



# GREAT LAKES RESTORATION INITIATIVE

## ACTION PLAN III

Fiscal Year 2020 - Fiscal Year 2024

October 2019

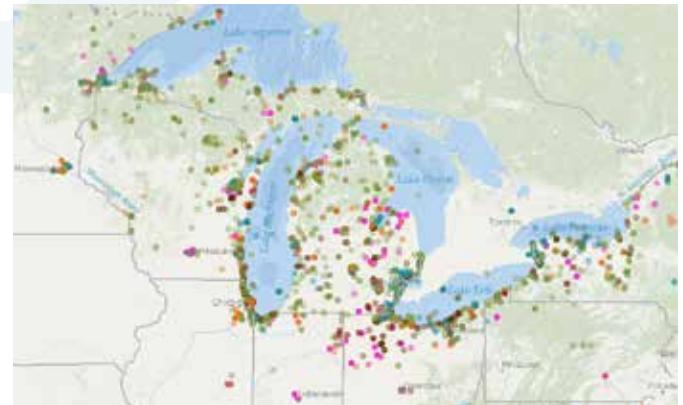


**The Great Lakes Restoration Initiative (GLRI or the Initiative)** was launched in 2010 as a non-regulatory program to accelerate efforts to protect and restore the largest system of fresh surface water in the world, and to provide additional resources to make progress toward the most critical long-term goals for this important ecosystem.

The GLRI has been a catalyst for unprecedented federal agency coordination, which has in turn produced unprecedented results. For example, under the Initiative's Action Plans I and II, GLRI accomplished the formal delisting of the Presque Isle Bay (PA), Deer Lake (MI), and White Lake (MI) Areas of Concern and moved a number of the remaining Areas of Concern closer to delisting through the removal of numerous environmental impairments. This activity reflects a major change from the 25 years before the Initiative, during which only one Area of Concern was delisted. GLRI resources have also been used for projects that have prevented more than one million pounds of phosphorus from entering the Great Lakes, reducing the excess phosphorus that contributes to harmful algal blooms in western Lake Erie, Saginaw Bay, and Green Bay. The GLRI produces economic benefits as well. A 2018 University of Michigan study\* shows that every dollar of federal spending on GLRI projects between 2010 and 2016 will produce \$3.35 in additional economic activity in the Great Lakes region through 2036. Restoration projects undertaken by GLRI partners include not only enhancement and rehabilitation projects, but also projects that protect existing high-quality resources. In general, protecting existing resources is less costly than restoring degraded resources.

Under GLRI Action Plan III, the GLRI federal agencies that make up the GLRI Interagency Task Force and Regional Working Group (GLRI federal agencies – see back cover) will continue to use GLRI resources to strategically target the biggest threats to the Great Lakes ecosystem and associated human health issues. By adding GLRI resources to federal agency base budgets and using the combined resources to work with nonfederal partners to implement protection and restoration projects, GLRI federal agencies will continue to accelerate progress toward achieving long-term goals (see below). To guide this work during the next five years, GLRI federal agencies have developed GLRI Action Plan III. All proposed federal actions are subject to final Congressional appropriations.

GLRI Action Plan III outlines the next phase of work on Great Lakes environmental problems, many of which will take decades to resolve. GLRI Action Plan III lays out the necessary next steps to get us closer to the day when we will be able to achieve our long-term goals for the Great Lakes and our commitments under the Great Lakes Water Quality Agreement between the U.S. and Canada.



Through Fiscal Year (FY) 2018, the GLRI federal agencies have invested over \$2.4 billion from the GLRI for over 4,000 projects to improve water quality, protect and restore native habitat and species, prevent and control invasive species, and address other Great Lakes environmental problems.

## The Great Lakes Restoration Initiative Accelerates Great Lakes Protection and Restoration in Five Focus Areas

FY 2010 – FY 2014: GLRI Action Plan I | FY 2015 – FY 2019: GLRI Action Plan II | FY 2020 – FY 2024: GLRI Action Plan III

### Toxic Substances and Areas of Concern

### Invasive Species

### Nonpoint Source Pollution Impacts on Nearshore Health

### Habitats and Species

### Foundations for Future Restoration Actions

### Long-Term Goals for the Great Lakes Ecosystem

- All Areas of Concern delisted
- Fish safe to eat
- Water safe for recreation
- Safe source of drinking water
- No new self-sustaining invasive species
- Existing invasive species controlled
- Harmful/nuisance algal blooms eliminated
- Habitat protected and restored to sustain healthy ecosystem function and native species

\*Socioeconomic Impacts of the Great Lakes Restoration Initiative. University of Michigan Research Seminar in Quantitative Economics. September 30, 2018.

# GLRI ACTION PLAN III

**GLRI Action Plan III** is responsive to Clean Water Act Section 118 amendments in 2015 and 2016 that codified the GLRI. This codification includes a mandate to review and revise the Action Plan every five years and to address five priority areas. The first four of these priority areas correspond directly with the first four Focus Areas listed on the previous page. The fifth priority area is addressed within the fifth Focus Area – Foundations for Future Restoration Actions – and within the GLRI operating principles. The Focus Areas are not silos; GLRI agencies will continue to coordinate and collaborate across Focus Areas in recognition of the interrelated nature of many Great Lakes issues.

Under GLRI Action Plan III, GLRI federal agencies will continue to identify and implement the programs and projects that will best advance progress toward achieving long-term Great Lakes goals in partnership with states, tribes, and other nonfederal stakeholders. The GLRI federal agencies will also continue to work collaboratively with partners to effectively and efficiently move toward achieving those goals, maintaining the progress that has been made, and communicating results.

GLRI Action Plan III continues to specify objectives with related commitments and measures of progress for each Focus Area. Recognizing that it will take many years to document ecological and human health benefits for an ecosystem as large and complex as the Great Lakes, the measures of progress track progress toward achieving the GLRI's long-term goals, but focus on outputs and/or outcomes that can be measured over the five-year period covered by this Action Plan. Agencies will report annually on 23 measures of progress, identified on page 4, including 14 measures that have annual targets.

GLRI Action Plan III reflects the many ideas developed during the first 10 years of the GLRI that were contributed by the Great Lakes Advisory Board, the U.S. Environmental Protection Agency (EPA) Science Advisory Board, the Government Accountability Office, the Congressional Research Service, states, tribes, municipalities, and the general public. The GLRI federal agencies will continue to actively seek additional input from their many partners to protect and restore the Great Lakes.

## The following principles will guide GLRI planning and implementation under Action Plan III.

**Accountability and Reporting** – The GLRI federal agencies will continue to track the progress and results of GLRI projects, including reporting on GLRI progress through the annual report required under Clean Water Act Section 118. Annual reports and other documents that describe GLRI reporting methodology can be found online at [www.glri.us/documents](http://www.glri.us/documents). The agencies will also continue to report Great Lakes Water Quality Agreement activities through the triennial Progress Reports of the Parties, as well as the overall health of the Great Lakes ecosystem through the triennial State of the Great Lakes reports.

**Communication and Outreach** – The GLRI federal agencies will continue to update publicly available online information and will seek new ways to communicate about the program and status of ongoing work. The agencies will continue to communicate scientific findings broadly to help inform and prioritize future work.

**Partnerships and Engagement** – The GLRI federal agencies will continue to draw from clearly communicated priorities and actions identified in Lakewide Action and Management Plans and Biodiversity Conservation Strategies (see [www.glri.us/documents](http://www.glri.us/documents)) by Lake Partnerships and other Great Lakes Water Quality Agreement activities to influence annual planning. In selecting the best combination of programs and projects for the Great Lakes protection and restoration, GLRI federal agencies will continue to consult with the Great Lakes states and tribes and engage with other nonfederal stakeholders. GLRI federal agencies will also continue to emphasize public/private partnerships. Further, the GLRI federal agencies will continue to work with tribal governments in the spirit of self-determination and consistent with federal Indian trust responsibilities and to support tribal priorities that are consistent with GLRI goals and objectives.

**Project Sustainability** – The GLRI federal agencies will continue to encourage project plans and designs that are resilient to the effects of multiple stressors, including a changing climate, ecological change, invasive species, population pressures, and other variables. GLRI federal agencies will also encourage project stewardship to promote the sustainability and long-term benefits of projects.

**Science-Based Adaptive Management** – The GLRI federal agencies will continue to support and enhance the science-based adaptive management approach developed under Action Plan II. Within and across each Focus Area, the GLRI federal agencies will use a structured management approach for addressing environmental uncertainties by testing hypotheses, linking science to decision making, and adjusting project implementation, as necessary, to improve the probability of success. GLRI federal agencies will use this flexible approach to monitor project effectiveness and inform future restoration actions using the best available science and traditional ecological knowledge in decision making.

# FY 2020 – FY 2024 Great Lakes Restoration Initiative Action Plan Summary

Focus Areas	Objectives	Commitments
Focus Area 1: Toxic Substances and Areas of Concern	<p>1.1. Remediate, restore, and delist Areas of Concern.</p> <p>1.2. Share information on the risks and benefits of consuming Great Lakes fish, wildlife, and harvested plant resources with the people who consume them.</p> <p>1.3. Increase knowledge about (1) "Chemicals of Mutual Concern" identified pursuant to the Great Lakes Water Quality Agreement's Annex 3; and (2) other priority chemicals that have negatively impacted, or have the potential to negatively impact, the ecological or public health of the Great Lakes.</p>	<ul style="list-style-type: none"> <li>Implement management actions necessary to remove Beneficial Use Impairments and delist Areas of Concern.</li> <li>Increase the availability and accessibility of information to vulnerable populations that consume Great Lakes fish, wildlife, and harvested plant resources.</li> <li>Fill critical data gaps for Annex 3 and other priority chemicals in the Great Lakes through discrete monitoring and assessment activities.</li> </ul>
Focus Area 2: Invasive Species	<p>2.1. Prevent introductions of new invasive species.</p> <p>2.2. Control established invasive species.</p> <p>2.3. Develop invasive species control technologies and refine management techniques.</p>	<ul style="list-style-type: none"> <li>Work with Great Lakes states and tribes to conduct rapid response actions or exercises.</li> <li>Manage pathways through which invasive species can be introduced to the Great Lakes ecosystem.</li> <li>Conduct early detection and surveillance activities.</li> <li>Implement control projects for GLRI-targeted invasive species.</li> <li>Conduct field testing of innovative control technologies and methods to prevent the introduction and to control the spread of invasive species.</li> <li>Develop/enhance invasive species-specific collaboratives to support rapid responses and communicate the latest control and management techniques.</li> </ul>
Focus Area 3: Nonpoint Source Pollution Impacts on Nearshore Health	<p>3.1. Reduce nutrient loads from agricultural watersheds.</p> <p>3.2. Reduce untreated stormwater runoff.</p> <p>3.3. Improve effectiveness of nonpoint source control and refine management efforts.</p>	<ul style="list-style-type: none"> <li>Implement systems of conservation practices on farms and in streams to reduce and treat nutrient runoff.</li> <li>Increase adoption of enhanced nutrient management practices to reduce risk of nutrient losses from farmland.</li> <li>Increase implementation of green infrastructure practices to infiltrate stormwater runoff.</li> <li>Implement watershed management projects in urban and rural communities to reduce runoff and erosion.</li> <li>Assess achievement of Great Lakes Water Quality Agreement's Annex 4 nutrient targets.</li> <li>Evaluate effectiveness of nonpoint source projects.</li> <li>Develop new or improved approaches for reducing or preventing harmful algal blooms.</li> </ul>
Focus Area 4: Habitats and Species	<p>4.1. Protect and restore communities of native aquatic and terrestrial species important to the Great Lakes.</p> <p>4.2. Increase resiliency of species through comprehensive approaches that complement on-the-ground habitat restoration and protection.</p>	<ul style="list-style-type: none"> <li>Identify habitats that support important Great Lakes species and take actions to restore, protect, enhance, and/or provide connectivity for these habitats.</li> <li>Update and implement recovery actions for federal threatened, endangered, and candidate species.</li> <li>Support population-level protections, enhancements, and re-introductions for state, tribal, and Great Lakes native species of importance.</li> </ul>
Focus Area 5: Foundations for Future Restoration Actions	<p>5.1. Educate the next generation about the Great Lakes ecosystem.</p> <p>5.2. Conduct comprehensive science programs and projects.</p>	<ul style="list-style-type: none"> <li>Support experience-based learning opportunities for youth to promote Great Lakes stewardship.</li> <li>Assess overall health of the Great Lakes ecosystem and identify the most significant remaining problems.</li> <li>Identify cross-cutting science priorities and implement projects to address those priorities.</li> </ul>

**Measures of Progress – These measures track results produced from GLRI funding unless otherwise noted.**

- 1.1.1.\*\* Areas of Concern where all management actions necessary for delisting have been implemented.
- 1.1.2.\*\* Beneficial Use Impairments removed in Areas of Concern.
- 1.1.3.\* Areas of Concern with a complete and approved list of all management actions necessary for delisting.
- 1.2.1. Number of state and tribal organizations that collect and share information with vulnerable populations regarding the consumption of Great Lakes fish, wildlife, and harvested plant resources.
- 1.3.1. Discrete chemical monitoring and assessment activities conducted.

- 2.1.1.\* Rapid responses or exercises conducted.
- 2.1.2. Projects that manage pathways through which invasive species can be introduced to the Great Lakes ecosystem.
- 2.1.3. Early detection and surveillance activities conducted.

- 2.2.1.\* Aquatic/terrestrial acreage controlled.
- 2.3.1. Technologies and methods field tested.
- 2.3.2. Collaboratives developed/enhanced.

- 3.1.1.\* Estimated pounds of phosphorus reductions from conservation practice implementation throughout Great Lake watersheds.
- 3.1.2.\*\* Acres receiving technical or financial assistance on nutrient management in priority watersheds.

- 3.2.1.\* Estimated gallons (in millions) of untreated stormwater runoff captured or treated.
- 3.2.2.\* Miles of Great Lakes shoreline and riparian corridors restored or protected.

- 3.3.1.\* Nutrient monitoring and assessment activities conducted.
- 3.3.2.\* Nutrient or stormwater runoff reduction practices or tools developed or evaluated.

- 4.1.1.\* Acres of coastal wetland, nearshore, and other habitats restored, protected, or enhanced.
- 4.1.2.\* Miles of connectivity established for aquatic species.

- 4.2.1.\* Species benefited where actions have been completed to significantly protect or promote recovery of populations.

- 5.1.1. Youth impacted through education and stewardship projects.

- 5.2.1. Annual Great Lakes monitoring conducted and used to prioritize GLRI funding decisions.
- 5.2.2. Identify and address cross-Focus Area science priorities to support implementation of GLRI and the Great Lakes Water Quality Agreement.

\* These measures have a numerical target.

#Measures 1.1.1, 1.1.2, and 3.1.2 track results from GLRI and other federal funding.

## FOCUS AREA 1

# TOXIC SUBSTANCES AND AREAS OF CONCERN

### Objective

- 1.1. Remediate, restore, and delist Areas of Concern.

### Commitment

- Implement management actions necessary to remove Beneficial Use Impairments and delist Areas of Concern.

**Since GLRI began,** GLRI federal agencies and their state, tribal, local, and private partners have accelerated cleanup of Areas of Concern – areas designated as the most contaminated sites on the Great Lakes under the 1987 Great Lakes Water Quality Agreement. Cleanup of Areas of Concern has led to community revitalization, which is especially important in environmental justice communities and opportunity zones.

Cleanup of Areas of Concern is achieved through remediation and restoration work, which then leads to removing Beneficial Use Impairments. Areas of Concern are delisted when all the Beneficial Use Impairments have been removed. From the start of the GLRI through the end of FY 2018, GLRI federal agencies and their partners removed 70 Beneficial Use Impairments in 23 Areas of Concern – seven times the number removed in the 22 years preceding the establishment of the GLRI. Three Areas of Concern have also been delisted: Presque Isle Bay in Pennsylvania and Deer Lake and White Lake in Michigan. Additionally, GLRI federal agencies and their partners completed all the management actions required at eight more Areas of Concern:

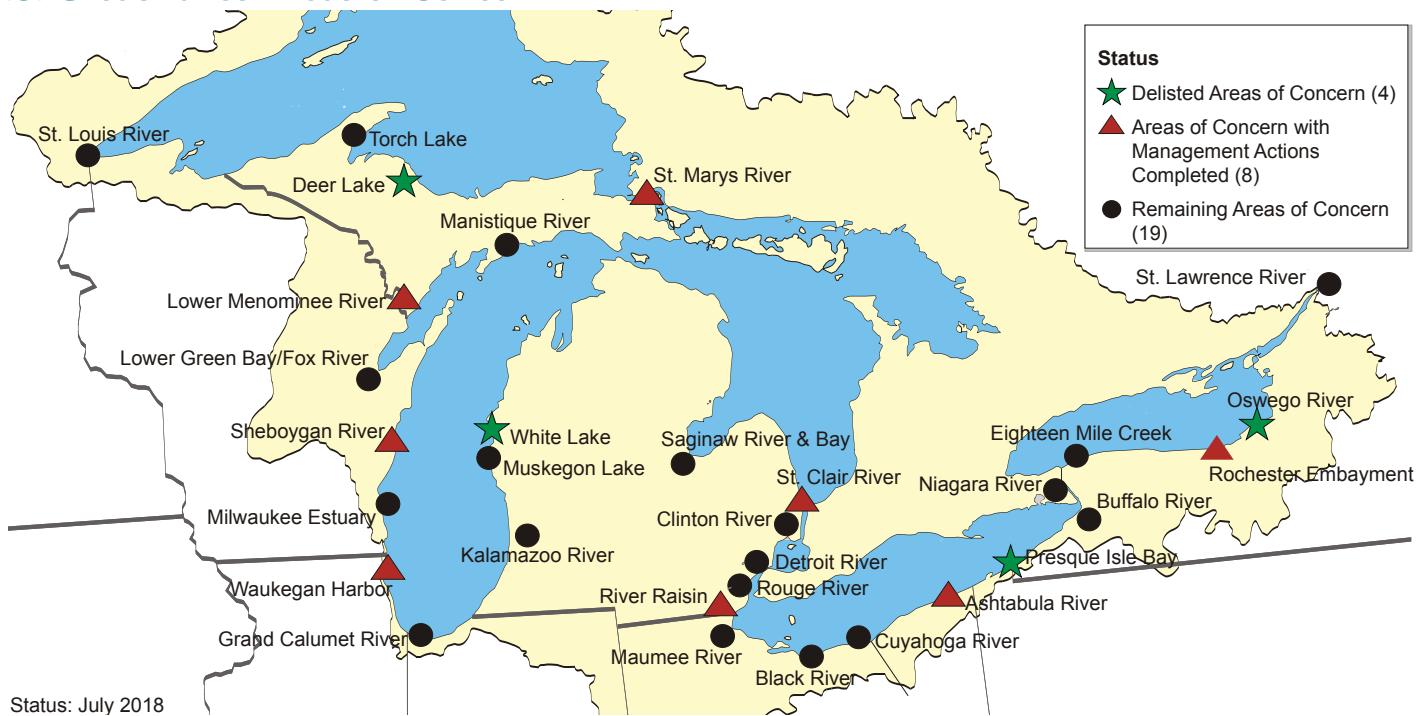
- River Raisin (MI)
- Lower Menominee (MI/WI)
- St. Clair River (MI)
- St. Marys River (MI)
- Sheboygan River (WI)
- Waukegan Harbor (IL)
- Ashtabula River (OH)
- Rochester Embayment (NY)

### How do you restore an Area of Concern?

The process for removing Beneficial Use Impairments and delisting Areas of Concern starts with a scientific assessment by the state and GLRI federal agencies to determine the extent to which beneficial uses are impaired and the types of management actions required to remediate the Area of Concern. After management actions are implemented, a monitoring and verification plan may be implemented by the state agency, the local public advisory council, EPA, and others, if necessary, to determine whether the Beneficial Use Impairments removal criteria have been met. An Area of Concern is eligible to be delisted when all Beneficial Use Impairments have been removed.

Examples of Beneficial Use Impairments include, but are not limited to: restrictions on fish and wildlife consumption; degraded fish and wildlife populations; degradation of benthos; restrictions on dredging activities; loss of fish and wildlife habitat; bird or animal deformities or reproductive problems; fish tumors or other deformities; and beach closings.

### U.S. Great Lakes Areas of Concern



## FOCUS AREA 1

Measures of Progress with Annual Targets	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 1.1.1. Areas of Concern where all management actions necessary for delisting have been implemented.	Baseline: 12 Universe: 31	16	18	19	20	22
• 1.1.2. Beneficial Use Impairments removed in Areas of Concern.	Baseline: 80 Universe: 255	93	101	109	118	128
• 1.1.3. Areas of Concern with a complete and approved list of all management actions necessary for delisting.	Baseline: 18 Universe: 31	22	24	26	28	31

"Baselines" identify results through FY 2018 and "Targets" are cumulative. "Universes" represent the total number possible.

**Under GLRI Action Plan III,** GLRI federal agencies and their state, tribal, local, and private partners will continue their remediation and restoration efforts and will continue to implement management actions in all remaining Areas of Concern. Management actions at the five remaining Areas of Concern that were originally targeted for management action completion under Action Plan II (covering FY 2015 - FY 2019) are expected to be completed by FY 2021: Buffalo River, Manistique River, Clinton River, Black River, and Muskegon Lake. Also, following input from states and tribes, the following 10 additional Areas of Concern have been identified where completion of management actions could conceivably be achieved in the next five years:

- Grand Calumet River (IN)
- Cuyahoga River (OH)
- Lower Green Bay/ Fox River (WI)
- St. Louis River (MN/WI)
- Maumee River (OH)
- St. Lawrence River (NY)
- Milwaukee Estuary (WI)
- Torch Lake (MI)
- Rouge River (MI)
- Eighteen Mile Creek (NY)

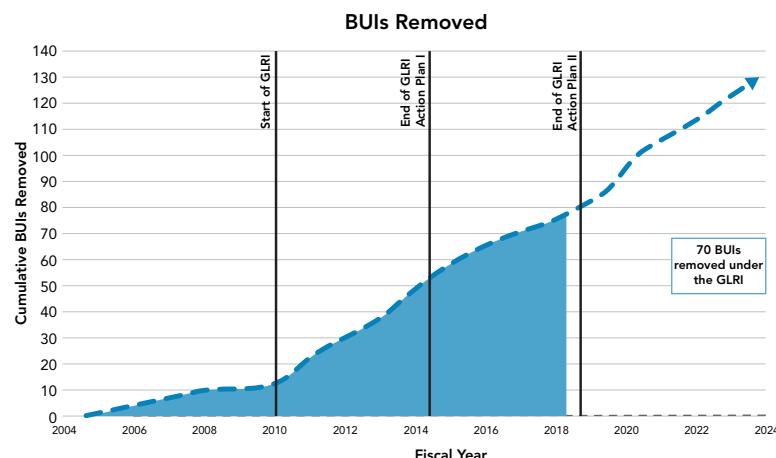
The Action Plan has set a target of actually completing all management actions at five of those 10 Areas of Concern. The five Areas of Concern where all management actions will be completed will depend on a number of factors, including the number and complexity of the management actions necessary to remove Beneficial Use Impairments.

Management actions are on-the-ground actions, including, but not limited to, remediating contaminated sediment through public/private partnerships and restoring habitat (e.g., improving fish passage, restoring wetlands, and removing dams), that will ultimately lead to the removal of Beneficial Use Impairments.

Under GLRI Action Plan III, GLRI federal agencies and their partners will also identify all of the management actions necessary for delisting at all of the Areas of Concern. Management action lists, compilations of remediation and restoration projects needed to remove Beneficial Use Impairments, constitute the "blueprints" for delisting Areas of Concern.

Under GLRI Action Plan III, GLRI federal agencies and their state, tribal, and local partners\* will hit the halfway point for removing Beneficial Use Impairments – a cumulative total of 128 out of 255 Beneficial Use Impairments are expected to be removed by the end of Action Plan III. While the delisting of Areas of Concern is not a specific measure of progress, delisting all Areas of Concern is the ultimate goal of the Area of Concern program.

## Path to Delisting



\*Including local Area of Concern advisory groups.

## FOCUS AREA 1

# TOXIC SUBSTANCES AND AREAS OF CONCERN

### Objective

1.2. Share information on the risks and benefits of consuming Great Lakes fish, wildlife, and harvested plant resources with the people who consume them.

### Commitment

- Increase the availability and accessibility of information to vulnerable populations that consume Great Lakes fish, wildlife, and harvested plant resources.

### Measure of Progress

- 1.2.1. Number of state and tribal organizations that collect and share information with vulnerable populations regarding the consumption of Great Lakes fish, wildlife, and harvested plant resources.

## Great Lakes Consortium for Fish Consumption Advisories

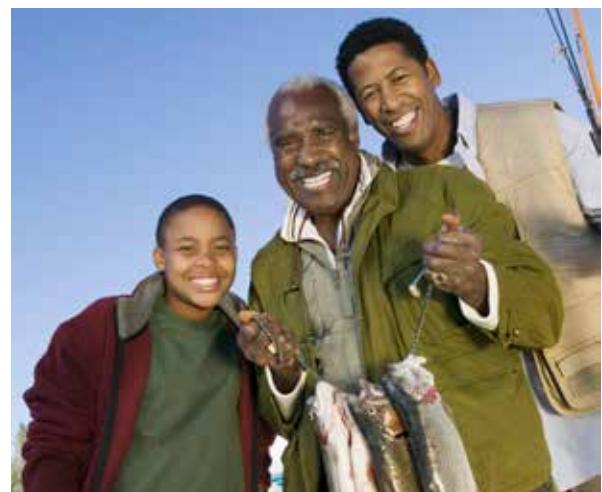
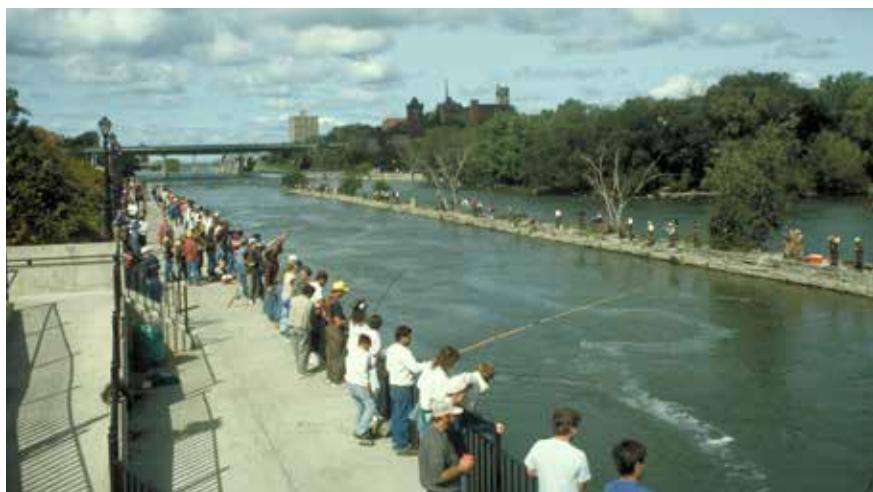


Fish advisory program managers from government health, water quality, and fisheries agencies collaborate through the Great Lakes Consortium for Fish Consumption Advisories (Consortium). Consortium members share fish contaminant data and assessment methods to promote consistency in fish consumption advice when communicating the risks and benefits of consuming fish to the public. Members use common educational messaging and coordinate outreach approaches for health education and community engagement. The Consortium seeks to communicate fish consumption advisories that will most effectively influence the behavior of fish consumers across the Great Lakes.

**Since the GLRI began,** GLRI federal agencies and their state and tribal partners have sought to increase the public's knowledge of the risks and benefits of fish consumption. They have also formed partnerships, such as the Consortium, to provide better fish consumption information in order to influence consumers to make healthier choices. The Consortium, along with individual federal, state, and tribal programs, has tested Great Lakes fish consumption messaging, designed new materials, evaluated effectiveness of the messaging, revised them as needed, and disseminated the improved state- and tribal-issued fish consumption guidelines.

**Under GLRI Action Plan III,** GLRI federal agencies and their state and tribal partners will continue to help the public make informed decisions about healthy

options for safe fish consumption, including expanding successful programs into other areas of the basin. This expansion will increase the availability and accessibility of safe fish consumption guidelines, as established by states and tribes, to vulnerable populations that consume Great Lakes fish. Agencies and their partners will also include more emphasis on the safe consumption of other wildlife and harvested plant resources. GLRI federal agencies and their partners will address the needs of vulnerable populations, particularly in environmental justice communities, and will provide the opportunity for the states and tribes to develop more innovative and effective outreach practices. Activities may include collection of information for use in programs to inform vulnerable populations and may incorporate traditional ecological knowledge.



## FOCUS AREA 1

### Objective

1.3. Increase knowledge about (1) "Chemicals of Mutual Concern" identified pursuant to the Great Lakes Water Quality Agreement's Annex 3; and (2) other priority chemicals that have negatively impacted, or have the potential to negatively impact, the ecological or public health of the Great Lakes.

### Commitment

- Fill critical data gaps for Annex 3 and other priority chemicals in the Great Lakes through discrete monitoring and assessment activities.

### Measure of Progress

- 1.3.1. Discrete chemical monitoring and assessment activities conducted.

**Since GLRI began,** GLRI federal agencies and their partners have characterized and assessed risks that emerging contaminants may pose to Great Lakes fish and wildlife, including completion of an evaluation of those contaminants with the greatest potential to adversely impact Great Lakes fish and wildlife. Through these characterizations and assessments, GLRI federal agencies and their partners were able to gain a better understanding of the presence and distribution of emerging contaminants, potential routes of exposure, and potential impacts on fish and wildlife.

GLRI federal agencies and their partners completed laboratory and field studies evaluating the biological effects of chemical mixtures and of long-term exposure of fish and other high-priority wildlife to contaminants.

### Under GLRI Action Plan III,

GLRI federal agencies will coordinate with appropriate state and tribal partners to fill critical monitoring and data gaps for priority chemicals in the Great Lakes. Conducting discrete monitoring projects will increase knowledge of Great Lakes Water Quality Agreement's Annex 3 Chemicals of Mutual Concern and other priority chemicals that have negatively impacted, or have the potential to negatively impact, the health of the Great Lakes. Monitoring data generated through this process will provide information on the magnitude and extent of these chemicals in the Great Lakes. For example, Great Lakes monitoring data may be collected to support EPA's Per- and Polyfluoroalkyl Substances Action Plan.

Annex 3 of the Great Lakes Water Quality Agreement calls for protection of human health and the environment through cooperative and coordinated measures to reduce the release of Chemicals of Mutual Concern from human activities into the Waters of the Great Lakes. The eight chemicals binationally designated as Chemicals of Mutual Concern currently include:

- Hexabromocyclododecane (HBCD)
- Long-Chain Perfluorinated carboxylic acids (LC-PFCAs)
- Mercury
- Perfluorooctanoic Acid (PFOA)
- Perfluorooctane Sulfonate (PFOS)
- Polybrominated Diphenyl Ethers (PBDEs)
- Polychlorinated Biphenyls (PCBs)
- Short-Chain Chlorinated Paraffins (SCCPs)

### Process to Identify Chemicals of Mutual Concern Under Annex 3 of the Great Lakes Water Quality Agreement

**Identify and target Chemicals of Mutual Concern and other priority chemicals for discrete science and assessment activities**

**Implement discrete science and assessment activities**

**Evaluate and report project results**

## FOCUS AREA 2

# INVASIVE SPECIES

### Objective

2.1. Prevent introductions of new invasive species.

### Commitments

- Work with Great Lakes states and tribes to conduct rapid response actions or exercises.
- Manage pathways through which invasive species can be introduced to the Great Lakes ecosystem.
- Conduct early detection and surveillance activities.

**Since GLRI began,** GLRI federal agencies and their partners have continued diligent efforts to prevent new introductions of invasive species in the Great Lakes ecosystem and to control existing invasive species populations. GLRI federal agencies and their partners have conducted 49 early detection field surveillances from FY 2015 through FY 2018. GLRI federal agencies and their partners also completed a total of 65 exercises and responses from FY 2015 through FY 2018 in response to new invasive species occurrences or expansion of the current range of existing invasive species, more than doubling the target of eight rapid responses and exercises per year over this period.

GLRI federal agencies and their partners continued extensive efforts to prevent bighead and silver carp from becoming established in the

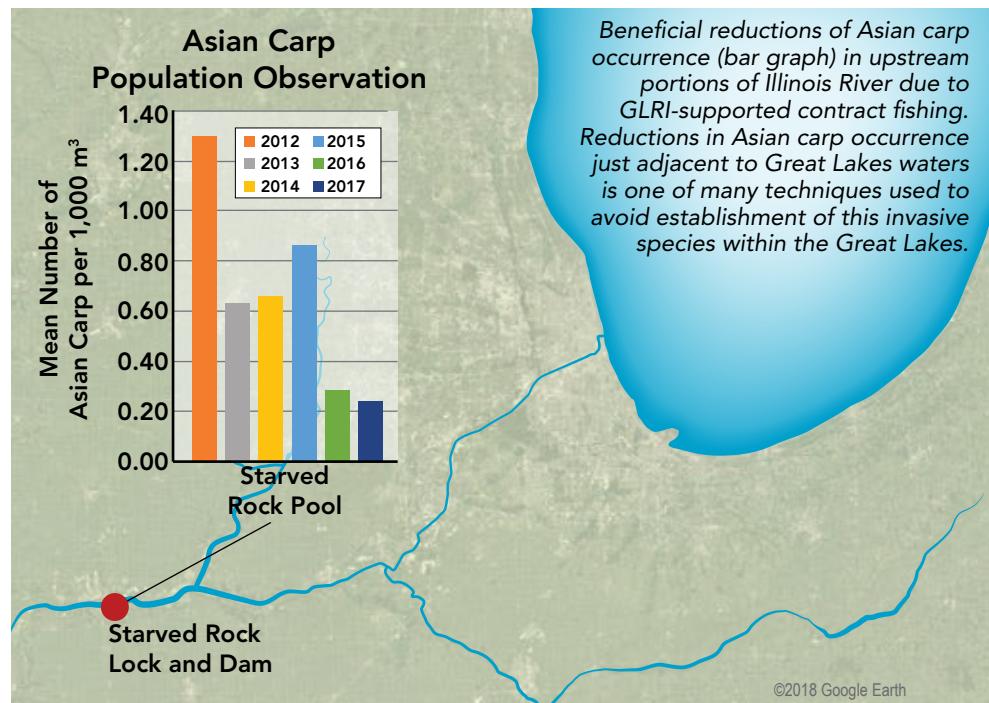
Great Lakes ecosystem. GLRI-funded actions during Action Plan II included installing and maintaining barriers to close Asian carp pathways to the Great Lakes, developing genetic testing tools, conducting contract fishing to remove over six million pounds of Asian carp from Upper Illinois Waterways near Lake Michigan, and assisting the Asian Carp Regional Coordinating Committee (ACRCC) to implement the Asian Carp Action Plan.

Surveillance programs continued to be a priority, forming the foundation for a multi-species early detection network. These surveillance activities were further refined and targeted by identifying 11 primary “injurious wildlife” species that have the potential to become invasive and highly detrimental to the Great Lakes. Other key GLRI-funded projects included the testing of new

technologies for managing ship ballast waters and establishing boat-washing stations in Michigan, Wisconsin, New York, and on tribal lands to reduce the potential for inadvertent spread of invasive species by recreational boats. Public education efforts have also helped boaters, anglers, and other resource users prevent the spread of invasive species.

### How Can Invasive Species Get into the Great Lakes?

- Canals and waterways
- Recreational boating
- Commercial shipping
- Illegal trade of banned species
- Release of aquarium species
- Release of live bait
- Spread of plant species purchased through nurseries, internet sales, and water garden trade



## FOCUS AREA 2

Measure of Progress with Annual Targets	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 2.1.1. Rapid responses or exercises conducted.	Baseline: 8 Universe: N/A	8	8	8	8	8

### Additional Measures of Progress

- 2.1.2. Projects that manage pathways through which invasive species can be introduced to the Great Lakes ecosystem.
- 2.1.3. Early detection and surveillance activities conducted.

*"Baseline"* identifies regularly expected annual exercises (1 per each of the 8 Great Lakes States). *"Targets"* for Measure 2.1.1 are not cumulative. *"Universe"* is not applicable.

### Under GLRI Action Plan III,

GLRI federal agencies and their partners will continue to prevent new invasive species from establishing self-sustaining populations in the Great Lakes ecosystem. GLRI federal agencies and their partners will continue to increase the effectiveness of existing surveillance programs by increasing detection abilities through the use of new and emerging technologies (e.g., environmental DNA or eDNA). GLRI will continue to support risk assessments that identify future potential invaders and their likely pathways of invasion to strategically allocate resources and attention to stakeholders who play an important role in stopping new invaders from entering the Great Lakes. GLRI partners will be able to use risk assessments in combination with updated "least wanted" lists (such as <http://www.gsgp.org/media/2017/ais-least-wanted-announcement.pdf>) to focus prevention activities. Increasing the ability and frequency of Great Lakes states to quickly address new invasions or range expansion of existing invasive species will be a key GLRI strategy. Because the Great Lakes can be a freshwater invasion pathway to the 31 states within the Mississippi River watershed and beyond, these prevention efforts will also benefit the entire nation.

GLRI will continue to help protect the Great Lakes from Asian carp, principally through prevention, control, and response actions. For example, GLRI funding supports (i) construction projects to prevent Asian carp from entering the Great Lakes via Eagle Marsh (outside Fort Wayne, IN) and the Ohio-Erie Canal (Akron, OH); (ii) contract fishing (pictured below) to control Asian carp in the Illinois River; and (iii) coordinated state and federal rapid responses in Lake Erie to remove grass carp. With support from the GLRI, the ACRCC will continue to work to implement the Asian carp action plan to prevent the various species of Asian carp, including grass carp, black carp, silver carp, and bighead carp, from establishing self-sustaining populations in the Great Lakes.



Locations sampled by the Great Lakes Early Detection and Surveillance Program are marked with a ●. This program is a collaboration between states and the U.S. Fish & Wildlife Service and is supported by the GLRI. Both traditional aquatic sampling methods and emerging technologies are deployed at these locations to detect non-native species and track the expansion of non-native species over time.

### Protecting the Great Lakes from Asian Carp

The ACRCC implements annual Asian Carp action plans that include surveillance, response actions, and testing of new control technologies. For example, the 2019 Asian Carp Action Plan includes aggressive new prevention and control efforts, including expanded Asian carp population reduction along established fronts, large-scale field trials of potential barriers and deterrent technologies, and actions to address black and grass carp threats. More information about the ACRCC and the Asian Carp Action Plan is available at <http://www.asiancarp.us>.



Contract fishing and removal of Asian carp species in the Illinois River is an example of critical activity identified by the Asian Carp Action Plan and supported by GLRI.

## FOCUS AREA 2

# INVASIVE SPECIES

### Objective

2.2. Control established invasive species.

### Commitment

- Implement control projects for GLRI-targeted invasive species.

## Controlling Invasive Species in the Great Lakes Basin



GLRI partners inspecting the effectiveness of terrestrial invasive species control along Lake Michigan sand dunes.

### Since GLRI began,

GLRI federal agencies and their partners have implemented projects to control invasive species, including, but not limited to: baby's breath, buckthorn, emerald ash borer, Eurasian watermilfoil, garlic mustard, *Hydrilla*, Japanese knotweed, invasive strains of phragmites, purple loosestrife, and sea lamprey.

Since 2010, GLRI partners adapted to the discovery of new, non-native species and better mapping of the distribution of invasive species. The focus of GLRI invasive species control projects is expected to continue to adapt and change to highlight new species of emerging concern.

GLRI federal agencies and their partners responded to numerous

invasive problem areas, with notable efforts including controlling *Hydrilla* infestations in New York, as well as *Phragmites* and invasive mussels across the basin. These control projects were done with partners that will continue maintenance and stewardship beyond the duration of the federally funded projects. Most projects will require additional, low-level maintenance as sites progress toward full recovery.

## FOCUS AREA 2

Measure of Progress with Annual Targets	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 2.2.1. Aquatic/terrestrial acreage controlled.	Baseline: 153,569 Universe: N/A	165,000	171,000	177,000	183,000	189,000

"Baseline" identifies results through FY 2018 and "Targets" are cumulative. "Universe" is not applicable.

### Under GLRI Action Plan III,

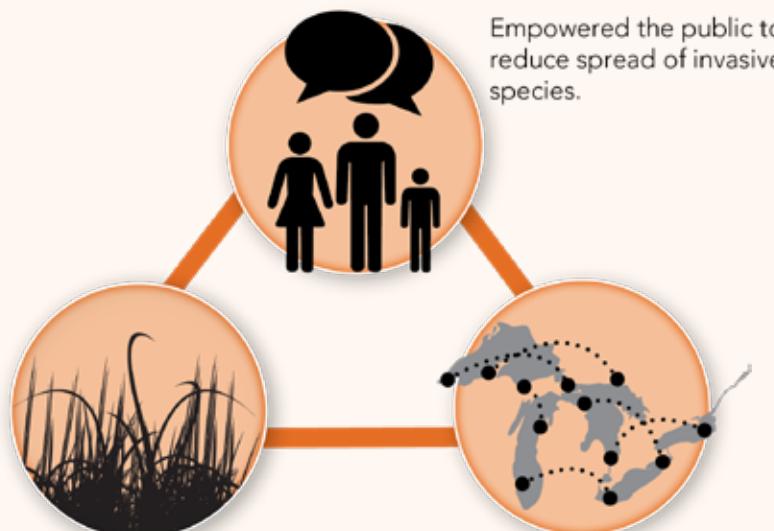
GLRI federal agencies and their partners will continue controlling aquatic, wetland, and terrestrial invasive species with an additional emphasis on maintaining the benefits of previously completed projects. Federal land management agencies (National Park Service, U.S. Fish & Wildlife Service, and U.S. Forest Service) will continue to implement control projects in national forests, parks, wildlife refuges, and other federal lands where they have direct implementation responsibility. These federal land management agencies will also continue to partner with states, tribes, and neighboring communities to promote larger-scale protection and restoration through control programs, such as Cooperative Weed Management Areas and Partnerships for Regional Invasive Species Management.

The Great Lakes Sea Lamprey Control Program will continue to identify strategic barriers to lamprey expansion and actively pursue actions to maintain their effectiveness while also advancing new control technologies. Sea lamprey control will be critical to ensuring that other GLRI accomplishments, such as the restoration of native open lake fish species, are not compromised in future years. Overall, invasive species control activities will continue to be strategically implemented to advance resiliency of GLRI projects.



### Supporting Sustainable Invasive Species Control through Community Projects

The GLRI is actively building the capability of Great Lakes communities to manage invasive species through supporting on-the-ground and in-the-water control projects by increasing local capacity and motivating use of adaptive management principles.



Local communities have relied on GLRI support to increase capacity to address both aquatic invasive species, including Hydrilla in New York (left photo) and various terrestrial invasive plant species in northern Wisconsin (right photo).

## FOCUS AREA 2

# INVASIVE SPECIES

### Objective

2.3. Develop invasive species control technologies and refine management techniques.

### Commitments

- Conduct field testing of innovative control technologies and methods to prevent the introduction and to control the spread of invasive species.
- Develop/enhance invasive species-specific collaboratives to support rapid responses and communicate the latest control and management techniques.

**Since GLRI began,** GLRI federal agencies and their partners have worked to develop and enhance several invasive species control technologies. Researchers worked to develop techniques to detect, attract, and remove Asian carp. Sea lamprey pheromones were synthesized and field-tested to assess whether

pheromones can be used to improve the efficiency of trapping sea lamprey. New procedures were developed and refined for testing the efficacy of ballast water treatment systems in the Great Lakes. Two innovative technologies were developed and field-tested as new controls for *Phragmites*. New partnerships and stakeholder networks

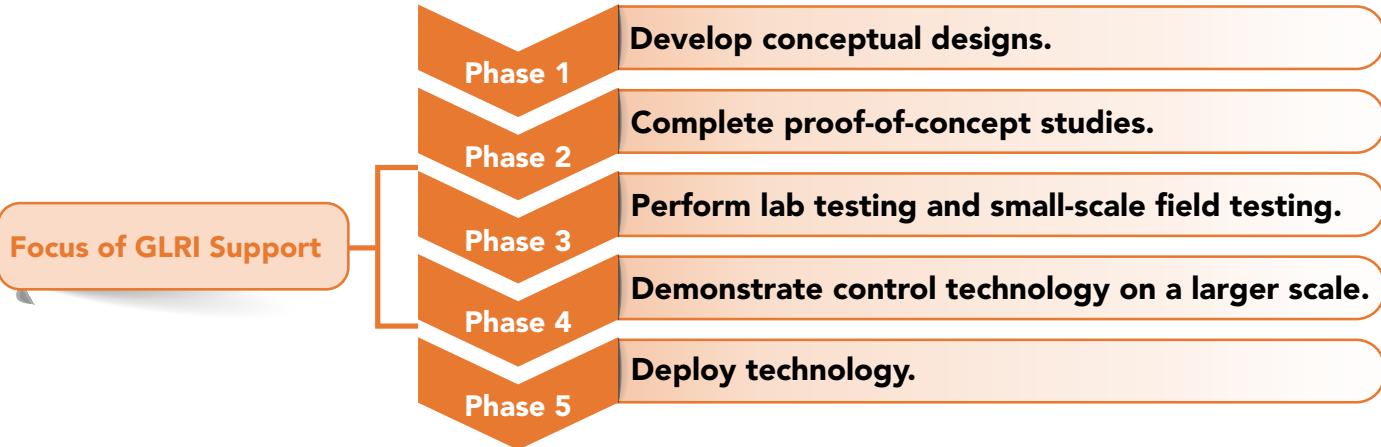
were established for monecious *Hydrilla*, grass carp, and invasive mussels. These partnerships, also known as collaboratives, support rapid responses and communicate the latest control and management techniques.

## The Importance of Developing Invasive Species Control Technologies

A number of effective control technologies have been developed to control invasive species in the Great Lakes. One of the longest-running and most effective invasive control technology programs is the sea lamprey control program. Its success is largely due to a multi-year effort to test almost 6,000 chemical compounds to identify the compound that most effectively controls sea lampreys without harming other species. GLRI federal agencies and their partners are using GLRI support to further refine sea lamprey control techniques and to develop targeted control methods for other invasive species impacting the Great Lakes ecosystem.



## Developing Invasive Species Control Technology for the Great Lakes Ecosystem



GLRI provides support for invasive species control technologies with proven potential that require additional testing. With that support, technologies have been deployed for *Hydrilla* and *Phragmites*. Additional technology testing and demonstration will continue to control these and other invasive species.

## FOCUS AREA 2

### Measures of Progress

- 2.3.1. Technologies and methods field tested.
- 2.3.2. Collaboratives developed/enhanced.

### Under GLRI Action Plan III,

GLRI federal agencies and their partners will continue to develop and enhance technologies to control Great Lakes invasive species by moving the latest technologies for invasive species detection and control from the testing phase to implementation in the field. GLRI federal agencies will continue to enhance invasive species collaboratives to support rapid responses and to communicate the latest control and management

techniques. The *Hydrilla* collaborative will demonstrate how small patches of *Hydrilla* can be eliminated without the use of large- scale treatments. GLRI federal agencies will continue to further refine sea lamprey control techniques and will work to develop targeted control methods for other invasive species impacting the Great Lakes ecosystem.

The GLRI will continue to support the Great Lakes Phragmites Collaborative

to facilitate communication across the region and serve as the resource center for information on *Phragmites* biology, management, and scientific research. Members of the Great Lakes Phragmites Collaborative identified the need for data-driven best management practices and developed the *Phragmites* Adaptive Management Framework to learn from management activities basin wide and guide future management decisions.



GLRI is supporting experiments and data collection as ongoing invasive species projects are implemented so that the effectiveness of these projects across the Great Lakes is known. Phragmites control, including mowing (Treatment A), aerial spraying (Treatment B), backpack spraying (Treatment C), burning (Treatment D), and flooding (Treatment E), are examples of a variety of approaches that may have varying success depending on the setting of project. A learning-while-doing approach, or adaptive management, will be applied to Phragmites control and other invasive species control efforts to increase the success rate and resiliency of future investments.

# NONPOINT SOURCE POLLUTION IMPACTS ON NEARSHORE HEALTH

## Objective

3.1. Reduce nutrient loads from agricultural watersheds.

## Commitments

- Implement systems of conservation practices on farms and in streams to reduce and treat nutrient runoff.
- Increase adoption of enhanced nutrient management practices to reduce risk of nutrient losses from farmland.

## Reducing Nutrient Runoff – Accomplishments to Date under GLRI



More than one million pounds of phosphorus runoff reduced from farmlands.



More than 700,000 cropland acres under conservation in agricultural priority watersheds.

**Since GLRI began,** GLRI federal agencies and their partners have funded multiple activities to reduce nutrient runoff and prevent nearshore harmful and nuisance algal blooms.

Phosphorus runoff from agricultural lands is an important source of excess nutrients to Great Lakes nearshore areas. Because implementing measures to prevent erosion and runoff from farmlands is often voluntary, the bulk of

GLRI efforts to date has been to provide farmers with financial and technical resources to adopt conservation practices. Outreach and funding have been targeted to where they would have the greatest impact on improving water quality.

GLRI federal agencies have used GLRI support to promote better nutrient management and more than double the number of farmland acres enrolled in agricultural conservation programs

in four priority watersheds. These programs have helped producers reduce phosphorus in runoff, preventing more than one million pounds of phosphorus from washing off agricultural lands to date. Continued support for technical assistance and comprehensive conservation planning will be vital to sustaining and further reducing excess nutrient loads into the Great Lakes.

## Agricultural Priority Watersheds

**Watersheds.** GLRI federal agencies and partners are currently focusing phosphorus reduction efforts in four GLRI priority watersheds: the Lower Fox River, the Saginaw River, the Maumee River, and the Genesee River. These agriculture-dominated watersheds are the watersheds most in need of phosphorus reductions to prevent excess algae growth in the Great Lakes. GLRI federal agencies and partners will continue to work in these watersheds, and others that need a reduction of excess nutrients, as appropriate.



## FOCUS AREA 3

Measures of Progress with Annual Targets	Baseline/Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 3.1.1. Estimated pounds of phosphorus reductions from conservation practice implementation throughout Great Lake watersheds.	Baseline: 1,113,603 Universe: N/A	1,600,000	1,900,000	2,200,000	2,500,000	2,800,000
• 3.1.2. Acres receiving technical or financial assistance on nutrient management in priority watersheds.	Baseline: 1,955,867 Universe: 10,000,000	2,200,000	2,370,000	2,515,000	2,685,000	2,817,500

"Baseline" for Measure 3.1.1 identifies results through FY 2018. Baseline for Measure 3.1.2 identifies results through FY 2017. "Targets" are cumulative. "Universes," when applicable, represent the total number possible.

### Under GLRI Action Plan III, GLRI federal agencies

and their partners will continue working on farms and in streams to reduce excess nutrient loads from agricultural watersheds, emphasizing utilization of conservation systems and work in priority watersheds. GLRI federal agencies and their partners will do this by:

- Improving the effectiveness of existing voluntary, incentive and market-based, and regulatory programs;
- Encouraging producers and agribusinesses to adopt innovative technologies and performance-based approaches to reduce excess nutrient runoff and soil losses;
- Expanding outreach and demonstration farm networks to improve adoption of on-farm nutrient management practices;
- Promoting practices that slow down and filter agricultural stormwater runoff, such as two-stage ditches, wetlands, and saturated buffers; and
- Emphasizing actions that result in long-term and sustainable nutrient reductions.



Example conservation practices: no-till farming (top) and grassed waterway (bottom).

### The **RIGHT SOURCE** of nutrient to be applied

... in the **RIGHT PLACE**  
subsurface injection and/or  
avoiding areas prone to runoff  
and erosion



### ...in the **RIGHT AMOUNT** as determined by soil, plant, and manure testing



... and at the **RIGHT TIME**  
will maximize crop uptake while  
reducing runoff, leaching, and  
gaseous losses



Conservation tillage  
prevents soil erosion  
and runoff

Riparian buffers reduce  
runoff and trap  
nutrients

Fencing keeps  
animal manure  
out of the stream  
and prevents  
streambank erosion



**"4R"** nutrient  
management practices

Subsurface injection of fertilizer  
and manure reduces nutrient runoff

Stream

An example of an enhanced conservation practice system: nutrient management practices coupled with minimal tillage, continuous cover, and riparian buffers. A holistic management approach is necessary to achieve nutrient load reductions.

## FOCUS AREA 3

# NONPOINT SOURCE POLLUTION IMPACTS ON NEARSHORE HEALTH

### Objective

3.2. Reduce untreated stormwater runoff.

### Commitments

- Accelerate implementation of green infrastructure practices to infiltrate stormwater runoff.
- Implement watershed management projects in urban and rural communities to reduce runoff and erosion.

## Reducing Stormwater Runoff – Accomplishments to Date under GLRI



More than 250 million gallons of untreated urban stormwater runoff prevented from entering the Great Lakes.

**100+**

More than 100 local watershed projects implemented in Great Lakes communities.

**Since GLRI began,** GLRI federal agencies and their partners have reduced the loading of sediment, nutrients, toxic contaminants, and pathogens to Great Lakes tributaries and nearshore waters by implementing projects in Great Lakes communities. GLRI funding supported green infrastructure projects in Great Lakes shoreline cities to reduce untreated stormwater runoff and to improve nearshore water quality. These green infrastructure projects had the added benefit of increasing greenspace in urban areas and providing habitat for pollinators. Watershed management projects were also implemented to stabilize streambanks, increase forest cover, construct wetland meadows, and improve water quality at beaches.



Examples of green infrastructure above: rain garden (bottom left), constructed stormwater wetland (top right), planting trees in a riparian corridor (bottom right).

## FOCUS AREA 3

Measures of Progress with Annual Targets	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 3.2.1. Estimated gallons (in millions) of untreated stormwater runoff captured or treated.	Baseline: 252 Universe: N/A	350	400	450	500	550
• 3.2.2. Miles of Great Lakes shoreline and riparian corridors restored or protected.	Baseline: 26 Universe: N/A	33	40	47	54	61

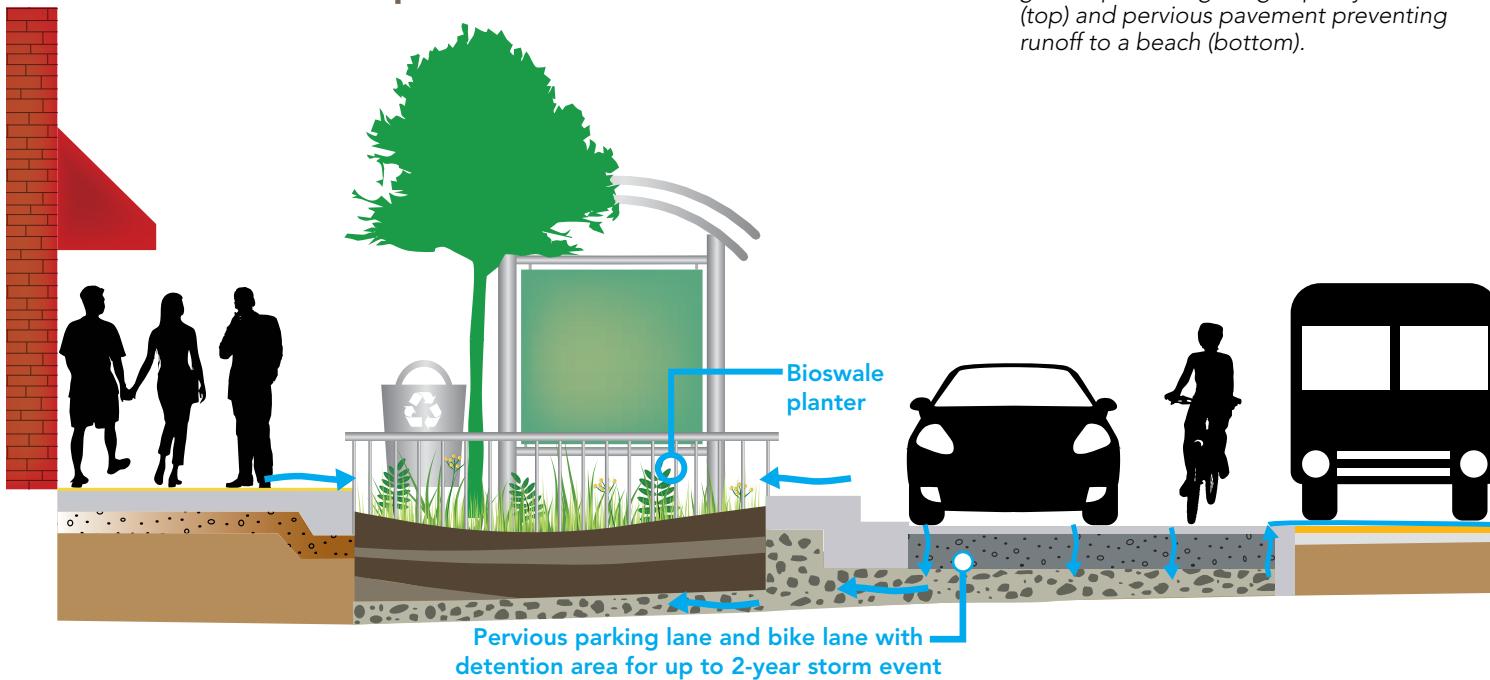
Measure 3.2.2 is applicable for restoration or protection from nonpoint source runoff, a subset of a similarly worded measure from the Habitat Focus Area under Action Plan II. "Baselines" identify results through FY 2018. "Targets" are cumulative. "Universes" are not applicable.

**Under GLRI Action Plan III,** GLRI federal agencies and their partners will continue to encourage and accelerate implementation of green infrastructure projects to reduce the impacts of polluted runoff on nearshore water quality. These projects will capture or slow the flow of untreated runoff and filter out sediment, nutrients, toxic contaminants, pathogens, and other pollutants from runoff before it enters Great Lakes tributaries, beaches, and nearshore waters.

In addition to supporting green infrastructure, GLRI funding will continue to support watershed management projects that slow and intercept runoff. For example, streambank improvement projects identified in watershed plans can be effective in improving and protecting water quality. Actions such as re-establishing riparian vegetation and stabilizing streambanks can help increase a stream's resiliency to stressors such as large storms. Restoration projects along coastlines can incorporate resilient features to mitigate effects of more extreme storms, high wave action, interrupted sediment transport, and presence of manmade physical structures. Activities to reduce stormwater runoff and streambank erosion also complement these restoration efforts and increase coastal resiliency.

**GLRI federal agencies will work with local partners to slow down and soak up stormwater runoff, and filter pollutants.**

### Green Infrastructure Captures and Filters Runoff



Examples of green infrastructure: rain garden protecting a high-quality woodland (top) and pervious pavement preventing runoff to a beach (bottom).

# NONPOINT SOURCE POLLUTION IMPACTS ON NEARSHORE HEALTH

**Objective**

3.3. Improve effectiveness of nonpoint source control and refine management efforts.

**Commitments**

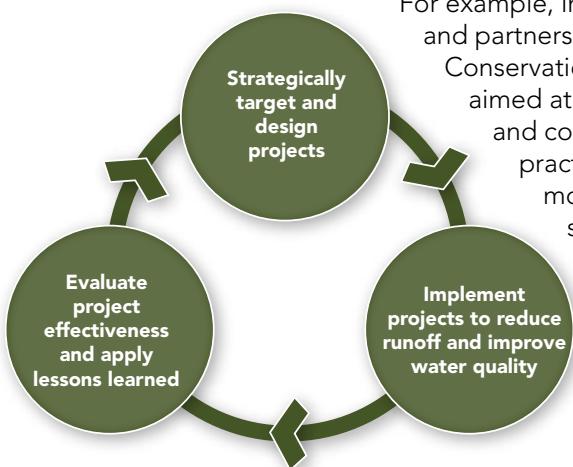
- Assess achievement of Great Lakes Water Quality Agreement's Annex 4 nutrient targets.
- Evaluate effectiveness of nonpoint source projects.
- Develop new or improved approaches for reducing or preventing harmful algal blooms.

**Since GLRI began,** GLRI federal agencies and partners have coordinated monitoring and assessments to improve the effectiveness of their nonpoint source control activities.

For example, in 2012, GLRI federal agencies and partners began working on a Conservation Effects Assessment Project aimed at evaluating various types and combinations of agricultural practices to determine which were most effective at removing soluble phosphorus that can drive algal blooms in Lake Erie. Participants in the Conservation Effects Assessment Project found that implementing systems of conservation practices (nutrient management, cover crops, and drainage management) in specific priority areas will have the greatest impact

on reducing phosphorus loads to western Lake Erie. GLRI federal agencies applied that information to accelerate phosphorus reduction accomplishments by 20% over the goal that had been planned under Action Plan II. Over the next five years, GLRI federal agencies expect to reduce an additional 1,500,000 pounds of agricultural phosphorus runoff – a 40% increase over the goal under Action Plan II.

Similarly, in 2014, GLRI federal agencies and partners began evaluating performance of various green infrastructure practices in urban areas (such as: Gary, IN; Detroit, MI; and Buffalo, NY). GLRI federal agencies will apply the information learned from these studies to improve effectiveness of stormwater reduction projects funded under GLRI. Over the next five years, GLRI federal agencies expect to more than double the amount of stormwater runoff reduced through green infrastructure practices to 550 million gallons by the end of FY 2024.

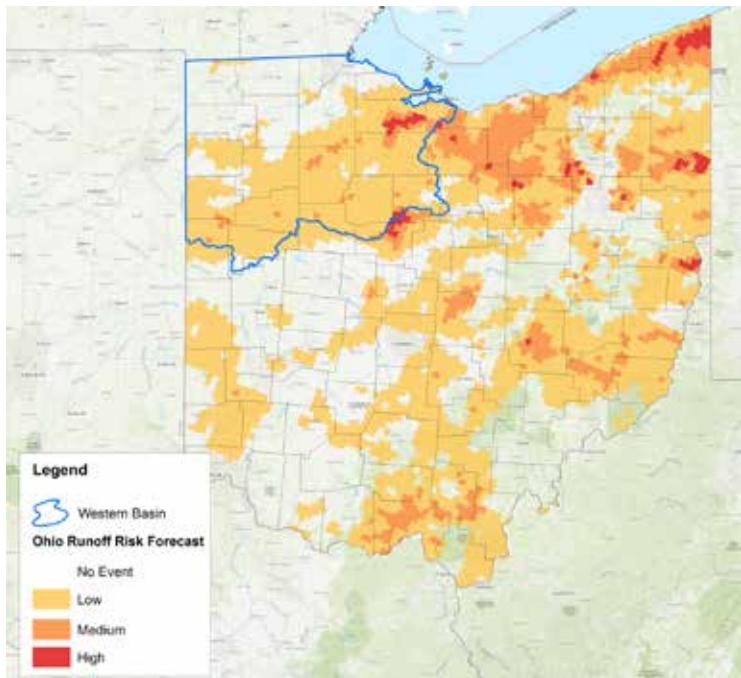


Nonpoint source projects and programs are continually improved through adaptive management.

**Decision-support tools improve****nonpoint source management.**

Under Action Plan II, GLRI federal agencies partnered with states to develop weather-based forecasts to help farmers avoid nutrient application when the chance of runoff is high. Runoff Risk Advisory Forecasts have been developed for Wisconsin, Michigan, Minnesota, and Ohio, and are being developed for other Great Lakes states. Under Action Plan III, GLRI federal agencies and partners will promote adoption of these tools and assess how effective they are at reducing phosphorus loads.

Pictured right: The Ohio Applicator Forecast is designed to help nutrient applicators identify times when the weather-risk for applying nutrients is low. The risk forecast is created by the National Weather Service and takes into account snow accumulation and melt, soil moisture content, and forecast precipitation and temperatures.



## FOCUS AREA 3

<b>Measures of Progress with Annual Targets</b>	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 3.3.1. Nutrient monitoring and assessment activities conducted.	Baseline: 30 Universe: N/A	30	30	30	30	30
• 3.3.2. Nutrient or stormwater runoff reduction practices or tools developed or evaluated.	Baseline: 10 Universe: N/A	10	10	10	10	10

"Baseline" and "Targets" for Measure 3.3.1 identify the regularly expected monitoring and assessment activities conducted annually. "Baseline" and "Targets" for Measure 3.3.2 identify the regularly expected practices or tools developed or evaluated annually. "Targets" are not cumulative. "Universes" are not applicable.

**Under Action Plan III,** GLRI federal agencies and their partners will continue to apply adaptive management to maximize nonpoint source-control efforts using a three-pronged strategy:

1. Continue the edge-of-field monitoring studies underway in agricultural priority watersheds, and establish new sites to test the effectiveness of innovative practices such as bioreactors;
2. Use the tools and lessons learned under Action Plan II to optimize outcomes of nutrient and stormwater reduction projects; and
3. Promote development of new strategies for nonpoint source control, such as market-based approaches, nutrient recovery, and manure transformation technologies.

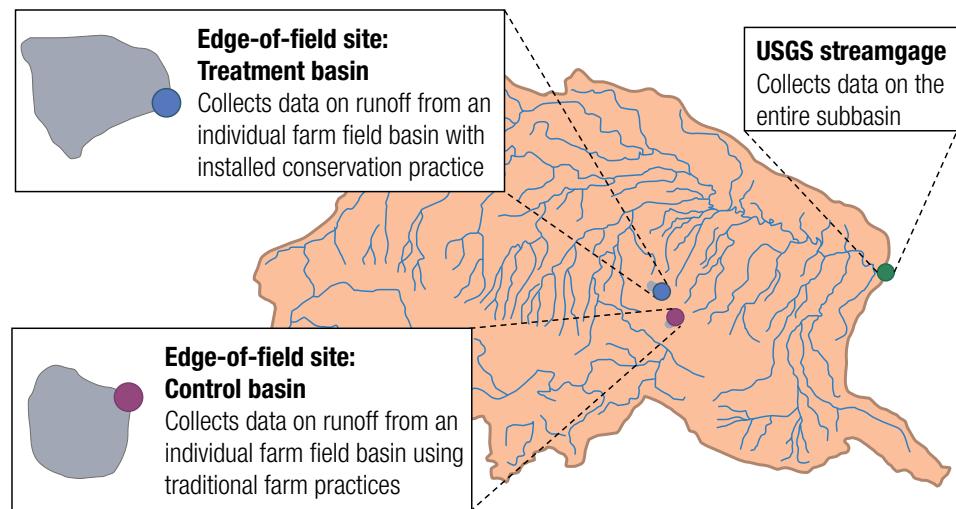
### Effectiveness monitoring of nonpoint source runoff in urban (top) and agricultural (bottom) settings.



**Annex 4 of the Great Lakes Water Quality Agreement calls for coordinating binational actions to manage phosphorus concentrations and loadings, and other nutrients if warranted, to control the growth of nuisance and toxic algae. Under Action Plan III, GLRI federal agencies and partners will continue to coordinate efforts to control and monitor nutrients in support of Annex 4 goals.**

**A typical agricultural edge-of-field study takes at least eight years.** Water quality data is collected downstream of fields and at the outlet of the watershed to measure improvements in water quality associated with agricultural conservation activities.

Under Action Plan II, six edge-of-field monitoring sites were established to evaluate the impact of nutrient-reduction activities in the priority agricultural watersheds. In addition, GLRI federal agencies and partners are monitoring the effectiveness of stormwater runoff reduction projects at four sites. The information learned from these studies will be used to improve future project designs so that water quality benefits can be maximized.



## FOCUS AREA 4

# HABITATS AND SPECIES

### Objective

4.1. Protect and restore communities of native aquatic and terrestrial species important to the Great Lakes.

### Commitment

- Identify habitats that support important Great Lakes species and take actions to restore, protect, enhance, and/or provide connectivity for these habitats.



GLRI will continue to support people and communities to better understand coastal processes under protected settings, including those in the Apostle Islands National Lakeshore (left photo), and implement the best approaches to restore the interface of the Great Lakes and shorelines where species and people interact, including, for instance, the Chicago waterfront (right photo).

**Since GLRI began,** GLRI federal agencies and their partners, including states and tribes, have worked to protect, restore, and enhance habitat in the Great Lakes basin. Key accomplishments include:

#### **Bringing Back the Great Lakes Piping Plover:**

**Plover:** Protecting its habitat and increasing the number of breeding pairs to 67 (as of 2018) over a much wider area of the Great Lakes, including breeding pairs identified in Illinois, Wisconsin, Pennsylvania, and New York.

**Lake Sturgeon Recovery:** Multiple Great Lakes tributaries have been selected for rearing and release of juvenile lake sturgeon to increase the population size in Lake Michigan and Lake Erie. The barriers to the successful return and spawning of lake sturgeon in Great Lakes tributaries are being addressed through innovative fish-passage projects such as those on the Menominee River in Wisconsin and the Boardman River in Michigan. A comprehensive approach was taken to make sure this long-lived, prehistoric fish remains in the Great Lakes for future generations.

**Coastal Wetlands Protection:** The GLRI has provided the resources necessary to assess, protect, and restore many of the remaining coastal wetlands across the Great Lakes. Partners across the basin have accelerated protection of remaining high-quality coastal wetlands and undertaken efforts to bring back coastal wetlands lost to human development and drainage practices. An example of such a coastal wetland restoration is the Howard Farms Restoration Project in Curtice, Ohio, which will restore 568 acres of coastal wetlands, restore hydrologic exchange with Lake Erie, provide fish nursery habitat, and provide stopover habitat for migrating birds and waterfowl. GLRI investments from FY 2015 through FY 2018 have protected or restored over 52,000 acres of coastal wetlands across the Great Lakes.



## FOCUS AREA 4

<b>Measures of Progress with Annual Targets</b>	Baseline/Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 4.1.1. Acres of coastal wetland, nearshore, and other habitats restored, protected, or enhanced.	Baseline: 370,488 Universe: 1,550,000	394,000	406,000	418,000	430,000	442,000
• 4.1.2. Miles of connectivity established for aquatic species.	Baseline: 5,289 Universe: N/A	5,700	5,900	6,100	6,300	6,500

"Baselines" identify results through FY 2018. "Targets" are cumulative. "Universes," when applicable, represent the total number possible.

**Under GLRI Action Plan III,** GLRI federal agencies and their partners will build upon and maintain past GLRI investments while recognizing where additional habitats and emerging issues are important to targeted species. Examples of such projects include: restoring riparian habitat corridors and riverine wetlands associated with significant fish barriers already removed and/or bypassed; further connecting high-quality terrestrial and aquatic habitat areas; and reducing impacts of human activities such as trash, litter, and debris in our waters. GLRI federal agencies and their partners will strategically collaborate between the GLRI invasive species and habitat restoration activities to reduce the possibility of past investments regressing due to invasive species occurrence.

GLRI federal agencies and their partners will continue to support projects that increase coastal communities' understanding of lake processes important to habitats and species. Collaborative partnerships will pursue innovation related to the use of natural and nature-based features that will enhance coastal ecosystem function and, when possible, consider the beneficial use of dredged material to create new habitats for species important to Great Lakes stakeholders. Projects will be initiated that use lessons learned from past efforts and address fragmented habitats by connecting habitats important to key species and communities to increase their resilience. Sound, cutting-edge science and tools will guide future GLRI-funded efforts to maximize their conservation value.



Lake trout (above) and native prey fish species (below) such as cisco and bloater are important native fish species to the open lake food web and a focus of GLRI restoration activities.



EPA Administrator Wheeler announces Trash-Free Great Lakes Grant Program to be offered in FY 2020.



Benefits of GLRI dam removal and stream channel restoration on the Ottaway-Boardman River include great recreational opportunities for paddling and fishing.

## FOCUS AREA 4

# HABITATS AND SPECIES

### Objective

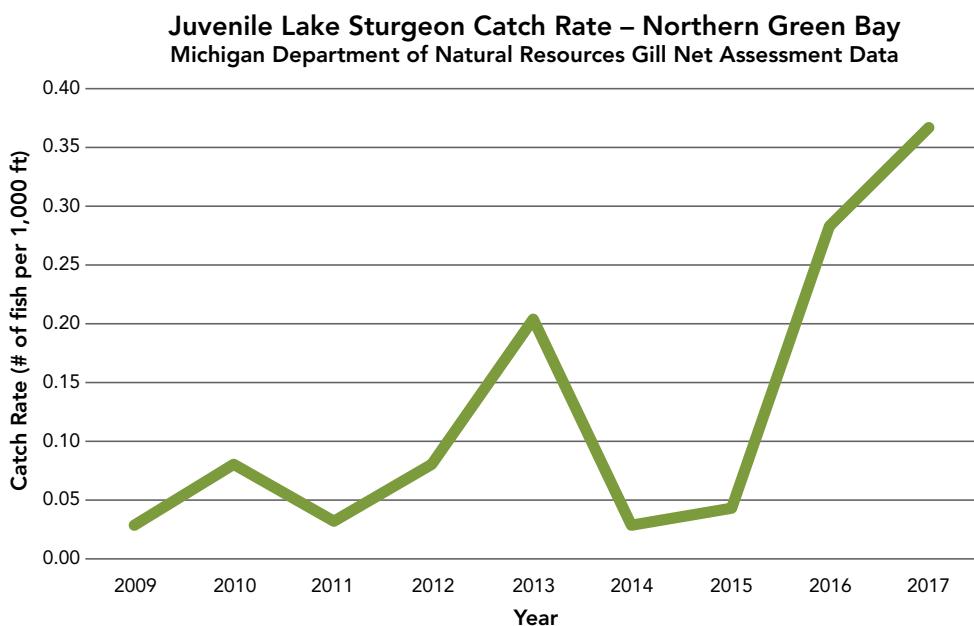
4.2. Increase resiliency of species through comprehensive approaches that complement on-the-ground habitat restoration and protection.

### Commitments

- Update and implement recovery actions for federal threatened, endangered, and candidate species.
- Support population-level protections, enhancements, and reintroductions for state, tribal, and Great Lakes native species of importance.

**Since GLRI began,** GLRI federal agencies and their partners have worked to maintain, restore, and enhance populations of native fish and wildlife species. This was accomplished through multi-jurisdictional and stakeholder groups, including the Council of Lake Committees, the Upper Mississippi and Great Lakes Region Joint Venture, the Great Lakes Coastal Assembly, the Lakewide Action and Management Plans, and others. Focus Area 4 will continue to be responsive and direct efforts to advance science needs, as well as support species reintroductions informed by changing Great Lakes conditions and management strategies.

GLRI federal agencies responded to needs of fish and wildlife management agencies through activities such as assessments of top-level predators in the open lakes, including lake trout and other salmonids, and assistance in the reintroduction of native prey species to support a healthy ecosystem and sustainable fishery. GLRI federal agencies will continue to be responsive to Great Lakes states, tribes, and communities and provide needed science, complement other restoration efforts, and address emerging issues.



Establishment of juvenile sturgeon-rearing trailers at strategic locations and release of reared individuals (top two photos on the right) in future years is expected to continue to increase population numbers of this iconic fish species to more resilient levels (bottom photo on the right).

## FOCUS AREA 4

Measure of Progress with Annual Targets	Baseline/ Universe	FY 2020 Target	FY 2021 Target	FY 2022 Target	FY 2023 Target	FY 2024 Target
• 4.2.1. Species benefited where actions have been completed to significantly protect or promote recovery of populations.	Baseline: 0 Universe: N/A	1	2	4	6	8

"Baseline" identifies results through FY 2018. "Targets" are cumulative. "Universe" is not applicable.

**Under GLRI Action Plan III,** GLRI federal agencies and their partners will continue to work to maintain, restore, and enhance the habitats of native fish and wildlife species in order to increase the resiliency and overall health of these species. Protection and restoration of federally listed species will be rooted in past successes from across the Great Lakes. GLRI federal agencies have identified a subset of federally threatened, endangered, and candidate species for demonstrating how GLRI investments can have the greatest impact in a relatively short time period. Agencies will maximize habitat improvements for aquatic and terrestrial species through collaborative conservation and monitoring at local and regional scales. This conservation network approach will especially benefit breeding marsh birds, such as rails, grebes, bitterns, black and common terns, and other species that rely on high-quality coastal wetlands.

GLRI federal agencies and their partners will target species protection, restoration, and enhancement projects based on consensus-based Great Lakes restoration and conservation plans developed by GLRI federal agencies, states, and tribes. Future projects will support population-level enhancements, reintroductions, and tracking of state, tribal, and other Great Lakes native species of importance. Expected outcomes will include avoiding species extinction, identifying key habitats and the factors that limit species recovery, and increasing or protecting population levels.

GLRI federal agencies and their partners will evaluate population dynamics to aid in successfully maintaining fish and wildlife communities. Results of annual project evaluations will be used to prioritize locations and species to be targeted in future projects. Drawing from western science and traditional ecological knowledge, GLRI federal agencies and their partners will continue to support protection of native species that have cultural, subsistence, and economic value.

### Examples of species that may benefit under this measure during Action Plan III include, but are not limited to:

Lake trout

Native prey fish

Wild rice

Dwarf lake iris

Great Lakes piping plover

Pitcher's thistle

Breeding marsh birds

Lake sturgeon

Brook trout

Native freshwater mussels

Lakeside daisy

American Hart's-tongue fern

Chittenango amber snail

Mitchell's satyr

Poweshiek skipperling

Moose

Rusty patched bumble bee



Protection and restoration of wild rice, such as shown above in the Kakagon Sloughs on the Bad River Reservation in northern Wisconsin, will continue to be a priority. Wild rice is a plant of significant cultural value to Great Lakes tribal nations.

# FOUNDATIONS FOR FUTURE RESTORATION ACTIONS

## Objective

- 5.1. Educate the next generation about the Great Lakes ecosystem.

## Commitment

- Support experience-based learning opportunities for youth to promote Great Lakes stewardship.



Removal of an invasive plant species.



CGLL Shipboard Science Workshop on the Research Vessel Lake Guardian.



Park visitor being educated on Lake Sturgeon.

**Since GLRI began,** GLRI federal agencies and their partners promoted Great Lakes ecosystem education and stewardship through a focus on training educators and engaging people through place-based experiential learning. Partners implemented a number of activities to promote Great Lakes-based environmental education and stewardship, including:



- The Center for Great Lakes Literacy (CGLL), a Great Lakes Sea Grant Network program, which seeks to develop a community of Great Lakes-literate educators, students, scientists, environmental professionals, and citizen volunteers dedicated to improved Great Lakes stewardship;
- The Great Lakes Bay Watershed Education and Training Program (B-WET), which provides hands-on environmental activities that are aligned with academic learning standards; and
- National Park Service interpretive programs, which offer hands-on experiences, educational resources, and networking opportunities to promote Great Lakes literacy among an engaged community of educators, scientists, and residents.



Collectively, CGLL, B-WET, and other education projects resulted in the training of more than 2,200 educators from FY 2015 through FY 2018, who in turn have provided hands-on experiential learning to an estimated 200,000 students.



Educators being trained at a Professional Development Day.



GLRI trained educators across the Great Lakes (FY 2018).

## FOCUS AREA 5

### Measure of Progress

- 5.1.1. Youth impacted through education and stewardship projects.

**Under GLRI Action Plan III,** GLRI federal agencies and their partners will continue to promote Great Lakes-based ecosystem education and stewardship for K-12 school students and other interested community members (for example, courses at parks, nature centers, museums, zoos, and on-board vessels).

GLRI agencies and their partners will continue to support activities centered on providing experience-based learning opportunities, with an emphasis on youth. GLRI federal agencies and their partners will also continue to develop Great Lakes-literate educators using the essential principles and fundamental concepts included in the Great Lakes Literacy curriculum.

These activities will support the overall goal of impacting as many youths as possible over time to foster Great Lakes stewardship, promote conservation, and expose and prepare under-represented youth for higher education opportunities in natural resource management. Where appropriate, activities will encourage opportunities to incorporate traditional ecological knowledge and cross-cultural learning. GLRI activities will also evaluate the effectiveness of education programs.



Park Rangers educate a youth group on ways they can improve the ecosystem.

The Center for Great Lakes Literacy is a collaborative effort led by Great Lakes Sea Grant network educators throughout the Great Lakes watershed. The center fosters informed and responsible decisions that advance basin wide stewardship. Educators use Great Lakes Literacy Principles, developed by education leaders in the Great Lakes Sea Grant network, as a framework for communicating key scientific concepts and the important connections between humans and the Great Lakes.



National Park Rangers introduce early learners to the Great Lakes ecosystems.

# FOUNDATIONS FOR FUTURE RESTORATION ACTIONS

## Objective

5.2. Conduct comprehensive science programs and projects.

## Commitments

- Assess overall health of the Great Lakes ecosystem and identify the most significant remaining problems.
- Identify cross-cutting science priorities and implement projects to address those priorities.



GLRI agencies use indicators to assess status and trends of the Great Lakes ecosystem.

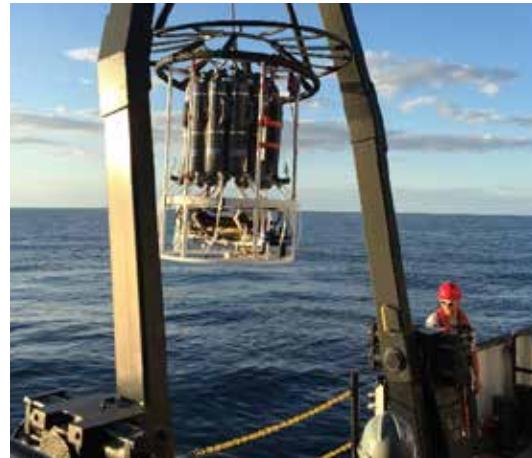


GLRI agencies assess conditions of nearshore and coastal zones.



GLRI agencies assess the overall health of the Great Lakes.

**Since GLRI began,** GLRI federal agencies and their partners have worked together using a science-based adaptive management approach to investigate complex scientific issues that affect multiple focus areas. These agencies and their partners used GLRI resources to monitor and assess the overall health of the Great Lakes. This work has contributed to the identification of current and emerging challenges to Great Lakes water quality and ecosystem health, which helps agencies evaluate the effectiveness of programs and policies. Part of this work includes the use of a suite of nine indicators of ecosystem health, in conjunction with 45 sub-indicators, to support U.S. commitments under the Great Lakes Water Quality Agreement. More than 200 government and non-government Great Lakes scientists and other experts worked to assemble available data, including annual monitoring data from the research vessel Lake Guardian pictured below, in this international effort. GLRI federal agencies and their partners have implemented targeted projects such as studying the causes and impacts of harmful algal blooms and *Cladophora*—two environmental issues that are caused by excess nutrients, influenced by invasive mussels, and have impacts on fish, wildlife, and humans.



Large research vessels allow scientists to test water quality and the health of bottom sediments near the coastline and far offshore. Cylindrical, multi-chambered "Rosette" samplers are used to collect water. Small metal "Ponar" samplers are used to scoop up and retrieve sediments.



## FOCUS AREA 5

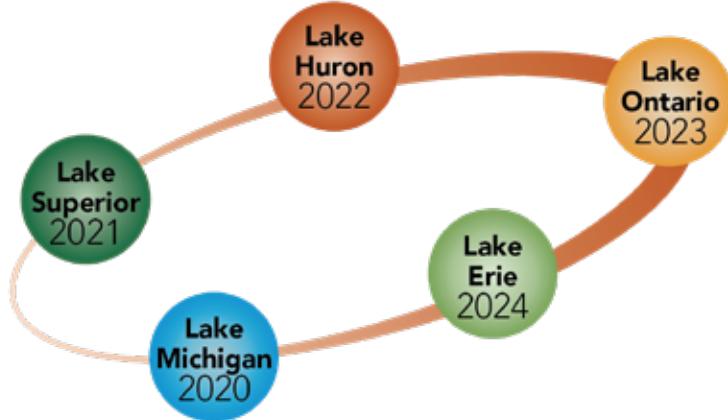
### Measures of Progress

- 5.2.1. Annual Great Lakes monitoring conducted and used to prioritize GLRI funding decisions.
- 5.2.2. Identify and address cross-Focus Area science priorities to support implementation of GLRI and the Great Lakes Water Quality Agreement.

### Under GLRI Action Plan III,

GLRI federal agencies and their partners will continue to investigate the most significant ecological problems in the Great Lakes. Monitoring the health of the Great Lakes at different scales will remain a priority, including, but not limited to, monitoring of: contaminants in Great Lakes fish, water quality and the lower food web in the offshore waters, and excess nutrients and harmful algal blooms in priority areas. GLRI federal agencies and their partners will identify and address cross-Focus Area science priorities to support implementation of the GLRI and the Great Lakes Water Quality Agreement. They will also continue to develop new tools for monitoring and forecasting, measure project effectiveness, prioritize management activities, and consider environmental and health outcomes.

### Cooperative Science and Monitoring Initiative



The GLRI-enhanced Cooperative Science and Monitoring Initiative coordinates scientific work to support Great Lakes management. Enhanced monitoring and field activities are conducted in one lake each year, tied to priorities identified by the Lake Partnerships.

### Science Highlights



GLRI federal agencies and their partners have developed new approaches to detect harmful algal blooms in real time. One approach uses an airplane mounted with a hyperspectral camera to capture images and improve harmful algal bloom forecasts when satellite imagery cannot be used due to cloudy conditions. A complementary approach includes a network of real-time continuous-

observing buoys that track detailed water quality conditions (including toxin concentrations) to support modeling, forecasting, and public warnings of harmful algal bloom conditions throughout western Lake Erie.



GLRI federal agencies and their partners are implementing a Great Lakes-wide, coordinated investigation into the factors that contribute to nuisance *Cladophora* algae growth. The collaborative effort relies on several research vessels, scuba divers, and field scientists to better understand the role of invasive mussels, bottom sediments, water transparency/sunlight, and nutrient levels.



GLRI federal agencies and their partners are developing an innovative Selective Fish Passage Project that matches physical and behavioral attributes of fish with technology and engineering to selectively pass desirable species and exclude invasive species. The project reconnects a watershed to the Great Lakes and will be used to apply lessons learned to other watersheds.

# Great Lakes RESTORATION



## Interagency Task Force and Regional Working Group Agencies



**U.S. Environmental Protection Agency**  
Great Lakes National Program Office



**U.S. Department of State**



**U.S. Department of the Interior**  
Bureau of Indian Affairs  
U.S. Fish & Wildlife Service  
National Park Service  
U.S. Geological Survey



**U.S. Department of Housing and Urban Development**



**U.S. Department of Agriculture**  
Animal and Plant Health Inspection Service  
Natural Resources Conservation Service  
U.S. Forest Service



**U.S. Department of Commerce**  
National Oceanic & Atmospheric Administration



**U.S. Department of Transportation**  
Federal Highway Administration  
Maritime Administration



**U.S. Department of Homeland Security**  
U.S. Coast Guard



**U.S. Department of the Army**  
U.S. Army Corps of Engineers



**Council on Environmental Quality**



**U.S. Department of Health and Human Services**  
Agency for Toxic Substances and Disease Registry  
Centers for Disease Control and Prevention