MICHIGAN

State of the Great Lakes

2020 REPORT

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

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Prepared by the Michigan Department of Environment, Great Lakes, and Energy on behalf of the Office of the Governor (April 2021)

TAKING BOLD ACTION

Protecting the Great Lakes today will have lasting impact for generations

2020 has put Michiganders and Americans everywhere to the test. While fighting the COVID-19 pandemic, we saw a historic, 500-year flooding event in Mid-Michigan that forced thousands of residents to evacuate their homes.

Despite these unprecedented circumstances, Michiganders continue to prove that tough times don't last, but tough people do, and by taking bold action, we can build a stronger, more sustainable state for our children and future generations. This past year has been unpredictable, but we've matched that uncertainty with bold actions to take on crises facing our waters, public health and economy.

COVID-19 highlighted several public health disparities across our state, including the need for access to clean water. Which is why early on during this crisis, I ensured that at-risk households had access to clean water for handwashing and sanitation by requiring service to be reconnected to residences that experienced shutoffs due to inability to pay. This action has provided crucial services to people across the state who need access to clean and affordable water.

Since the start of my administration, I've remained laser-focused on working to improve and rebuild Michigan's crumbling infrastructure — from our roads to bridges to water. We've seen the economic and emotional devastation that can happen when infrastructure fails. We must prioritize investing in infrastructure that will secure jobs, bolster our economy and protect public health and our waters.

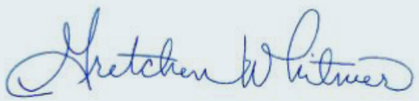
In October, I announced the MI Clean Water Plan, a $500 million comprehensive infrastructure investment in systems from source to tap. It marks a significant investment after decades of underinvestment in infrastructure and is a unified approach to cleaner, more affordable water.

While my administration continues to work toward a lasting infrastructure that protects public health, it's become even more clear that we're facing a global climate crisis that will directly impact our environment, economy and residents, with communities of color and low-income Michiganders suffering disproportionately.

Michigan continues to see climate-fueled disasters, including high water levels, historic flooding and toxic algal blooms. The science is clear, and its message is urgent: the earth's climate is now changing faster than at any point in the history of modern civilization.

Action in the next decade will be paramount to reducing the harmful impacts of the real threat of climate change, so we've launched the MI Healthy Climate Plan. It sets some of the strongest goals in the country for combating climate change. Our goal is a 100 percent carbon-neutral Michigan by 2050. The transition will mitigate the future impacts of climate change and enable Michigan to take full advantage of the global energy transformation — from the jobs it will generate for our skilled workforce to the protections it will provide for natural resources and the savings it will bring to communities and Michiganders.

This year has tested us all, but it has also shown what we are made of. Real change requires leaders from across the country to make bold choices, and that is what I'm committed to doing for the health of the Great Lakes region. The actions and bold ideas we implement today will have a lasting impact for generations to come.



Governor Gretchen Whitmer

Building on Success

We made significant strides this past year, now we need to keep the momentum going

We faced new challenges and opportunities for the Great Lakes State in 2020, as we continued to do the work to protect and restore the world's largest freshwater resource. This year provided opportunities for learning and adapting to new experiences, with the COVID-19 pandemic resulting in nearly all Department of Environment, Great Lakes, and Energy (EGLE) staff working remotely. We have continued to serve our 10 million Michigan residents by ensuring that we carry out our mission to protect Michigan's environment and public health by managing air, water, land and energy resources.

One silver lining from the COVID-19 pandemic has been the renewed interest among Michiganders to reconnect to the outdoors and enjoy our water playground. We look forward to building on that renewed connection to further drive Great Lakes stewardship.

We remain steadfast in our work to address issues ranging from emerging contaminants such as PFAS, impacts from severe storm events and stress on our infrastructure systems, to high water levels, changing climate, and the continued threat of invasive species.

This year also brought many new opportunities, including significant investments to improve our water infrastructure to be safer, more efficient and resilient to better protect water resources and public health across the state.

Our successes are many, such as accomplishing a decades-long cleanup of the Lower Menominee River Area of Concern; reef restoration resulting from quagga mussel treatments along Sleeping Bear Dunes that shows promise for restoring important fish spawning habitat; and our continued efforts to build the next generation of water stewards and leaders through EGLE's Office of the Great Lakes' work with partners on the From Students to Stewards Initiative.

We took much of our work virtual and used new tools and technologies to enhance and expand our collaborations with partners, reaching more people than ever. Regina Strong, EGLE's Environmental Justice Public Advocate, and her office are focusing on transformative approaches to engage with people and communities in a more meaningful and inclusive manner. All of the work we do must be informed by our collective efforts to engage with the public to address public health, equity and Environmental Justice in communities across Michigan.

This year has also provided opportunities to think about how we build back a stronger, more resilient and adaptive Great Lakes State from an environmental, economic and social perspective. EGLE will lead the Michigan Council on Climate Solutions, which will craft and implement the Governor's MI Healthy Climate Plan.

This 2020 State of the Great Lakes report is a testament to the hard work of our staff and our many partners at the local, state, regional and binational levels to protect, restore and promote our precious freshwater resources. This has never been more important as we face the challenges of the COVID-19 pandemic.

I am proud of all the successes that are a result of our partnerships with all of you. But there is always more to do. It's important work that we cannot accomplish on our own. Won't you join us?

Liesl Eichler Clark
Director, Michigan Department of Environment, Great Lakes, and Energy

THE GREAT LAKES AT-A-GLANCE

A look at some of the issues that impact the lakes bordering Michigan

GREAT LAKES PROFILE

Total surface area of the Great Lakes

86,910 SQUARE MILES

Surface area of Great Lakes, Great Lakes bays and Lake St. Clair under Michigan jurisdiction

42,167 SQUARE MILES

Miles of Great Lakes shorelines

3,288

Source: NOAA

2019 WATER LEVEL RECORDS

Which months saw record highs?

Lake Superior: **May-September**

Lakes Michigan-Huron: **None**

Lake Erie: **May-September**

2020 WATER LEVEL RECORDS

Lake Superior: **January, February**

Lakes Michigan-Huron: **January-August**

Lake Erie: **February-May**

Source: U.S. Army Corps of Engineers

LAKE ASSESSMENTS

Based on a set of nine overarching indicators of ecosystem health supported by 45 science-based sub-indicators.

Source: U.S. EPA and Environment and Climate Change Canada, 2019 State of the Great Lakes Highlights report
Binational.net/wp-content/uploads/2020/05/May-4.2020-2019-SOGL-FINAL.pdf

TOP CONTAMINANTS

What has been found in the water column and fish tissue?

1. PCBs
2. Chlordane
3. Dioxins
4. Mercury

Source: EGLE

FISH EAT ADVISORIES

258

"Do Not Eat" or "limited" consumption warnings for all water bodies across Michigan as of May 2019.

Source: Department of Health and Human Services

AREAS OF CONCERN

Fourteen areas of legacy contamination were identified across Michigan in 1987.

3 DELISTED

Lower Menominee River 2020, White Lake 2014, Deer Lake 2014

11 ACTIVE

Clinton River, Detroit River, Kalamazoo River, Manistique River, Muskegon Lake, River Raisin, Rouge River, Saginaw River/Bay, St. Clair River, St. Marys River, Torch Lake (U.P.)

Source: EGLE

BEACHES AND E. COLI

Number of monitored Great Lakes beaches where action was taken to protect public health.

Year	Monitored	Action
2019	198	41
2018	210	60
2017	185	43
2016	209	43
2015	203	65
2014	160	50
10 year avg.	**215**	**59**

Source: EGLE

DRINKING WATER SOURCES

5.39 MILLION

Michiganders get their drinking water from the Great Lakes or connecting waterways.

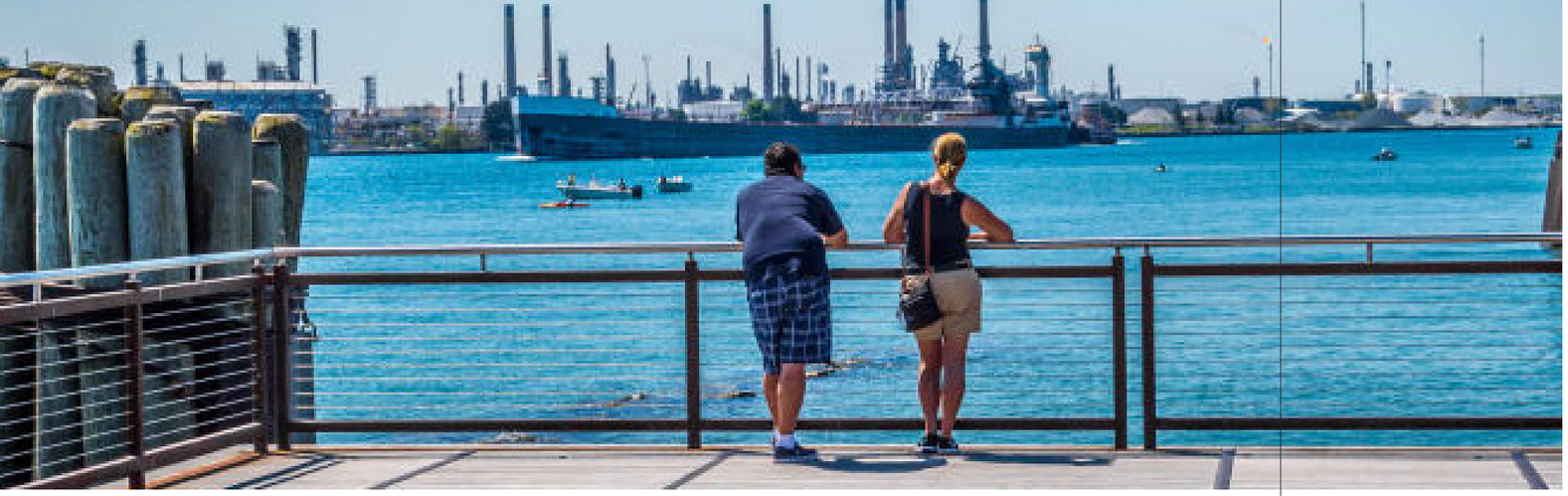
289

Number of community water suppliers that draw from the Great Lakes or connecting waterways.

2.58 MILLION

Number of residents who use wells

Source: EGLE



(Left) Industry and shipping docks line a portion of the St. Mary River at Port Huron. Legacy industry can have adverse impacts on nearby communities. (Right) A steel plant in southwest Detroit is one of several industrial and manufacturing facilities in the area. (Photos courtesy of the Michigan Department of Transportation)

LEADING ON JUSTICE

New EGLE office helps to sustain communities along the Great Lakes through the lens of Environmental Justice

By Regina Strong, Environmental Justice Public Advocate, Michigan Department of Environment, Great Lakes, and Energy

The connection between Michigan and other Great Lakes communities is based not only on the region's abundant natural resources and interdependent economies, but also on the impact of those connections on the wellbeing of the area's residents. As a region with a longstanding industrial past, its residents, particularly those in vulnerable and Environmental Justice communities, have dealt with legacy challenges for decades.

Recognizing the resulting complexities, ranging from access to drinking water to residents affected by pollution, the state took action to address impacts on people across the state.

In early 2019, Governor Whitmer created the Office of the Environmental Justice Public Advocate and the role of the Environmental Justice Public Advocate. The Executive Order that created the office also created an Interagency Environmental Justice Response Team, bringing several state agencies together to develop statewide strategies. The office works collaboratively across state agencies to proactively engage with the communities to address Environmental Justice issues and complaints. Efforts focus on ensuring that low-income residents and communities of color are equitably represented in various actions. The office also works closely with 12 federally-recognized tribes in Michigan on a wide range of Great Lakes and environmental issues.

Earlier this year, Governor Whitmer stressed the importance of including the voices of people affected by environmental issues: "We must ensure that the implementation and enforcement of environmental protections, regulations and policies in Michigan will be fair and meaningful to all Michiganders, regardless of geography, race, color, origin or income."

Michigan has the unique distinction of serving as the heart of the automotive industry, along with industrial sites and businesses on the shores of the Great Lakes. From historic logging operations to industries that compromised the ecosystem of the lakes, the work of the Office of the Environmental Justice Public Advocate addresses impacts on communities that are economically disadvantaged and continue to be disproportionally affected by cumulative effects of past environmental degradation. The office takes a holistic approach in considering how these communities are affected by decision-making and looks for ways to improve policies and public engagement. The goal is to ensure that the state's residents have opportunities for meaningful access and equitable participation in the development and implementation of environmental laws and regulations.

With significant investments under way in Great Lakes restoration, work continues to address challenges presented by Michigan's industrial past, as well as new emerging issues such as the contaminant PFAS. These efforts ensure that Michigan creates an equitable and vibrant quality of life in communities across the state, while protecting residents and preserving the state's resources.

Last year, the Office of the Environmental Justice Public Advocate and the Interagency Environmental Justice Response Team launched the Michigan Advisory Council on Environmental Justice. The council serves as an advisory voice for the state on Environmental Justice issues and includes representation from front-line community members, community organizations, local governments, tribes and labor, as well as business and industry.

To hear directly from communities, the Response Team is also planning virtual regional roundtables around the state in 2021 to ensure that people throughout Michigan are at the table on environmental issues. The Office of the Environmental Justice Public Advocate is currently developing a Michigan-specific EJ Screening Tool to better identify Environmental Justice communities. Other efforts under way include work toward integrating Environmental Justice into EGLE's work through training and implementation.

Michigan is moving aggressively to address climate change on numerous fronts, with a focus on ensuring that low-income residents and communities of color are equitably represented in the actions. We are thinking not only about the adaptation and stress issues caused by climate, but also equity and ensuring that low-income residents and communities of color are provided with the tools so both can adapt to climate effects.

CLIMATE'S IMPACT ON WATER

Michigan's climate, energy, and water infrastructure initiatives drive community resiliency and water stewardship

By Dr. Brandy Brown, Office of Climate and Energy, and Emily Finnell, Office of the Great Lakes, Michigan Department of Environment, Great Lakes, and Energy

Across Michigan, communities are being affected by changing climate. This is evident from the shores of Lake Superior, now the fastest warming lake recorded on earth, to record high waters in other lakes, increases in waterborne diseases and failing infrastructure from severe and intense storms.

To help Michigan combat the global effects of climate change, Governor Whitmer recently ordered EGLE's Office of Climate and Energy to coordinate the state's efforts to achieve carbon neutrality by 2050 through development and implementation of the MI Healthy Climate Plan, outlined in Executive Order 2020-182 and Executive Directive 2020-10. The MI Healthy Climate Plan is a comprehensive effort meant to protect public health and the environment while helping to develop new clean energy jobs by making Michigan carbon-neutral by 2050.

The Office of Climate and Energy was created by Governor Whitmer to coordinate activities of state departments and agencies on climate response, provide insight and recommendations to state government and local units of government on how to mitigate climate impact and adapt to climate changes, and provide guidance and assistance for the reduction of greenhouse gas emissions, renewable energy and energy efficiency, and climate adaptation and resiliency.

Michigan is moving aggressively to address climate change on numerous fronts, with a focus on ensuring that low-income residents and communities of color are equitably represented in the actions, EGLE Director Liesl Clark told an audience at the Climate Leadership Conference in Detroit.

"We are thinking not only about the adaptation and stress issues caused by climate, but also equity and ensuring that low-income residents and communities of color are provided with the tools to both adapt to climate effects and that they'll benefit from climate initiatives like clean jobs and green infrastructure," she said during a plenary address.

In addition, the MI Clean Water Plan is investing $500 million in Michigan's aging water infrastructure. The plan presents an opportunity to improve drinking and wastewater infrastructure, expand green infrastructure, address water loss through leaky systems and educate the public about water and energy efficiency and conservation.

Both of these new initiatives present an opportunity to create a greater focus on advancing Michigan's water conservation and efficiency goals and objectives under the Great Lakes Compact through strategic integration into Michigan's effort to achieve a carbon neutral footprint by 2050 to address climate change, increase energy efficiency, improve aging infrastructure and protect the environment and public health.

Over the coming months, EGLE's Office of the Great Lakes, Office of Climate and Energy, Office of the Clean Water Public Advocate and the Water Use Advisory Council will work collaboratively to identify opportunities to strategically integrate water stewardship into current and future climate, energy and water infrastructure policies and programs. New technological advancements have also occurred within various water sectors that need to be considered, which can provide insight into potential water, energy and infrastructure savings for all water user groups.

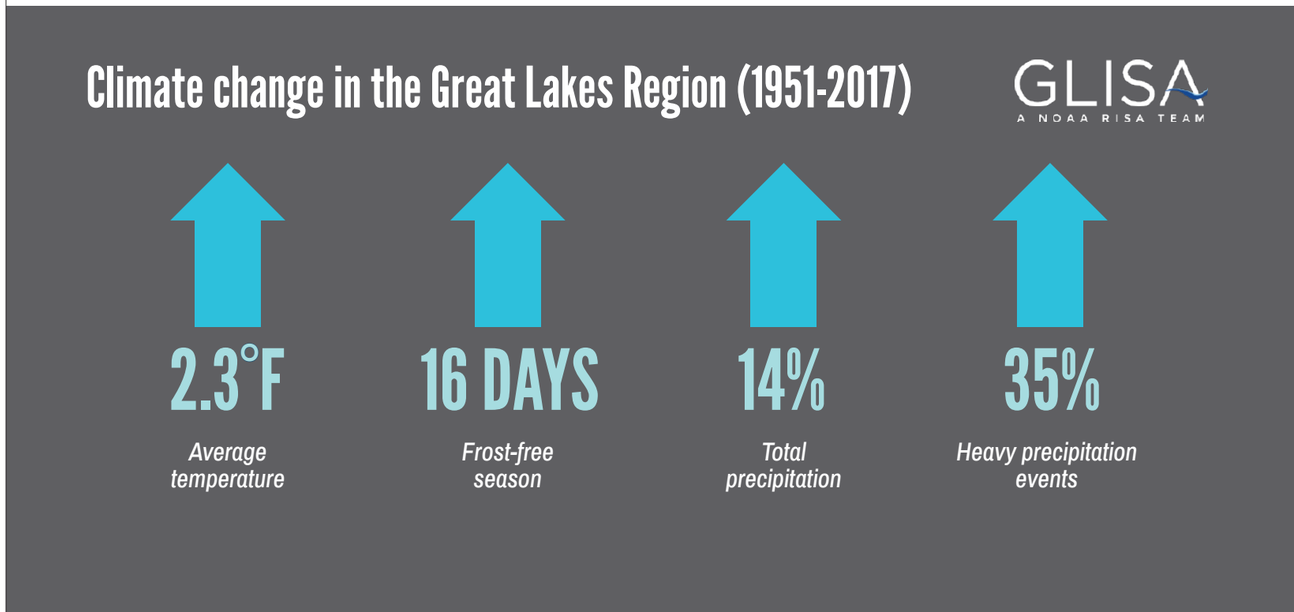
U.S. 23 runs along Lake Huron in East Tawas. High water levels, driven by increased precipitation due to climate change, are having a detrimental impact on northeast Michigan infrastructure, such as Tawas State Park. (Photo courtesy of Michigan Department of Transportation)

The overarching goal is to ensure businesses, industry, agriculture, utilities, communities and the public have the best available information, tools and technologies to engage in activities to improve efficiency and water conservation to ensure sustainability of our water resources.

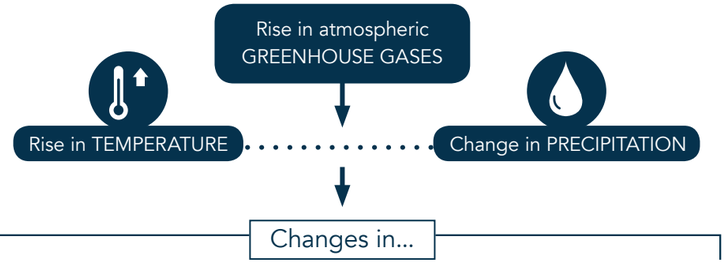
Programs such as the Catalyst Communities, facilitated by the Office of Climate and Energy, the collaborative Resilient Communities Program and the Department of Health and Human Services' Healthy Homes offer tools and resources for municipalities and residents to help prepare for climate change impacts and build resilient communities. Creating resilient communities from a social, ecological and economic perspective can also help in the face of new challenges such as the COVID-19 pandemic.

The Catalyst Communities program is based on four themes that will move Michigan toward climate readiness: emergency preparedness, adaption planning resources, economic resilience and integrating equity. The program will provide education, training, planning and technical resources to local public officials as they prepare for climate impacts on emergency response and public health.

The online Climate Academy launched in November 2020 provides training for local officials through a multi-tier instruction curriculum focused on adapting locally



CHANGES IN OUR ATMOSPHERE LEAD TO HEALTH EFFECTS



AIR QUALITY

Exposure Pathway
- Wildfire smoke
- Particulates
- Longer pollen season
- Ozone and smog

Health Outcomes
- New and worsening existing respiratory illness
- Allergic diseases
- Mental stress

EXTREME WEATHER EVENTS

Exposure Pathway
- Heat waves
- Extreme cold
- Storms

Health Outcomes
- Heat illness and death
- Cold-related injuries
- Worsening existing cardio-respiratory illnesses
- Mental stress

WATER QUALITY AND QUANTITY

Exposure Pathway
- Drought
- Flood
- Harmful algal blooms

Health Outcomes
- Waterborne diseases
- Worsening existing respiratory illness
- Mental stress

ECOSYSTEM CHANGES

Exposure Pathway
- More animal hosts
- More ticks and mosquitoes
- Longer vector season

Health Outcomes
- Lyme disease
- West Nile Virus
- Other tick- and mosquito-borne diseases

to the impacts of climate change on communities, mitigating harms and implementing clean energy solutions. After completing the sessions, attendees will be better equipped to prepare their communities for potential climate impacts. Participants will work to secure a resilient future for their communities into the next century by building emergency response preparedness, public health awareness and economic revitalization solutions. These tools will help every Michigan community to succeed in a changing climate and the transition to clean energy.

Michigan's investment in water infrastructure improvements, including green infrastructure solutions, increases community resiliency to changing climate by offering nature-based solutions that mimic natural systems to help communities better mitigate impacts from the increased frequency and intensity of storms that lead to flooding and high waters. Programs such as the Water Leak Pilot launched by the Office of the Clean Water Public Advocate can help residents and communities address leaky systems to save money on water and energy bills as well as conserve water.

In addition, the Resilient Communities Program created by EGLE's Coastal Management Program — in partnership with the Michigan Association of Planners, the University of Michigan and the Land Information Access Association — helps to foster and support planning that promotes community resilience in the face of rapid economic changes and increasing climate variability.

Creating a more resilient future will require collaborative and collective action by many partners at the watershed scale, long-term and adaptive management approaches, nature-based solutions and ongoing communication and information sharing. These programs and efforts will help to build back a better and more resilient Great Lakes State, one in which communities, infrastructure, ecosystems and economies can withstand, adapt to and recover from future climate-related stressors and changing conditions and that is socially equitable and inclusive of all people. ◆

HISTORIC HIGH WATERS

State, federal and local partners collaborate on coordinated response to rising water levels

By Jay Eickholt, Michigan Department of Environment, Great Lakes, and Energy

Home to more than 11,000 inland lakes, 51,000 miles of rivers and surrounded by four Great Lakes, Michigan communities have a strong connection to water. But this relationship is changing due to climate change and intense weather events that are leading to record amounts of water throughout the state. For coastal communities, this change is constant.

Michigan is in the middle of the wettest one-, three-, and five-year periods since recordkeeping began more than a century ago. Most of the Great Lakes met or broke monthly or all-time records in late 2019 and 2020. The rising waters on the Great Lakes resulted in major shoreline erosion, inland inundation, flooded homes that had been dry for decades and infrastructure impacts from rising surface water and groundwater. The changes have caused concern for many local governments as they struggled to mitigate impacts from high waters.

In late 2019, local emergency managers and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) began to coordinate and restructure internal processes to help with emergency permit reviews for residential and municipal property protection. Local emergency management continued to engage with state and elected officials about issues communities were facing. The Federal Emergency Management Agency (FEMA) also issued a notice to the state of Michigan that the impacts from rising water levels would not be eligible for a Stafford Emergency Declaration. Therefore, Michigan would not receive any federal disaster relief.

At the urging of Governor Whitmer and with the full support of state leadership, EGLE formed an inter-agency group consisting of local, state and federal experts. The group was a starting point to engage at all levels of government to streamline state processes to the maximum extent possible to assist local response agencies and residents. In February 2020, a High Water Summit was held in Lansing to bring all levels of government up to date with the high water situation in Michigan and act as a starting point for a core state team to coordinate state efforts and troubleshoot questions that may arise.

Key takeaways from the summit:

- Local emergency management needs to be engaged with their community and residents to ensure all properties are encompassed in response efforts and assistance is being provided in a uniform way.
- There would be no federal disaster relief; communities and the state of Michigan would have to coordinate resources and fund any actions.
- Stakeholders would have to work collaboratively to collect data and complete mapping to show the impacts from high water. This information would help inform future infrastructure development and community recovery efforts.
- EGLE committed to expedite shoreline protection permitting through its Water Resources Division so public health and critical infrastructure can be protected.
- A state agency action team would meet regularly to communicate and coordinate efforts to address high water issues.

Since the summit, the state agency action team has met monthly to coordinate response efforts and resources to address high waters. It also has been in regular communication with federal and local agencies. EGLE has continued to expedite permits for shoreline protection efforts such as revetments and other protective measures. These shoreline protection efforts continue to be a large part of individual property owner responses to high water. The permitting of projects on the Great Lakes went from roughly 200 permits in fiscal year 2010 to more than 2,000 in fiscal year 2020.

Michigan's park system has also been heavily impacted by high waters. The Michigan Department of Natural Resources (DNR) has been funding protective measures for state lands and parks, as well as assisting with road stabilization that leads to state properties.

In December 2020, the Michigan Department of Natural Resources (DNR) moved a historic shelter at Orchard Beach State Park in Manistee 230 feet away from the Lake Michigan shoreline, which was being eroded by high water levels. (Photo courtesy of DNR)

A tiger dam, a tube structure used to hold back water, was installed in Spring 2020 along the canal in the Jefferson-Chalmers area of Detroit next to sandbags that were installed the prior year. (Photo courtesy of EGLE)

Learn More

The U.S. Army Corps of Engineers catalogs water level data and forecasts, basin conditions, outflows, and other information relating to Great Lakes water levels at their Great Lakes Information website. Information is updated regularly.

One example is a $5 million relocation and shoreline revetment at Orchard Beach State Park in Manistee County to protect a historic pavilion structure at the top of a bluff that was being eroded by high water levels.

The Michigan Department of Health and Human Services (DHHS) has received a grant from the federal Centers for Disease Control and Prevention (CDC) that earmarked funds for mitigation against the environmental health hazards caused by high water.

The DHHS cited recent flooding due to severe storms in Michigan's Upper Peninsula as an example of areas that would be served by the initiative. Funding will be shared with local health departments to better plan and improve resilience in Michigan communities.

The state agency action team will continue to monitor Great Lakes water levels for 2021 and collaborate on a variety of high water and disaster work groups to ensure a coordinated and efficient response at all levels. Efforts are also ongoing to assist local government in identifying at-risk properties.

In addition to responding to immediate challenges due to high waters, the state is partnering with local, state and federal partners to help provide tools and resources to communities to improve resiliency and explore new approaches that protect the environment and public health and safety.

Further research is needed to study the long-term impacts of a hardened shoreline on sediment movement and beach nourishment as a result of many measures taken to address high waters not only in Michigan but across the Great Lakes region. ◆

Creating Resilient Communities

New tools, planning help coastal communities strive and thrive in light of constant change

By Andrea Brown, Michigan Association of Planning

Communities create master plans as a tool to use so they can thrive, both now and in the future. More and more, there is a sense that these plans should focus on making a community as resilient as possible. In the past year, the rising level of the Great Lakes and the COVID-19 pandemic are dramatic examples of the adversity communities are facing.

As the professional association for community planners and appointed land use officials in the state of Michigan, the Michigan Association of Planning (MAP) understands that community planning directly affects long-term community resiliency in a complex and changing world. Resilience is the ability of a community to recover or "bounce back" from adversity — whether an economic downturn, extreme weather, environmental disaster or demographic shift.

Over the past six years, MAP has partnered with the Michigan Department of Environment, Great Lakes, and Energy's (EGLE) Coastal Management Program, the University of Michigan (U-M) and the Land Information Access Association (LIAA) to develop strategic approaches that increase the knowledge of municipal planners and officials about community resilience.

An early objective of the partnership was to introduce the idea of integrating coastal sustainability and resilience into municipal master plans. U-M and LIAA provided the technical expertise and science-based approaches, while MAP provided access to professional planners as well as appointed and elected municipal leaders. Together, we developed and delivered a master planning process for a community resilience workshop curriculum to prepare municipalities to create and adopt their own local resilience policies. Long-term resilience starts with adopted municipal plans and policies that establish the steps that are necessary to position a community for resilience success.

MAP also published an issue of our magazine on resilience planning best practices and hosted a daylong Resilience Summit, which highlighted national experts, our partners and local practitioners who are doing the work in Michigan.

Building on shared knowledge and experience, MAP's next round of EGLE funding provided a grant match for six coastal communities to hire planning consultants to assist in developing and adopting local resilience plans. This pilot project served to build the knowledge of private sector planners, enhancing their experience and positioning them to provide resilience planning services to municipalities throughout the state. MAP also developed and launched a workshop for planning consultants to ensure they possess the necessary skills to successfully work with local governments.

Once a plan is adopted, implementation is key. MAP has received additional funding from EGLE to assist communities seeking to implement resiliency policies and ordinance changes identified in their master plans. This would enable municipalities to take actions that might otherwise be delayed due to inertia, leadership changes or cost. Grand Haven (see page 18) is a successful example.

Educating local officials is an important first step, but even when equipped with tools and best practices for resiliency planning, there are barriers to moving from planning to implementation. To help coastal leaders understand the range of policies and solutions to prepare for and respond to high waters, MAP produced a publication, Survive and Thrive, which summarized lessons learned from the pilot communities.

Next up? MAP, in coordination with EGLE's Coastal Management Program, Michigan Sea Grant and U-M, will pilot a leadership academy for coastal communities. The academy will consist of a sequence of three intensive, peer-learning virtual workshops for local decision-makers dealing with coastal hazards. The approach is intended to build and nurture a cluster of 12-15 local community leaders from several jurisdictions who will forge the strong relationships necessary to carry forth strategies to respond to the impacts of rising Great Lakes water levels and the resolve to collectively work together going forward.

Resiliency Roadblocks

Five barriers to moving from planning to implementation.

1. Limited "next step" expertise to make technical, science-based changes to local policy.

2. Not all local officials have been exposed to sustainability and resiliency concepts or understand their roles to drive policy change.

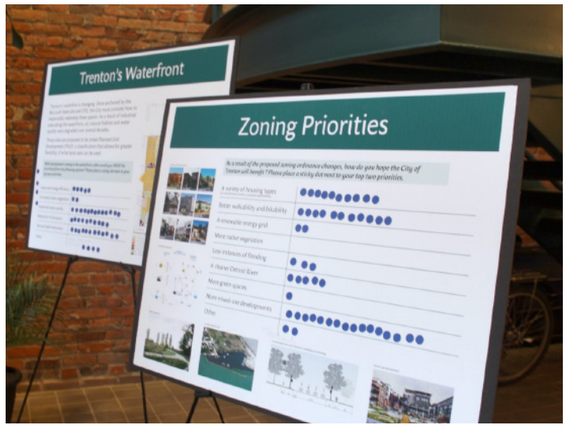
3. Ideological and partisan messaging can prevent some communities from exploring science-based policy solutions.

4. Difficulty rallying leaders and residents around policy change that has longer-term benefits.

5. Lack of funding or staff resources to make necessary resiliency changes to the master plan or local zoning codes.

Source: Michigan Association of Planning

Participants in the academy will come away from this experience with the technical knowledge and local partnerships necessary to advance planning and zoning changes in their community that provide non-structural approaches to coastal shoreline protection. Participants will return to their communities and organizations as ambassadors for coastal resilience, to lead local efforts to educate the community and build on momentum acquired at the leadership academy. ◆



Public comments were tabulated following a city of Trenton zoning ordinance session. (Photo courtesy of Beckett Raeder Inc.)

Community Case Study

Grand Haven city and township collaborate on sustainability changes to their master plans

A collaborative effort by the city of Grand Haven and Grand Haven Township is an important example of community resiliency planning. Tourism is important for the city's and region's economy, and the area's natural features are essential components to the area's quality of life.

In 2015, the city and township formed a joint planning committee to participate in a study funded by a grant from EGLE's Coastal Management Program to determine the potential physical and environmental impacts of dynamic coastline processes on their communities with a simple scenario-based approach. The city is on the shores of Lake Michigan and is characterized by sand dunes, wetlands and beaches. The Grand River runs along the northern boundary of the city as it empties into the lake.

Building Coastal Resiliency in the City of Grand Haven, a report about the effort, provided the basis for the resiliency recommendations that were subsequently incorporated into a master plan update, which was adopted in 2016. The master plan encourages development patterns that are economically, socially and environmentally viable.

The city followed up on the plan by participating in the Michigan Association of Planning's Coastal Resilience Regulatory Solutions project, which was completed in 2018. With the goal of protecting sensitive natural landscapes, the city retained the Land Information Access Association (LIAA) to map "at risk" landscapes, update the city's Sensitive Areas Overlay District, develop a shoreline setback requirement and create a management guide for homeowners living in sensitive landscapes. The city completed all four initiatives in less than a year. ◆

(Top) The Grand Haven beachfront as seen from the air. (Bottom) Erosion from high water levels has devastated beachfront property near Grand Haven. (Photos courtesy of Land Information Access Association)

International Cooperation

Great Lakes Commission works to translate a network of climate resiliency efforts into a comprehensive action plan

By Erika Jensen, Interim Executive Director, Great Lakes Commission

Record high lake levels and increasingly severe weather events throughout the Great Lakes basin are highlighting the need for regional climate resilience. The Great Lakes states and provinces are leading many important efforts to build resilience, including enhancing coastal wetlands, preventing erosion and reducing nutrient pollution that leads to harmful algal blooms.

These efforts are dispersed across the complex network of stakeholders in the Great Lakes basin — including two federal governments, dozens of tribal nations, eight states, two Canadian provinces and thousands of municipalities. As each jurisdiction works independently to address the effects of climate change, members of Congress and others are asking this question: who is coordinating all this work?

The Great Lakes Commission (GLC), a binational government agency, is working to answer that question. The GLC membership, which includes representatives from each of the eight U.S. states (Michigan, Illinois, Indiana, Minnesota, New York, Ohio, Pennsylvania and Wisconsin) and two Canadian provinces (Ontario and Quebec) in the Great Lakes basin, convened a Standing Committee on Climate Resilience in January 2020.

Through this forum, the GLC is working to define resilience for the Great Lakes basin and catalog the programs and projects in each jurisdiction that contribute to Great Lakes resilience. It also is formulating a joint action plan to identify short-, medium-, and long-term goals that will help ensure a resilient future for the 48 million people who call the Great Lakes region home.

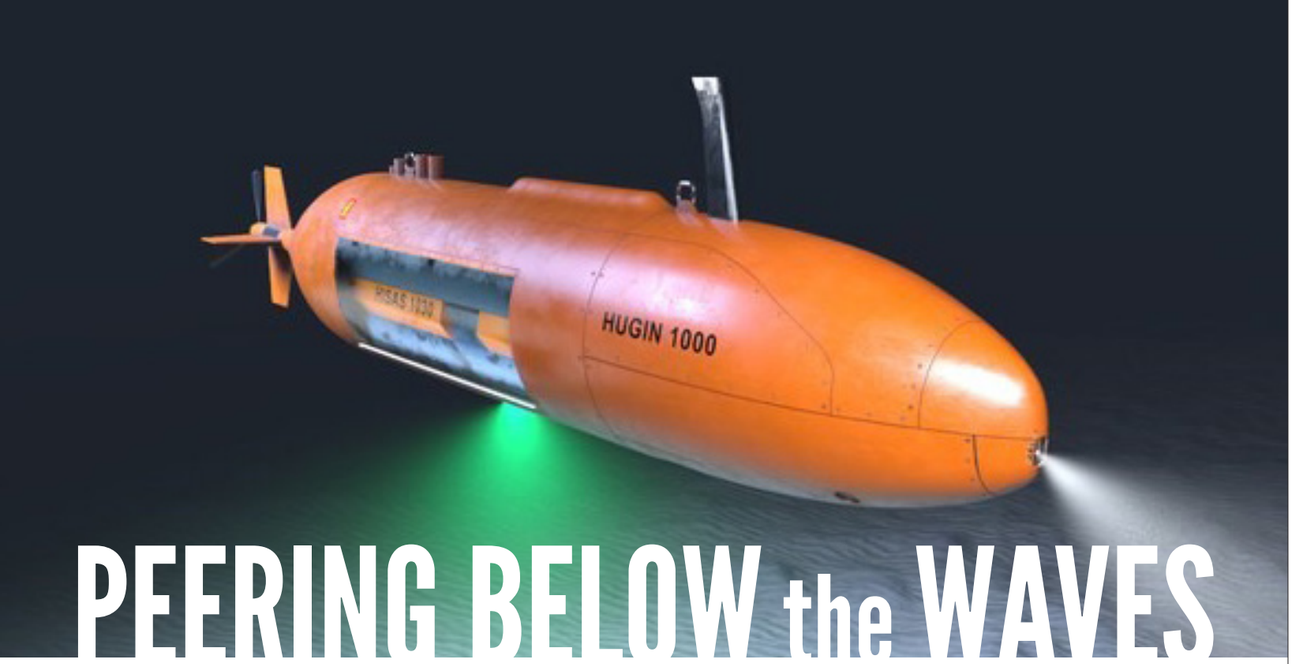
The GLC is taking a comprehensive view of resilience: one in which communities, infrastructure, ecosystems and the economy can withstand, adapt to and recover from climate-related stressors and changing conditions to ensure equitable and inclusive social, economic and environmental well-being across the basin.

The good news is that there is a strong foundation of work to build upon — both federal governments, all of the state and provincial governments, municipalities, and countless nongovernmental stakeholders are working on projects and making investments that will contribute to climate resilience. The GLC is focused on convening these groups, facilitating dialogue and information-sharing and ultimately leveraging individual programs into basinwide progress.

The GLC is working with our partners to develop and implement a climate resilience action plan. This plan will outline goals and list high-level activities, programs and tasks needed in the areas of climate change and resilience. Agreement on this broad set of goals is intended to help the region's stakeholders work together effectively to ensure that the Great Lakes and its communities are resilient and productive for generations to come. ◆

About the Commission

The Great Lakes Commission is an interstate compact agency established under the Great Lakes Basin Compact of 1955. The Commission is authorized by state and U.S. federal law and dedicated to promoting a strong economy, healthy environment and high quality of life for the Great Lakes-St. Lawrence basin and its residents. Learn more at www.glc.org.



PEERING BELOW the WAVES

Lakebed 2030 initiative provides a vision for a comprehensive mapping of Great Lakes bottomlands

By Hans W. Van Sumeren, Director, Great Lakes Water Studies Institute at Northwestern Michigan College

There is a need for better mapping of the Great Lakes and all the world's large lakes. In fact, there is significantly more information at a much higher resolution of the surface of Mars than there is for either the Great Lakes or the world's oceans. Estimates of high-resolution bathymetry and substrate data for the Great Lakes basin vary from 4-12 percent, lagging behind the 20 percent coverage of the world's oceans. With advances in technology and the need for a better understanding of the Great Lakes, we are now at a key juncture to develop partnerships and raise the funding needed to launch Lakebed 2030, a full mapping of all the Great Lakes.

Why it's important

Large gaps in lakebed mapping indicate a need for data collection strategies. New collaborative approaches combined with accessible data repositories and technological advancements can help move researchers closer to a well-understood Great Lakes basin and may allow for one day realizing a complete and comprehensive view of the basin's lakebed. A Lakebed 2030 initiative would drive support and the development of strategies for obtaining 100 percent coverage of the Great Lakes bottomlands.

Great Lakes initiative

Partnering with the Marine Technology Society and the Great Lakes Observing System, Northwestern Michigan College in Traverse City has hosted several TechSurge Lakebed 2030 conferences to discuss the initiative.

A successful Lakebed 2030 project will produce a definitive map of the Great Lakes, empower policy decision-making, encourage sustainable use of the lakes and foster scientific research that relies on comprehensive information on the Great Lakes. Funding mechanisms could include promoting public/private partnerships, attracting new investments, aligning priorities with the philanthropic sector priorities and crowdfunding.

The bigger picture

The vision for Lakebed 2030 is to develop a comprehensive map for a sustainable and healthy Great Lakes, foster new joint research collaboration and cooperation within the Great Lakes basin and prioritize critical Great Lakes mapping needs. It also could synthesize past, current and future mapping efforts to define trends, knowledge gaps and priorities for future research.

(Above) A Kongsberg Mesotech Ltd. maritime autonomous underwater vehicle, with multibeam sonar, used to map bottomlands. (Photo courtesy of Kongsberg Mesotech Ltd.)

What needs to be done

Fulfilling this vision requires building capacity at local, regional and international scales and further developing (or creating) collaborations that share collected data, technological advances and workflow strategies. The information must be freely accessible in a digital repository so gaps in data coverage can be assessed and prioritized through continuing collaborations.

Advancements in technology

Autonomous survey platforms will be integral to a Lakebed 2030 initiative. Rapid advances in acoustic technology and robotics are leading to innovative approaches that maximize efficiency, resolution and visualization.

Multibeam sonar data can provide a broad understanding of the lakebed bathymetry, substrate and water column in a single pass. Unmanned surface vessels, autonomous underwater vehicles and long range sub-surface gliders now navigate all marine domains equipped with a wide variety of sensor packages. The use of these platforms extends data collection windows and requires significantly fewer personnel for operation. Further developments in unmanned aerial systems can capture nearshore environments at a much lower cost and faster response.

How it works

The bathymetric mapping systems used today can collect data across multiple frequencies at swath widths of more than three times the water depth. This use of multiple frequencies provides multispectral backscatter return from the lakebed, with each return providing significant delineation in habitat classification and general lakebed structure. Staggering those frequencies during a single collection pass ensures comparability of the backscatter across all frequencies thus providing the user multiple perspectives of the lakebed in a single transect.

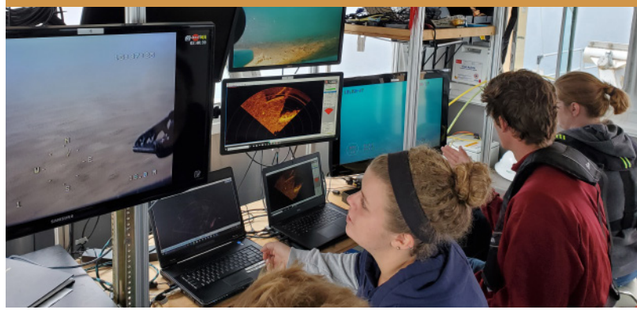
Mapping the Straits

Recent mapping in the Straits of Mackinac by the National Oceanic and Atmospheric Administration (NOAA) included the use of multiple autonomous surface vessels coupled virtually to a survey vessel, which allowed for a near doubling of the swath of mapping coverage without requiring additional personnel or time on task. Massive amounts of data being collected include multiple depths at decimeter resolution and highly accurate positions, identification of lakebed features, significant substrate identification and complete water column coverage. Advancements such as this have revolutionized the ability to comprehensively visualize the lakebed and water column.

What could Lakebed 2030 deliver?

The initiative would provide a framework for a comprehensive map of the Great Lakes, supporting:

- Quantitative understanding of Great Lakes ecosystems and their functioning as the basis for their management and adaptation.
- Development of a universal data and information portal.
- Capacity building and accelerated technology transfer, training and education supporting Great Lakes literacy.
- Binational support for a healthy and resilient Great Lakes where marine ecosystems are mapped and properly managed.
- Support the articulation of the economic, cultural and security values of the Great Lakes through mapping products.
- Promote a more targeted and effective information flow as well as innovative ways of conducting Great Lakes mapping.



Northern Michigan College students conduct multibeam sonar operations as part of one of the numerous marine sector training programs offered by the college. (Photo courtesy of Hans W. Van Sumeren)

What's next

Realizing a comprehensive map of the Great Lakes will require significant contributions from beyond the formal mapping and science channels. Integrating commercial off-the-shelf mapping technologies into crowdsourcing opportunities represents an additional approach toward reducing the gaps in data coverage and accelerating the vision of Lakebed 2030. Off-the-shelf technologies are improving in quality and accessibility and could be used to outfit ferries, commercial ships and recreational vessels to collect data during their normal operations.

RESTORING GREAT LAKES REEFS

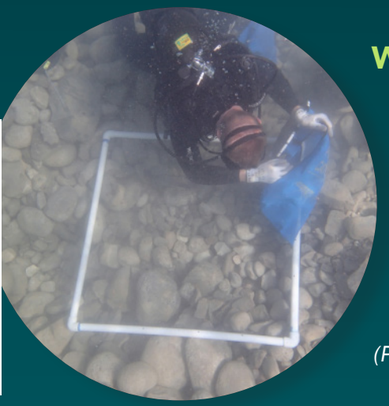
Work is taking place around the state to rehabilitate important fish spawning habitat

Most people are aware that reefs are an important component of ocean systems and provide food, cover and spawning areas for marine fish. However, not everyone is aware that similar areas exist in the Great Lakes — and are just as important. The Michigan Department of Natural Resources (DNR) is working with partners and collaborators throughout the Great Lakes to better understand how reefs function in these systems, identify and protect high-quality spawning reefs and restore degraded reefs to fully functioning reproductive habitat for fish.

A diver collects samples on a rock reef. (Photo courtesy of Fauna Creative)

WHAT IS A REEF?

Reefs in the Great Lakes are made of rocks, not coral, but high-quality reef habitat is still critical for native fish including lake trout, lake whitefish, cisco, walleye, smallmouth bass and yellow perch. During spawning season, these fish use reefs to deposit and protect eggs. At other times of the year, reefs provide cover for young fish and forage for fish of all sizes. Reefs have enormous influence on Great Lakes fish populations. A large, fully functioning Great Lakes reef complex could produce more fish in a year than a modern / state-of-the-art hatchery.



A diver uses a grid to quantify invasive species impacts on a reef. (Photo courtesy of Michigan Department of Natural Resources)

BUILDING REEFS

When people think of habitat restoration, the picture that often comes to mind is of some kind of physical manipulation; think logs in streams or replanting wetland plants along a lakeshore. Those same kinds of physical habitat manipulations are also occurring in the Great Lakes, but often on a much larger scale. Twenty-nine reefs were constructed in Thunder Bay, Lake Huron, in 2010 and 2011 with different configurations to measure fish community responses to habitat restoration. Reef construction increased the capacity for fry production without apparently decreasing the use of intact natural reefs.

A pile of rocks to be used in reef restoration near Elk Rapids. (Photo courtesy of Matthew Dae Smith/Big Foot Media)

THE RIGHT MATERIALS

In the past, reef "restoration" might have taken on aspects of a recycling project, with any excess material at hand dumped into a body of water and serving more as a fish "attractor" than as a functioning reef. In recent years, significant efforts have gone into understanding the material makeup of Great Lakes reefs and incorporating these optimal designs and materials to more closely mimic historic functioning of these systems. Regular ongoing evaluations, using cutting edge tools such as side-scan sonar mapping, are also providing insights into how restored reefs respond to the harsh physical conditions (e.g., waves, strong currents, ice scour) present in the Great Lakes.

Ice covers dock pilings in Elk Rapids reef project. (Photo courtesy of Michigan Department of Natural Resources)

SUCCESS STORY

After much of the habitat of the St. Clair and Detroit Rivers was destroyed or modified due to dredging, construction of shipping channels or sedimentation, the construction of new limestone cobble reefs in both systems has been a major component of regional habitat restoration efforts. These efforts have been undertaken by partners from state, federal and provincial governments; private entities; not-for-profit organizations; and academic institutions. The new reefs provide a place for lake sturgeon, walleye and other native fish to lay their eggs, where they and newly hatched fry will be protected from sediment, strong currents and predators. Over a dozen native fish species have been documented using the reefs.

A lake sturgeon caught near Saugatuck. (Photo courtesy of Michigan Department of Natural Resources)

LESSONS LEARNED

Reef habitat restoration in the Great Lakes is built on a long history of research documenting the importance of reefs and how they function — conducted with support from numerous partners and collaborators — and has significant implications for Great Lakes fish populations. The lessons learned from these projects are being implemented in the many ongoing and new habitat restoration efforts around the Great Lakes. With habitat improvement for the fish they pursue, Great Lakes anglers can expect increased success for many years to come.

REEF DEGRADATION VARIES AROUND MICHIGAN

There are a number of environmental stressors on reefs in Michigan waters and work is progressing among numerous stakeholders to find solutions to improving degraded reefs. Some examples:

CONTAMINANTS

Case study: Legacy contaminants such as copper mine tailings (stamp sands) from the Wolverine and Mohawk mines are migrating southward due to wave action and inundating Buffalo Reef.

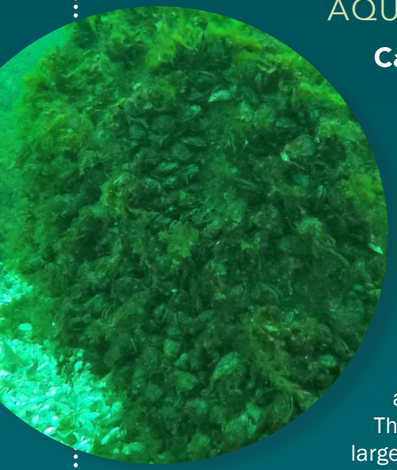
Where: Keweenaw Peninsula, Lake Superior

What's being done: Various efforts over the past few years, including removing a 25-foot-high stamp-sand ridge from the Lake Superior shoreline, dredging of a natural trough that is in Lake Superior north of the reef and dredging of Grand Traverse Harbor.

Behind the effort: Michigan Department of Natural Resources, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Keweenaw Bay Indian Community, the Great Lakes Indian Fish and Wildlife Commission and the Michigan Department of Environment, Great Lakes, and Energy.

Wave action has slowly moved stamp sands from along the shore of the Keweenaw Peninsula into Lake Superior and inundated Buffalo Reef. (Photo courtesy of the Michigan Department of Environment, Great Lakes, and Energy)

AQUATIC INVASIVE SPECIES



Case study: Invasive species have changed the architecture of reef complexes.

Where: Good Harbor Reef, Sleeping Bear Dunes National Lakeshore, Lake Michigan

What's being done: In the mid-2000s, intensive monitoring and research of the nearshore waters was launched to test efforts to eradicate Dreissenid mussels along the Sleeping Bear Dunes National Lakeshore. Starting in 2016, divers began clearing mussels from rocks at an experimental plot; that summer, close to one million mussels were removed from 430 square feet of the reef and results to date have been extremely promising. In 2019, a slightly larger treatment (300 square meters) was conducted using Zequanox (a bacteria-based molluscicide), resulting in a significant reduction in mussel density in the weeks following application. These efforts are helping to "reset" Good Harbor Reef and lay the groundwork for larger-scale ecosystem restoration efforts throughout the Great Lakes.

Behind the effort: U.S. National Park Service, Michigan Department of Natural Resources, Great Lakes Commission, the University of Wisconsin-Milwaukee and LimnoTech.

Quagga mussels coat an underwater rock. (Photo courtesy of Harvey Bootsma with University of Wisconsin-Milwaukee)

SEDIMENTATION

Case study: Excessive sedimentation has degraded important reef habitats and nursery areas for fish species as a result of human development and land use changes, such as logging and agriculture.

Where: Saginaw Bay, Lake Huron

What's being done: Rock is being placed to restore reef habitat and create a sheltered environment protected from predators where fish eggs can incubate. As the eggs hatch, the warm and highly productive waters of the inner bay will provide excellent nursery habitat and abundant food sources for larval and young fish, encouraging fast growth and increasing survival potential.

Behind the effort: U.S. Environmental Protection Agency, U.S. Geological Survey, Purdue University, Michigan Department of Natural Resources and the Saginaw Bay Watershed Initiative Network.

REEF RESTORATION

Case study: Invasive species have directly influenced native fish through predation or competition for food resources.

Where: Elk Rapids and Harbor Springs, Lake Michigan

What's being done: In rocky spawning reefs, rusty crayfish, along with invasive round goby, can consume more than 50 percent of the eggs that are laid by native fish species. Invasive crayfish and gobies also compete with native species by feeding on invertebrates that are important fish prey and removing aquatic plants that provide habitat for fish. Spawning reef restoration approaches are being developed and tested that involve control or removal of invasive rusty crayfish and round goby across several spawning reefs in Little Traverse Bay and Grand Traverse Bay. Innovative barriers and trapping methods to remove invasive crayfish to keep them off reefs are also being tested. Initial results are promising: Nearly 25 percent of fish eggs were retained after restoration versus just over 5 percent prior to restoration.

Behind the effort: The Nature Conservancy, Central Michigan University and the Michigan Department of Natural Resources.

A rusty crayfish. (Photo courtesy of Fauna Creative)

The information for this article was provided by Michigan Department of Natural Resources Basin Coordinators Jay Wesley, Lake Michigan; Patrick Hanchin, Lake Superior; Randy Claramunt, Lake Huron; and Jim Francis, Lake Erie; and compiled by David Clapp, Manager, Charlevoix Fisheries Research Station, Fisheries Division, DNR.

Overseas Hitchhikers

New federal regulatory framework is proposed to control unwanted travelers found in ballast water of ships plying the Great Lakes

By Sarah LeSage, Michigan Department of Environment, Great Lakes, and Energy

Zebra mussels have forever changed the Great Lakes by causing serious ecological and economic harm. They are native to the Caspian Sea in Eastern Europe and were discovered in Lake St. Clair in 1988, having arrived in ballast water that was discharged from an oceangoing ship.

Ballast water has been the primary pathway for non-native aquatic species to become established in the Great Lakes basin as global trade connects the Great Lakes to ports across the world.

The zebra mussel invasion of the Great Lakes played a central role in prompting passage of federal legislation in 1990. The Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) was established to prevent the introduction of all new aquatic invasive species and to limit the spread of aquatic invasive species already in U.S. waters.

Among other important objectives, the NANPCA also initiated ballast water regulation. Regulating ballast water—which ships take onboard to control or maintain trim, draught, stability or stresses of the vessel during a voyage — is complicated, evolving and influenced by economic growth and global trade, as well as by the irreversible harm that can be caused by aquatic invasive species.

Since the pivotal NANPCA, ballast water regulation has changed substantially with advancements at international, national and state levels. In the absence of protective federal regulations, Michigan has since 2007 required oceangoing vessels to treat discharged ballast water to prevent the movement of aquatic invasive species. The vessels can use one of four treatment methods: hypochlorite, chlorine dioxide, ultraviolet radiation or deoxygenation. Vessels can also use an alternative treatment, but they have to prove its effectiveness to the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

Michigan is not the only government body to pass ballast water regulations. The U.S. Coast Guard published rules, the U.S. Environmental Protection Agency (USEPA) developed a permitting

Ballast Discharges in Great Lakes

Ballast water regulation is a state and binational issue. A total of 1,080,934 metric tons of ballast water was discharged at U.S. and Canadian ports on the Great Lakes by overseas vessels from 2010 through 2013. Top 10 Great Lakes ports receiving ballast water discharges in that timeframe.

1. Duluth-Superior, Minnesota
2. Thunder Bay, Canada
3. Hamilton, Canada
4. Toledo, Ohio
5. Windsor, Canada
6. Milwaukee, Wisconsin
7. Sarnia, Canada
8. Goderich, Canada
9. Toronto, Canada
10. Valleyfield, Canada

Source: U.S. Environmental Protection Agency

The Federal Leda is a bulk carrier that stops in ports on the Great Lakes and throughout Europe. Here, it's docked in northern Michigan. (Left) Cargo ships and outdoor recreation enthusiasts alike share the waters of the Great Lakes. Ballast water from freighters can often carry non-native species which can be introduced into the Great Lakes without proper treatment. (Photos courtesy of Dave Kenyon, DNR)

program and other Great Lakes states developed and implemented their own programs. In response to this complex regulatory framework, the Coast Guard Authorization Act of 2018 was established. Also known as the Vessel Incidental Discharge Act (VIDA), it streamlines requirements for the commercial vessel community.

VIDA creates a new regulatory framework that:

- Overhauls ballast water regulation in the United States.
- Establishes a new part of the Clean Water Act.
- Preempts state authority to have state-specific regulations.
- Establishes the USEPA as the federal lead in establishing new standards for ballast water.
- Establishes the U.S. Coast Guard as the federal lead on monitoring, inspection and standards enforcement.
- Authorizes $50 million for a Great Lakes and Lake Champlain Invasive Species Program.

In accordance with VIDA, the USEPA released in October 2020 a proposed new standard on its VIDA website, which explains the proposed new standards. Michigan submitted numerous concerns about the failure of the proposed standards to protect water quality and prevent the introduction of aquatic invasive species and their spread within the Great Lakes. In addition, a formal objection to the proposed standard was submitted in December 2020 by Governor Whitmer. The USEPA is evaluating the comments prior to finalizing the standards.

More than 30 years have passed since the initial zebra mussel invasion and discovery. They have quickly colonized all the Great Lakes, spread to many inland lakes in the region and continue to spread to the western U.S. and Canada by recreational vessels. New aquatic invasive species which can be spread from nearby waters or from across the world continue to threaten the Great Lakes.

While advancements have been made to mitigate some of the risks of introducing aquatic invasive species via ballast from oceangoing vessels, there is more work to be done. It's critical to remain engaged on ballast water regulation and make investments in treatment technology to protect the unique Great Lakes ecosystem and the people and businesses that rely on them. ◆

IMPACT OF **AQUATIC INVASIVE SPECIES**

42%
Threatened or endangered species considered at risk due to non-native species

180+
Non-native aquatic organisms have colonized the Great Lakes since the 1800s

$24 million
Spent each year to control aquatic invasive plants in Michigan

$5.7 billion
Total economic impact of aquatic invasive species in the Great Lakes region

A U.S. Fish and Wildlife Service fisheries biologist weighs a bighead carp, considered an invasive species. (Photo courtesy of USFWS)

LAST LINE OF DEFENSE

Agreement between Michigan, Illinois and the U.S. Army Corps of Engineers is a significant step in keeping invasive carp out of Great Lakes

By Joanne Foreman, Michigan Department of Natural Resources

For more than two decades, the Great Lakes region has worked tirelessly to make sure invasive carp do not enter Lake Michigan. Bighead, silver and black carp — the invasive Asian carp species of greatest concern — have been identified in the Chicago River just a few miles west of Lake Michigan. Efforts have been under way for a number of years to keep the carp from advancing any farther. It is predicted that the arrival of live bighead, silver or black carp in the Great Lakes could have drastic effects on the region's $7 billion fishery, $16 billion boating industry and other tourism-based industries, property owners, recreationalists and others dependent on the Great Lakes and its tributaries.

The States of Michigan and Illinois have announced an effort to work jointly to protect the Great Lakes through an intergovernmental agreement that will allow Illinois to use up to $8 million appropriated in 2018 by the Michigan Legislature to support the pre-construction engineering and design phase of the Brandon Road Ecosystem Project in conjunction with the U.S. Army Corps of Engineers. The project evaluated options and technologies near the Brandon Road Lock and Dam site in Will County, Illinois, near Joliet, to prevent the upstream transfer of aquatic nuisance species from the Mississippi River Basin into the Great Lakes Basin, while minimizing impacts to existing waterway uses and users.

The pre-construction and engineering design agreement, finalized by both the State of Illinois and the U.S. Army Corps of Engineers on December 29, 2020, stipulates Illinois cover 35 percent of the projected costs. With Michigan's $8 million financial commitment through the intergovernmental agreement, the Illinois Department of Natural Resources will contribute the remaining $2.5 million to complete the project. Illinois' portion of the funding was made possible by Illinois Gov. JB Pritzker's Rebuild Illinois bipartisan capital plan. Other funding would be secured through the U.S. Army Corps of Engineers Work Plan.

The Brandon Road project will install layered technologies

Efforts under way at the Brandon Road Lock and Dam are key to preventing the movement of invasive Asian carp from the Chicago Area Waterway System into the Great Lakes. (Photo courtesy of U.S. Army Corps of Engineers)

including an electric barrier, underwater sound, an air bubble curtain and a flushing lock in a newly engineered channel designed to prevent invasive carp movement while allowing barge passage. An electric dispersal barrier installed in the waterway near Romeoville, Illinois in 2002 to prevent invasive species from moving into and out of the Great Lakes has since been supplemented by two additional electric barriers in the same location. A fourth more powerful barrier at the Romeoville site is expected to be operational in 2021.

As the Brandon Road project moves forward, current efforts will continue, including the electric barriers near Romeoville and expanded nonstructural measures, focused commercial fishing, monitoring and prescribed netting to reduce the risk of spawning or of small fish movement through the existing lock and dam. ◆

CLEAN WATER CHAMPION

Public advocate's mission is to inform, support and collaborate on drinking water issues

By Ninah Sasy, Office of the Clean Water Public Advocate, Michigan Department of Environment, Great Lakes, and Energy

Infrastructure needs are great in Michigan, and the costs for maintenance, repair or replacement are a financial commitment everyone must make so that facilities can continue serving residents efficiently and safely.

The American Society of Civil Engineers (ASCE) 2018 Report Card for Michigan's Infrastructure and the 21st Century Infrastructure Commission Report each highlighted underinvestment in infrastructure such as roads, bridges, dams, schools, transit, water and sewer systems, railways and energy systems. The ASCE Report Card cited estimates that drinking water system owners in Michigan are underfunding improvements for Safe Drinking Water Act compliance by as much as $563 million every year.

The Great Lakes and its connecting waterways provide drinking water to approximately 5.3 million Michiganders, so issues that affect the health of the lakes also have an impact on the availability of clean drinking water. Underfunded infrastructure can create issues not only for end-users but the lakes as well, as wastewater or storm water systems, if not properly maintained, can discharge contaminated water back into the Great Lakes, potentially causing harm to public health and the environment.

Pipes are replaced in the Kalamazoo area through the Drinking Water State Revolving Fund. (Photo courtesy of Michigan Department of Environment, Great Lakes, and Energy)

To help deal with some of the drinking water quality and wastewater protection challenges that municipalities face, Governor Whitmer has launched the MI Clean Water Plan. The program leverages $500 million for water infrastructure funding to address urgent infrastructure issues including undersized sewers, failing septic systems, unaffordable water rates and protection from lead, PFAS and other contaminants that can affect drinking water.

Water drawn from the Great Lakes for use by residents and businesses must be effectively treated to make it safe for use. An efficient and properly maintained water system is critical to holding costs down for all customers. Similarly, individual customers can be adversely affected by improper maintenance or leaking pipes in their homes, driving up utility costs and potentially introducing contaminants into the system.

The Office of the Clean Water Public Advocate, which is housed in the Michigan Department of Environment, Great Lakes, and Energy (EGLE), is launching a Water Leak Pilot program in two Michigan communities in partnership with community-based organizations and state and local partners. The program aims to reduce water waste in Highland Park and Benton Harbor. Water leaks are a financial burden for municipalities and their residents. They can contribute to water quality concerns and are an energy burden for utilities.

During the 12-month pilot period, the Water Leak Pilot program aims to reduce water waste and the financial burden associated with it, increase community education about water leaks, conduct household water audits, share tips for energy savings and provide assistance for on-premise plumbing water repairs.

The Water Leak Pilot program is part of the Office of the Clean Water Public Advocate's Focus on Water Initiative, which brings together multi-sector partners to support community efforts and connect resources to address water concerns.

The Office of the Clean Water Public Advocate also has recruited more than 130 residents in communities across Michigan to serve as Clean Water Ambassadors. They will advise EGLE on drinking water issues in their communities and statewide. Ambassadors have diverse backgrounds that include experience advocating for policies that positively impact our Great Lakes. Ambassadors will help Michigan continue to improve efforts for better water quality in Michigan. ◆

Clean Water Ambassadors represent communities all across Michigan. The ambassadors will advise the Office of the Clean Water Public Advocate on local and statewide drinking water issues.

A technician tests a water sample for PFAS in the state lab in Lansing. (Photo courtesy of EGLE)

Protecting Water Resources

Keweenaw Bay Indian Community takes historic step toward developing water quality standards that contribute to community wellbeing

By Stephanie Cree, Keweenaw Bay Indian Community

Silver River Falls on the Keweenaw Bay Indian Community along the shores of Lake Superior. The KBIC has been granted the power to set its own surface water quality standards. (Photo courtesy of KBIC Natural Resources Department)

The Keweenaw Bay Indian Community (KBIC) along the shores of Lake Superior took a historic step this year toward setting independent surface water quality standards for the lakes, rivers and streams that are a key part of the KBIC identity.

The Upper Peninsula community that straddles Keweenaw Bay in Baraga County is the first tribe in Michigan to achieve Treatment as a Sovereign regulatory authority for water quality from the U.S. Environmental Protection Agency (USEPA). Setting clean water standards ultimately affects the health of Keweenaw Bay and Lake Superior, into which many of the community's streams and rivers flow.

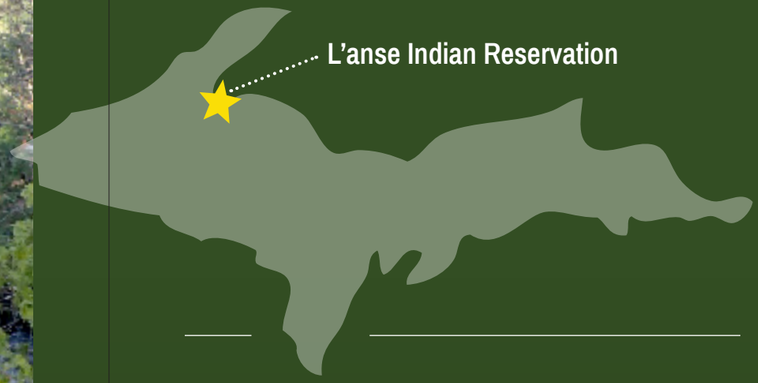
Treatment as a Sovereign permits the KBIC to administer a water quality standards program and certification program for its L'Anse Indian Reservation under the Clean Water Act. The designation is a legal status referring to the transfer of specific authorities from the federal government to federally recognized Indian tribal governments for environmental regulatory programs.

"The KBIC is excited to begin working on the development of water quality standards that will take into account the well-being of our local community," KBIC President Warren "Chris" Swartz said. "By obtaining Treatment as a Sovereign, we will continue building relationships with our local, state and federal partners in protecting our water resources here on the KBIC L'Anse Reservation."

KBIC officials say it is important for Tribes to assume authority over their reservation waters because current standards do not apply to many small communities where surface waters are located. The water quality standards KBIC is developing with the help of the USEPA and the state of Michigan will better represent the community it is protecting.

Having good water quality is a priority for KBIC political integrity, economic security, food sovereignty and the wellbeing of community members. All of the reservation's water bodies and resources are invaluable and have provided gifts of subsistence and cultural and spiritual benefits to many generations of the KBIC Ojibwa.

The USEPA granted the authority to KBIC in April 2020, but it's a status the Tribe has been working toward since 2013.



Before making that application, the Tribe collaborated with the USEPA on water programs since 1999.

"I am pleased to recognize the Tribe's authority to protect rivers and streams on the L'Anse reservation and to safeguard the health and heritage of its community and natural resources," Kurt Thiede, the USEPA Region 5 Regional Administrator at that time said following the KBIC approval.

Tribes must meet certain criteria to apply for Treatment as a Sovereign, including federal recognition status, a governing body that exercises legal authority and tribal capability to carry out Clean Water Act obligations.

"With honoring our first treaty with all orders of creation which includes our obligations and connections to the natural environment, it is imperative that we take the next steps in exercising our sovereignty," Swartz said.

The process Tribal officials are following to establish water quality standards is rigorous and must be approved in accordance with the Clean Water Act by the USEPA.

KBIC first began the process by reviewing state, federal and tribal standards. It then contracted with instructors from Michigan Technological University in Houghton for guidance on refining the standards. The process began approximately five years ago with a fish consumption survey. Tribal authorities used the information from the survey to help set a human health criteria that would be specific to the area where the standards would apply.

The KBIC is also using about 15 years of surface water quality data that has been collected to aid in developing other parts or the water quality standards.

In conjunction with the KBIC's application in 2013 for the authority to set water quality standards, it also established the Natural Resources Department to administer environmental programs on the reservation.

Management activities had grown substantially since its fish hatchery began operating in 1988. Department programs include fisheries and fish stocking, surface and groundwater quality, air quality, restoration and brownfields programs, wildlife and wetland stewardship, native plant restoration and garden programs and participation in the binational protection of Lake Superior.

With offices in Pequaming and L'Anse, more than 50 staff members implement natural resources programs, serve community needs and participate in research and monitoring in partnerships with government, university and other entities.

The KBIC's assumption of authority over the reservation's water resources as well as its natural resource programs will provide the authorities and programs necessary to advance efforts to ensure protection of water resources for future generations. Community members depend upon good quality water for a variety of purposes including fishing, trapping, swimming, boating, gathering, drinking and residential use, and for spiritual and cultural purposes. The health of the water is directly related to the health of the KBIC and the wellbeing of its many plant, fish and wildlife relatives.

The KBIC's Natural Resources Department website provides more information about the Tribe's water quality standards program. ◆

Keweenaw Bay Indian Community members participated in an area cleanup effort on Lake Superior Day in 2019. (Photo courtesy of KBIC Natural Resources Department)

FIGHTING FOR **LAKE ERIE**

Adaptive Management Plan another tool to help Michigan reach goal of reducing harmful algal blooms

By Michelle Selzer, Michigan Department of Environment, Great Lakes, and Energy

For a number of years, Lake Erie's western basin has been plagued by algal blooms that are harmful to aquatic life and can have detrimental effects on the area's drinking water supply. The growth of the blooms often is fed by phosphorus and nitrogen getting into the lake from a number of sources, such as wastewater treatment plant discharges and farm fields. It is also due in part to the relative shallowness of the lake.

In February 2018, Michigan released a Domestic Action Plan (DAP) road map to deal with the harmful algal blooms in Lake Erie. The plan was developed by a team from the Department of Environment, Great Lakes, and Energy (EGLE); Department of Agriculture and Rural Development (MDARD); and the Department of Natural Resources (DNR). The goal of the DAP is to reduce the amount of phosphorus entering Lake Erie by 40 percent by 2025.

In conjunction with the DAP, Michigan has developed an Adaptive Management Plan that will allow for a more structured way to learn about the impacts of actions to reach the state's reduction goals and then use the results of those actions to adjust future paths forward. The adaptive management cycle consists of six iterative steps: setting goals; planning and prioritizing; implementing; monitoring; evaluating; and adjusting.

EGLE, MDARD and DNR staff are working together as the Adaptive Management Team to plan and implement a cohesive and structured adaptive management process. The team is developing joint annual progress reports and two-year work plans, along with five-year DAP updates to keep stakeholders engaged in the work ahead.

"While we have made some progress, such as reducing phosphorus loads from wastewater treatment plants, there is a lot more work that needs to be done," EGLE Director Liesl Eichler Clark said. "Reaching our goal of a healthy Lake Erie is going to take some time. Using the Adaptive Management Plan, we can evaluate our progress along the way and adjust as we go to make sure the Lake Erie Domestic Action Plan is completed properly and protects public health and the environment."

Western Lake Erie has had recurring incidences of harmful algal blooms, which in 2014 forced the city of Toledo to warn residents not to drink water drawn from Lake Erie. (Photo courtesy of Aerial Associates, Inc.)

Public engagement has been an important element to finalizing an effective Adaptive Management Plan. During an open public comment period, stakeholders provided valuable insight into the plan and its goals. Comments will be incorporated into the plan before it is formally implemented.

The adaptive management approach is expected to maximize environmental and economic benefits, while addressing the nutrient issues in Michigan's portion of the Western Lake Erie basin. In addition to the western basin, Michigan's adaptive management approach is helping to address a related problem in the central basin, where a growing dead zone at the bottom of the lake in the summer and fall, caused by decaying algae, is depleting oxygen, which organisms need to survive.

Michigan is making progress, but this is a complex problem that requires gathering more information. This is why the state is taking an adaptive management approach. Finding solutions to the Lake Erie algal bloom and dead zone problems is going to take time and require collective impact of regional and binational efforts to achieve progress in improving the ecological health of Lake Erie.

To keep up to date on the DAP, the adaptive management process, and other efforts toward a healthier Lake Erie or to learn more about the Adaptive Management Plan, go to the Taking Action on Lake Erie website.

A water sample is taken from Lake Erie, which experienced a large algal bloom. (Photo courtesy of Michigan Department of Agriculture and Rural Development)

Focus on Lake Erie

Other Great Lakes partners with Domestic Action Plans for Lake Erie:

- Ohio
- Pennsylvania
- Indiana
- Ontario, Canada
- U.S. Environmental Protection Agency

Read the plans here: binational.net/2018/03/07/daplanphosredinlakeerie/

TESTING FOR PATHOGENS

Technique honed for beach water sampling now also used to identify COVID-19 hotspots

By Dr. Shannon Briggs, Michigan Department of Environment, Great Lakes, and Energy

Monitoring of Great Lakes beaches for harmful pathogens is conducted across the state by local health officials working in collaboration with the Michigan Department of Environment, Great Lakes, and Energy (EGLE). While the monitoring is voluntary and performed at the local level, EGLE awards grants to the local health departments, who are obligated to report their results to the state.

Now, that same technology is being used to help detect the COVID-19 pathogen in wastewater, which will allow for quicker identification of coronavirus hotspots and outreach to area residents.

In 2018, Michigan became the first state to use a rapid testing method for water quality to quickly address potential public health concerns. Quantitative Polymerase Chain Reaction (qPCR) analyzes samples for genetic targets such as Escherichia coli (*E. coli*).

The method provides results on the same day that a sample is collected, often in under three hours. Previously, testing was done using the standard Colilert® culture method, which requires overnight incubation.

After verifying qPCR results with traditional culture testing methods for *E. coli*, Tami L. Sivy, Ph.D., Professor of Chemistry at Saginaw Valley State University, said qPCR is proving to be better at protecting human health in that it provides nearly real time determination of fecal contamination at area beaches.

A Wayne State University employee confirms the direction of flow of wastewater in a sewer and the sewer pipe diameter. (Photo courtesy of Wayne State University)

Now, a newer technology called digital droplet PCR (ddPCR) is also being used to test beach water samples to detect genetic markers indicative of specific sources of fecal contamination. This molecular source tracking relies on genetic markers found in a bacterium called Bacteroides and can differentiate between various sources, whether human or animal. As labs around the state become more familiar with using ddPCR to test water samples, it will become an even more valuable tool for protecting public health and allowing for safe recreation.

Both qPCR and ddPCR methods are being used in a new way to identify the presence of the COVID-19 coronavirus in fecal matter in wastewater. This quick turnaround allows local health officials to identify potential outbreaks of the highly contagious pathogen.

Testing wastewater for viruses, such as the SARS-CoV-2 virus that causes COVID-19, can be an effective tool for monitoring transmission of COVID-19 within a local community or at individual facilities. The virus is shed in human waste as one of the first symptoms of infected people whether or not they experience or report other symptoms. These wastewater results can then inform local public health actions to prevent further spread within that community.

EGLE and the Michigan Department of Health and Human Services (DHHS) in September 2020 provided $10 million for a three-month pilot program to fund local public health department efforts to coordinate with counties, universities and other institutions across the state on COVID-19 wastewater testing programs. These local efforts have the potential to be an early warning system for the spread of COVID-19 within a community or for coronavirus outbreaks.

EGLE will coordinate sample collection, lab analysis, data reporting and communication with the local monitoring teams. DHHS will provide project support to participating local health departments, including how to integrate local wastewater data with other types of COVID-19 surveillance and public health responses.

The early detection of SARS-CoV-2 in wastewater, as part of a comprehensive COVID-19 surveillance system, could help identify a new emergence of infection in a community, monitor the level of virus in different areas across the state, monitor virus in facilities with vulnerable populations within a specific sewershed (providing earlier detection and reducing need for repeated testing of humans in the facility) and provide timely information to inform response plans at state and local levels to curtail transmission. Since nearly 70 percent of Michigan residents rely on public wastewater systems, surveillance of such systems has the potential to provide data on a large proportion of the Michigan population. ◆

How qPCR is Used in Beach Sampling

- Saginaw Valley State University works with EGLE and the U.S. Environmental Protection Agency to develop rapid DNA testing methods to determine the levels of fecal contamination at swimming beaches of the Saginaw Bay Watershed. SVSU students are testing samples taken in 2020, performing molecular source tracking analysis.
- Bacterial monitoring of beaches on the shores of Lake Superior provides valuable data concerning the effectiveness of surface water improvement projects, especially in conjunction with beach sanitary surveys. Analysis of samples at Sherman Park in Sault Ste. Marie led to a storm water drainage and dune renovation project to reduce shoreline inputs of contaminants, significantly reducing the number of days the beach is closed to the public.
- Oakland University has partnered with the Macomb County Health Department, St. Clair County Health Department, the U.S. EPA and EGLE to develop rapid recreational water quality tests. The university tests 11 beaches to allow the public and local health departments to better assess recreational water safety and help identify sources of contamination.

More Information

EGLE has launched a website that provides an overview of the wastewater surveillance pilot program. The site also includes sampling locations and testing data.

Legacy of Achievement

Lower Menominee River Area of Concern delisting was 35 years in the making

By Stephanie Swart, Michigan Department of Environment, Great Lakes, and Energy

The Lower Menominee River Area of Concern (AOC) became the third remediation site to be delisted from Michigan's 14 original AOCs designated under the Great Lakes Water Quality Agreement.

The area was designated as a focus for long-term cleanup in 1987 by the United States and Canada – along with 13 other contaminated sites around Michigan. Delisting doesn't mean this area has been returned to pristine historical condition. It means the legacy environmental problems identified in a 1990 remedial action plan meet established criteria today, but work continues.

Remediation and restoration efforts will still take place in the Lower Menominee River through a collaboration of local, state and federal oversight. Some of those efforts include continued monitoring of natural system recovery, maintenance of invasive species, facilitating fish passage, testing for fish viability, engagement with local partners, educational outreach, dam maintenance and collection of shoreline paint wastes.

The river's sediment was fouled by arsenic and other related legacy contaminants, including paint sludge, coal tar, heavy metals, petroleum and PCBs from industry near the river.

The long-term change from a highly-contaminated three-mile section of the Menominee River into one that has grown as a sportfishing destination with successfully reproducing fish and wildlife populations is a result of 35 years of work and commitments by stakeholders. Some of the accomplishments include improvements to wastewater treatment systems and sewer management by the cities of Menominee and Marinette, four contaminated sediment remediation projects and four habitat restoration and enhancement projects.

▲ *Before and after photos of Menekaunee Harbor in Marinette, Wisconsin, demonstrating ecological restoration work in the Lower Menominee River Area of Concern in the Upper Peninsula. (Photos courtesy of EGLE)*

AOC and BUI Defined

Areas of Concern are defined by The U.S.-Canada Great Lakes Water Quality Agreement as locations where significant impairment of beneficial uses has occurred as a result of human activities at the local level, namely pollution from legacy contamination and development.

Beneficial Use Impairments are a change in the chemical, physical, or biological integrity of the Great Lakes system sufficient to cause significant environmental degradation.

Source: U.S. Environmental Protection Agency

When the Lower Menominee River was designated as an AOC, six beneficial use impairments (BUI) were identified: beach closings (restrictions on recreational contact), restrictions on dredging activities, degradation of benthos, restrictions on fish and wildlife consumption, loss of fish and wildlife habitat, and degradation of fish and wildlife populations.

The beach closings BUI was removed in 2011, the degradation of benthos and restrictions on dredging in 2016, fish and wildlife consumption in 2018, and degradation of fish and wildlife populations and loss of fish and wildlife habitat in 2019.

The final delisting report was filed in July 2020, followed by the approvals from the U.S. Environmental Protection Agency and the U.S. State Department and support from the Government of Canada. Local tribes were also consulted as part of the delisting process.

Public participation is a key component of the AOC program. The Lower Menominee River AOC's Citizens Advisory Committee has a long history of involvement. Members have included concerned citizens, local business owners, retirees, riparian property owners, recreational users, environmental advocates, industry representatives and the Menominee Indian Tribe of Wisconsin. Several individuals have spent nearly 30 years advocating for improved environmental quality in their communities.

Three AOCs Delisted

Besides the Lower Menominee River AOC being delisted in 2020, two other locations have been delisted. Deer Lake, near Ishpeming in the Upper Peninsula, and White Lake, in Muskegon County were both delisted in 2014. EGLE's Areas of Concern webpage offers in-depth information about each of the 14 sites.

Map shows outline of the Lower Menominee River Area of Concern. (Map image courtesy of USEPA)

Committee members worked with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the Wisconsin Department of Natural Resources (WDNR) to identify local issues, develop local targets and goals, provide historical context, help with project implementation and manage support grants.

After almost 30 years of focusing on BUI removals and contamination, the committee looks to transition into a watershed organization, whose most important function will be to serve as a unifying voice and a steward for the Lower Menominee River.

A Technical Advisory Committee (TAC) was also instrumental in the delisting. The TAC was formed in 1988 to provide state government and local technical experts an opportunity to assist with the development and implementation of the AOC's Remedial Action Plan. TAC members provided technical analyses to inform BUI status, recommended goals for management and restoration of the AOC and reviewed and provided input on project plans, monitoring data, Remedial Action Plan updates and BUI removal documents. TAC members also provided support for monitoring programs to assess impaired uses leading to BUI removal and ultimately delisting of the AOC. ◆

STATUS OF MICHIGAN AOCs

Significant progress is being made around the state as cleanup work continues

There are 11 remaining Great Lakes Areas of Concern (AOC) in Michigan in various states of remediation. Mitigation work on Beneficial Use Impairments (BUI) and monitoring continue on these long-term projects to restore natural habitat fouled by legacy contamination. Three former AOCs have been delisted and are considered successfully remediated.

1 TORCH LAKE

Two BUIs remain, degradation of benthos and restrictions on fish and wildlife consumption. Work continues to clean up contaminated sediment and waste drums in two areas of the lake. Experiments to determine the effectiveness of benthic restoration were started in the summer of 2020 and will continue into 2021.

2 MANISTIQUE RIVER

Remedial work is complete and two BUIs (restrictions on fish consumption and restrictions on dredging activities) remain. Ongoing monitoring will help to determine when the final two BUIs can be removed.

3 ST. MARYS RIVER

Remedial work is complete on the Michigan side of the AOC, while additional contaminant removal continues on the Canadian side. The last three BUIs (restrictions on fish consumption, fish tumors or other deformities and degradation of benthos) will be removed in coordination with Canadian efforts.

4 MUSKEGON LAKE

Four of the listed nine BUIs have been removed from the AOC. In 2020, work took place to remove unnatural lake fill and invasive species and create shoreline wetland habitat and hydrologically reconnect restored wetlands to Muskegon Lake and Muskegon River at four project sites. Additionally, a project at the mouth of Ryerson Creek began in the summer of 2020 and will remove mercury-contaminated sediments and enhance wetland habitat.

5 SAGINAW RIVER/BAY

The federal Superfund program is working to remediate contaminants in the riverbed, banks and floodplains of the Tittabawassee River. Monitoring of related issues around Saginaw Bay (including bacterial contamination along beaches, colonial nesting bird/bald eagle productivity, and fish tissue contamination) by federal, state and educational institutions is ongoing. Three of 12 BUIs have been removed: restrictions on drinking water consumption or taste and odor problems, tainting of fish and wildlife flavor and loss of fish and wildlife habitat.

6 ST. CLAIR RIVER

Of the 10 original BUIs, only two remain (restrictions on fish and wildlife consumption and restrictions on drinking water consumption or taste and odor problems). Significant work on shoreline rehabilitation, reefs, wetlands and tributaries has restored fish and wildlife habitat, resulting in the loss of the fish and wildlife habitat BUI being removed in 2017. Habitat restoration included the construction of fish spawning reefs which can benefit lake sturgeon, various shoreline stabilization and habitat projects, wetland creation and a project to enhance fish passage in a tributary. All these efforts benefit a variety of fish and wildlife — from game and nongame fish, to amphibians and reptiles, to pollinators and birds. All projects to restore the AOC on the U.S. side have been completed and monitoring is continuing to assess when the final BUIs can be removed.

7 CLINTON RIVER

The removal of the degradation of aesthetics BUI is the first of eight to be removed for this site. All habitat restoration projects have been completed and are in the post-monitoring phase to assess improvements to fish and wildlife habitats and populations. Separate monitoring efforts are also ongoing to assess bacterial contamination at Lake St. Clair Metropark and contaminated sediments within the lower Clinton River.

8 KALAMAZOO RIVER

The federal Superfund program is working toward removing PCB contaminants from the riverbed, banks and floodplains, as well as the removal of the Trowbridge and Otsego City dams. Plans are being implemented to remove two other dams — Plainwell No. 2 and Allegan City — and provide extensive habitat restoration over the next several years. The Kalamazoo River Natural Resource Damage Trustee Council plans to fund approximately $25 million in restoration projects in the watershed during the coming decade, as a result of a legal settlement. Beach closings is the only one of eight BUIs that has been removed.

9 DETROIT RIVER

Of 11 BUIs, two have been removed: tainting of fish and wildlife flavor and restrictions on drinking water consumption or taste and odor problems. Extensive habitat restoration has been accomplished recently including the installation of fish spawning reefs, shoal restorations around islands in the river to protect and create wetlands and slow water areas and several projects have been completed on Belle Isle restoring habitat for a variety of fish and wildlife species. Current priorities include characterizing the chemical contaminants in the river sediment and working toward remediation of these areas.

10 ROUGE RIVER

There are 11 habitat restoration projects either in the design or implementation phase. In addition, there is an effort to design a habitat enhancement project for the Rouge Flood Control Channel to improve fish migration from the Detroit River into the Rouge River watershed. Contaminated sediment assessment work also continues to address the remaining BUIs, primarily within the lower main stem of the Rouge River. None of the nine BUIs for this site have been removed.

11 RIVER RAISIN

All planned projects were complete in 2016 when the remaining PCB contaminated sediment was removed and a cap installed. Research and monitoring are continuing on the bald eagles, herring gulls and fish of the area to assess the remaining four BUIs, which are restrictions on fish and wildlife consumption, bird or animal deformities or reproductive problems, degradation of benthos, and restrictions on dredging activities.

REMOVED FROM THE LIST

12 Lower Menominee River, 2020

13 Deer Lake, 2014

14 White Lake, 2014

MAKING ECONOMIC WAVES

Reports by Great Lakes Restoration Initiative and Michigan Sea Grant demonstrate broad jobs impact from lakes

By Christina Pastoria and Judy Palnau, Michigan Department of Environment, Great Lakes, and Energy

The Great Lakes are intertwined with Michigan's economy in deep and far-reaching ways. When you think of "the Great Lakes economy" any number of things might come to mind. You might think of shipping and transportation. You might think of fishing and other recreational activities. You might even be thinking about major water-using industries such as manufacturing, mining and energy production.

This network of water-based prosperity is laid out in Michigan Sea Grant's 2020 Great Lakes economy report, which details the jobs and wages supported by the Great Lakes. The report documents 1.3 million Great Lakes jobs that generated $82 million in wages annually. While it is no surprise that most jobs are in the manufacturing sector, the biggest increases came in the transportation and warehousing (23 percent), agriculture (11 percent) and tourism and recreation (10 percent) sectors.

The report makes it clear: when the Great Lakes are healthy, Michigan's economy prospers. The body of evidence supporting this claim is continuously expanding.

For example, a comprehensive study of the overall economic impact of the Great Lakes Restoration Initiative (GLRI) that was conducted in 2018 demonstrated substantial economic benefits for the Great Lakes region. The study projects that for every dollar of federal spending on environmental restoration and revitalization, the GLRI will produce more than $3.35 of additional economic impact in the Great Lakes region through 2036. For more heavily impacted cities such as Detroit, the benefit is even greater — more than $4 in economic impact for every dollar spent over that same time period.

The GLRI economic impact study calculated the economic impact of restoration based on jobs and wages, but that is not the only way to assess value. The value of the services that a healthy, functioning ecosystem provides to the state's economy can also be measured. In 2018, the Michigan Areas of Concern program selected Earth Economics and ECT Consulting to create a tool to model the incremental impacts of environmental restoration projects and feed the results into another model that would calculate the economic value of those incremental impacts.

▲ *Commercial fishing is one of the many industries whose viability directly ties to the health of the Great Lakes. (Photo courtesy of Michigan Sea Grant)*

This means that the model, which was completed in December 2020, can provide an estimation of how restoration projects affect the environment, the economy and people at a local scale. It can tell us how a habitat project in the Saginaw Bay will change the fish population or flood risk, and, in turn, what that will do for local anglers and homeowners. It can tell us how improving storm water management in the Detroit River will affect water quality, and in turn, what that will do for beach towns and local beachgoers.

All this restoration promises to create benefits for Michigan's economy for years to come, centered around a clear driving force — outdoor recreation and tourism. Even with sites of significant contamination, outdoor recreation and tourism are already major forces in Michigan's economy. As restoration turns more and more of Michigan's toxic hot spots of contamination into viable recreation areas, their impact will only get stronger. In fact, the 2018 GLRI economic impact report found that half of the total anticipated increase in economic activity generated by GLRI activities will come from tourism industries.

One example of increased economic activity is recreational fishing. Instead of toxic hot spots of contamination, some waterways in Michigan have now become hot spots for sport fishing. In addition to improving performance of businesses directly involved in recreational fishing (such as charter boating companies, bait and tackle shops and gear suppliers), the increased economic activity also triggers a cascade of positive impacts for associated industries such as hotels and local restaurants and shops. ◆

Tourism Impact

115 million: Number of people who visited Michigan in 2014

$22 billion: Amount spent in local economies by tourists

$13 billion: Amount spent in Michigan's coastal counties

Source: Michigan Sea Grant

Manufacturing is one of the pillars of Michigan's economy that relies heavily on access to the state's water resources. (Photo courtesy of Michigan Sea Grant)

History of Transformation

The National Oceanic and Atmospheric Administration (NOAA) documented Great Lakes projects over the GLRI's first 10 years in a story map — Restoring a National Treasure — that highlights the Great Lakes as an important natural resource that supports recreational and commercial fisheries, industry, transportation, recreation and tourism.

The story map represents the transformational work the GLRI has done to help strengthen valuable Great Lakes fisheries, restore coastal wetlands that improve the quality of our water and provide recreational opportunities for the public's use and enjoyment.

Green Jobs

Michigan's new Office of Outdoor Recreation Industry plants seeds for continued economic growth

By Brad Garmon, Office of Outdoor Recreation Industry, Michigan Department of Natural Resources

Michigan's Office of Outdoor Recreation Industry was created by Governor Whitmer and stems from a growing awareness of outdoor recreation's full contribution to Michigan's economy, pegged by the federal government's Bureau of Economic Analysis at $10.1 billion per year and growing. From 2012-17, Michigan's outdoor recreation-based gross domestic product (GDP) grew 18 percent —twice as fast as the overall state GDP.

The Office was created with the specific mission of developing, promoting and enhancing Michigan's outdoor recreation lifestyle industry. It is housed within the Michigan Department of Natural Resources (DNR) and collaborates closely with the staff of the Michigan Economic Development Corporation (MEDC) to grow, retain and attract outdoor recreation companies, jobs and investment.

The first goal of the Office is to expand the conception of the outdoor economy from only tourism or hospitality jobs to embrace and build on opportunities in the design and production of outdoor recreation vehicles, gear and equipment — areas where Michigan has a strong competitive advantage.

The outdoor recreation industry supports more than 120,000 jobs and contributes more than $4.3 billion in direct private sector compensation to the state overall, and a major portion of those are in the retail sector—supporting the purchase of shoes, boats and gear. But nearly 6,000 of those Michigan outdoor recreation jobs are in outdoor recreation-related manufacturing — making those boats and gear. Those jobs provide 10 percent of the industry's total compensation in the state. Michigan's capabilities in product design, advanced and lightweight materials, and advanced manufacturing will be critical pieces in growing this industry, along with targeting some support to the innovators and the makers who are going to be designing and tinkering with the gear and vehicles that will shape the way we play and get outdoors in the years ahead.

Economic Driver

Michigan's outdoor recreation industry has a large impact on the state's economy.

120,000: number of jobs

$4.3 billion+: direct private sector compensation

Source: Office of Outdoor Recreation Industry

Sector	2009	2018	Percent change	Gain/loss
Manufacturing	757,970	823,735	+8%	+65,765
Tourism and Recreation	217,635	240,864	+10%	+23,229
Transportation and Warehousing	118,550	153,060	+23%	+34,510
Agriculture, Fishing and Food Production	118,430	133,352	+11%	+14,992
Science and Engineering	25,489	26,326	+3%	+837
Utilities	10,980	10,803	-2%	-177
Mining	5,012	5,416	+7%	+404
Total	**1,254,066**	**1,393,556**	**+10%**	**+139,914**

In the economic contribution from boating and fishing, for example, Michigan is ranked fifth in the country; in recreational vehicles it's ranked seventh, suggesting opportunities to build on Michigan's strengths while celebrating our outdoor assets.

From inventing the modern snowboard, outboard motor and synthetic fly fishing line, to designing the new Ford Bronco and the world's first all-electric adventure vehicle, Michigan has always been the place to design, develop and deliver the tools and gear of the great outdoors. The goal is to make sure the future of outdoor recreation is designed and produced here in the Great Lakes State. ◆

This Michigan Sea Grant chart shows tourism and recreation saw a 10 percent increase in jobs in Michigan from 2009 to 2018.

TRAINING FUTURE LEADERS

From Students to Stewards Initiative aims to build lifelong connections with lakes and inspire tomorrow's decision-makers

By Nick Assendelft, Michigan Department of Environment, Great Lakes, and Energy

Students from Cedarville High School in the eastern Upper Peninsula are learning how to be citizen scientists and stewards of the Great Lakes.

They've installed water quality sensors in local streams and will monitor data that is fed in real time to a database which is part of the MiWaterNet program run by the Center for Freshwater Research and Education at Lake Superior State University (LSSU) in Sault Ste. Marie. Cedarville (Les Cheneaux) schools have been monitoring streams since 1993.

The Cedarville students are continuing a tradition of learning water stewardship at a young age. Engaging students leads to a lifelong dedication to caring for the Great Lakes and support for programs and policies that benefit one of the largest freshwater systems in the world.

Cedarville expanded the student monitoring program after receiving a grant in 2020 through the From Students to Stewards Initiative sponsored by the Michigan Department of Environment, Great Lakes, and Energy's (EGLE) Office of the Great Lakes in collaboration with Grand Valley State University. Other partners in the project are the Michigan Department of Education (DOE) and the MiSTEM Network through the Michigan Department of Labor and Economic Opportunity (LEO).

◀ *Cedarville High School students install a monitor in a local waterway. The monitor is part of the MiWaterNet program run by the Center for Freshwater Research and Education at Lake Superior State University in Sault Ste. Marie. (Photo courtesy of Mi-STEM Network)*

Two Cedarville students check a solar-powered monitoring station as part of a stewardship program funded by EGLE's From Students to Stewards program. (Photo courtesy of Mi-STEM Network)

Les Cheneaux Community Schools, which includes Cedarville High, in Mackinac County is one of six school districts across Michigan that received funding. Les Cheneaux's collaboration with LSSU through the MiWaterNet study system will teach students in grades nine through 12 about high-tech, real-time water monitoring and data collection. It also will expand freshwater-focused, place-based education opportunities.

The other districts are Allegan Area Educational District, Comstock Public Schools, Copper Country Intermediate School District, Niles Community Schools and Northport Public Schools.

The From Students to Stewards program emphasizes that everyone at all ages has a role in stewardship of the Great Lakes. Fueling a youth's curiosity will translate into a lifelong dedication to caring for the Great Lakes. Linking water literacy to STEM concepts is critical to fostering future water stewards, leaders and decision-makers.

Whether advocating for policies with local or state governments, investing time in volunteer activities or participating in initiatives that work toward the betterment of the lakes and their connected resources, stewardship is a vital commitment that Michigan's residents can make to assure the long-term viability of the lakes.

Helping youths grow into stewardship role models is a long-term goal of the From Students to Stewards Initiative and this year, despite the challenges posed by the COVID-19 pandemic, the six school districts launched efforts to engage students in stewardship at an early age.

"Fostering stewardship across all age groups in Michigan is central to EGLE's core mission. Students who understand how their actions impact the environment will grow into leaders and decision-makers who have the knowledge and the will to build a more sustainable future," said Emily Finnell, Great Lakes Senior Advisor and Strategist at the Office of the Great Lakes. "The From Students to Stewards Initiative is a critical step toward ensuring that every student in the State of Michigan has access to place-based, water-focused education and quality experiential opportunities. We are proud to join our partners at the MiSTEM Network and the Department of Education in supporting these projects."

From Students to Stewards prepares students for high-quality water-focused STEM careers and connects them with community organizations and local businesses that are dedicated to freshwater stewardship. The districts that were chosen will include their experiences in a toolkit and roadmap that other schools can use to develop their own Great Lakes-based curriculum to cultivate the next generation of water stewards, leaders and decision-makers.

The six school districts shared approximately $56,000 under the initiative that will teach elementary through high school students about the Great Lakes, Michigan watersheds, and the impact people have on water resources.

Allegan Area Educational District in Allegan County will engage the Outdoor Discovery Center Education Network to provide teachers place-based education training and resources.

Comstock Public Schools in Kalamazoo County will develop a long-term monitoring project on the Kalamazoo River and Morrow Lake for kindergarten through eighth grade students. Instructors will also integrate freshwater-focused projects and allow students to connect with the lake and river over a number of years.

Copper Country Intermediate School District in Houghton County will establish and lead a Water Literacy Consortium for the western Upper Peninsula and organize a regional summit to identify best practices and share success stories for water-focused, place-based education. It also will expand teacher professional development opportunities and build on the existing structure of the Meaningful Water Literacy Learning Experiences.

Niles Community Schools in Berrien County is developing a year-long Earth Science course with water as its central theme, guided by the Great Lakes Literacy Principles and Michigan's Science and English standards. The coursework will include field work, water quality testing and classroom-based labs, as well as multi-media learning opportunities.

Northport Public Schools in Leelanau County is integrating freshwater literacy principles into the development of community action projects related to regional watershed conservation efforts. The projects will be integrated into grades five to 11 and the district will partner with the Inland Seas Education Association and Grand Traverse Band of Ottawa and Chippewa Indians to expose students to water-focused career opportunities. ◆

Learn More

The partners in the From Students to Stewards program hosted a webinar in February 2020 to explain details of the program. A recording has been posted to Grand Valley's FSTS program page.

Thank you.

Many thanks to the experts, contributors, partners, writers and editors who contributed their time and efforts to this 2020 State of the Great Lakes Report. The stories reflect the dedication this past year of our region's natural resource stewards and community voices within our state who all share a passion for Michigan's Great Lakes water resources. The views and opinions expressed within this publication are those of the individual authors and do not necessarily reflect the official policy or position of the Michigan Department of Environment, Great Lakes, and Energy, the Office of the Great Lakes, or their partners.

Gretchen Whitmer, Governor

Liesl Eichler Clark, Director, EGLE

This report is available digitally at the Michigan Office of the Great Lakes webpage, *Michigan.gov/OGL*

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