	United States Geologic Survey	kkowalski@usgs.gov
Annette Trebitz	U.S. EPA	trebitz.anett@epa.gov
Rebecca Rooney	University Waterloo	rebecca.rooney@uwaterloo.ca
Doug Tozer	Birds Studies Canada	dtozer@birdscanada.org
Gina Varrin	Ministry of Natural Resources and Forestry	Regina.Varrin@ontario.ca
Jan Ciborowski	University of Windsor	cibor@uwindsor.ca
Brian Henshaw	Beacon Environmental	bhenshaw@beaconenviro.com
Bonnie Fox	Conservation Ontario	BFox@conservationontario.ca
Mhairi McFarlane	Nature Conservancy Canada	Mhairi.McFarlane@natureconservancy.ca
Doug Pearsall	The Nature Conservancy	dpearsall@TNC.org
Carolyn Schultz	Ontario Nature	carolines@ontarionature.org
Robert Foster	Northern Bioscience	rfoster@northernbioscience.com
Dawn Sucee	Ontario Federation of Anglers and Hunters	dawn_sucee@ofah.org
Chantal Vis and Gary Allen	Parks Canada	Chantal.Vis@pc.gc.ca Gary.Allen@pc.gc.ca
Erin O-Brien Tracy Hames	Wisconsin Wetlands Association	erin.obrien@wisconsinwetlands.org tracy.hames@wisconsinwetlands.org
Jonathan Staples	Ontario Ministry of Natural Resources and Forestry	Jonathan.Staples@ontario.ca
Danielle MacCorkindale	Otonabee Region Conservation Foundation	Danielle.MacCorkindale@ontario.ca
Elizabeth Riggs	Huron River Watershed Council	eriggs@hrwc.org
Jennifer McKay	Tip of the Mitt	jenniferm@watershedcouncil.org
Kyle Rorah	Ducks Unlimited	krorah@ducks.org
Bud Harris	Retired from University of Wisconsin – Green bay	harrish@uwgb.edu
Matt Cooper	Central Michigan University	mcooper@northland.edu
Kim Fish	Michigan Department of Environmental Quality	FISHK@michigan.gov
Melanie Burdick	Water Division, MI EPA	Burdick.Melanie@epa.gov

Kerryann Weaver	Minnesota Environmental Protection Agency	weaver.kerryann@epa.gov
Kevin O'Donnell	USEPA-Great Lakes National Program Office	ODonnell.Thomas@epa.gov
David Sweetnman	Georgian Bay Forever	david.sweetnam@georgianbayforever.org
Dawn White	Great Lakes Indian Fish and Wildlife Commission	dwhite@glifwc.org
Clinton Jacobs	Walpole Island Land Trust	crjacobswifn@yahoo.com
Dean Jacobs	Walpole Island First Nation	dean.jacobs@wifn.org
Kathie Brosemer	Sault Tribe	kbrosemer@saulttribe.net
Randy Gilbertson	Wisconsin Tribal Conservation Advisory Council	burroaks12@centurytel.net
Chris Caldwell	Sustainable Development Institute at the College of Menominee Nation	ccaldwell@menominee.edu
Krystal Kiogima	Little Traverse Bay Band of Odawa Indians	kkiogima@ltbbodawa-nsn.gov
Daugherty A. Johnson, III	Little Traverse Bay Band of Odawa Indians	djohnson@ltbbodawa-nsn.gov
Nicholas Reo	Dartmouth College	nicholas.j.reo@dartmouth.edu
Barry Warner	University of Waterloo	bwarner@uwaterloo.ca
Jonathan Price	University of Waterloo	jsprice@uwaterloo.ca

Figure B.1 State or province where a survey respondent primarily worked, showing roughly the same number of respondents in United States and Canada

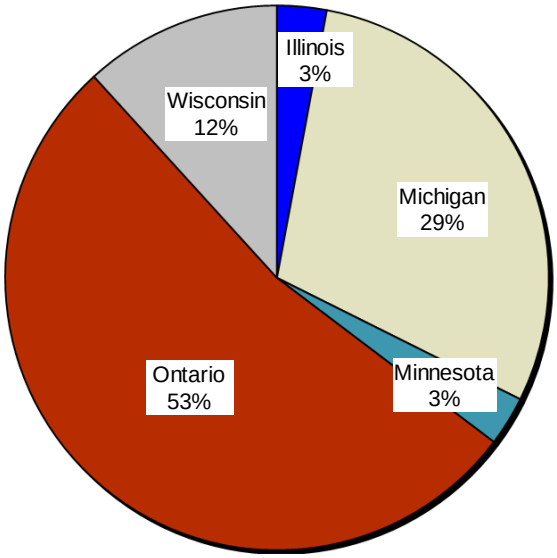

Figure B.2 Great Lakes where a survey respondent primarily worked, showing a good representation of all five Great Lakes

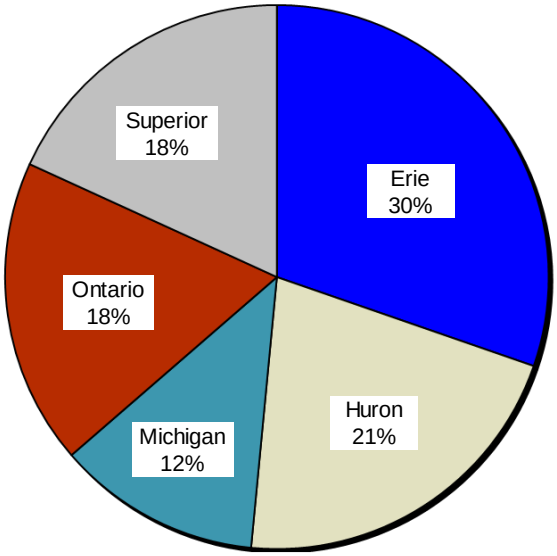

Figure B.3 Response to if there are wetlands in the Great Lakes that are threatened, showing over 90% of the respondents agreeing with a threat being present

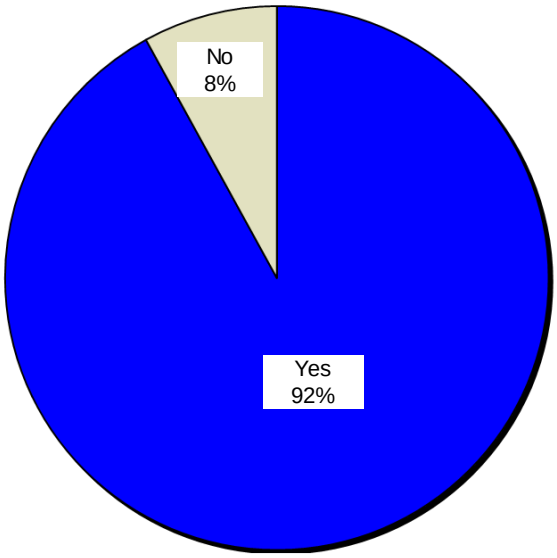

Figure B.4 Respondent's understanding of the level of protection provided to each wetland class, showing coastal wetlands as the most protected of all wetland types
(1 being low and 5 being high)

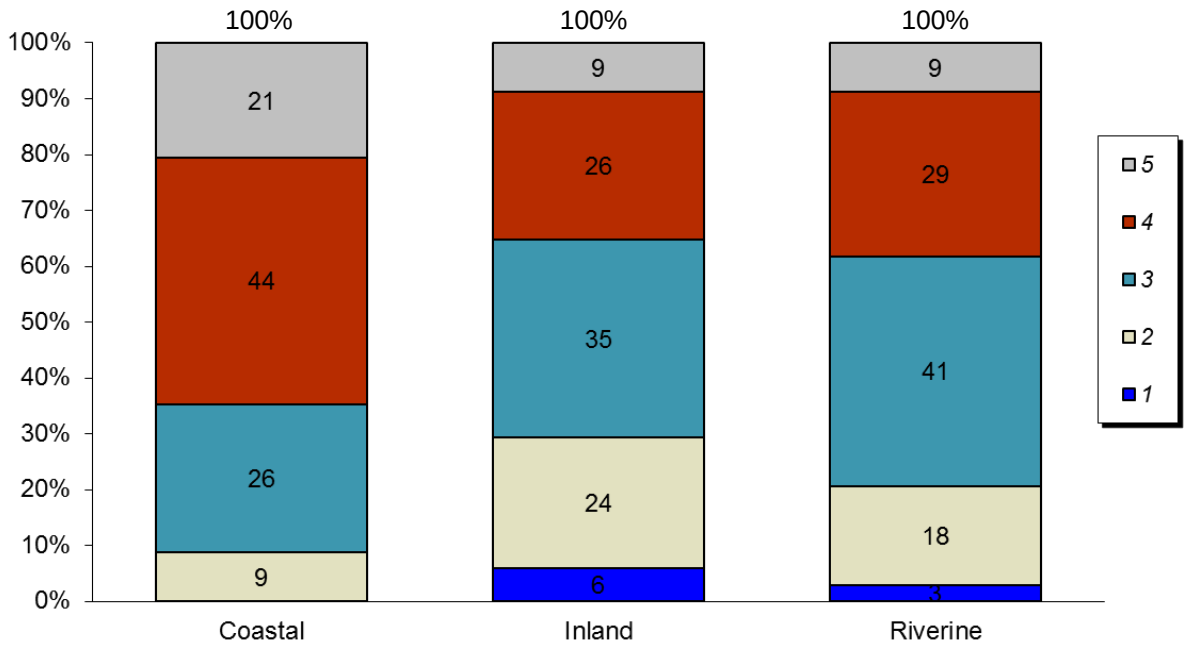

Figure B.5 Respondents' input on how threatened each wetland type is in their local area showing wet meadows, vernal pools, and dunes/swale as the top three most threatened wetland types

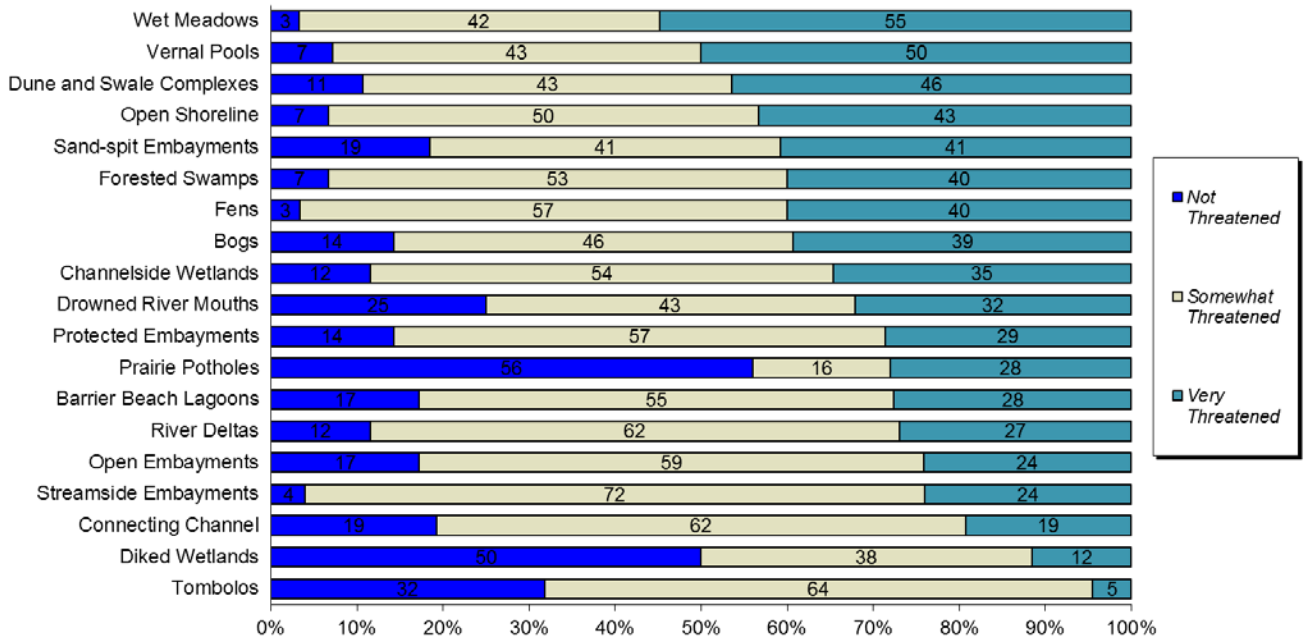

Figure B.6 Respondents' input on how threatened the habitat integrity of each wetland type is in their local area, showing wet meadows, open shoreline, and channel side wetlands with poorest habitat integrity

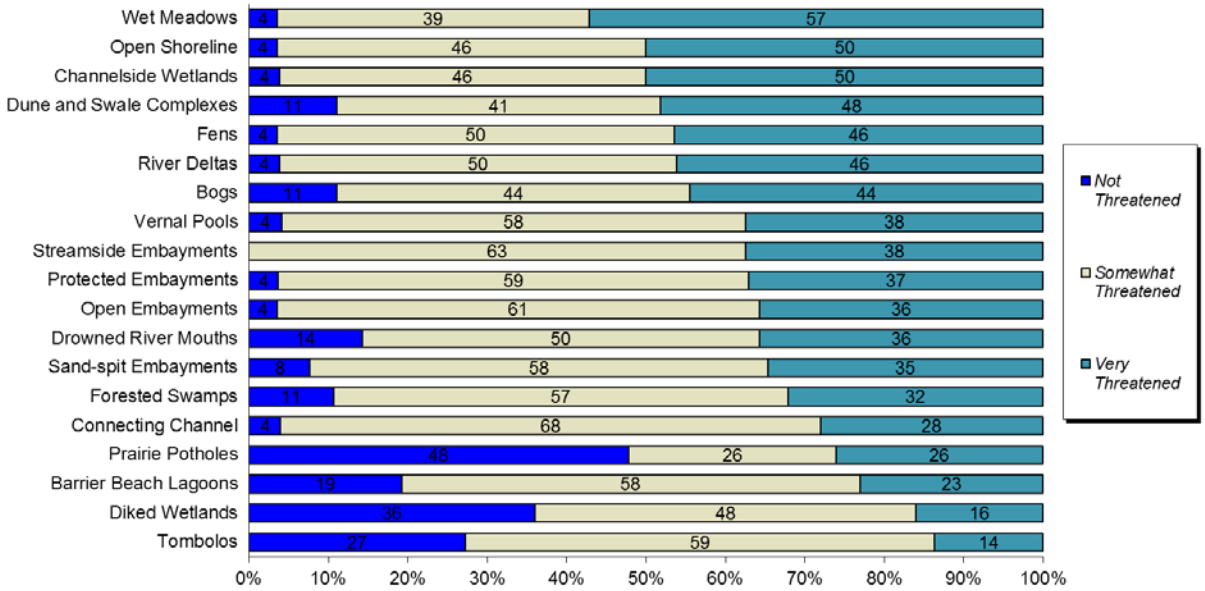

Figure B.7 Respondents' input on whether protections for wetlands in the Great Lakes have grown more stringent in the past ten years, showing no clear trend

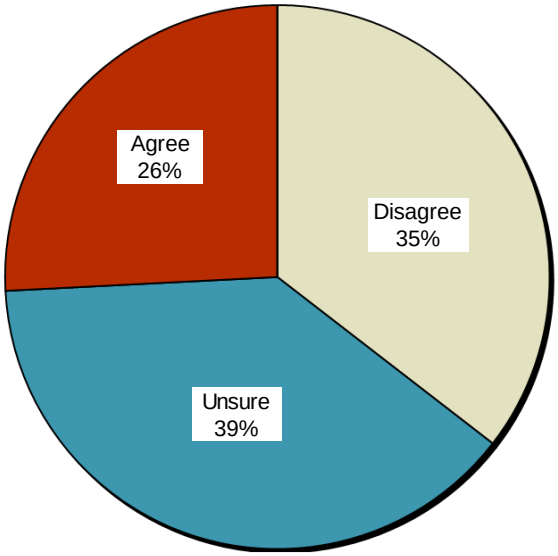

Figure B.8 Respondents' input on if wetland area has expanded in the Great Lakes in the last ten years, showing that majority thought the wetland areas have not expanded

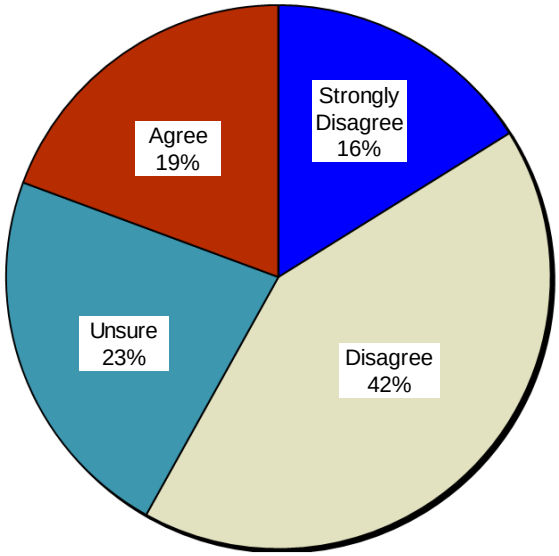

Figure B.9 Respondents' input on factors that have an adverse impact on wetlands they are familiar with, showing top threats as invasive species, draining wetlands, pollution, and climate change
(1=low and 5=high)

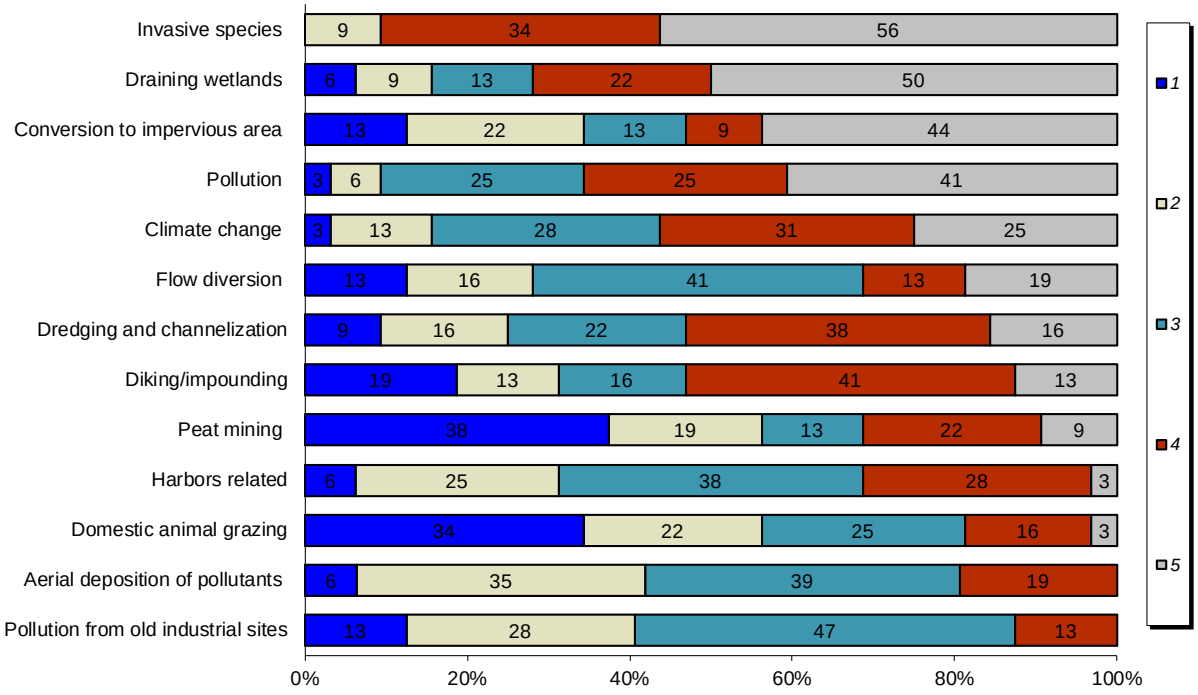

Figure B.10 Respondents' input on impact of local, state/provincial, and federal laws on wetlands, showing that local laws are weakest in providing protection

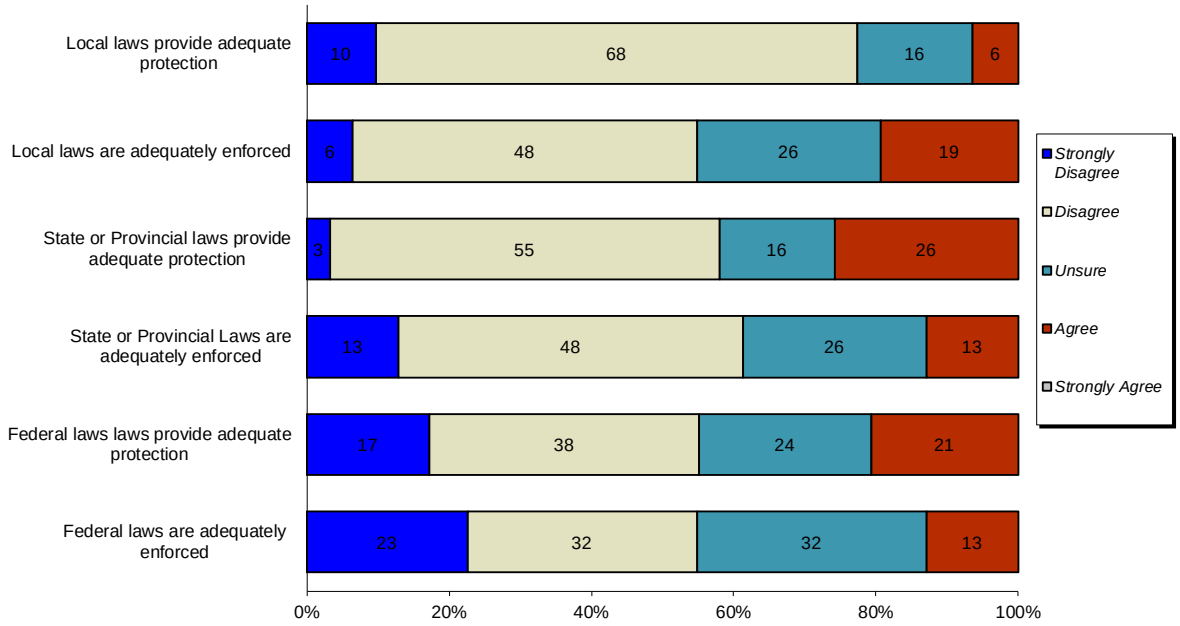

Figure B.11 Respondents' input on who leads the restoration of wetlands, showing regulatory frameworks as the most important driver

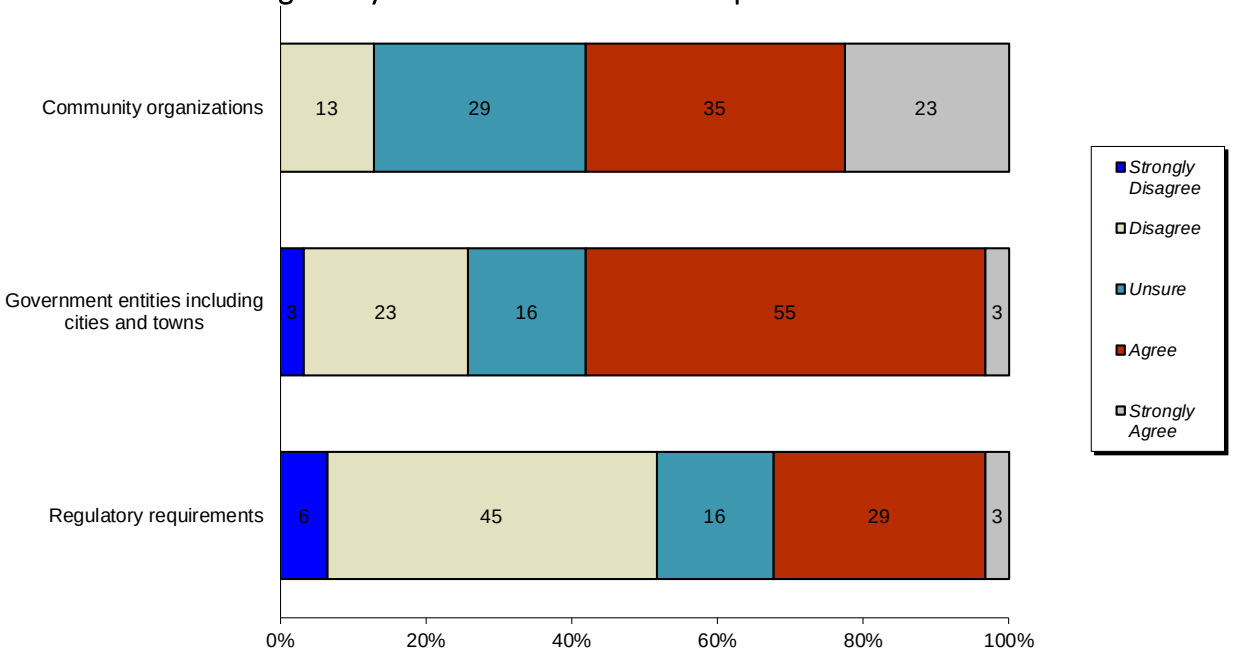

Figure B.12 Respondents' input on barriers to the restoration of wetlands, showing funding as the biggest barrier

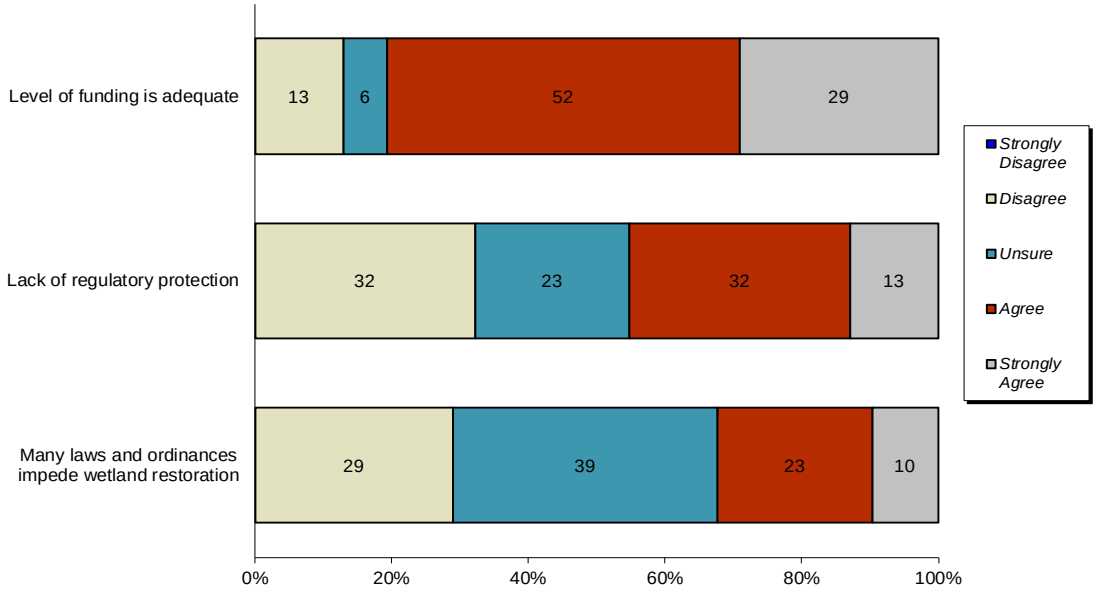

Figure B.13 Respondents' input on who leads the restoration of wetlands, showing public is keenly engaged

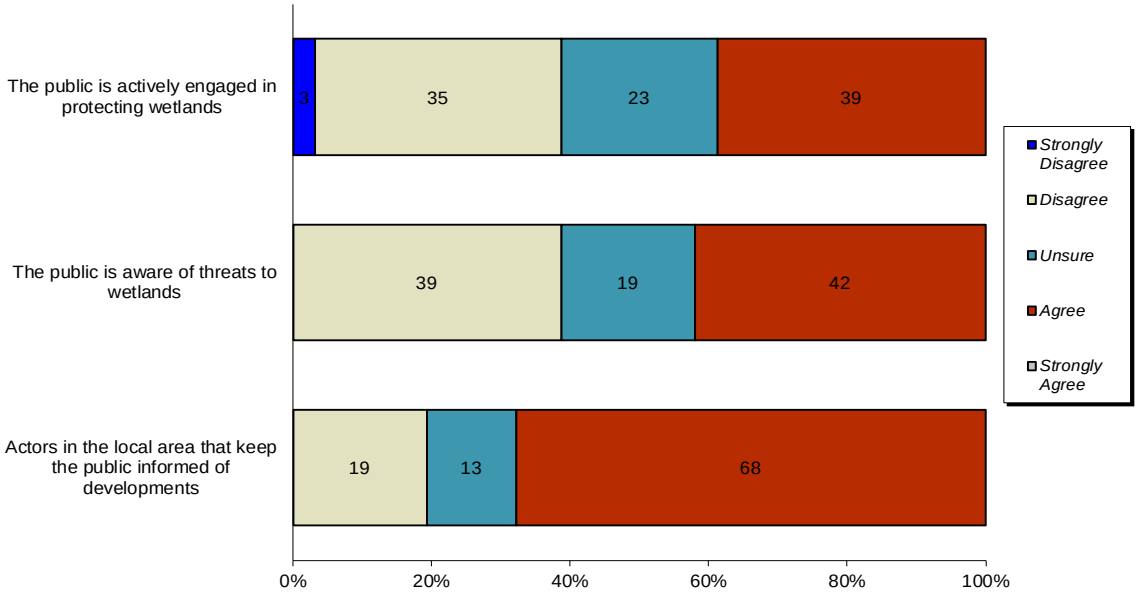

Figure B.14 Respondents' input on importance of tools/BMPs to protecting wetlands in the Great Lakes, showing restoration programs as most important of all

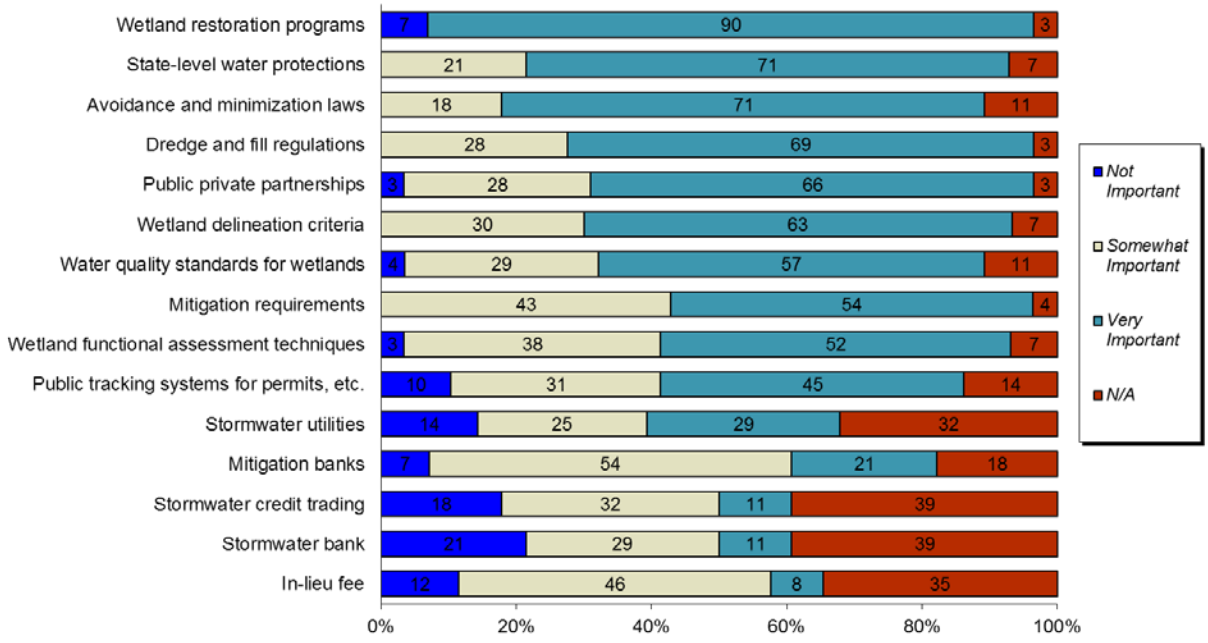

Figure B.15 Respondents' input on their level of familiarity with regulatory tools/BMPs to protect wetlands in the Great Lakes, showing they are most familiar with delineation criteria followed by restoration programs