MI/EGLE/WRD-25/014

Michigan's Surface Water Monitoring Strategy 2025

Great Lakes Watersheds Assessment, Restoration, and Management Section

Water Resources Division

Michigan Department of Environment, Great Lakes, and Energy

Acknowledgements:
Great appreciation is extended to contributing staff of the Michigan Department of Environment, Great Lakes, and Energy for their hard work and assistance in the development of this Monitoring Strategy Update.

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Table of Contents

Table of Contents 3

List of Acronyms 5

Executive Summary 7

Section 1: Monitoring Strategy Elements 11

Introduction 11

Water Quality Monitoring 14

Monitoring Strategy Goals 15

Specific Objectives 15

Monitoring Design 16

Water Quality Indicators 20

Quality Assurance 24

Data Management 27

Data Analysis/Assessment 30

Reporting 30

General Support and Infrastructure Planning 33

Section 2: Surface Water Monitoring 38

Great Lakes

Water Chemistry 38

Biological 42

Fish Contaminants 44

Wildlife Contaminants 46

Sediment Chemistry 48

Support and Participation 48

Inland Lakes

Water Chemistry 50

Biological 55

Fish Contaminants 60

Wildlife Contaminants 62

Sediment Chemistry 62

Support and Participation 63
Rivers and Streams
Water Chemistry 65
Biological 68
Fish Contaminants 73
Wildlife Contaminants 74
Sediment Chemistry 75
Geomorphology 75
Support and Participation 76
Wetlands
Monitoring Summary *78*
Literature Cited 82
Appendix A. **Gaps** by Monitoring Activity 85

List of Acronyms

AIS	Aquatic Invasive Species
AOC	Area of Concern
ATTAINS	Assessment and Total Maximum Daily Load Tracking and Implementation System
BEACH Act	Beaches Environmental Assessment and Coastal Health Act
BMP	Best Management Practice
CLMP	Cooperative Lakes Monitoring Program
CMI	Clean Michigan Initiative
CWA	Clean Water Act
CWF	Clean Water Fund
DDT	Dichloro-diphenyltrichloroethane
DNA	Deoxyribonucleic Acid
EFB	European frog-bit
EPS	Emerging Pollutants Section
EGLE	Michigan Department of Environment, Great Lakes, and Energy
FCMP	Fish Contaminant Monitoring Program
FD	Fisheries Division
FOSS	Field Operations Support Section
FY	Fiscal Year
GIS	Geographic Information System
GLRI	Great Lakes Restoration Initiative
GLWARMS	Great Lakes Watersheds Assessment, Restoration, and Management Section
GLWQA	Great Lakes Water Quality Agreement
HAB	Harmful Algal Bloom
HUC	Hydrologic Unit Code
ICE	Internal Control Evaluation
MDEQ	Michigan Department of Environmental Quality
MDHHS	Michigan Department of Health and Human Services
MDNR	Michigan Department of Natural Resources
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MiCorps	Michigan Clean Water Corps
MiRAM	Michigan Rapid Assessment Method
MPART	Michigan PFAS Action Response Team
NARS	National Aquatic Resource Survey
NCCA	National Coastal Condition Assessment
NHD	National Hydrography Dataset
NLA	National Lakes Assessment
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source

NREPA	Natural Resources and Environmental Protection Act
NWCA	National Wetlands Condition Assessment
OIALW	Other Indigenous Aquatic Life and Wildlife
PBDE	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
PFOS	Perfluorooctane sulfonate
POCIS	Polar Organic Chemical Integrative Sampler
PPG	Program Partnership Grant
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
qPCR	Quantitative Polymerase Chain Reaction
TMDL	Total Maximum Daily Load
µg/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCMP	Water Chemistry Monitoring Program
WQS	Water Quality Standards
WQX	Water Quality Exchange
WRD	Water Resources Division

Executive Summary

Long before we heard of Pure Michigan, the citizens of this Great Lakes state supported a clean Michigan. Specifically, the Clean Michigan Initiative (CMI) $675 million bond that was passed by voters in 1998 to clean up, protect, and enhance Michigan's environmental quality, natural resources, and infrastructure. The bond included a Clean Water Fund (CWF), of which $45 million was set aside for water quality monitoring. CMI-CWF funds were intended to be spent at a rate of $3 million annually over 15 years; however, Michigan Department of Environment, Great Lakes, and Energy-Water Resources Division (EGLE-WRD) staff worked diligently to make these funds last as long as possible. Each year the WRD drafted a spending plan that outlined funding allocations until the final spending plan in 2019, which allocated the last remaining available CMI-CWF. It was later that year that Renew Michigan funds were provided to replace the CMI-CWF. Since 2020 the WRD has been authorized to allocate $3.5 million Renew Michigan funds annually for monitoring-related activities. While those funds endure, the WRD will continue to write annual spending plans that outline a multitude of monitoring efforts to protect human health, aquatic life, and other designated uses of the surface waters of the state.

The WRD recognizes comprehensive water quality monitoring is necessary to ensure a healthy environment and the protection of human health (Michigan Department of Environmental Quality [MDEQ], 2016). Many efforts require long-term status and trend monitoring, while others, such as emerging issues, require flexibility and swift actions. "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters," written in 1997 (MDEQ, 1997), was the first comprehensive account, or Monitoring Strategy, to document the four monitoring goals of the WRD, which are:

- Assess the current status and condition of surface waters and determine whether Water Quality Standards (WQS) are being met.
- Measure spatial and temporal water quality trends.
- Evaluate the effectiveness of water quality restoration and protection programs.
- Identify new and emerging water quality problems.

In 1997 funding and staffing resources devoted to water quality monitoring had been dropping substantially for almost a decade. This led to a decline in monitoring efforts that, in turn, led to numerous reports criticizing EGLE for lacking an adequate monitoring program (Michigan Environmental Science Board, 1993; Michigan Office of the Auditor General, 1995; Michigan Mercury Pollution Prevention Task Force, 1996). As a result of these resource constraints, the first Monitoring Strategy was written as a "wish list" that built on existing monitoring and identified activities and resources needed to establish a comprehensive, state-of-the-art water quality monitoring program.

The approval of the CMI bond in 1998, followed by Renew Michigan, led to the establishment, and then continuation, of long-term monitoring activities that better

address the goals of the Monitoring Strategy. Updates were written in 2005 and 2017 (MDEQ, 2005; MDEQ, 2017a) to reflect monitoring efforts, evaluate the effectiveness and continued relevance of ongoing monitoring activities, and identify **gaps**. The WRD has made progress regarding many monitoring activities since the previous update in 2017. Pilot projects to fill data **gaps** have become routine monitoring activities, additional projects are underway, and new statistical approaches have become standard practices for statewide and regional monitoring. This document is the most recent compilation of WRD monitoring efforts in Michigan's surface waters and addresses that, in the last nearly a decade, monitoring has developed and grown with the evolving nature of program needs, technology, and technical guidance/science.

It is important to highlight the value of the dollar has changed since 1998, with substantial cost increases occurring since the last Monitoring Strategy update in 2017. The WRD saw significant rate increases with the current technical services contract that started in January 2025. And while laboratory fees through the EGLE Environmental Laboratory have been fixed for more than a decade, prices are set to rise dramatically in 2026. Considering both contractor and laboratory costs, the WRD is beginning the process to determine what monitoring activities to continue and what activities must be reduced or cut in the absence of receiving additional funding.

This document is divided into two sections. Section 1 provides an overview of WRD monitoring elements as outlined by the United States Environmental Protection Agency (USEPA): objectives; core and supplemental indicators; data quality, assessment, reporting, management; programmatic evaluation; and general support and infrastructure planning (USEPA, 2003). Section 2 describes the monitoring activities (e.g., water chemistry, biological condition, fish contaminants) used to assess water quality in Michigan's Great Lakes, inland lakes, rivers and streams, and wetlands. Both sections outline **gaps** that can be defined as: (1) where the WRD does not have the necessary methodologies or procedures to fully implement the Monitoring Strategy; (2) where limitations exist due to staffing and or budgetary issues; or (3) where the adaptive management process calls for an evaluation of monitoring approaches to determine whether newer science techniques and technologies exist to better evaluate the goals of the Monitoring Strategy. Appendix A shows all **gaps** addressed in this Monitoring Strategy by monitoring activity.

Below is a select list of new and developing monitoring efforts since the 2017 Monitoring Strategy Update was written, including a select list of **gaps** that have been filled.

- Per- and polyfluoroalkyl substances (PFAS) monitoring is a massive effort within the WRD with sampling in water chemistry, fish tissue, and sediment.
- Early detection and rapid response for Aquatic Invasive Species (AIS) has become part of routine monitoring efforts at high-risk water bodies.

- The WRD is developing an updated approach to Harmful Algal Bloom (HAB) monitoring and reporting.
- Microplastics will be monitored in rivers and streams by the WRD for the first time in 2025.
- Beginning in 2023, with plans to continue through 2027, at a minimum, six neonicotinoids and fipronil were added to probabilistic water chemistry monitoring efforts to determine typical concentrations of these pesticides in rivers and streams.
- The WRD is wrapping up the fourth cycle of macroinvertebrate community status trend monitoring in rivers and streams in 2025 and is considering a pause beginning in 2026 to evaluate whether this activity should continue or if effort should be shifted to other WRD monitoring goals and objectives.
- Some notable **gaps** that have been filled:

    - The "Quality Assurance Manual for Water, Sediment, and Biological Sampling" written in 1994, was updated in 2023 (EGLE, 2023a).
    - Sentinel site monitoring began in 2024 and is continuing on an annual basis.
    - Biological assessment metrics in Procedure 51 (EGLE, 2024b) *for macroinvertebrates only* in wadeable streams have been updated.
    - Biological survey reports were paused after 2020 to allow staff to use these new metrics beginning with 2021 surveys. Those reports are ready to be written using an R Shiny/Markdown template designed by WRD staff to streamline the reporting process.
    - The use of R has increased dramatically.
    - Apps, primarily ArcGIS Survey123, are by far the primary mode for data collection via work iPhones.
    - Many equipment **gaps** have been filled.
    - The WRD is in the process of improving data storage for many monitoring activities.

The Clean Water Act (CWA) gives states and territories the primary responsibility for implementing programs to protect and restore water quality. Section 106(e)(1) of the CWA requires the USEPA to determine that a state is monitoring the quality of navigable waters, compiling, and analyzing data on water quality, and including it in Section 305(b) of the Integrated Report prior to the award of Section 106 grant funds. This Monitoring Strategy demonstrates Michigan's continued dedication to administer monitoring and assessment requirements under the CWA and the authority of Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

Please note our Monitoring Strategy continues to be an ongoing, iterative process. As such, we welcome comments and input from a broad array of stakeholders, including agency managers and staff (federal, state, and tribal), local governments,

academia, the private sector, environmental organizations, and the public. This document serves as a current benchmark and does not preclude the WRD from adding, eliminating, or modifying water quality monitoring activities, as appropriate, based on evolving needs and stakeholder input.

Section 1: Monitoring Strategy Elements

Introduction

Michigan is surrounded by four of the five Great Lakes and 3,288 miles of Great Lakes shoreline. It is uniquely made of two peninsulas that attract both residents and tourists to its natural resources. According to a July 2024 report by Tourism Economics, an Oxford Economics company, 2023 was a record-breaking year for visitors, with more than 128 million people spending nearly $30 billion (Michigan Economic Development Corporation [MEDC], 2024) in Michigan. After all, this is the place to fish for walleye, walk along cherry trees and tulips, drink craft beer if so inclined, take in one of the world's largest surface freshwater ecosystems, and if you are lucky, find an Agate or Petoskey stone on the beach.

But Michigan's water resources do not stop at the shoreline. More than 75,000 miles of rivers and streams run through Michigan with the Michigan Department of Natural Resources (MDNR) reporting over 12,000 of these miles are coldwater trout streams. Since 1970 the MDNR has designated 2,091 river and stream miles along 16 rivers as Natural Rivers under the authority of Part 305, Natural Rivers, of the NREPA. Michigan rivers are also known for their picturesque waterfalls, like the Black River corridor in Gogebic County, which is part of the United States Forest Service, National Scenic Byway System. And more than 400 miles away from this waterfall, the Huron and Clinton Rivers provide a unique escape from their urban setting in southeast Michigan, with their 13 Metroparks that cover nearly 5,000 acres. Over 7.3 million people visit the Metropark system each year, according to Huron-Clinton Metropolitan Authority's Metropark Web site.

Michigan's inland lakes are extremely valuable. It is often reported that Michigan has 11,000 lakes. The United States Geological Survey (USGS) National Hydrography Dataset (NHD) shows there are actually 46,000 inland lakes and reservoirs in Michigan with a minimum size of 0.1 acres. To clarify by size, Michigan has 26,266 lakes greater than 1 acre; 6,537 lakes greater than 10 acres; 1,148 lakes greater than 100 acres; 98 lakes greater than 1,000 acres; and 10 lakes greater than 10,000 acres (Breck, 2004).

The water bodies that work quietly behind the scenes are our wetlands. They are a large reason our surface waters are what we likely think about when we hear a Pure Michigan campaign. They provide excellent waterfowl and fish nursery habitat, flood and erosion control, groundwater recharge, and many water quality benefits, all while providing their own aesthetic beauty.

It is important to note that groundwater is an important water resource, and while it can impact surface water, it is not covered in this document. Groundwater monitoring in Michigan is largely limited to regulatory requirements and is conducted by staff in the WRD Permits Section. In 2018 a final report was provided to EGLE from Western Michigan University that was written using federal CWA Section 205(j) pass-through grant funds. The report addressed considerations for a groundwater management plan for Michigan (EGLE, 2018). This grant was overseen by groundwater staff in the WRD's Permits Section. **Gap**: To date, the WRD has not determined how surface water and groundwater monitoring efforts should be coordinated.

Table 1 provides some statistics for Michigan's surface water resources – resources that exist through the relatively recent geologic formations underfoot. Glacial processes laid the framework for today's topography, hydrology, and abundant groundwater resources in Michigan. Michigan's surficial geology is dominated by continental glaciation (similar to present day Greenland). Landscapes (e.g., glacial outwash plain, end moraine, ground moraine) tell us whether a water body is well drained, poorly drained, or highly erosive. Moraines with underlying till comprise most of Michigan's geology with glacial outwash plains providing the foundation for most of Michigan's river valleys. Figure 1 shows the geologic formations of Michigan and provides a clear view of our landscape differences.

Table 1. Michigan statistics. Taken from Table 1.1 in Chapter 1 of Michigan's 2024 Integrated Report (EGLE, 2024a).

Michigan Data	Statistic	Source
State surface area	96,760 square miles	Sommers, 1977
Population	9.9 million	United States Census Bureau 2010 estimate
Surface Water Resources	**Statistic**	**Source**
Great Lakes – including bays and Lake St. Clair	42,167 square miles (~45 percent of total Great Lakes area)	USGS NHD 1:24,000 scale
Rivers and streams (including Connecting Channels)	76,419 river miles	USGS NHD 1:24,000 scale
Inland lakes and reservoirs with surface area >.01 acre	46,000 covering 870,109 acres	USGS NHD 1:24,000 scale
Wetlands	6,465,109 acres	United States Fish and Wildlife Service (USFWS) National Wetlands Inventory

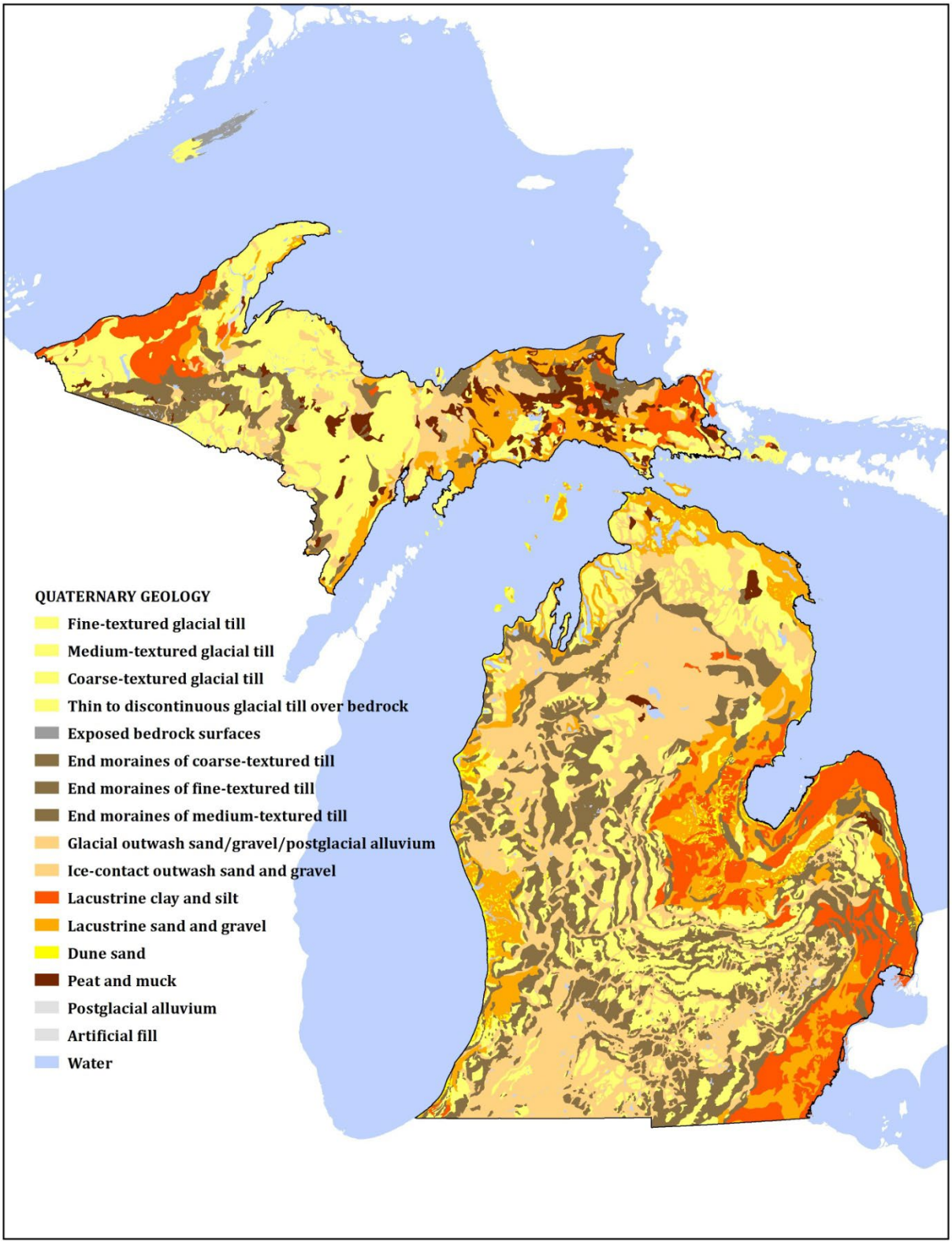

Figure 1. Quaternary Geological Formations of Michigan.

Water Quality Monitoring

Monitoring is fundamental to understanding the environment around us. It tells us the what, where, and when of environmental issues. Without water quality monitoring, we would not know what pollutants are in a water body, where you can safely eat the fish, and when the beaches are safe for swimming. One critical responsibility of the WRD is to conduct comprehensive water quality monitoring of Michigan's surface waters, under the authority of Part 31, to ensure healthy people, communities, ecosystems, and economies by assessing water, pathogens, biological communities, fish/wildlife contaminants, and sediment.

The majority of ambient surface water monitoring in the WRD is performed by staff within the Great Lakes Watersheds Assessment, Restoration, and Management Section (GLWARMS), formerly the Surface Water Assessment Section. Since the 2017 Monitoring Strategy Update was written, however, organizational changes have increased the monitoring efforts led by staff in other Sections. Figure 2 shows the current WRD organization chart.

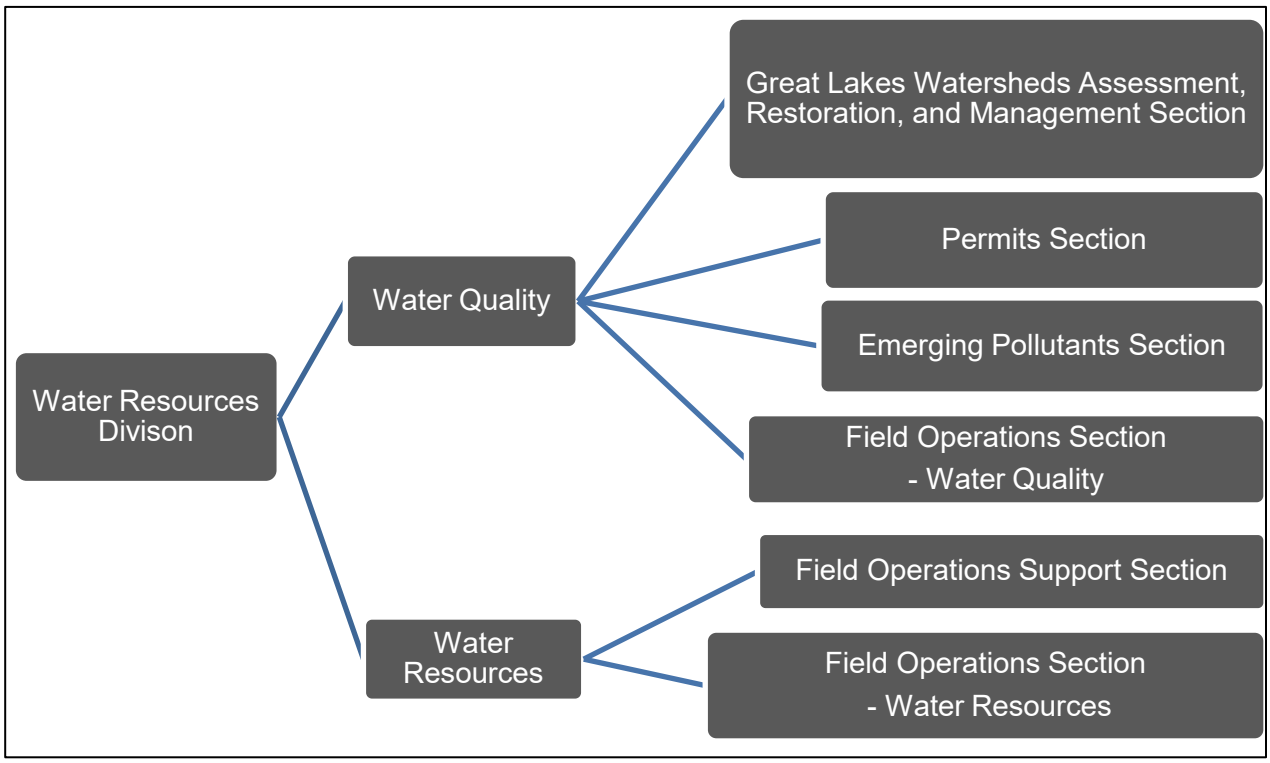

Figure 2. WRD organization chart showing Sections.

The Emerging Pollutants Section (EPS) was created in 2020. While monitoring support requests are made for the GLWARMS, from this and other Sections, staff in the EPS is

designing a new microplastics project that involves collecting ambient water samples in rivers and streams. Surface water monitoring is also performed by staff in the Permits Section but is limited to specific point source needs. Finally, wetland monitoring was conducted within the GLWARMS when the previous Strategy was written; however, the unit leading those duties was moved to the Field Operations Support Section (FOSS) in 2020. For wetlands, a full description of monitoring activities can be found in the "State of Michigan Wetland Monitoring and Assessment Strategy," (MDEQ, 2015a).

Monitoring Strategy Goals

The goals of the WRD Monitoring Strategy are largely unchanged from those established in 1997. These broad goals are inclusive of the more specific CWA objectives related to monitoring.

- Assess the current status and condition of surface waters and determine whether WQS are being met.
- Measure spatial and temporal water quality trends.
- Evaluate the effectiveness of water quality restoration and protection programs.
- Identify new and emerging water quality problems.

While the fundamental goals remain the same, the monitoring activities (formerly called "essential elements") used to assess water quality continue to evolve. They are largely accomplished through WRD staff efforts but also by volunteers, through contracts and grants, and in partnerships with other agencies. In this update, the monitoring activities are:

- Water Chemistry
- Beaches and other Recreational Waters (pathogens)
- Inland Lake Quality and Eutrophication
- Biological (e.g., Condition, AIS)
- Fish and Wildlife Contaminants
- Sediment Chemistry
- Hydrology/Stream Geomorphology
- Volunteer Monitoring

Specific Objectives

Monitoring activities in each water body type has its own list of specific objectives and are described in Section 2.

Monitoring Design

Designs for monitoring activities are selected to ensure that management and programmatic needs are effectively addressed. Each monitoring activity is reviewed at appropriate intervals to determine whether the resulting data are achieving agency objectives and to evaluate whether the study design can be improved. In general, WRD monitoring activities fall under one of two types of site-selection design, targeted and probabilistic, and across a few different project-scale designs (basin cycle, statewide, and special studies).

Site-Selection Design

Depending on the monitoring objective, site selection is either targeted – selected specifically to answer a question about a location/area – or probabilistic – selected randomly to answer a question about a larger area (e.g., watershed, statewide). Within a monitoring activity, both site-selection criteria can be used.

Targeted Monitoring

Targeted monitoring activities support various water quality programs through addressing specific questions and/or issues. A workgroup in the GLWARMS solicits surface water monitoring recommendations from external stakeholders, EGLE staff, and other professionals every year to support implementation of the Monitoring Strategy. Targeted monitoring supports various water quality programs by providing a platform for the WRD to address specific questions and/or issues that warrant action but occur outside the scope of current monitoring activities. Each year, the WRD receives more targeted monitoring requests than can be completed in a single field season due to staffing, budgetary, and logistical capacity constraints. The subset of targeted requests ultimately selected for monitoring are determined through the targeted monitoring request process. During this process, all requests are evaluated individually by biologists and other water quality specialists to determine priority based on a common set of scoring criteria. The process also facilitates communication and collaboration among WRD Sections (e.g., GLWARMS, Permits, FOSS, Field Operations, EPS) as staff work together to fulfill targeted requests.

The targeted monitoring request process is initiated each October. The workgroup coordinates with EGLE communications staff to distribute press releases, e-mail notices, and social media posts announcing that the WRD is soliciting requests for monitoring from external stakeholders. Though requests that conform to the WRD's annual basin-year cycle are given higher priority, requests that occur in watersheds outside of their basin year are given fair consideration, especially if the request is time sensitive. Beginning with the 2024-2025 cycle, the workgroup implemented an online screening form to refine the candidate pool of requests. Potential requestors are presented with a series of questions before being given the option to submit a targeted request. Requests

better served by other EGLE programs or that could be fulfilled with existing data are routed to the appropriate resources instead of submitting a duplicative targeted request. This change was designed to increase the WRD response time, improve stakeholder satisfaction with the targeted request process, and reduce overall staff time commitment during the evaluation of requests.

If a request passes through the screening form, it is submitted to the GLWARMS for evaluation. New incoming requests are first reviewed by staff to determine the nature of the request and to categorize requests by monitoring activity (e.g., water chemistry sampling, biological sampling). Once requests are categorized, they are scored and evaluated in a series of meetings. The meetings are organized by WRD district boundaries and include the targeted monitoring workgroup, GLWARMS watershed biologists, Field Operations staff, Permits biologists, and many other water quality topic specialists. After all requests have been scored, managers and supervisors convene to determine an appropriate scoring cutoff for selecting requests based on available resources and staff capacity. This process gives the WRD a precise estimate of the level of effort needed each year to meet monitoring goals and affords management and staff an opportunity to discuss any necessary changes, additions, alterations, or deletions of program elements. Once a cutoff is decided, WRD staff is sent the list of requests selected for monitoring for the upcoming field season.

Monitoring assignments from the targeted monitoring request process are carried out by WRD biologists and engineers or the technical services contractor. Requests to be completed are incorporated into monitoring workplans and Quality Assurance Program Plans (QAPP), as appropriate. These plans detail the monitoring objectives, sampling activities, and the staff/funding resources necessary to carry out the plan. In all cases, requestors are provided with the results once monitoring is completed.

All targeted monitoring requests (active and completed) are housed in an Access database. The targeted monitoring database was redesigned to its current format in 2021. The redesign allowed different monitoring activities within a request to be tracked separately. This is useful when one component of a request is complete, but others are still pending. At one time, the targeted monitoring database was also used to track almost all monitoring activities conducted by the WRD (not just targeted monitoring). This practice was discontinued in 2023, and the targeted monitoring database is now reserved for the assessment and tracking of targeted requests.

Probabilistic

A probabilistic design allows the WRD to measure water quality at a desired scale, such as statewide or watershed, and make statistically valid conclusions with a relatively small number of sites from the target population. The USEPA requires that states incorporate probabilistic study designs into the monitoring of at least one water body type (e.g., inland lakes, rivers, and streams).

The WRD uses this design for a few monitoring activities. Since 2005 water chemistry monitoring has been performed using a probabilistic design in rivers and streams. The following year (2006), a probabilistic sampling design was implemented to evaluate macroinvertebrate community health in wadeable streams. Since 2012 the WRD has participated in the National Aquatic Resource Survey-National Lakes Assessment (NARS-NLA) and generally uses Section 106 Monitoring Initiative funds to intensify that effort to a statewide evaluation. Finally, the WRD-FOSS is responsible for wetland monitoring in EGLE-WRD and has used a probabilistic design for evaluating state-scale wetland condition status and trends through the NARS-National Wetland Condition Assessment (NWCA) since 2016.

Note that probabilistic sites can be used to evaluate long-term changes. In these instances, sites become known as “fixed” and part of routine monitoring efforts. Examples of these include: (1) the probabilistic water chemistry monitoring sites in rivers and streams were fixed after the first cycle, allowing repeated sampling to determine changes over time; and (2) a subset of the 2006-2011 biological condition surveys (first five-year basin cycle with sites selected probabilistically) for wadeable streams has been designated as trend stations. These sites have been resampled every five years during their basin cycles, allowing for long-term changes to be evaluated at the state- and sometimes watershed-scales after a minimum period of three complete basin cycles (15 years). **Gap**: Over the next few years there are plans to evaluate the efficacy of this approach for macroinvertebrate community sampling and, if needed, consider alternate sampling designs that may better address the Monitoring Strategy goals.

Project-Scale Design

Monitoring plans are framed to address the scale of the project and the amount of available effort.

Basin Cycle

There are 64 Hydrologic Unit Codes (HUC) at the 8-digit scale that are at least partially located in Michigan. The WRD split and combined HUC 8 and HUC 10 boundaries to create 85 groupings, which are aggregated into 42 “watershed units” that are monitored on a five-year basin cycle (Figure 3). This five-year rotation originates from the National Pollutant Discharge Elimination System (NPDES) permit cycle with biological assessment occurring two years prior to an NPDES permit reissuance to provide information on receiving water condition. Due to the nature of this monitoring approach, any statewide summary of data collected by basin cycle must wait for all five years of data to be collected. Many monitoring activities use this basin cycle schedule to manage the effort of evaluating the thousands of river miles and water bodies in Michigan.

Statewide

Statewide monitoring, using either a probabilistic or targeted design, is used to answer “big picture” questions. These efforts do not “bin” sampling locations geographically (i.e.,

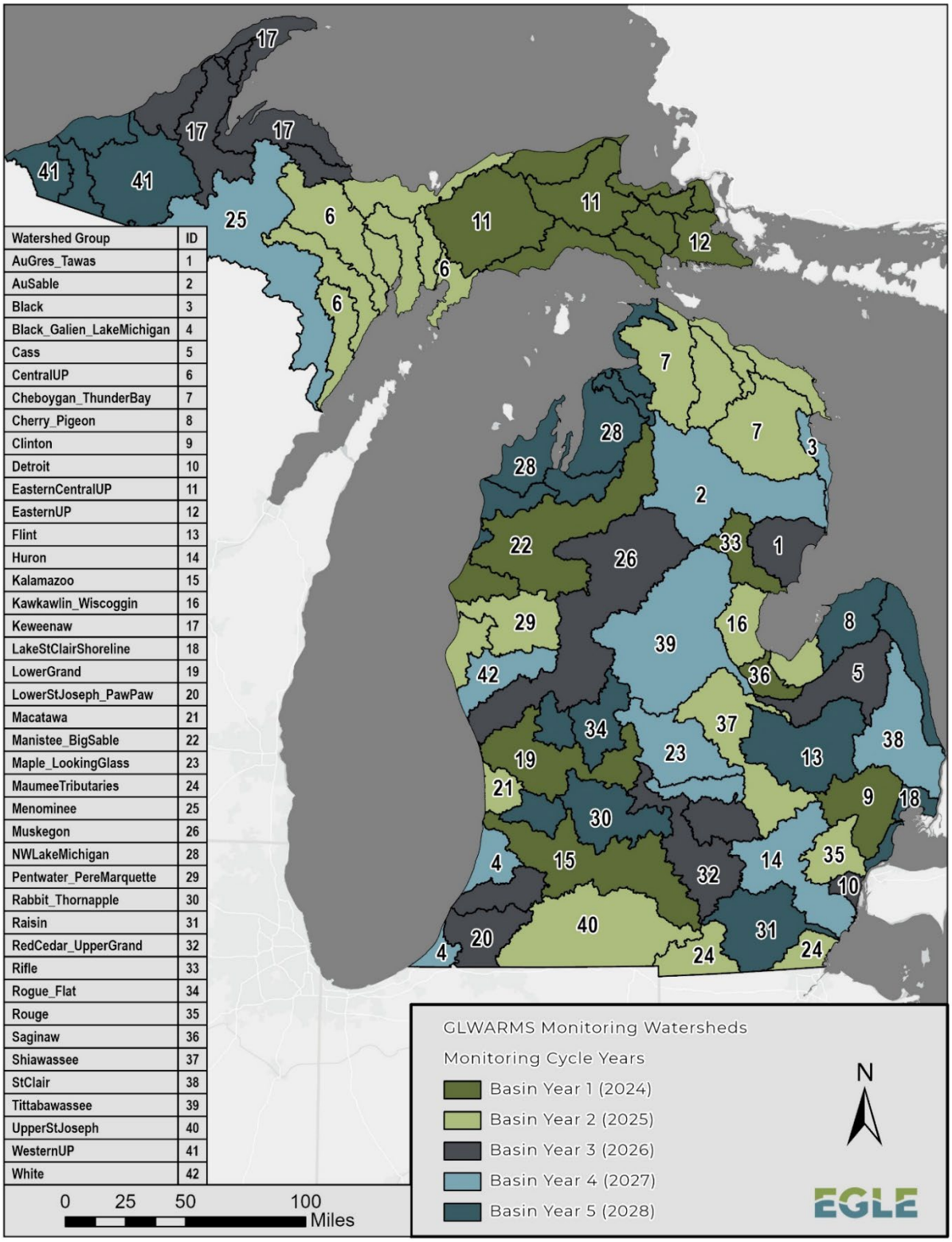

Figure 3. Michigan's watershed groups and basin years as delineated to balance monitoring efforts.

basin cycle), rather sites are visited throughout Michigan without the limitation of being held to a rotating schedule. One example of this includes water chemistry monitoring efforts in rivers and streams. The NARS assessments also use a probabilistic design to determine water quality condition at the national/regional level of all water body types, and the WRD increases the NARS sample size in Michigan when desirable, to make statewide level determinations. Sentinel site monitoring, which began in 2024, is also an example of a statewide activity that is not confined by basin year. These sites were chosen based on specific, targeted guidelines, and while the WRD will not make data extrapolations for a "statewide" conclusion, this is a statewide effort each year.

Special Studies

Each special study is designed individually to answer specific questions. Examples of these studies include potential success stories of water quality improvements for Best Management Practices (BMP) installation or geomorphology projects.

Water Quality Indicators

Core Indicators

Core indicators are the routine physical, chemical, and biological parameters used to assess water quality status and WQS attainment and evaluate temporal trends. Monitoring can include water chemistry values, physical water quality measurements, bacteria counts, biological community assessments, fish and wildlife contaminants levels, bulk sediment chemistry screening values, and bulk sediment toxicity thresholds. Table 2 lists these parameters by media (water, biological, fish tissue) and water body type. If applicable, the designated uses associated with indicators are identified. It is important to note that the WRD collects data for several chemicals in water, fish tissue, and sediment that, while important to understand the status of water quality in Michigan's surface waters, do not currently have water quality values. We look to our federal partners for support to increase the ability to make WQS comparisons to those indicators.

Designated Uses

All surface waters of the state are designated and protected at a minimum for all of the following designated uses: agriculture, navigation, industrial water supply, warmwater fishery, Other Indigenous Aquatic Life and Wildlife (OIALW), partial body contact recreation, and fish consumption (R 323.1100[1][a]-[g] of Michigan's Part 4 Rules). In addition, all surface waters of the state are designated and protected for total body contact recreation from May 1 to October 1 (R 323.1100[2]). Specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes Connecting Channels are designated and protected for coldwater fisheries (R 323.1100[4]-[7]). Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and Connecting Channels are designated and protected as public water supply sources (R 323.1100[8]).

Table 2. Routine (core) indicators monitored by the WRD. Parameters associated with numeric and narrative WQS have the corresponding designated uses listed. Methods and quantifications levels can be found in program reports. Note that screening levels for contaminants in sediment related to dredging activities are not included in this list but can be found in Procedure 48 (MDEQ, 2018).

Indicator	**Corresponding Designated Use, if applicable**	**Rivers and Streams**	**Inland Lakes**	**Great Lakes**
Total Phosphorus in water	OIALW	X	X	X
Orthophosphorus in water			X	X
Nitrogen, Ammonia in water	Fish community	X	X	X
Other Nitrogen species in water (Nitrate, Nitrate + Nitrite, Nitrite, Kjeldahl Nitrogen)	Public water supply (nitrate only)	X	X	X
Chlorophyll-*a* in water, Secchi Depth	OIALW		X	X
Hardness in water		X		X
Cations (Calcium, Magnesium) in water		X	X	X
Anion, Chloride in water	Public water supply, OIALW, fish community	X	X	X
Anion, Sulfate in water	OIALW, fish community	X	X	X
Total Dissolved Solids in water	Public water supply		X	X
Field/Sonde pH in water	Fish community, partial body contact, total body contact	X	X	X
Field/Sonde temperature and dissolved oxygen in water	Fish community	X	X	X
Field/Sonde Conductivity in water		X	X	X
Alkalinity in water			X	X
Total Organic Carbon in water				X
Dissolved Organic Carbon in water		X		
Total Suspended Solids in water	OIALW	X	X	X
Turbidity in water	OIALW		X	X
Low level mercury	OIALW, fish consumption	X		X
Non-mercury low level metals as total in water (Copper, Chromium, Lead,)	OIALW, fish community	X		X
Low level Metals as total in water (Nickel, Zinc, Cadmium, Manganese)	OIALW, fish community	X		
E. coli in water per 100 milliliters (for Great Lakes and inland lakes, beaches only)	Partial body contact, total body contact	X	X	X

Indicator	Corresponding Designated Use, if applicable	Rivers and Streams	Inland Lakes	Great Lakes
Macroinvertebrate Community in wadeable nonwadeable streams	OIALW	X		
Fish Community in wadeable streams	Fish community	X		
Algae, macrophytes, bacteria slimes, fungi	OIALW, fish Community	X	X	
Hexachlorobenzene in fish tissue		X	X	X
gamma-BHC (Lindane)* in fish tissue		X	X	X
Aldrin in fish tissue		X	X	X
Dieldrin in fish tissue		X	X	X
Total DDT* in fish tissue	Fish Consumption[1]	X	X	X
4,4'-DDE*; 4,4'-DDD*; 4,4'-DDT in fish tissue		X	X	X
2,4'-DDE; 2,4'-DDD; 2,4'-DDT in fish tissue		X	X	X
PFOS* in fish tissue		X	X	X
Heptaclor Epoxide in fish tissue		X	X	X
Mercury in fish tissue	Fish Consumption[1]	X	X	X
Selenium in fish tissue	Fish Consumption[1]	X	X	X
Oxychlordane in fish tissue		X	X	X
Chlordane *(alpha-, gamma-)* in fish tissue	Fish Consumption[1]	X	X	X
cis-Nonachlor in fish tissue		X	X	X
Styrene, (octachloro-, hexachloro-, heptachloro-, pentachloro-) in fish tissue		X	X	X
Heptachlor in fish tissue		X	X	X
Terphenyl in fish tissue		X	X	X
Toxaphene in fish tissue	Fish Consumption[1]	X	X	X
Mirex in fish tissue		X	X	X
PBB* (FF-1, BP-6) in fish tissue		X	X	X
Total PCB* (congener method) in fish tissue	Fish Consumption[1]	X	X	X
Dioxin in fish tissue	Fish Consumption[1]	X	X	X
Mercury in wildlife tissue		X	X	X
Organochlorine contaminants: DDT and its metabolites in wildlife tissue		X	X	X
HCB* in wildlife tissue		X	X	X
alpha-HCH* in wildlife tissue		X	X	X
gamma-HCH* Heptachlor in wildlife tissue		X	X	X

Indicator	Corresponding Designated Use, if applicable	Rivers and Streams	Inland Lakes	Great Lakes
Heptachlor epoxide in wildlife tissue		X	X	X
Chlordane *(alpha-, gamma-)* in wildlife tissue		X	X	X
Dieldrin in wildlife tissue		X	X	X
Toxaphene in wildlife tissue		X	X	X
20 PCB congeners in wildlife tissue		X	X	X
PFBS* in water		X	X	X
PFOS* in water	Fish Consumption[1]	X	X	X
PFOA* in water		X	X	X
PFHxS* in water		X	X	X
PFNA* in water		X	X	X

[1]Fish tissue concentration thresholds developed by the Michigan Department of Health and Human Services (MDHHS).

**gamma*-benzene hexachloride (BHC) (Lindane)

**Dichlorodiphenyldichloroethylene (DDE)

*Dichlorodiphenyldichloroethane (DDD)

**Dichlorodiphenyltrichloroethane (DDT)

* Perfluorooctanesulfonic acid (PFOS)

*Polybrominated biphenyls (PBB)

* Polychlorinated Biphenyls (PCB)

* Hexachlorobenzene (HCB)

* *alpha*-hexachlorocyclohexane (*alpha*-HCH)

* *gamma*-hexachlorocyclohexane (*gamma*-HCH)

* Perfluorobutanesulfonic acid (PFBS)

* Perfluorooctanoic acid (PFOA)

* Perfluorohexanesulfonic acid (PFHxS)

* Perfluorononanoic acid (PFNA)

Supplemental Indicators

Supplemental indicators are parameters in addition to routine indicators that are used for specific studies. These consider causes of specific water quality issues or impairments and are used to determine the source or extent of impacts such as point sources and nonpoint sources (NPS), atmospheric deposition, and emerging issues (e.g., PFAS). Supplemental indicators can also be used to follow up on issues such as determining the effectiveness of a BMP or finding causes of impairments.

Quality Assurance

WRD Quality Assurance Manual

The WRD "Quality Assurance Manual for Ambient Water, Sediment, and Biological Sampling" was updated in 2023 (EGLE, 2023a). This document contains standard operating procedures for water, sediment, and biological sampling of surface waters and point source discharges used by WRD staff related to water quality monitoring. This process ensures that monitoring data collected to support various objectives and water quality programs are accurate and reliable. Note this is a gap that has been filled since the 2017 Update. Before the 2023 Manual was updated, WRD staff was referring to a document from 1994.

Quality Management Plan (QMP)

The WRD recognizes the importance of Quality Assurance (QA) and Quality Control (QC) and strives to ensure all monitoring data meet high standards of quality. The WRD follows the EGLE QMP, which provides the framework to ensure that environmental programs and decisions are supported by data of the type and quality needed and expected for their intended use (EGLE, 2023b). The QMP also ensures that decisions involving the design, construction, and operation of environmental technology are supported by appropriate quality-assured engineering standards and practices. The QMP is updated every five years. It was most recently approved by the USEPA on December 6, 2024, and will be valid through December 6, 2029.

The QMP is EGLE's broad, overarching document covering all aspects of quality. It states the EGLE project managers are responsible for ensuring that program-level and project-level QAPPs follow USEPA specifications. The QMP also references the EGLE Policy and Procedure 09-026[1], Quality Assurance, which states that all staff, contractors, grantees, and regulated entities involved with the planning, collecting, or analysis of environmental data for EGLE must meet established standards for

[1] Per the current QMP, in 2018 MDEQ Policy and Procedure 09-004, Quality Assurance/Quality Control, and Policy and Procedure 09-020, QAPPs, were combined into one Policy and Procedure 09-026, Quality Assurance, which covers all aspects of quality assurance-related data.

QA/QC. This policy also provides the expectations and process for developing program-level and project-level QAPPs. All WRD staff is required to follow these procedures.

QA Project Plans

In addition to the standard operating and section procedures, the WRD and its contractors develop QAPPs for water quality monitoring activities that are state and/or federally funded. A QAPP is a document that details the procedures and protocols required for data collection to ensure a project meets its goals and objectives. When a QAPP is required, it must be developed and approved before monitoring can take place. Per EGLE's QMP, EGLE has the authority to approve its own project-level QAPPs for non-competitive assistance agreements and delegated programs under the performance partnership agreements with the USEPA. QAPPs within the WRD that meet these criteria are often written by WRD staff but can also be written by contractors and grantees.

The USEPA requires that states develop QAPPs for federally-funded monitoring projects. These documents are required for all monitoring activities. For USEPA-funded projects, QAPPs must be approved in accordance with the USEPA's QAPP Standard (USEPA, 2023). QAPPs that support Great Lakes Legacy Act work are submitted to the USEPA, Region 5, for review and approval.

Project Managers and Lead Biologists

Routine monitoring activities within the WRD have project managers who ensure the monitoring goals and objectives are met. There are lead biologists for all watersheds, Total Maximum Daily Load (TMDL) lakes that are monitored regularly, and other activities (such as Sentinel Site monitoring). All Section 106 Monitoring Initiative projects are also led by a project sponsor who oversees project managers and work groups to ensure the project stays on task. Project sponsors are generally Unit Supervisors in the WRD.

Laboratory Certifications

EGLE Environmental Laboratory

The EGLE Environmental Laboratory is the primary state-run laboratory for analyzing environmental samples for state agencies in Michigan and is certified by the Laboratory Certification Program, which operates under the authorization of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399), and the USEPA. All laboratories testing Michigan drinking water samples for regulatory and compliance monitoring must be certified by this program.

The Laboratory Certification Program certifies laboratories to ensure that proper methods and quality control are used in the testing of drinking water samples. The

certification process includes an extensive review of the applicant laboratory QAPP, Standard Operating Procedures, as well as an on-site audit of the facility and analytical data. Areas of certification include bacteriology, wet chemistry, organic chemistry, and inorganic chemistry.

The EGLE Environmental laboratory also does regular proficiency testing for non-drinking water samples. Proficiency tests are done on all the analytes and matrix combinations currently run in-house using accredited providers. If the lab fails a particular parameter, they investigate and take corrective actions, then perform another test to verify the issue has been resolved.

Contract Laboratories

Wisconsin State Laboratory of Hygiene

Some water chemistry samples that cannot be analyzed by the EGLE Environmental Laboratory are sent to the Wisconsin State Laboratory of Hygiene, which is certified by the Wisconsin DNR and the USEPA.

The WRD has had multiple contracts with this facility, the most recent beginning on October 1, 2020. The primary use of this laboratory is to analyze trace metal samples (total copper, lead, chromium, nickel, cadmium, manganese, and zinc) at concentrations beyond the capabilities of the EGLE Environmental Laboratory. In addition to these metals, total mercury samples collected in the Great Lakes Connecting Channels, Saginaw Bay, and Grand Traverse Bay for trend analysis are analyzed by this laboratory. This is because the EGLE Environmental Laboratory did not have the capability to analyze low-level total mercury when Great Lakes Connecting Channels and Bays monitoring was initiated and consistency in sampling staff, methods, and equipment is of the utmost importance when performing trend analysis.

Whitewater and Associates

Whitewater and Associates is a subcontractor through the current technical services contract. This company's analytical laboratory is fully certified for drinking water inorganic chemistry and microbiology by EGLE and for environmental sample analysis by the Wisconsin DNR.

Additional Laboratories

Additional laboratories may be used on an as-needed basis (e.g., when analyzing parameters outside of the capability of contract labs, lab capacity issues, instrumentation limitations, etc.) if laboratory methods, QAPPs, Standard Operating Procedures, Proficiency Testing, etc. demonstrate comparable quality control methods and/or certifications. These laboratories are used through Memorandums of Understanding, contracts, or subcontracts.

Data Management

A data management system should contain all relevant information (raw data, metadata, and QA information), allow for relatively easy queries and retrieval, and be readily accessible to all data users, including the public. The majority of WRD water quality monitoring data are stored electronically in at least one of these locations:

- USEPA Water Quality Exchange (WQX), Water Quality Portal, and How's My Waterway – All systems maintained by the USEPA, housing data fed by WQX.
- Online outside of WQX, such as on a WRD Web site.
- Coming Soon – EGLE-WRD is working with Gold Systems Incorporated to move EGLE data into Elements. This will replace Access Databases and will streamline Michigan's data connection to WQX.
- Microsoft Access databases developed by WRD staff.

Much of EGLE data stored in internal Access databases are available online via the above-mentioned USEPA data management systems. Specific dataset availability is described below. Some data are currently only available upon request, but the project with Gold Systems should make the vast majority of EGLE-collected data available to the public via WQX and other USEPA portals.

Available Online

Water Chemistry – Water Chemistry Monitoring Program (WCMP) Data in WQX

The water chemistry data management goal is to have all data collected by WRD staff and contractors uploaded to the WQX within one year of sampling. This includes all river and stream probabilistic station data; Great Lakes targeted station data (in Connecting Channels/Saginaw Bay/Grand Traverse Bay); grab samples collected during biological condition surveys and special studies; and intensive monitoring conducted to support specific program needs. For data generated by other laboratories, WRD project managers are responsible for providing the data as they become available to the data management coordinator for entry into the WQX and/or WRD databases. It is sometimes difficult to meet the one-year objective for water chemistry data availability with the time needed for QA by the laboratory, followed by the QA performed by WRD staff. WRD staff is working diligently to improve the time frame these data are available electronically.

Long-term datasets for river and stream probabilistic stations and the Great Lakes targeted stations (in Connecting Channels/Saginaw Bay/Grand Traverse Bay) are also stored in an internal Access database. This database is not available to the public; however, the public can retrieve data through WQX (among other USEPA data management portals) or by a specific information request to WRD staff. Note this is one

of the databases currently being transferred into Elements, also making the data available in WQX with this pathway after QA.

PFAS in Water Chemistry and Edible Portion Fish Tissue – Data Online

Surface water and edible portion fish tissue PFAS data are entered into an online Interactive Mapping Tool on the Michigan PFAS Action Response Team (MPART) PFAS Geographic Information System (GIS) Web site.

Beach Monitoring – Data Online and in WQX

Beachguard has been a public-facing database for years and was recently moved to an improved, also publicly available, platform that houses data for many EGLE programs. Beachguard now resides in the MiEnviro portal, which supports various programs such as Air Quality Permitting/Compliance, Water Quality, and Resources Permitting/Compliance. All inland lake and Great Lakes beach monitoring data associated with pass-through grants provided to local health departments can be found in Beachguard (Figure 4). The data are entered directly into MiEnviro Beachguard by county health department staff and include *E. coli* levels at monitored beaches as well as information on beach closings.

Figure 4. Visit MiEnviro Beachguard.

In addition, as a requirement of receiving federal Beaches Environmental Assessment and Coastal Health Act (BEACH Act) funds, the state must submit beach monitoring and notification information to the USEPA for entry into the federal PRAWN database. These *E. coli* concentration data are sent to the USEPA with a beach identification number for entry into the Central Data Exchange, which are then entered into the WQX.

Non-Beach Pathogen Monitoring – Data Online and in WQX

Non-beach pathogen (primarily *E. coli*) data are collected by the WRD and its contractors. Data are entered into an online Interactive Mapping Tool on the WRD Web site, Michigan's Statewide *E. coli* TMDL, and are also put into WQX. Note this is one of the databases currently being transferred into Elements, also making the data available in WQX with this pathway after QA.

Biological Community Data – Data in WQX

The biological community (fish, benthic macroinvertebrates) and physical habitat data collected during the watershed surveys or special studies are stored in an Access database maintained by the WRD. Staff has access to the database to generate biological survey and habitat data tables. The data are also available via WQX, but that

system does not contain the metric scores, only the counts of macroinvertebrates and fish. Note this is one of the databases currently being transferred into Elements, also making the data available in WQX with this pathway after QA.

Sediment During Biological Condition Assessments – Some Data in WQX

The WRD makes every attempt to enter sediment chemistry data collected during watershed surveys into WQX within one year of sampling. Historical sediment data currently available electronically are also available via WQX; historical sediment data not available electronically will be entered as resources and priorities allow.

NPS Monitoring Grants – Data in WQX

Recipients of NPS pass-through grants are required to provide most environmental monitoring data in an Excel spreadsheet using a template provided by WRD staff. At the close of each grant, WRD staff enters the data into WQX. Note there are data that continue to not be entered into WQX. Examples include, but are not necessarily limited to, projects that use microbial source tracking to identify *E. coli* sources, watershed inventories, and geomorphology survey information.

Volunteer Monitoring – Data Online

Lake and stream data generated through the Michigan Clean Water Corps (MiCorps) are available to the public on the MiCorps Data Exchange Network. The MiCorps Web site was redesigned in September 2025 to be more user-friendly and utilize new tools and technology to improve communication and data sharing (e.g., optimized for viewing on multiple devices). MiCorps data will also be entered into the new Elements system, making the data available in WQX and How's My Waterway.

Available by Request – Some Planning to Move to WQX

Great strides have been made since the previous update to make our data accessible to the public. However, **gaps** persist as the WRD continues to work on public access for the following data:

1. ### Fish Contaminant – Data to be Available in WQX

   The WRD has developed an Access database to store all fish contaminant data. Fish contaminant data used by the MDHHS to establish fish consumption advisories are available to the public via the MPART GIS page. Note this is one of the databases currently being transferred into Elements, also making the data available in WQX with this pathway after QA.

2. ### Inland Lake Field Generated Data – Data to be Available in WQX

   The WRD inland lake data, including field-generated data collected during lake monitoring efforts (e.g., Secchi depth readings, temperature/dissolved oxygen profiles, and water chemistry), are currently being transferred into Elements, also making the data available in WQX with this pathway after QA.

3. Wildlife Database – Available Upon Request Only

   The bald eagle contaminant and productivity data are entered into a database developed and maintained by the University of Maryland. Data are available upon request, but the database is not accessible to the public. Contaminant data collected on herring gull eggs are stored in spreadsheets and provided in each report. Electronic versions of the data are available upon request.

4. Reports Database – Available Upon Request Only

   The WRD maintains a water quality monitoring reports database in Microsoft Access, which is available to WRD staff. Reports can be searched by water body name, county, hydrological unit code, or author. Report content varies, including but not limited to, basin cycle watershed biological condition, statewide water chemistry, and historical work such as Whole Effluent Toxicity Testing. See below under *Reporting* for information regarding how reports can be obtained.

Data Analysis/Assessment

Assessment Methodology

The WRD uses established methods to assess the attainment status of waters relative to Michigan WQS. This approach ensures relevant information is used consistently to make water quality assessments for the Integrated Report. The Assessment Methodology includes information regarding how data are obtained and used to assess designated use support in Michigan's surface waters. An in-depth description of these considerations is provided in Chapter 3 of the most recent *Water Quality and Pollution Control in Michigan. 2024 Sections 303(d), 305(b), and 314 Integrated Report* (EGLE, 2024a).

Analysis/Assessment by Activity

In addition to the Assessment Methodology, other data analysis tools are used depending on the specific objective. Appropriate data analysis is performed for temporal and spatial trend assessment, program effectiveness assessment, and evaluation of emerging issues. Descriptions of analysis and assessment are listed in Section 2 under each monitoring activity in each water body type.

Reporting

The WRD uses the USEPA's Assessment and TMDL Tracking and Implementation System (ATTAINS) database for the Integrated Report, which the CWA requires to be submitted to the USEPA every two years. These data are also available via How's My Waterway for reports dated 2018-2024.

The WRD (sometimes via contractors and grantees) produces individual written reports that summarize results of water quality monitoring activities. Staff strive to put recent reports for monitoring activities, including watershed reporting, on the EGLE Water Quality Monitoring Reports Web site that span the previous ten years (approximately two basin cycles) in a format compliant with the American Disabilities Act; however, some reports, including legacy reports dating back to at least the 1950s are not available to the public unless requested. Many of these reports include appendices that contain raw data.

Watershed reports often focus on biological community assessments. If warranted by a targeted monitoring request, water and sediment grab samples may be included. Currently, reports also include a specific section describing NPS issues. This is one example of the WRD's efforts to make sure sampling results are used by programs that benefit from monitoring. Data from other sources, such as the MDNR and USGS, may or may not be incorporated. Likewise, data collected by the WRD through other monitoring activities, including water chemistry fixed station, fish contaminants, wildlife contaminants, inland lake sediment cores, and data collected through WRD grants are often presented in separate reports. To address the feasibility of incorporating all available data in one document, the WRD developed a comprehensive pilot report on the Menominee River watershed in 2015. This pilot report and other recommendations were evaluated, and it was determined to be too time intensive.

Recently, R Markdown and R Shiny were used in tandem to develop dynamic staff reports summarizing biological data collected over EGLE's five-year rotating watershed basin cycle. R Markdown enabled the automated generation of structured, reproducible reports that integrated boilerplate narrative, tabular summaries, and spatial visualizations. The R Markdown template was then integrated into the R Shiny application, which provided an interactive platform for staff to customize report content based on specific basins and years of data collection. Throughout development, efforts were made to maximize accessibility from an American Disabilities Act perspective by applying best practices in layout design, color contrast, and alternative text. This integrated and accessible approach enhanced efficiency, consistency, and data usability with the goal of allowing for improved public dissemination of monitoring results.

All reports produced by the WRD and its contractors require the completion of a report distribution form before being finalized. The distribution form ensures copies are sent to all interested stakeholders, potentially including, but not limited to, relevant WRD staff in Permits Section, FOSS, Field Operations, MDNR-Fisheries Division (FD), and appropriate federal and local agencies.

Programmatic Evaluation

Per the QMP

The QMP states that audits regarding implementation of the Monitoring Strategy include, but are not limited to, the review of QA data collected; periodic comparison of biological monitoring results among staff; peer and supervisory review of data analysis and monitoring conclusions; and periodic reviews and updates of monitoring plan elements and designs to ensure monitoring objectives are met. Note that the GLWARMS is planning to evaluate the efficacy of long-term monitoring efforts within the next few years to determine whether improvements or additions are needed to address Monitoring Strategy elements. Any changes that are decided will be introduced in the next Monitoring Strategy update.

Internal Controls Evaluation

In 1986 the State of Michigan established a biennial Internal Control Evaluation (ICE) process. State statute requires that principal departments perform a self-evaluation of their internal control framework and submit results to the Governor on a biennial basis. As a part of the ICE process, the Michigan Department of Technology, Management, and Budget issues guidance to assist all State departments in evaluating internal controls. This guidance includes the use of the ICE evaluation tool, known as a Risks, Control Activities, and Monitoring Worksheet, which provides a consolidated view of the process and control framework, including objectives, risks, severity/frequency, key control activities, actual monitoring, and conclusions reached.

In 2024 monitoring efforts in the GLWARMS were chosen by executive leadership for a facilitated Risks, Control Activities, and Monitoring Worksheet process with the Office of Internal Audit Services. Risks associated with events that could prevent monitoring objectives being achieved and points of potential operational error were scored based on likelihood and severity. This process highlighted where key improvements can be made that will maximize improvement.

Renew Michigan Spending Plans

Monitoring activities funded through the Renew Michigan state general funds are reviewed annually when the monitoring coordinator writes an implementation proposal, called a Spending Plan. Renew Michigan funds allocated to the WRD for monitoring are not used for staff time, so these funds are largely used for contracts (e.g., technical services, volunteer monitoring program), laboratory analyses (e.g., water chemistry, pathogens, fish tissue, sediment toxicity), equipment, and supplies. The Spending Plan is reviewed and approved by all layers of WRD management. This annual process allows WRD staff and management to identify new monitoring needs each year, determine what projects should be modified to better meet program objectives, and

eliminate projects when objectives have already been met or otherwise are no longer necessary.

Auditor General

Monitoring activities are subject to audits by the Michigan Office of the Auditor General. These reviews are extensive and may include inquiries of monitoring objectives, workplans, QAPPs, final reports/work products, data availability, and grant/contract paperwork.

USEPA Review

Monitoring Strategies, such as this, are long-term implementation plans that should be updated over a timeline not to exceed ten years according to the USEPA (2003) document, *"Elements of a State Water Monitoring and Assessment Program."* It is important that a strategy be comprehensive in scope and identify technical issues and resource needs that are currently impediments to an adequate monitoring program. The WRD and USEPA agree that periodic reviews and Monitoring Strategy updates are necessary and plan to discuss the frequency, timing, and substance of future updates.

General Support and Infrastructure Planning

Staffing

While the majority of monitoring is conducted by staff in the GLWARMS, all Sections within the WRD have some monitoring responsibility. This integrated approach to monitoring resources in Michigan affords personnel in the WRD the maximum knowledge and expertise needed to protect human health and water resources. This approach also makes it difficult to estimate actual effort and dollars spent on monitoring. Staffing levels for monitoring are relatively consistent to the number shown in the 2005 and 2017 Strategy Updates. However, extensive reorganizations make it difficult to compare full-time employee rates between reports.

Within the GLWARMS, the number of staff who spend time on monitoring varies slightly annually depending on the basin cycle year and other programmatic needs. The GLWARMS conducts a level-of-effort estimate to determine the amount of monitoring that can be conducted each year. Time needed for other work such as data analysis, report writing, and other programmatic activities are incorporated into this process. In 2025 it was estimated that approximately 19 staff could spend an average of 26 days in the field and complete all other work tasks. Since 2021 the average number of field days approved by GLWARMS management has ranged from 22-29. The goal of the level-of-effort process is to create a balance between field and office hours that allows staff to accomplish all Monitoring Strategy elements in a safe and timely manner. It is important to note that, even with this level-of-effort evaluation, the monitoring effort

today continues to leave the WRD with **gaps** that cannot be filled, and these are identified throughout this document.

Funding

Performance Partnership Grant (PPG)

Section 106 of the federal CWA provides grant funds to states to assist in administering programs for the prevention, reduction, and elimination of pollution. The WRD works to protect and enhance the state's water quality under the authority of Part 31, and associated rules. Beginning in 2010, Sections 106 and 319 federal funds were combined into the PPG.

In fiscal year (FY) 2024, the WRD was awarded approximately $10.94 million in federal dollars that were state-matched with approximately $2.53 million, for a total PPG of $13.47 million. Monitoring is one of many activities that are supported by the PPG. These activities include:

- Management and administration.
- Permit issuance.
- Compliance.
- Enforcement.
- Monitoring and assessment.
- Management of water quality and program data.
- Section 401/Rule 97 Certification.
- Develop the Integrated Report.
- Restore and protect waters impaired or threatened by NPS pollution.

BEACH Act Funds

Since 2003 Michigan has received BEACH Act funds for monitoring Great Lakes beaches. This funding is distributed by the WRD to local health departments to monitor Great Lakes beaches and supports a 0.25 full-time employee to manage reporting requirements. Annual federal funding supports monitoring once per week for 10 weeks at 30 percent of Michigan's Great Lakes beaches. Please note the federal funding allocated to Michigan is not sufficient and has been documented by the United States Government Accountability Office (GAO0-07-591).

Federal Section 106 Monitoring Initiative Funds

Beginning in FY 2005 Congress specifically dedicated a portion of the CWA Section 106 annual appropriation as Water Quality Monitoring Strategy Implementation funding. These supplement the base Section 106 grant and have two components: (1) funding for states, tribes, and other eligible entities to participate in statistically valid surveys of the Nation's waters; and (2) funding for states and other eligible entities to enhance their water monitoring and assessment programs consistent with their monitoring strategies.

This allocation, also referred to as enhancement funding, is “set aside” to fill monitoring **gaps** identified by agencies. The difficulty with the restrictions on these funds is that, depending on the enhancement project, these new activities or “filled” **gaps** are often unsustainable when they are no longer eligible for “gap funding.”

Great Lakes Restoration Initiative (GLRI)

The federal budget has included GLRI funds since FY 2010, which target significant problems in the region, including AIS, NPS pollution, and contaminated sediment. The USEPA and its federal partners coordinate state, tribal, local, and industry actions to protect, maintain, and restore the chemical, biological, and physical condition of the Great Lakes. EGLE has received several GLRI grants that included monitoring for beaches, Areas of Concern (AOC), Lake Michigan (Coordinated Science and Monitoring Initiative), sediment remediation, fish contaminants, and wetlands among other things.

Wetland Program Development

Wetland Program Development grants have been an important funding source for development of the wetland monitoring strategy and now Level III monitoring (see Wetland Section of this document).

Renew Michigan

Monitoring effort support, outside of staffing time covered with the PPG, is largely from the state fund Renew Michigan. Since 2020 the WRD has received approximately $3.5 million annually of Renew Funds for monitoring. A Spending Plan is prepared each year summarizing how these dollars will be spent. The loss of these funds would dramatically reduce the WRD’s ability to meet the goals of this Monitoring Strategy, including those notably important to the public such as beach, fish contaminants, and volunteer monitoring.

State General Funds

The General Fund refers to state appropriations, expenditures, and receipt transactions that do not fall under special constitutional or statutory requirements requiring separate accounting. Approximately $500,000 in general funds have been appropriated to the WRD since FY 2015 and are typically used toward rapid beach monitoring technology. It is undetermined whether these funds will continue in future fiscal years.

Training and Workshops

In-house training is provided by, and to, WRD staff, with topics such as grants management, geomorphology, and AIS identification. Funding for staff to attend conferences and outside training has grown since the previous Monitoring Strategy Update. Because we can use Section 106 Monitoring Initiative funds for training related to monitoring, approximately 10 staff members were able to travel to the National Water

Quality Monitoring Conference in Green Bay, Wisconsin in 2025. The WRD is grateful for this opportunity as staff members were able to increase efficiency, effectiveness, and the quality of monitoring efforts.

Monitoring Initiative funds are also used to get a few staff to the annual Region 5 Monitoring Managers Meeting each December, and when offered, these funds will be used for staff to travel to the Section 303d/TMDL Workshop in Shepardstown, West Virginia, which was converted to a virtual meeting in 2025. The WRD hopes to continue using these funds for monitoring-related training and conference attendance.

The importance of macroinvertebrate identification training has been given renewed emphasis. In 2024 staff from Bay Mills Indian Community came to Lansing to provide continuing education to WRD aquatic biologists. The intention is that a similar course will occur every few years. Some WRD staff may become trained to be in-house taxonomists and, in turn, train other staff. New microscopes are being purchased to have the equipment needed to gain this capacity.

Staff has access to limited professional development funds provided by the state of Michigan that are funded through union dues. These funds are available each year to employees with union representation and are provided on a first come, first serve basis at the beginning of each fiscal year.

Training opportunities outside of the EGLE budget have been identified through scholarships. WRD aquatic biologists have attended the biennial National Water Quality Monitoring Council's Conference through scholarships (typically one biologist each conference), which affords statistical training opportunities, including training using the statistical program R. Staff looks forward to future scholarship opportunities and will continue to apply when presented.

In 2024 and 2025 the Association of Clean Water Administrators provided $1,000 for staff to travel to the first and second annual National WQS Workshops. The remaining funding needs for travel were covered using state funds. Travel reimbursement for these events made it possible for the WRD to send two staff instead of one.

Equipment

Equipment maintenance and replacement is a part of environmental monitoring. The primary mechanisms for equipment purchases is currently Section 106 Monitoring Initiative, GLRI, and Renew Michigan funds.

A small annual GLWARMS budget is also available for Section needs, which when necessary, has included the purchase of routine field supplies, repair/maintenance of equipment and boats, and to replace worn equipment such as Type III and IV personal floatation devices, safety equipment, chest waders, and rain gear. Using these funds

for equipment and supplies takes away from other uses such as staff attendance at meetings. While the WRD has been able to fill equipment **gaps** with other funding sources in recent years, such as Section 106 Monitoring Initiative and GLRI funds, the nature of field work and equipment wear will continue to make equipment replacement an ongoing need. Some current and upcoming needs are discussed throughout this document.

Laboratory

Most laboratory expenses are paid using Renew Michigan. Fish contaminant analysis also uses GLRI, Refined Petroleum Fund, and MDHHS funding in addition to Renew Michigan for laboratory expenses.

Section 2: Surface Water Monitoring

Great Lakes

Water Chemistry

WCMP

For more than two decades, the WRD's Great Lakes water chemistry monitoring has been largely performed in two bays and three connecting channels: Saginaw Bay, Grand Traverse Bay, St. Mary's River, St. Clair River, and the Detroit River. Efforts in these water bodies, along with probabilistic samples in rivers and streams (discussed in Section 2: Rivers and Streams subsection) are part of the long-term effort referred to as the WCMP. The WRD is currently working on a report that will capture the status and trends associated with this nearly 30-year dataset. Results will help guide the WRD with difficult decisions that will need to be made due to the increased cost of contractor

support and laboratory analysis. Table 2 in Section 1 shows the core indicators used for evaluating water quality in the Great Lakes.

The objectives of the WCMP in the Great Lakes are to determine current water quality status, trends, and WQS attainment; provide programmatic support; and evaluate emerging issues as they arise. In addition, water chemistry data are often used by the AOC and Lakewide Action and Management Plan staff in the GLWARMS, several universities, and other government agencies.

Saginaw Bay

Monitoring in Saginaw Bay as part of the WCMP began in 1999. Each year, seven sites are sampled once monthly from April through November (Figure 5). An additional objective specific to Saginaw Bay is using the data to evaluate progress regarding nutrient reduction targets in this water body, under Annex 4 of the Great Lakes Water Quality Agreement (GLWQA).

Another use of this dataset is that it, along with data from other sources, led to placing Saginaw Bay on the Section 303(d) list as impaired for nutrients (R 323.1060 of the Part 4 Rules, WQS, of the NREPA) in the 2024 Integrated Report. It is noteworthy that Saginaw Bay is the first water body to have a TMDL in development using the recommendations in the new "TMDL Vision 2.0."

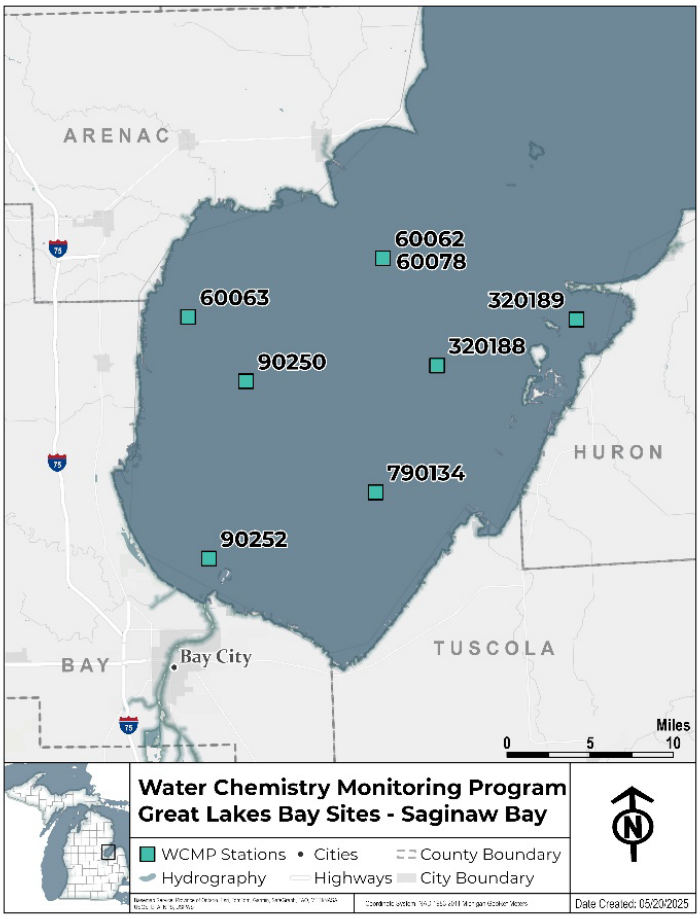

Figure 5. Saginaw Bay monitoring locations.

Current effort: While routine monitoring is ongoing, WRD management is considering reducing this effort, to perhaps every other year, while data are being collected for the TMDL development process. This potential reduction is largely due to budget constraints; however, the timing is appropriate given other work being done throughout the watershed by the Saginaw Bay Monitoring Consortium. In addition to other monitoring efforts and funding sources to the Saginaw Bay Monitoring Consortium, the WRD recently provided support through a $1.29 million GLRI pass-through grant for monitoring being performed by Saginaw Valley State University. That grant is set to expire in the fall of 2026.

Gap: Any **gaps** will be defined once the TMDL is written.

Grand Traverse Bay

Monitoring in Grand Traverse Bay as part of the WCMP began in 1999. Four sites in Grand Traverse Bay are sampled three times annually, once during each month of May, July, and October (Figure 6).

Current effort: While this effort is ongoing, WRD management is considering a reduction in sampling for Grand Traverse Bay, also. The staff report being drafted now will discuss monitoring results over the past nearly 30 years, and that summary will help navigate future efforts.

Gap: No **gaps** are identified at this time.

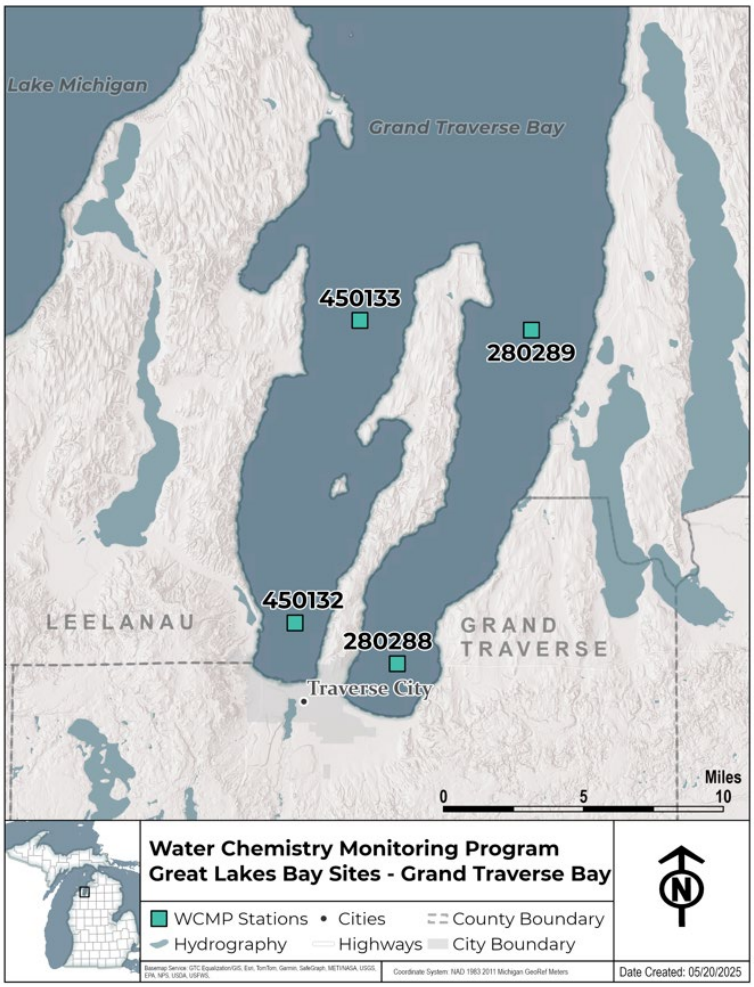

Figure 6. Grand Traverse Bay monitoring locations.

Connecting Channels

Two stations, one near the head and one near the mouth, in each Connecting Channel have been sampled monthly from April through November since 1999 as part of the WCMP. Figures 7 and 8 show the St. Mary's River (right) and the St. Clair River and Detroit River (left) routine sites.

In 2022 a special study was performed in the Detroit River in addition to routine data collection. According to a recent report from the USGS (Totten and Duris, 2019), it was found that some water chemistry parameters had seemingly higher concentrations near the Michigan shoreline compared to the WCMP routine sampling stations located close to the United States/Canadian border. The USGS study also showed that, while horizontal differences were found, vertical concentrations were fairly consistent throughout the channel. The WRD pilot project looked at near-surface samples along six transects in the Detroit River. A preliminary look at the data appear to align with USGS results. In 2023 transects were continued in the Detroit River and added to the

St. Clair River; however, transects were limited to the latitudes of the routine head and mouth sampling points, meaning just two transect per Connecting Channel. In 2024 sampling along two transects was performed in all three Connecting Channels.

Figure 7. Long-term monitoring stations in the St Clair and Detroit Rivers

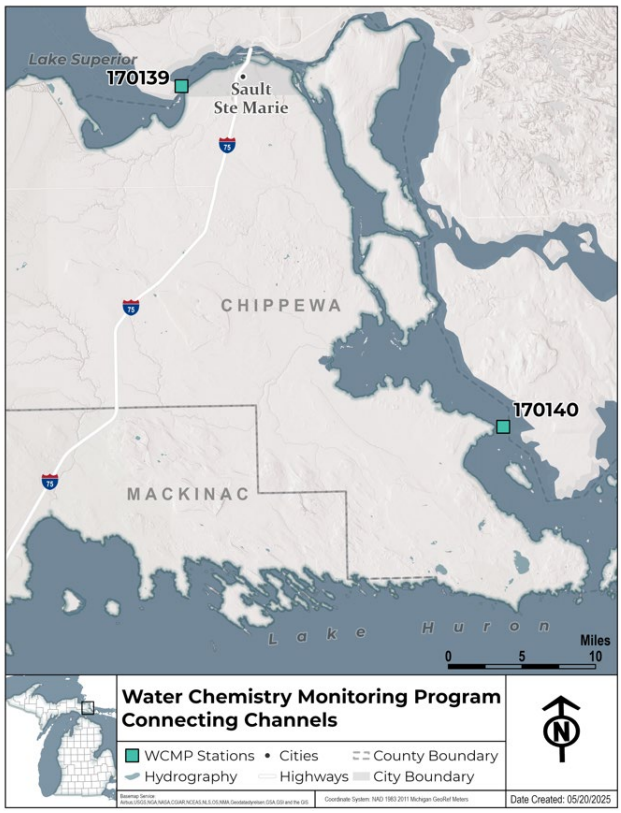

Figure 8. Long-term monitoring stations in the St. Mary's River.

Current effort: In 2025, the WRD is again collecting transect data along the latitudes of the head and mouth routine sampling points in all three Connecting Channels. All transect data, beginning with the 2022 pilot project in the Detroit River, will be evaluated in a report separate from the near 30-year WCMP report summary that is being drafted. It is undetermined at this time what the level of effort will be for the Connecting Channels beginning in 2026 as decisions are now being made regarding budget concerns with increased contractor and laboratory costs.

Gap: Gaps will be identified after the WCMP summary report for data through 2024 and the transect report are drafted.

Surface Water PFAS

One major emerging issue is PFAS, which threaten human health through many routes of exposure, including consumption of contaminated drinking water and fish. Water monitoring for PFAS became part of routine monitoring in the Great Lakes in 2017, with sampling occurring at a rate of approximately ten samples each year. The suite of

PFAS chemicals selected by the WRD represents both historic and current uses of this class of compounds. Objectives of PFAS monitoring in water are identifying and differentiating sources to surface water, monitoring the impact of remediation and source reduction efforts, and prioritizing areas for additional monitoring. While these objectives are consistent among Great Lakes, rivers and streams, and inland lakes, it is important to note that, due to the significant impact of dilution on samples collected from the Great Lakes, concentrations of PFAS within these samples are typically insufficient for source identification and differentiation.

Current effort: The rate of upcoming monitoring in the Great Lakes is expected to be single sampling events at five to ten locations per year. Sampling locations are prioritized based on proximity to drinking water intakes, areas of significant PFAS contamination, areas with known or suspected releases of PFAS to environmental media, areas with elevated concentrations of PFAS within fish tissue, and major confluences of surface water bodies. In addition, a special study is being conducted in 2025 in conjunction with EGLE's Drinking Water and Environmental Health Division and the WRD Technical Services contractor to evaluate PFAS in water to determine the extent of elevated levels of perfluorooctane sulfonate (PFOS) and cyanotoxins that have been observed at a drinking water intake.

Gaps: Measurement/quantification of total PFAS is increasingly requested by the public; however, discrepancies in quantification/estimation by different methods make comparison difficult. Regardless of water body type, the lack of USEPA-approved methodology for measuring total PFAS within surface water is a gap. In addition, deployment of passive samplers for PFAS analysis could be performed to circumvent the significant impacts of dilution on samples collected in the Great Lakes; however, time and costs associated with passive sampler use is significantly more than what is associated with collecting individual grab samples.

The WRD will continue to evaluate the effectiveness of current efforts and recognizes new objectives and **gaps** may be needed as more data are collected.

Biological

Beach Monitoring for Pathogens

In 2003 the USEPA began awarding funds from the BEACH Act for monitoring Great Lakes beaches. The WRD receives those funds and passes them through to local health departments for monitoring. Only health officers of health departments have the authority to determine if a beach should be open or closed; therefore, the WRD's primary role is to provide funding to support their sampling efforts. The WRD objectives are to use the *E. coli* data to determine WQS attainment at Great Lakes beaches and manage a statewide database. Note that the WRD also provides

pass-through funding for inland lake beaches using Renew Michigan dollars, and that effort is discussed in the Inland Lakes subsection.

In 2015 the WRD also began receiving Technical Support state funding that allowed Michigan to be the first state to monitor beaches statewide using quantitative polymerase chain reaction (qPCR), a rapid testing method for water quality. The advantage of this method is that it provides same-day results of *E. coli* deoxyribonucleic acid (DNA) in beach water samples, providing a faster response time to close and open beaches.

Current effort: Approximately 200 of the 620 identified Great Lakes public beaches are monitored per year. The WRD attempts to fund all counties that submit proposals, though not always at the full level requested due to high demand and finite resources. Whenever a location is not supporting a total body or partial body contact recreation designated use, the WRD continues to monitor the site and is required to develop a TMDL.

Gap: The WRD recognizes that only 50 percent of beach monitoring requests by local health departments are typically funded. This will be further exacerbated if laboratory analysis costs rise unless an increase in federal dollars become available.

AIS

In 2010 the WRD hired an Aquatic Biology Specialist who reported directly to the WRD Director to work on AIS issues. The majority of the tasks for this position were policy- and procedurally-related, so monitoring within the WRD was initially limited to "add-on" observations made by GLWARMS aquatic biologists during routine field sampling in wadeable rivers and streams (see Rivers and Streams subsection for current efforts). The WRD partnered with Central Michigan University in 2013 to investigate AIS monitoring nationally and determined what species were applicable to support planning efforts in Michigan (Section 205j grant awarded by the USEPA). In 2014 the WRD partnered with the Nature Conservancy for a Great Lakes-specific interstate project (GLRI project awarded by the USFWS). This resulted in a basin-wide effort targeting highest priority locations for AIS, which remains ongoing.

In 2015 the WRD hired a second Aquatic Biology Specialist tasked with creating AIS monitoring objectives that address Michigan's Aquatic Invasive Species State Management Plan 2013 Update (MDEQ, 2013b) goals, which are: prevent new introductions, limit established populations, early detection, and manage high-priority species.

Priority AIS projects for Great Lakes have focused on coastal areas, particularly coastal and drowned river mouth emergent marshes. European frog-bit (EFB) was first introduced to Michigan in 1996. EFB has spread to many coastal areas along the eastern coastline and continues to spread along the Lake Michigan shoreline, in the Upper Peninsula, and inland in the Lower Peninsula.

Current effort: The WRD supports both research, surveillance, and control projects to address EFB in these waters. The WRD also actively participates in, and leads portions of, the EFB Collaborative, which enhances surveillance and management of EFB and guides research needs within the Great Lakes basin.

Gap: The AIS Program is focusing on **gaps** in inland lakes at this time, which can be found in the Inland Lake subsection.

Biological Condition

The WRD does not have an indicator for monitoring biological condition in the Great Lakes. While the WRD understands this is an important monitoring **gap**, opportunities in other water body types are being prioritized at this time. The WRD looks forward to investigating biological condition in the Great Lakes as time and resources allow.

Fish Contaminants

For environmental, resource, and logistical reasons, fish tissue is often an appropriate measure for bioaccumulative contaminants. For approximately 45 years, the WRD has sampled contaminants in edible portion fish tissue and whole body to evaluate impacts of contaminants to human health and wildlife, respectively. These efforts are part of WRD's Fish Contaminant Monitoring Program (FCMP). The yearly level of effort is determined by funding and staff availability, which have increased for edible portion monitoring in recent years with the availability of GLRI and Renew Michigan funds for analysis, GLRI funding for staff costs, and the increased demand to evaluate potential impacts of PFAS contamination across the state.

The objectives for fish contaminant monitoring are largely consistent in the Great Lakes, inland lakes, rivers, and streams. These are to determine whether the Fish Consumption designated use is supported and report the status in the Integrated Report, support the MDHHS fish consumption advisories, evaluate remediation efforts and impacts from point sources, investigate emerging contaminants, evaluate temporal trends, and evaluate contaminants in the diet of piscivorous wildlife to support the WRD's Wildlife Contaminant Monitoring Program. See the inland lakes and rivers and streams subsections for details specific to those water body types.

All FCMP samples are processed by WRD staff and sent to the MDHHS laboratory. If the concentration of any contaminant exceeds any MDHHS fish consumption screening value for edible portion samples, two actions follow: (1) a fish consumption advisory is issued by the MDHHS and published in their next Eat Safe Fish Guidance update; and (2) the WRD makes the determination whether the water body is impaired and should be placed on the Section 303(d) list as not meeting WQS. The current exception is the mercury in legal-sized northern pike. The WRD assessment methodology for this

species uses a 0.35 milligrams per kilogram (mg/kg) fish tissue value (minimum of five legal-size northern pike).

Gaps: Aging equipment is a concern for the FCMP. One example is that the WRD only has one reliable electrofishing boat, which has been in service for a decade. A second boat would ensure the program would not have to pause for a lengthy period due to equipment failures. Another potentially looming gap is that the WRD receives approximately $800,000 each year from the MDHHS for the analysis of mercury and PFAS in edible portion samples; however, these funds are not guaranteed. The loss of this revenue would mean that the WRD would have to find other sources of funding or the number of samples processed each year would be substantially cut back.

Whole Fish Trend Monitoring

In Michigan's Great Lakes and Connecting Channels waters, the WRD has established ten fixed stations that are sampled every three to five years to measure temporal trends in bioaccumulative contaminants in fish tissues (Figure 9). This effort analyzes whole fish samples of one to three sentinel species of top predators (e.g., walleye and/or lake trout) and common carp (see Table 2 in Section 1 for the list of indicators).

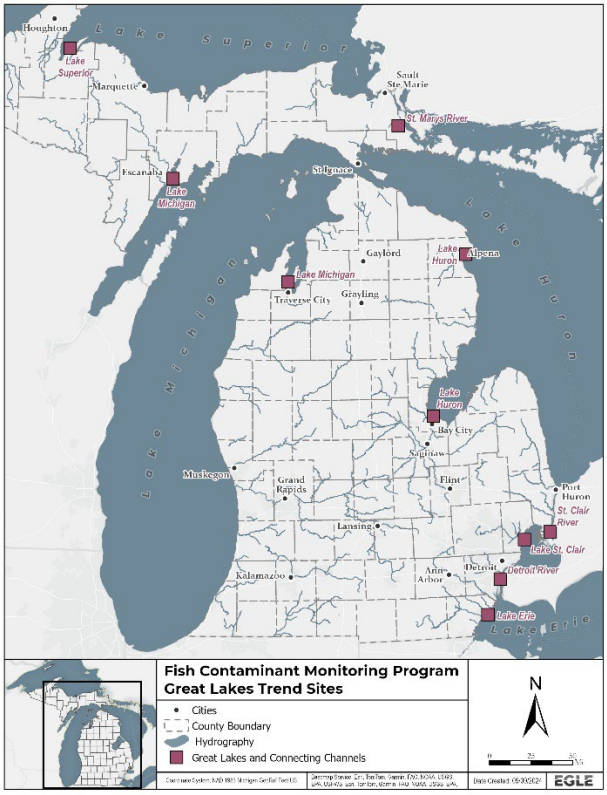

Figure 9. Fixed trend fish contaminant stations in the Great Lakes.

Current effort: the WRD plans to maintain whole fish trend monitoring in the Great Lakes and Connecting Channels at the current level of effort, collecting fish from two to three of the ten fixed stations each year. In 2017 PFAS were added to the list of contaminants assessed at the whole fish trend locations. In 2019 the WRD released a mercury trend report for whole fish samples collected between 1990 and 2015 (Bohr, 2019). The WRD plans to evaluate Polychlorinated Biphenyl (PCB) and chlorinated pesticide whole fish data and release a similar report.

Gaps: Numerous collections of carp from Great Lakes bays have been unsuccessful, corresponding with potential population declines noted for some species. Also, current efforts were designed for legacy contaminant trends (e.g., mercury and PCBs), which may not be suitable for emerging contaminants such as PFAS. If it is decided to

investigate trends in additional contaminants, other fish species and locations may need to be considered.

Edible Portion Monitoring in the Great Lakes

The WRD collects fish from selected locations each year to measure contaminant levels in edible portions. All edible portion fish tissues are analyzed for mercury and PFAS. Samples may be selected to be analyzed for PCBs, chlorinated pesticides (e.g., DDT), dioxins and dioxin equivalents, polybrominated diphenyl ethers (PBDE), and/or selenium. See Table 2 in Section 1 for a complete list of core indicators in fish tissue. Emerging contaminants may be added to the list periodically.

Current effort: Edible portion monitoring in the Great Lakes and Connecting Channels has continued at a similar effort in recent years compared to historical effort. In 2025 the WRD received funding from the MDHHS to increase its Great Lakes fish tissue monitoring efforts to update the Eat Safe Fish advisories. This effort will include a comprehensive look at contaminant levels of highly targeted game species of fish in Michigan's waters of the Great Lakes.

Gaps: The WRD recognizes that GLWARMS staffing for edible fish portion sample collection and tissue analysis by the MDHHS laboratory is operating near capacity based on current funding sources. It is also understood that a significant part of the current budget for this program is shared with all surface water quality monitoring in the WRD, and any changes in programmatic needs could cause a decrease of funding to this program to support other monitoring activities. That possibility, combined with impending increased cost of laboratory expenses, likely means this program is currently at its maximum performance without an influx of funding. Given that the WRD receives more monitoring requests each year, and it is expected that demand will increase as PFAS investigations continue and public concern grows, the WRD will have difficult decisions to make in the next few years.

Wildlife Contaminants

Monitoring the productivity and contaminant levels in fish-eating (piscivorous) wildlife provides valuable information on the health of the Great Lakes ecosystem. Many persistent contaminants occur at biologically relevant concentrations in the environment that are not easily measured in water. In addition, wildlife can serve as a "first alert" for the detection of changes in environmental quality and the potential for adverse effects to occur on human health.

Routine wildlife contaminant monitoring consists of two components, bald eagle nestling plasma/feathers and herring gull eggs. Mink and muskrat livers are included in the wildlife monitoring on a project-specific basis. Efforts provide data necessary to determine contaminant levels in piscivorous wildlife, assist in the identification of waters that may exceed WQS, evaluate the overall effectiveness in protecting wildlife from toxic

contaminants in support of programs such as AOCs, and determine whether new chemicals are accumulating in wildlife.

Bald Eagle Nestling Plasma/Feathers

-Water Resource Division staff member with eaglet. Photo provided by Kevin Cox.

Since 1999 EGLE, or its USFWS partner, has funded researchers from various universities (Michigan State University, Clemson University, and the University of Maryland) to measure contaminant levels in bald eagle blood and feathers each year, track year-to-year variability of concentrations, and evaluate contaminant trends. The bald eagle monitoring project design provides coverage of both the coastal Great Lakes and inland waters; however, discussion is limited to the Great Lakes section. Great Lakes-associated nests are defined as those nests within 8.0 kilometers of the shorelines of the Great Lakes and along tributaries where anadromous fish are accessible. Eaglets from selected nests have been monitored annually, while others have been sampled according to EGLE's five-year rotating basin schedule. Samples are analyzed for PCBs, mercury, DDT, and a few other selected pesticides (See Table 2 in Section 1). Previous bald eagle contaminant data were collected in the late 1980s and early 1990s, allowing for temporal and spatial trend analysis in contaminant levels. On a much smaller scale, the program has also evaluated emerging contaminants, such as PFAS, in eaglet plasma.

Current effort: Productivity estimates and legacy contaminant sampling continues within Michigan's AOCs; however, several factors have resulted in a reduced effort in recent years including staff limitations due to the COVID-19 outbreak, highly-pathogenic avian influenza impacts on the bald eagle population, and budget funding cuts. The WRD and its project partners are currently researching bald eagle genetics to determine if productivity estimates are inflated in Michigan's AOCs due to migration of healthy birds into the AOCs from non-AOC areas.

The WRD has recently received GLRI grants through the USEPA and USFWS to expand its bald eagle monitoring effort and assess emerging contaminants (e.g., PFAS) and other Chemicals of Mutual Concern in non-AOC areas. The WRD is in the process of obtaining federal and state permits to allow the 40+ year-old bald eagle sample archive to be moved from chest freezer storage at the University of Maryland to more secure storage at the WRD's equipment warehouse.

Gap: The WRD feels there would be a benefit to evaluating trends in emerging chemicals in archived samples; however, there is no funding available to support that effort currently.

Herring Gull Eggs

The herring gull project started in 2002. In addition to the bioaccumulative contaminants of concern tested in bald eagles, herring gull samples are also analyzed for dioxin and furans with emerging contaminants, such as PFAS, evaluated occasionally. Herring gull eggs are collected annually at five colonies along the Great Lakes in Michigan by Calvin University. This project complements the herring gull egg monitoring project conducted by the Canadian Wildlife Service and resulting data are used to assess spatial and temporal trends in bioaccumulative contaminants in the Great Lakes.

Current effort: While CMI-CWF dollars were used for this work, funding is now through the USFWS. The current role of the WRD is to use contaminant data to assess progress of legacy contaminant remediation for the AOC program.

Sediment Chemistry

The WRD does not perform routine sediment chemistry sampling in the Great Lakes.

Support and Participation

GLWQA

There are WRD activities that support the binational GLWQA through monitoring and other actions. Amended most recently in 2012, the GLWQA expresses the commitment of Canada and the United States to restore and maintain the chemical, physical, and biological condition of the Great Lakes ecosystem. The basin's state, provincial, and tribal governments, along with the public, have long been important partners in implementing the GLWQA. The GLWQA consists of ten Annexes, and the WRD has monitoring-related roles in three:

Annex 1 – AOC

As described above, the FCMP collects contaminant data to support AOC. Sediment-related support is provided through managing contracts regarding sediment-related feasibility studies and remedial investigations. An aquatic biologist specialist with sediment chemistry expertise is housed in the GLWARMS and provides support by overseeing AOC sediment projects as funding is received. These projects help remove contaminants from the ecosystem, furthering progress towards remediating AOC

Beneficial Use Impairments regarding fish consumption, restrictions on dredging activities, degradation of benthos, fish tumors, and bird or animal deformities. There are no established core indicators for sediment; however, heavy metals (including mercury), Polycyclic Aromatic Hydrocarbons, and PCBs are often collected at a minimum and toxicity testing may also be conducted. Indicators in sediment are specific to the site and pollutant of concern.

Annex 2 – Lakewide Management

The WRD has Lakewide Action and Management Plan Coordinators.
Monitoring-related technical support for this Annex is largely through data sharing of WCMP results and identifying needs and **gaps**.

Annex 4 – Nutrients

Monitoring in Saginaw Bay and technical support for monitoring in Western Lake Erie are used to support Annex 4.

National Coastal Condition Assessment (NCAA)

The WRD accepted Section 106 Monitoring Initiative funds to lead sampling efforts for the NARS NCCA in 2010. In 2015 the WRD accepted the funding with the work being performed by the Technical Services Contractor. In both 2020 and 2025 the WRD declined the funding for the NCCA due to lack of staff time to accomplish the substantial task of coastal sampling at what has consistently been over 100 sites for each assessment. While the WRD appreciates the National coordination and information that results from the NCCA, most of the data do not support the Michigan Monitoring Strategy goals. However, NCCA data can be used for screening to determine if further monitoring is warranted. In addition, any data collected for emerging contaminant research provides an obvious benefit to the WRD mission. For each NCCA cycle, the WRD always looks at the level of effort needed to complete the goals and objectives in our Monitoring Strategy and determines whether additional effort can be made by staff to participate in the NCCA. The WRD believes that NARS is valuable and may participate in the future if time allows.

Inland Lakes

Water Chemistry

Trophic Status Sampling

In 2014 the WRD partnered with the MDNR-FD for a pilot monitoring effort that involved the WRD visiting a subset of MDNR-FD status and trend lakes. For the following five years, through 2019, the WRD visited all lakes sampled by the MDNR-FD, totaling 126 inland lakes. The WRD visited each lake for spring turnover in March-May and again in July for summer lake conditions. Water samples from July, along with the MDNR-FD August samples, were used to calculate the Trophic State Index for each lake. In addition, the WRD recorded temperature/dissolved oxygen profiles at each visit and performed shoreline habitat assessments in July only. The goal of this project was to collaborate with the MDNR-FD to accomplish joint objectives of examining status and trends in water chemistry, shoreline/near shore conditions, and fisheries of inland lakes. This collaboration was paused in 2019 as the WRD shifted its focus on monitoring lakes

found to be hyper-eutrophic in previous years. The MDNR-FD monitoring program is ongoing and WRD support is limited to financial support for water chemistry analysis through 2025.

Beginning in 2018 the WRD focused its inland lake monitoring and expanded assessment methodology to make nutrient-driven designated use support decisions using a broader weight-of-evidence approach in inland lakes. There was a historic list of lakes in the Integrated Report that had been sampled once, determined to be hypereutrophic, and assessed as having insufficient information to make an assessment decision. Additional monitoring and an expanded assessment methodology using a multiple lines of evidence approach allowed the WRD to make assessment decisions on most of those lakes. Additional lakes were assessed that had reports of frequent algal blooms or large-scale herbicide treatments.

Current effort: The current objective of this water quality monitoring is to continue assessing inland lakes for WQS attainment regarding the OIALW designated use, noting that monitoring for nutrient expression will continue to occur as resources allow for lakes identified based on nutrient expression complaints, extent of lake management measures, remotely sensed data, or other monitoring.

Gap: The WRD is considering establishing a Fixed Station Inland Lake Trend Monitoring Program. Current monitoring has not been adequate to answer questions related to changes in inland lake conditions. The NLA can give a state-scale report every five years on lake quality, but design changes in lake size over the years, implementation of site selection in Michigan, and the relatively wide four-month sampling window limit the comparability across years at the state scale in Michigan.

Developing a statistically sound program at the state level to adequately characterize changes in inland lakes is a monitoring activity that the WRD is actively exploring. Possible study design elements include sampling a to-be-determined number of lakes on a regular basis. Consideration would be given to include a range of lake sizes, levels of development, and regions of the state. Some level of public access to the lake will likely be needed to ensure the ability to sample regularly. Additional considerations may include the use of historic data (MDNR-FD status and trend, volunteer data through the MiCorps Cooperative Lakes Monitoring Program [CLMP], and NLA) in site selection and trend analysis. Sampling design would likely include spring and summer sampling but could be expanded to include Regional Monitoring Network design elements and a broader suite of water chemistry parameters.

Chloride Special Study

In 2024 the WRD initiated chloride-focused monitoring efforts in two lakes with known elevated chloride levels and a third lake as a comparison, reference lake. The objective was to make designated use support decisions for the two study lakes with a goal of understanding the direct and indirect effects of excess chloride. The impact of road salt on Michigan inland lakes is an expanding problem that has been identified around the state.

Current effort: A report will be written on the chloride study results with the hope to further understand chloride impacts to inland lake stratification and nutrient expression.

Gap: Further chloride-focused monitoring is not planned; however, the WRD recognizes the need to identify the scale of chloride pollution and solidify appropriate assessment methods for monitoring chloride in inland lakes and may conduct limited targeted monitoring as resources allow.

Dissolved Oxygen Related to Fish Community

In 2024 the WRD incorporated language from the coldwater inland lake dissolved oxygen WQS (R 323.1065(1) of the Part 4 Rules) into the 2024 Integrated Report Assessment Methodology with the objective of evaluating dissolved oxygen impacts on the Coldwater Fishery designated use. Temperature and dissolved oxygen profile data, primarily from volunteer monitoring efforts, were used to identify lakes that had dissolved oxygen below 7.0 milligrams per liter (mg/L) in the upper 1/3 of the metalimnion.

Current effort: The WRD plans to continue these efforts using volunteer lake data through the MiCorps CLMP and may use other data as available.

Gap: The WRD considers that refinement is needed to improve Coldwater Fishery designated use assessment. Possible efforts include developing R code to analyze profile data and using additional data sources. The WRD would like to examine how the temperature where the dissolved oxygen concentration drops to 3.0 mg/L (TDO3 [temperature at 3 mgÁL-1 dissolved oxygen]) compares to the WQS and how it could be considered for assessment. There is also a need to develop assessment methodology to determine if a pollutant, such as phosphorus, is causing dissolved oxygen impairments in coldwater lakes.

TMDL-Related Monitoring

TMDL Implementation

WRD staff has completed 17 TMDLs through 2024 for inland lakes, addressing phosphorus (11) and *E. coli* (6). Routine follow-up monitoring has been conducted at the four lakes (Lake Allegan, Lake Macatawa, Ford Lake, and Belleville Lake) shown in Figure 10 to assess progress toward attainment of the TMDL goals as part of cooperative agreements with local partners.

Current effort: The WRD will continue routine monitoring in 2025. TMDL goals for these lakes are to achieve the following total phosphorus targets: Lake Allegan (60 micrograms per liter [µg/L]); Lake Macatawa (50 µg/L); Ford Lake (30 µg/L); and Belleville Lake (30 µg/L). Beyond 2025 the WRD will determine whether the frequency of this monitoring should be modified, considering factors such as trend results, effort required as part of cooperative agreements, or the need to spend these resources for other programmatic needs.

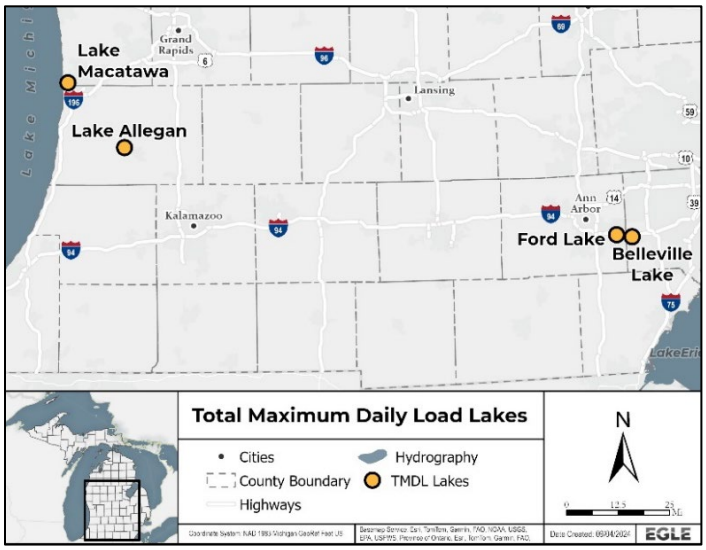

Figure 10. Locations of biennially-monitored TMDL Lakes.

Gap: The WRD should develop a clear plan for monitoring lakes that have existing TMDLs to evaluate how regulatory programs should work towards meeting TMDL goals.

TMDL Development

In the 2024 Integrated Report, over 40 inland lakes were on the Section 303(d) list with nutrient-related parameters. The WRD prioritized TMDL development among these lakes in TMDL Vision 2.0.

Current effort: Under TMDL Vision 2.0, Michigan has identified priorities for TMDL development from 2022-2032. Saginaw Bay was prioritized due to its Category 5 listing from nutrient impacts. Several agencies have teamed together with EGLE to conduct monitoring on Saginaw Bay and its tributaries. Monitoring for the Saginaw Bay TMDL is being conducted by Saginaw Valley State University through a partnership with the Saginaw Bay Monitoring Consortium. In addition, the Recovery Potential Screening

Tool was used to identify six inland lakes to prioritize nutrient impaired waters. Existing models are being reviewed to determine the best fit for monitoring parameters at these inland lakes. Monitoring will be conducted prior to developing each TMDL to collect data needed to run the selected models. The inland lakes identified are Paw Paw Lake (Berrien County), Pontiac Lake (Oakland County), Van Etten Lake (Iosco County), Hess Lake (Newaygo County), Hamlin Lake (Mason County), and Long Lake (Grand Traverse County).

Gap: With the TMDL Vision 2.0 in place for current efforts, no further **gaps** are identified at this time.

Surface Water PFAS

Water monitoring for PFAS became part of routine monitoring in inland lakes in 2016, with sampling occurring in 20 to 80 lakes each year. Surface water is analyzed for a suite of per- and polyfluoroalkyl substances, which have been selected to represent both historic and current uses of this class of compounds. Sampling locations are prioritized based on proximity to drinking water intakes, areas of significant PFAS contamination, areas with known or suspected releases of PFAS to environmental media, areas with elevated concentrations of PFAS within fish tissue, and major confluences of surface water bodies.

Current effort: Upcoming monitoring is planned at a rate of approximately 55 lakes per year. The objectives for surface water PFAS monitoring in inland lakes continue to be to identify and differentiate sources of PFAS to surface water, monitor the impact of remediation and source reduction efforts, and prioritize areas for additional monitoring. As in other surface waters, routine inland lake PFAS sampling is performed as a single event. Note the intention is not to make designated use decisions based on these data, rather results are used to evaluate whether follow-up fish tissue sampling is warranted.

Gap: As mentioned for PFAS in water sampling in the Great Lakes and rivers and streams, measurement/quantification of total PFAS is increasingly requested by the public; however, discrepancies in quantification/estimation by different methods make comparison difficult. Regardless of water body type, the lack of USEPA-approved methodology for measuring total PFAS within surface water is a gap. Note the WRD will continue to evaluate the effectiveness of current efforts and recognizes new objectives and **gaps** may be needed as data are collected**.**

Satellite Imagery

The WRD partnered with the USGS under a Joint Funding Agreement to produce estimates of inland lake Secchi depths from 1999-2013. The predicted water clarity of

approximately 4,000 inland lakes was validated using volunteer data through the MiCorps CLMP.

Current effort: Through a separate Joint Funding Agreement with the USGS, working with University of Minnesota, the WRD is finalizing an updated inland lake remote sensing project. This goal is to have a public interactive map showing 2019-2023 estimated water clarity information, including Secchi disc depth, colored dissolved organic matter, and chlorophyll-*a* concentrations at monthly intervals. While work is ongoing, a final product data is expected in 2025. If funding was available, the WRD would consider continuing this effort with more recent data.

Gap: The WRD is aiming to develop inland lake assessment methods to use both remotely sensed Secchi and chlorophyll-*a* data and deployed chlorophyll-*a* sondes. This assessment may require large-scale data analysis as well as field data collection to enable comparisons or independent evaluations.

Biological

Cyanobacteria

The WRD partners with the MDHHS and local health departments to collect information on HAB occurrences. The WRD has responded to citizen reports of cyanobacteria blooms (also known as blue-green algae blooms) since 2016, often conducting follow-up monitoring for the presence of cyanobacteria and algal toxins. For several years, WRD staff responded to most credible cyanobacteria bloom reports received by phone or through our AlgaeBloom@Michigan.gov mailbox, often visiting the same lake multiple times to provide accurate status updates to lake residents and local health departments.

This response approach yielded a great deal of information about cyanobacteria bloom timing, frequency, duration, extent, and whether a HAB event was present during sampling. This robust approach required extensive staff hours and laboratory analysis funding of water samples for algal toxins. In hopes of streamlining the process, a guidance document with a response flow chart was first developed in 2022 to identify when sampling was necessary. It is important to note that since the 2020 Integrated Report Assessment Methodology, repeated cyanobacteria blooms are considered as a line-of-evidence that an inland lake may not be meeting the narrative nutrient WQS (R 323.1060 of the Part 4 Rules).

Current effort: While staying within the WRD, the responsibility of this monitoring is moving from the GLWARMS to the EPS.

Gap: Any **gaps** for this activity will be identified once the transition of responsibilities is complete.

Beach Monitoring for Pathogens

Public beaches have been identified at 622 sites on inland lakes throughout the state with typically 200 beaches monitored per year. The WRD provides inland beach monitoring grants to local health departments who use that funding to support and augment *E. coli* monitoring at inland beaches based on public access and volume of use. These grants were first available in 2003 with CMI-CWF dollars and continues today with Renew Michigan funding.

Local health departments use the results to assess whether beach closings are necessary based on exceeding *E. coli* standards. Sampling procedures and allowable *E. coli* levels are defined in R 323.1062 of the Part 4 Rules. With regard to total body contact and partial body contact recreation, local health departments have primary responsibility in Michigan for beach monitoring.

In 2015 Michigan became the first state to monitor beaches statewide using rapid testing equipment that produces same-day results. The rapid testing equipment uses a method called qPCR, which measures DNA and produces results in four hours or less. This DNA testing identifies fecal contamination quicker and, when available, could help reopen beaches faster when test results show they are safe for swimming. During the transition to qPCR methods, beach monitoring will use results from both culture and qPCR methods to build correlations and comparisons.

Note that other pathogens may be monitored. Fecal coliform can be measured in wastewater treatment plant effluent, and other pathogen indicators have been used in conjunction with *E. coli* to help with source tracking. The WRD has assisted local health departments in using molecular source tracking methods to identify sources of fecal contamination that can cause beach closures. In addition, the WRD conducts special studies when needed.

Current effort: There are no changes planned for this monitoring effort. Monitoring objectives continue to be: (1) assessing the current water quality and WQS attainment at inland lake beaches; and (2) supporting local health department monitoring efforts to determine whether beach water is safe for swimming through technical assistance and grant opportunities. An exciting update is the recent migration of these data to be

located in MiENVIRO; therefore, the third objective of this effort will be to maintain that database.

Gap: As laboratory analysis costs increase, the WRD will need additional funding to maintain the level of monitoring that can be performed by local health departments. The WRD also recognized that only 50 percent of what is requested by local health departments are typically funded and that additional dollars could further support monitoring efforts.

Biological Condition

The WRD has used MDNR-FD status and trend inland lake fish community data to assess Coldwater and Warmwater Fishery designated uses for some previous Integrated Reports but has not consistently continued this data mining with the MDNR-FD.

Gap: The WRD does not conduct other biological monitoring in inland lakes. The WRD recognizes that macroinvertebrate and fish community metrics are used by some states for evaluating designated use support in inland lakes and that this is an important monitoring **gap** in Michigan; however, other opportunities are being prioritized at this time. The WRD looks forward to investigating biological condition in inland lakes as time and resources allow.

AIS

Early Detection and Rapid Response

Inland lakes continue to be some of the most susceptible water bodies for AIS; therefore, the majority of AIS efforts are focused on this water body type. AIS early detection monitoring was initiated in 2014 with a pilot study on 15 lakes. Since that time AIS in inland lakes have been sampled as part of WRD routine efforts. Each year, staff sample 10-20 inland lakes using methods modified from the Wisconsin DNR (2013; draft) to better suit Michigan inland lakes. Methods include a meander survey around the entire littoral zone, aquatic plant rake tosses, and snorkeling/wading a subset of locations that are determined to be the highest risk for AIS introductions (e.g., boating access sites). Methods are heavily weighted toward aquatic plant sampling but all native and AIS plants are recorded.

Since the inception of inland lake AIS early detection monitoring, staff has sampled over 120 lakes across the state (Figure 11). Most notably, AIS have been documented in every lake sampled except for three that were adjacent to the Lake Superior shoreline. Further analysis found that lakes located closer to major population centers and those in the southern part of Michigan tended to be more invaded than lakes further north.

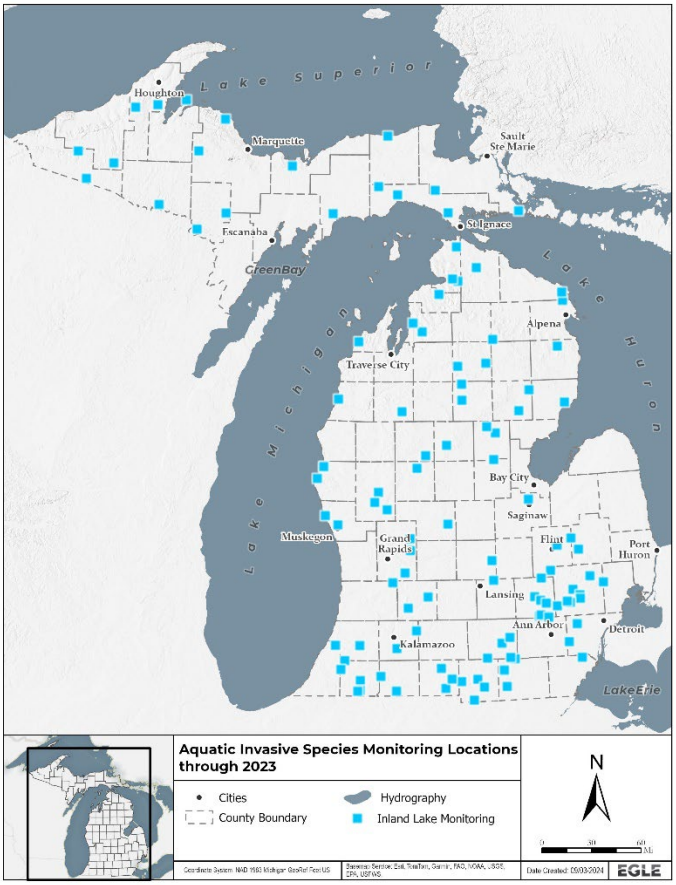

Figure 11. From the AIS Storymap, all AIS lakes sampled through 2023.

Lakes are selected for early detection monitoring using a multiple lines of evidence approach where lakes with several risk factors for AIS introductions are chosen to be sampled. Most notable risk factors include public access, recreation popularity, connection to other infested waterways or the Great Lakes, and proximity to known watch list species occurrences. While somewhat subjective, selecting lakes for sampling based on these factors has resulted in numerous previously unreported detections of AIS.

Other inland lake monitoring activities include special projects such as a multi-year effort to better understand the impacts of EFB on native aquatic plant communities. This project involved sampling 20 inland lakes (ten with EFB and ten without) annually using point intercept over a two-year period. Crews sampled the same points in sequential years within the selected lakes to better understand aquatic plant community dynamics and any potential impacts linked to EFB presence.

One intention of AIS monitoring is to detect an invasive species early in its invasion stage, while the population is small and localized. If an AIS population is detected early enough, there is a chance that response actions will result in eradication. The WRD specifically leads efforts for early detection and response efforts for aquatic invasive plants on Michigan's watchlist. On average, WRD staff responds to five new reports of watch list aquatic plants annually. Invasive species on the watch list have been

identified as posing an immediate or potential threat to Michigan's economy, environment, and human health. These species either have never been confirmed in the wild in Michigan or have a limited known distribution.

Biologists throwing a rake to collect aquatic vegetation. Photo provided by Jeremy Hartsock.

Response efforts include delimitation surveys, treatment (hand-pulling, herbicide, etc.) and pre- and post-treatment monitoring with a goal of eradication when practical. Eradication is achieved when the target species has not been present at the site for three consecutive growing seasons. On average, sites take five to six years to eradicate from time of detection, through treatment and post-treatment monitoring. To date, the WRD has successfully eradicated 11 populations of watch list aquatic plants with several populations nearing eradication. These populations were all in small private water bodies and posed a significant threat to public waterways if they had spread.

Current effort: Continue annual early detection effort of sampling 10-20 inland lakes. Also continue tracking the approximate 12 lakes that have had eradication efforts.

Gaps: The primary gap is the need for additional funding opportunities to expand the work AIS staff conduct with new technologies such as small, unmanned aircraft systems, unmanned underwater vehicles, satellite imagery, and eDNA. Staff is pursuing short-term pilot funding for eDNA analysis through the USFWS National Early Detection and Rapids Response Framework and Interjurisdictional project funding, although the status of that funding is unresolved. Another gap is the need to improve education and outreach about AIS to the public. This could include infographics,

brochures, story maps, inland lake maps, etc. Finally, AIS activities would benefit from understanding the impacts of AIS and how to monitor those impacts.

AIS Exotic Plant Watch

There is an AIS component to the MiCorps volunteer monitoring program, CLMP. For details see below under Volunteer Monitoring.

Fish Contaminants

The objectives for fish contaminant monitoring are largely consistent in the Great Lakes, inland lakes, rivers, and streams. These are to determine whether the Fish Consumption designated use is supported and report the status in the Integrated Report, support MDHHS fish consumption advisories, evaluate remediation efforts and impacts from point sources, investigate emerging contaminants, evaluate temporal trends, and evaluate contaminants in the diet of piscivorous wildlife to support the WRD's Wildlife Contaminant Monitoring Program. See the Great Lakes Subsection for more background on the FCMP. See the Great Lakes Subsection and Rivers and Streams Subsections for details specific to those water body types.

Gap: The WRD has not adequately filled the gap listed in the 2017 Monitoring Strategy Update of a small electrofishing vessel that could be used to sample waters without an improved launch.

Edible Portion Monitoring

The WRD collects fish from selected locations each year to measure contaminant levels in edible portions. All edible portion fish tissues are analyzed for mercury and PFAS. Samples may be selected to be analyzed for PCBs and pesticides such as DDT, dioxins and dioxin equivalents, PBDE, or selenium. See Table 2 in Section 1 for a complete list of core indicators in fish tissue. Emerging contaminants may be added to the list periodically.

All FCMP samples are processed by WRD staff and sent to the MDHHS laboratory. If the concentration of any contaminant exceeds any MDHHS fish consumption screening value for edible portion samples, two actions follow: (1) a fish consumption advisory is issued by the MDHHS and published in their next Eat Safe Fish Guidance update (Michigan.gov/EatSafeFish); and (2) the WRD makes the determination whether the water body is impaired and should be placed on the Section 303(d) list as not meeting WQS. The current exception is the mercury in legal-sized northern pike. The WRD assessment methodology for this species uses a 0.35 mg/kg fish tissue value (minimum of five legal-size northern pike).

Current effort: MPART was established in 2017 to address PFAS contamination in Michigan. To assist MPART with its investigations, the WRD has significantly increased its monitoring efforts related to PFAS. Public demand for fish contaminant monitoring has also increased over PFAS concerns. Between 2019 and 2023 the average number of edible portion monitoring samples from inland lakes submitted by the WRD each year to the MDHHS laboratory has increased 104 percent compared to the 2009 to 2018 period. To maintain sample analytical result turnaround time and to keep up with this increased demand, the WRD is supporting three full-time equivalents in the MDHHS laboratory for fish contaminant monitoring sample analyses.

Gap: Gaps for edible portion monitoring in inland lakes are consistent with those listed in the Great Lakes section.

Whole Fish Trend Monitoring

Of the 22 fixed stations the WRD has established to measure temporal trends in bioaccumulative contaminants in fish tissues, seven are located in inland lakes and five are in river impoundments (Figure 12). A top predator species (largemouth bass, walleye, or lake trout) serve as the sentinel species for the inland lake whole fish trend monitoring stations.

Current effort: the WRD plans to maintain the whole fish trend monitoring at the inland lake stations based on current level of effort, collecting fish from one to two of the seven fixed stations each year. In 2017 PFAS were added to the list of contaminants assessed at the whole fish trend locations. In 2019 the WRD released a mercury trend report for whole fish samples collected between 1990 and 2015 (Bohr, 2019). The WRD plans to evaluate PCB and chlorinated pesticide whole fish data and release a similar report.

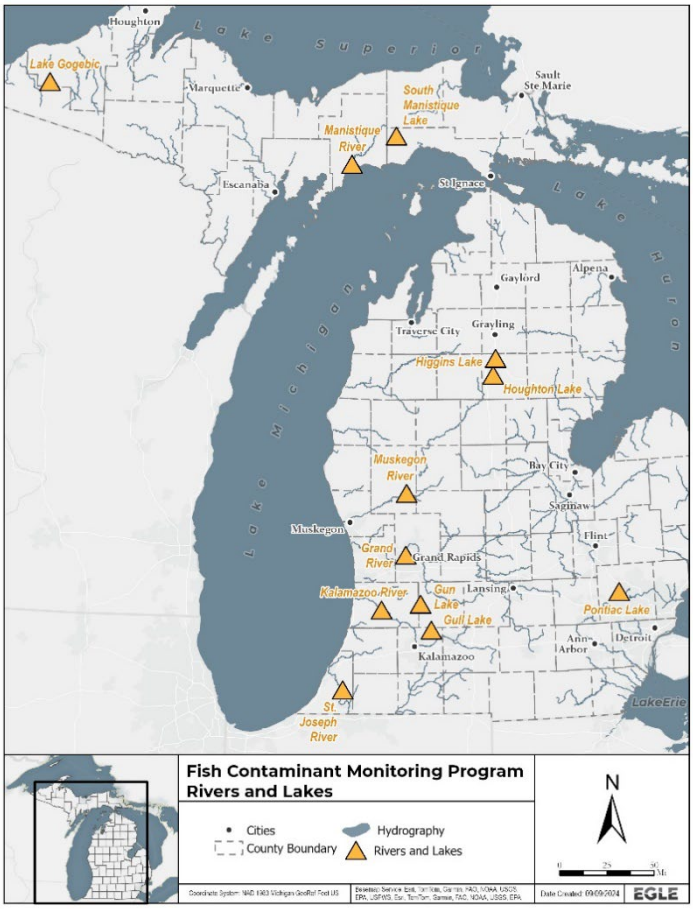

Figure 12. Michigan's fixed trend whole fish contaminant inland lake and impoundment stations.

Wildlife Contaminants

Bald eagle monitoring provides coverage for all major water resources in Michigan, including inland lakes. Please see the "Wildlife Contaminants in the Great Lakes" Section for details on this program.

Sediment Chemistry

The WRD partnered with researchers at Michigan State University to perform an inland lake sediment coring project from 1999-2010 using CMI-CWF dollars. At the conclusion of that study, sediment chemistry monitoring was collected on a targeted basis at a much lower rate.

In the 2018 Integrated Report Assessment Methodology, language was added saying that bulk sediment chemistry data along with corresponding bulk sediment toxicity data can be used to make WQS assessments. Since then, targeted sediment chemistry monitoring has become, while not abundant, more routine in annual monitoring efforts.

Often, sediment chemistry will be collected as a screening tool with later sediment toxicity monitoring to make a WQS assessment.

Current effort: Plans are for bulk sediment chemistry and/or toxicity monitoring to largely occur through targeted monitoring requests.

Gap: No **gaps** are identified at this time. The 2017 Monitoring Strategy Update included the need for a boat to collect sediment samples in inland lakes. That issue was filled with retrofitting the boat used by Michigan State University for the early sediment sampling with a Vibracore.

Support and Participation

Volunteer Monitoring

The MiCorps CLMP was established in 1974 and is the second oldest volunteer lake monitoring program in the nation. The program was expanded in 1992 when EGLE formed a cooperative agreement with the Michigan Lakes and Streams Association. In 2004 MiCorps was created through Michigan Executive Order #2003-15 and is currently sponsored by EGLE with funds provided by Renew Michigan and is administered in partnership with Michigan State University Extension, the Michigan Lakes and Streams Association, and the Huron River Watershed Council. Volunteers from approximately 300 lakes per year are enrolled and trained for the MiCorps CLMP Program (Figure 13).

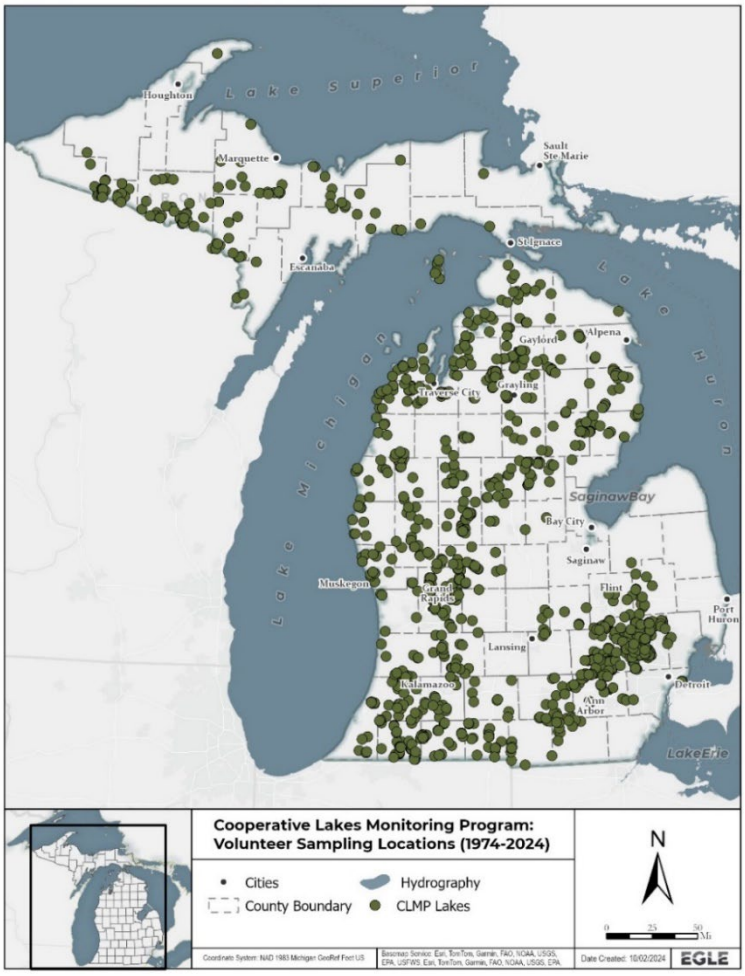

Figure 13. CLMP volunteer-sampled lakes from 1974-2024.

Many types and sizes of lakes, both private and public, participate in the MiCorps CLMP. Several lakes have been sampled for decades and trends in water quality can be observed over time to help riparian users make lake management decisions. Objectives are to help citizen volunteers collect high quality indicators and document changes over time; educate lake residents, users and interested community members in the data collection to build a constituency of community members who practice sound lake management; and foster water resource stewardship statewide to facilitate the preservation and protection of Michigan's water resources.

Current effort: The new MiCorps contract with Michigan State University has a start date of October 1, 2025.

Gaps: The WRD is considering the feasibility of evaluating chloride impacts to inland lakes through this program. Incorporating available technology would also be beneficial, such as using online data collection and modernizing data visualization using GIS. Also, while documenting changes over time is an objective of this effort, analyzing for trends remains a gap for this activity.

NLA

The NLA under the USEPA's NARS Program is designed to help the USEPA and its partners provide regional and national statistically-valid estimates of the condition of inland lakes. During most assessment years, the WRD requested additional sites in Michigan to allow for a state-scale assessment. In 2022 additional lakes were sampled in the Northern Lakes and Forest ecoregion in a study design with Minnesota, Wisconsin, and United States Forest Service. The WRD plans to continue state-scale NLA surveys in the future and intends to continue to pursue ways to use this data for understanding the conditions of inland lakes. The WRD also produces individual lake reports on lakes sampled as part of the NLA.

Rivers and Streams

Water Chemistry

WCMP

Water chemistry monitoring objectives in rivers and streams are to determine current water quality status and WQS attainment of various parameters, determine spatial and temporal water quality trends, provide program support, and evaluate emerging contaminants.

Probabilistic water chemistry monitoring was added to the WCMP in 2005. It is designed to understand typical values of various elements and chemicals in rivers and streams and determine if those values vary across the state or change over time. Rather than designed by basin cycle, this activity yields statewide results every year, giving it the capacity to evaluate water quality issues rather quickly. In total, it includes 250 probabilistic, subsequently fixed, sites in rivers and streams (Figure 14) that are sampled across the state over a five-year period. Sites are sampled at a rate of four times annually, once in May, July, September, and November, with 50 of the 250 sites

sampled each year. In addition, five sites are carried over and sampled the following year to give the WRD the ability to evaluate year-to-year variation. While a statewide analysis can be made annually, the maximum confidence that can be yielded includes all 250 sites. Parameters analyzed are shown in Section 1, Table 2.

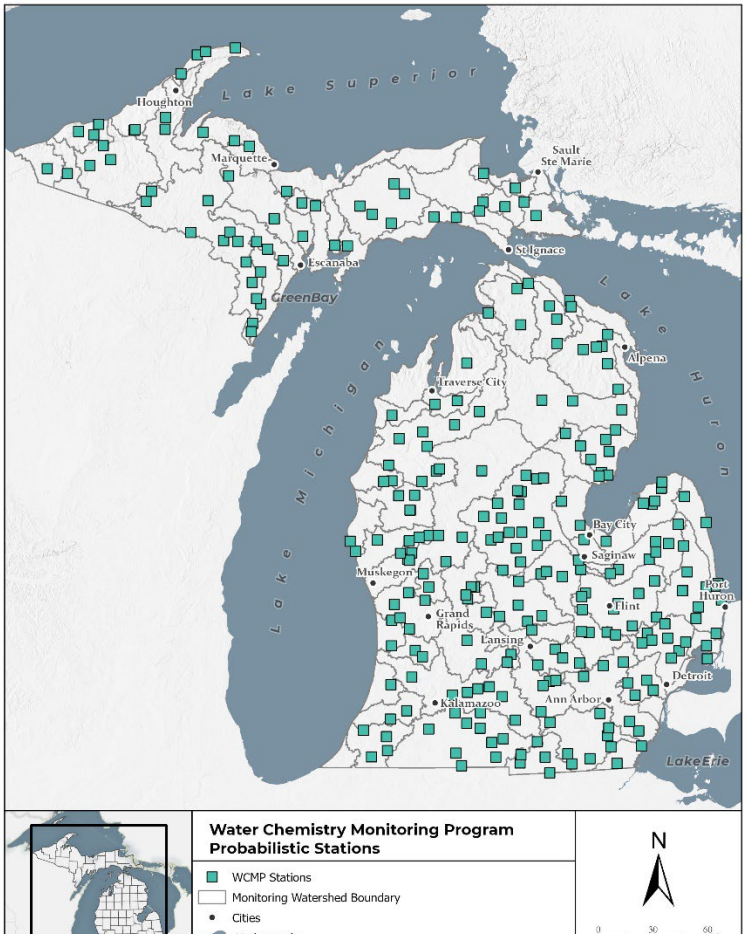

Figure 14. The 250 fixed probabilistic water chemistry sites.

This design is ideal for providing programmatic support with the ease of adding supplemental parameters and yielding statewide results after one year of data collection. In 2009 and 2011-2013 the WRD added *E. coli* monitoring as a screening mechanism to understand its extent in rivers and streams. In 2021 *E. coli* was reinserted into the program and expanded to include the collection of sufficient data to enable the calculation of a mid-summer 30-day geometric mean; thus, WCMP probabilistic sites are currently visited eight times a year. This includes the routine May, July, September, and November sampling plus an additional four visits that occur weekly in July-August following the routine July event. Note that only *E. coli* data are collected during the additional weekly visits.

Current effort: The addition of *E. coli* to this portion of the WCMP is expected to continue through 2025, which will provide a dataset using all 250 probabilistic sites. Other supplemental parameters have recently been added to this program. From 2019 to 2023 the WRD added PFAS, and since 2023 to present the WRD includes a subset of neonicotinoid pesticides. Most recently, beginning in 2025, THE WRD is adding microplastics to this program, with plans to continue this as a four-year effort. Note that funding is not available to complete the fifth year of the probabilistic cycle, meaning the dataset will have a total of 200 sites vs the typical 250.

Gap: The WRD is evaluating the possibility of reducing the number of fixed sites to 25 (from 50) to allow for the addition of new probabilistic locations. The remaining 25 sites would be randomly selected each year, keeping the annual effort at 50 sites. This

redesign would continue to provide trend analysis and would also extend the coverage of water quality assessment throughout the state. WRD staff is also considering performing a water chemistry data inventory in rivers and streams to determine if there is adequate information to update ambient background levels of various heavy metals for NPDES permitting. This may identify a monitoring gap if it is decided that further sampling is needed.

Targeted Water Chemistry Sampling non-PFAS

Water chemistry collection in rivers and streams outside of the WCMP is done through the targeted monitoring process. This effort varies each year, depending on the requests received and available Renew Michigan funding.

Surface Water PFAS

EGLE developed its first watershed-scale PFAS source tracking investigation in the Flint River watershed in 2016. Studies in the River Raisin, Huron River, Kalamazoo River, and St. Joseph River watersheds followed in 2018. EGLE's ongoing PFAS monitoring efforts are now included as part of the MPART, a team of seven state agencies established under an Executive Directive in 2017 to ensure coordination in implementing a response to PFAS contamination. The WRD continues to identify new locations of PFAS contamination through surface water and fish contaminant monitoring efforts, which help inform the MDHHS fish consumption guidance as well as site investigations to identify, differentiate, and remediate PFAS contamination. Overall, Michigan remains a leader in addressing PFAS in the environment.

Surface water is analyzed for a suite of PFAS selected to represent historic and current uses of this class of compounds. The objectives in rivers and streams are similar to other water body types and include identifying and differentiating sources to surface water, monitoring the impact of remediation and source reduction efforts, and prioritizing areas for additional monitoring.

Current effort: Three to five watersheds are targeted per year, with a total of 90-200 sites to be sampled annually. Sampling locations are prioritized based on proximity to drinking water intakes, areas of significant PFAS contamination, areas with known releases of PFAS to environmental media, areas with elevated concentrations of PFAS within fish tissue, and major confluences of surface water bodies.

Gap: As mentioned for PFAS in water sampling in the Great Lakes and inland lakes, measurement/quantification of total PFAS is increasingly requested by the public; however, discrepancies in quantification/estimation by different methods make comparison difficult. Regardless of water body type, the lack of USEPA-approved methodology for measuring total PFAS within surface water is a gap. Note the WRD will continue to evaluate the effectiveness of current efforts and recognizes new objectives and **gaps** may be needed as data are collected**.**

Biological

Pathogens

According to the 2024 Integrated Report approximately 40 percent of the 76,419 river miles in Michigan have been assessed for Total Body Contact (EGLE, 2024a). Of those assessed miles, only 4,562 were identified as supporting this designated use (Figure 15). Because Michigan is tackling *E. coli* impairments through a statewide bacterial TMDL, which was approved by the USEPA in 2019, the WRD is able to focus on implementing TMDLs where positive impacts on water quality can be made rather than expending resources on producing TMDLs indefinitely.

Bacteria monitoring objectives in Michigan's rivers and streams are:

- Assess the current condition of rivers and streams and determine whether the Total Body Contact and Partial Body Contact Recreation designated uses are being supported by comparing results with the WQS for *E. coli* (R 323.1062 of the Part 4 Rules). Currently, many water bodies are listed as "insufficient information"' or "unassessed" for these designated uses.
- Fulfill stakeholder monitoring requests (Targeted Monitoring Requests).
- Re-monitor prior TMDL sites and/or approved TMDL watersheds to provide further assessment or determine if progress has been made.
- Determine sources of pollution to priority waters with impaired Partial Body Contact designated use. Priority sites are defined as having more than 70 percent of monitoring results exceed 1,000 *E. coli* per 100 mL during the Total Body Contact season.
- Monitor to support NPS success stories and program.
- Monitor near known or suspected sources to broaden our understanding of *E. coli* contamination.

Current effort: For 2025 approximately 130 sites are planned for monitoring in addition to another almost 30 that were selected through the targeted monitoring process. The total number of sites in recent years has typically been between 150 and 160, which is limited by staff time and the quick hold time of the samples. Field effort is divided between the GLWARMS and technical services contractor. Note this effort is in addition to the probabilistic sampling conducted through the WCMP, which will be complete after 2025.

Gap: No **gaps** are currently identified for *E coli* monitoring in rivers and streams. The WRD will continue to evaluate the effectiveness of current efforts and recognizes new objectives and **gaps** may be needed as data are collected.

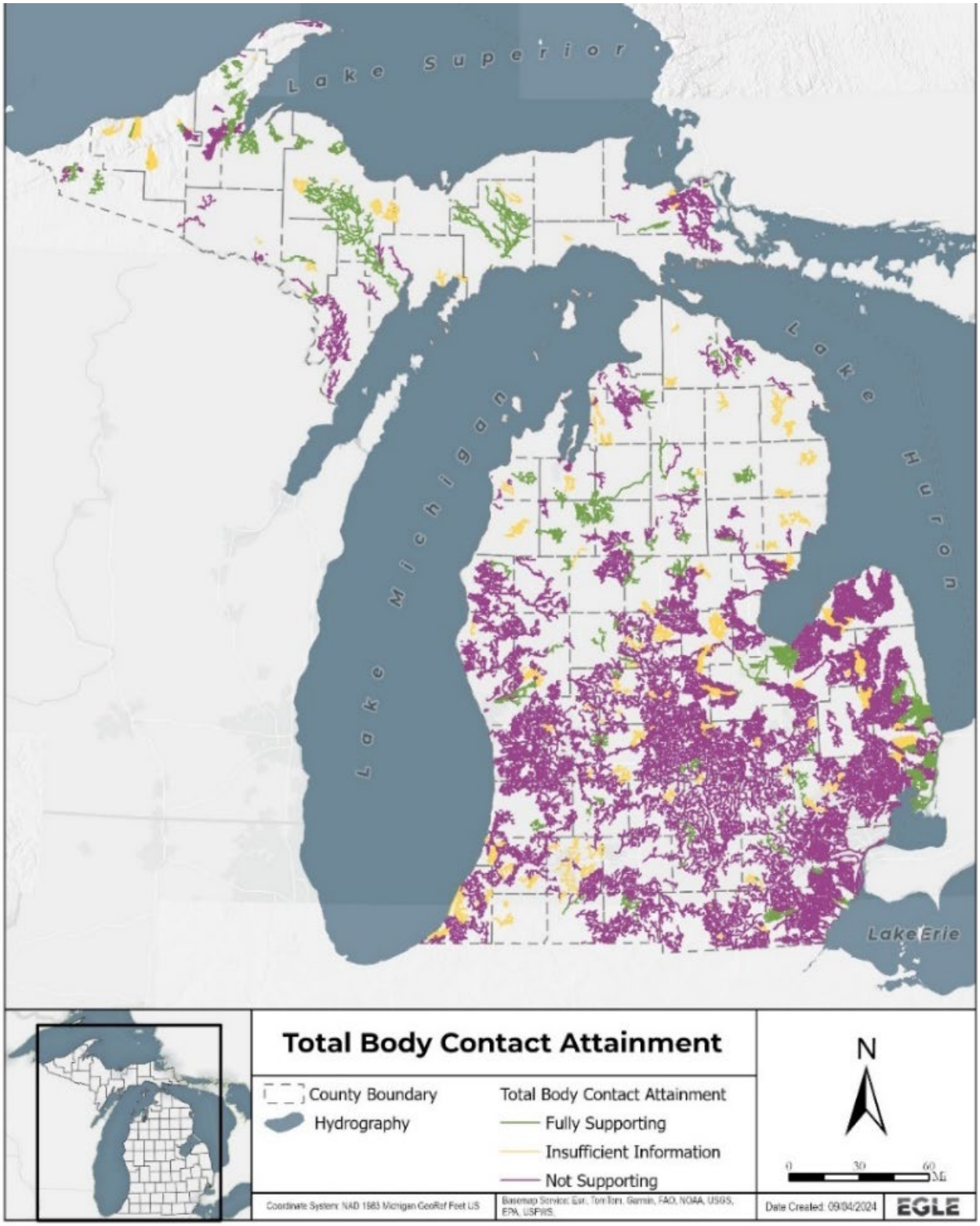

Figure 15. 2024 Total Body Contact – Assessed Streams.

AIS

The majority of AIS monitoring conducted by the WRD is performed in inland lakes (see the Inland Lake subsection). Efforts for AIS in rivers and streams are largely limited to observations made by aquatic biologists during other biological monitoring.

Current effort: Since 2016 AIS monitoring has been incorporated into routine Procedure 51 surveys in wadeable streams with biologists noting presence, absence, and relative density of AIS observed during the survey. Additional AIS monitoring in rivers and streams is generally the result of new detections. Most notable is monitoring to better understand New Zealand mudsnail (*Potamopyrgus antipodarum*) and Didymo (*Didymosphenia geminata*) populations. New Zealand mudsnails were first detected in 2016 and have since been found in over ten watersheds in the Northern Lower Peninsula. Didymo was first confirmed to be blooming in the St. Mary's River in 2015. More recently didymo blooms have been detected in the Manistee River (2021) and Boardman River (2022). Didymo cells have also been found in the Rapid River (2023) and Au Sable River (2024) but have not been found producing stalks. The WRD has both conducted regional monitoring and provided financial support for research to better understand both these species, which is ongoing.

Gap: There are no **gaps** being investigated at this time in rivers and streams.

Biological Condition

Wadeable Rivers and Stream Biological Assessment

The WRD has a long-standing procedure (Procedure 51; EGLE, 2024b) that uses a rapid multi-metric bioassessment technique to evaluate the macroinvertebrate and fish communities and habitat quality in wadeable rivers and streams. Macroinvertebrate collection and counting methods have been consistent since 2006, when the identification subsample size was set at 300 organisms. Following the 2006 revision and a review of the original Reference Site Evaluation for Procedure 51 (MDEQ, 2017b), EGLE initiated a data-driven redevelopment of the macroinvertebrate community scoring system (Tetra Tech, 2023). The updated macroinvertebrate scoring method was finalized in 2024 and will be used in the 2026 Integrated Report to assess rivers and streams that were sampled between 2021-2024 using updated assessment methodology. The updated method is expected to be more sensitive and will identify more sites and river miles as not supporting the OIALW designated use.

Current effort: Most biological surveys are selected through routine monitoring efforts evaluating status and trends in macroinvertebrate communities, which results in approximately 100 to 120 sites each year (Procedure 27; MDEQ, 2015b) – see a further description below. Sites are also selected through the targeted monitoring process discussed in Section 1.

Gap: Procedure 51 does not have metrics for coldwater fish, and the warmwater metrics would benefit from a review to assess if updates are needed. To prioritize these projects, the WRD has a Section 106 Monitoring Initiative project with the objective of

reviewing existing data (Procedure 51, NARS, and MDNR-FD data) and determining whether additional data should be collected (versus already available) to update the fish community metrics.

Status and Trends

To distribute effort and to provide program support to Permits Section staff in the NPDES program, this work is currently conducted using the basin-cycle approach. Each year status sites are probabilistically selected, allowing for a statewide assessment of condition every five years. A subset of these random sites from the first cycle, 2006-2010, are now fixed and resampled during their basin years to provide a trend evaluation. Results are used for both statewide and select watershed-level analyses. Depending on the number of river miles sampled during a given year, between 50 to 70 status sites are sampled with that work falling into the watersheds scheduled for basin-cycle monitoring. Over the basin cycle, there are 178 trend sites visited for the statewide analysis and an additional 87 trend sites at select locations for watershed analyses.

Nutrient Expression

WRD staff recently created a nutrient expression guidance document for wadeable rivers and streams that was, in part, funded with Section 106 Monitoring Initiative dollars. Given the potential effects of excessive filamentous algae and macrophytes on water quality, this guidance document was developed with the objective of providing a more systematic monitoring and assessment approach regarding Michigan's narrative nutrient criteria (R 323.1060[2]).

Current effort: Sites are largely identified through the targeted monitoring process and visited at a rate approved through the level-of-effort process described in Section 1. Biological condition surveys performed for a specific concern are determined through the targeted monitoring process described in Section 1

Nonwadeable Rivers: Macroinvertebrate Monitoring

Approximately 5 percent of the river and stream sites that are probabilistically chosen each year are nonwadeable. The procedure to assess nonwadeable rivers, which uses a multi-metric index for site assessment, was first used in 2005. This procedure (Procedure 22) was finalized in 2013 (MDEQ, 2013a). Like Procedure 51, this is a two-person effort. Biologists sample all available shoreline habitat at 11 transects using a D-frame net. Macroinvertebrates are composited and subsampled, counting 25 percent of the total sample. Individuals are identified on-site to lowest practical taxa level, typically family for insects.

Current effort: Monitoring using Procedure 22 are a small portion of watershed surveys with generally less than ten sites visited each year.

Gap: The nonwadeable macroinvertebrate scores have not been used to make non-support assessment decisions.

Diatom study

The WRD recently partnered with the USEPA and two other Region 5 State agencies to collect diatoms in rivers and streams. The objective of this study for Michigan was to sample diatoms across the state and provide the data to the USEPA. The USEPA, through a contractor, is performing the sample identification and determining whether indices developed by other agencies work well for Michigan's rivers and streams. It should be noted that, even if the indices are valuable in evaluating water quality, diatom identification is a niche ability not currently found within the WRD. The WRD is grateful for the support from the USEPA to investigate diatoms as a biological indicator of water quality; however, it may take time for the WRD to build the capacity to include this into routine monitoring efforts.

Sentinel Sites

To address monitoring strategy goals, EGLE-WRD designed a monitoring program capable of detecting subtle long-term changes to water quality and aquatic biota in Michigan rivers and streams. The Sentinel Site Monitoring Program assesses the abiotic characteristics and biological communities of least-impacted wadeable rivers and streams; systems believed to represent the closest modern approximation to natural lotic conditions in Michigan prior to European settlement. Least-impacted systems are often used by water resource professionals as the standard against which all other systems are compared. Any changes to least-impacted systems must be understood by resource managers to account for the effects of shifting baselines during assessments of ecosystem health.

Current effort: Seven sites are currently monitored for the Sentinel Site Monitoring Program. Site selection was informed first by a reference list used to recalibrate the WRD's Procedure 51 scoring metrics. Further site-selection criteria identified sites surrounded by large, contiguous tracts of protected public land and with the lowest likelihood of anthropogenic disturbance. One such site was selected from each of the seven stream classes identified by the Procedure 51 scoring recalibration. Each site is visited three times annually. Monitoring efforts comprise water chemistry sampling and discharge measurements collected during each site visit, macroinvertebrate community and habitat surveys once annually, fish community surveys biennially, and the installation of continuous monitoring equipment. Continuous monitoring equipment includes in-stream staff gages, trail cameras to capture staff gage readings over time, in-stream temperature loggers, and ambient air temperature loggers. Equipment is installed for the duration of the ice-free season to capture a wide range of environmental conditions.

Gap: The Sentinel Site Monitoring Program was launched during the 2024 field season. Since a foundational dataset is still being developed, additional time is needed to confidently identify programmatic **gaps**. However, due to the nature of the site selection criteria, most sentinel sites are designated coldwater streams. Additional coverage of warmwater streams may be considered for future monitoring.

Fish Contaminants

The objectives for fish contaminant monitoring in rivers and streams are to determine the support status of the Fish Consumption designated use for the Integrated Report, support MDHHS fish consumption advisories, investigate emerging contaminants, as needed, evaluate remediation efforts and impacts from point sources, evaluate temporal trends in fish contaminants, and evaluate contaminants in the diet of piscivorous wildlife to support the WRD's Wildlife Contaminant Monitoring Program effort.

Edible Portion Monitoring

The WRD collects fish from selected locations each year to measure contaminant levels in edible portions (Objectives 1 and 2). All edible portion fish tissues are analyzed for mercury and PFAS. Samples may be selected to be analyzed for PCBs and pesticides such as DDT, dioxins and dioxin equivalents, PBDE, or selenium. See Table 2, Section 1, for a complete list of core indicators in fish tissue. Emerging contaminants may be added to the list periodically.

Current effort: The MPART was established in 2017 to address PFAS contamination in Michigan. To assist MPART with its investigations, the WRD has significantly increased its monitoring efforts related to PFAS. Public demand for fish contaminant monitoring has also increased over PFAS concerns. Between 2019 and 2023 the average number of edible portion monitoring samples from rivers and streams submitted by the WRD each year to the MDHHS laboratory has increased 92 percent compared to the 2009 to 2018 period. To maintain sample analytical result turnaround time and to keep up with this increased demand, the WRD is supporting three full-time equivalents in the MDHHS laboratory for fish contaminant monitoring sample analyses.

All FCMP samples are processed by WRD staff and sent to the MDHHS laboratory. If the concentration of any contaminant exceeds any MDHHS fish consumption screening value for edible portion samples, two actions follow: (1) a fish consumption advisory is issued by the MDHHS and published in their next Eat Safe Fish Guidance update (Michigan.gov/EatSafeFish); and (2) the WRD makes the determination whether the water body is impaired and should be placed on the Section 303(d) list as not meeting WQS. The current exception is the mercury in legal-sized northern pike. The WRD assessment methodology for this species uses a 0.35 mg/kg fish tissue value (minimum of five legal-size northern pike).

Gap: Gaps for edible portion monitoring in rivers and streams are consistent with those listed in the Great Lakes section.

Whole Fish Trend Monitoring

The WRD has established 22 fixed stations to measure temporal trends in bioaccumulative contaminants in fish tissues (Objective 5). None of the stations are in free-flowing streams; however, five sites are established in impounded river reaches.

Common carp are used as the sentinel species in those impoundments and are collected every three to five years.

Current effort: the WRD plans to maintain the whole fish trend monitoring effort at the river impoundment stations based on current levels, collecting fish from one to two of the five fixed stations each year. In 2017 PFAS were added to list of contaminants assessed at the whole fish trend locations. In 2019 the WRD released a mercury trend report for whole fish samples collected between 1990 and 2015 (Bohr, 2019). The WRD plans to evaluate PCB and chlorinated pesticide whole fish data and release a similar report.

Gap: Long-term stations have been lost to dam removals.

Caged Fish/Passive Sampler Studies

Caged fish studies are routinely used to identify potential sources of bioaccumulative contaminants in rivers, to determine spatial and temporal trends of these contaminants (Objective 5), and to evaluate remediation efforts (Objective 4). Cages containing channel catfish are placed at various locations along a river or its tributaries upstream and downstream of known or suspected sources. Passive samplers are also used in lieu of caged fish studies (e.g., Polar Organic Chemical Integrated Samplers for PFAS monitoring). After 28 days the cages or passive samplers are retrieved and parameters of interest are analyzed.

Gap: The USEPA has recently shown more interest in conducting caged fish studies in Michigan's AOCs (e.g., River Raisin, Clinton River); however, the WRD is only able to conduct one or two caged fish studies and a Polar Organic Chemical Integrative Sampler (POCIS) study each year due to staff constraints and limited equipment. Theft and destruction of cages during deployments has also reduced the number of WRD fish cages in recent years. The WRD looks to the USEPA for support if more studies are desired. Furthermore, the WRD uses hatchery-raised channel catfish in its caged fish studies. Michigan-based aquaculture facilities that receive channel catfish from out-of-state suppliers are having issues maintaining levels of these fish needed for the private sector (e.g., farm pond stocking), which makes it increasingly more difficult for the WRD to obtain fish for its caged fish studies. Disease testing requirements and lower production of channel catfish from the out-of-state hatcheries are contributing to this supply chain issue. The use of passive samplers, such as semi-permeable membrane devices, can be used in lieu of caged fish; however, it is currently unknown how these two methods compare in order to maintain the long-term trends the WRD has been evaluating with its caged fish studies.

Wildlife Contaminants

Mink and Muskrat

Occasionally, EGLE-WRD hires trappers with a fur harvesting license to obtain mink and muskrat samples from select locations with known bioaccumulative chemical

contamination. These studies are discussed here because data are assessed at a watershed scale in comparison to the bird studies, which are conducted on a statewide scale. Mink and muskrat liver samples are analyzed for the same bioaccumulative contaminants of concern such as mercury, PCBs, and chlorinated pesticides (e.g., DDT) that are tested in the birds. Select studies have also evaluated emerging contaminants such as PFAS. Jaws are removed for lesion analysis, which has been conducted by Michigan State University. The resulting data are used to assess spatial and temporal trends in bioaccumulative contaminants in Michigan's rivers, with a primary focus on AOCs for Beneficial Use Impairment assessments.

Sediment Chemistry

Sediment inquiries from the targeted monitoring request process, regardless of water body type, are generally incorporated into an annual sediment workplan that is carried out by the GLWARMS Aquatic Biology Specialist who is the expert in sediments. Sediment indicators depend on the known and/or suspected sources of contamination. Results are provided to targeted monitoring requestors.

Geomorphology

Channel morphology surveys are conducted to monitor how conditions within a stream change over time, demonstrate success for stream restoration projects, or provide dimensions for designs based on Natural Channel Design principles. Geomorphology surveys can consist of cross-section measurements, longitudinal profiles, pebble counts, and Bank Assessment for Nonpoint Consequences of Sediment. Cross-section and longitudinal profiles are conducted using survey equipment. Channel cross-sections are used to identify bankfull conditions, floodplain access, and channel entrenchment. Longitudinal profiles are used to identify stream features (e.g., riffles, pools, runs, or glides) as well as channel slopes. Pebble counts measure sediment particle size distributions and can be used to determine stream power and the potential for erosion and aggradation. Bank Assessment for Nonpoint Consequences of Sediment can be used as both a qualitative or quantitative measure of streambank erosion and can identify high priority areas for future implementation work or estimate the erosion rates along each segment of the channel. Geomorphology surveys are conducted by staff who have received training through attending appropriate hydrology courses.

Gaps:

- Geomorphology Training for Staff:
    - Hydrology courses taught by Rosgen are offered through Wildland Hydrology. These classes are expensive and have limited availability.
    - There may be other appropriate hydrology courses for staff to attend.

    - Skills and knowledge from training stay with the individual upon changing jobs or leaving the NPS Program.

- Software Licenses for Rivermorph:
    - EGLE uses a shared Rivermorph license paid for by the MDNR, which has limited availability as only one person can use the license at a given time. A dedicated EGLE license or WRD license could be used to ensure access more consistently among GLWARMS staff.

- Geomorphology Equipment:
    - While no new equipment is needed currently, electronic equipment for geomorphology surveys is aging. The SP80 GNSS Receiver used for geomorphology surveys is about 15 years old. A newer survey-grade Global Positioning System can make corrections to data in the field, which will reduce post-processing time.

Support and Participation

Volunteer Monitoring

The objectives of the MiCorps Volunteer Stream Monitoring Program are:

- Provide funding, training, and technical assistance to support and expand volunteer water quality monitoring organizations statewide for the purpose of collecting, sharing, and using reliable data on the ecological quality of Michigan rivers and the possible stressors that may be impacting water quality.

- Educate and inform the public about water quality issues to foster water resources' stewardship to facilitate the preservation and protection of Michigan's water resources.

MiCorps is a network of volunteer monitoring programs in Michigan, created through Michigan Executive Order #2003-15. MiCorps assists the WRD in collecting and sharing water quality data for use in water resources management and protection programs.

The MiCorps Volunteer Stream Monitoring Program provides grants, technical assistance, and training to volunteer stream monitoring groups in Michigan to ensure they are collecting reliable, high-quality data. Collectively, these stream monitoring organizations create a network of professionals and volunteers throughout Michigan. The data include in-stream and riparian habitat measurements as well as macroinvertebrate community surveys. Using best estimates of sensitivity ratings for each macroinvertebrate order or family, each station is scored, resulting in a MiCorps Water Quality Rating estimate for that site.

These data are primarily used by the individual watershed groups to address watershed goals and concerns and are used by EGLE as a screening tool to assist WRD biologists

with site selection in the assessment of Michigan watersheds. Data are available to the public via the MiCorps Data Exchange.

Since 2005 MiCorps has provided grant funding as part of the Volunteer Stream Monitoring Program to organizations interested in monitoring their streams and rivers. For the last four years approximately $75,000 annually is made available to recipients for start-up, implementation, or maintenance grants through a competitive grant application process. Funding for this program is provided by EGLE under Renew Michigan general funds.

NPS Program

Staff in the NPS Program request monitoring related to NPS pollution through the targeted monitoring request process. Depending on the objective, requests can be carried out during watershed surveys or as special studies. The NPS Program focuses targeted monitoring on locations for different purposes, such as:

1. Problem identification assessments to determine impacts from potential NPS pollution.
2. BMP effectiveness monitoring – this includes monitoring pre- and post-BMP implementation to document potential success stories.
3. Locations that will help characterize water quality and be used to prioritize sites for implementation in a watershed management plan.

In addition to the sites identified through the targeted monitoring process, the NPS monitoring coordinator also tracks NPS projects for potential success stories, which can include environmental or social monitoring. Sometimes via the pass-through-grant process, grantees can conduct pre- or post-BMP effectiveness monitoring. If the monitoring occurs outside of the grant period, NPS staff conduct the monitoring either within the NPS Unit, or through the targeted monitoring process. Measurement of social indicators before and after NPS outreach or education efforts can determine whether the NPS efforts have led to the intended social outcomes. Social monitoring often includes surveys to measure a change in knowledge or behavior for a targeted population. All grants collect data after QAPP approval and data is submitted electronically at the closeout of the project.

Rivers and Streams Condition Assessment

The WRD has an established procedure to assess rivers and streams and does not generally participate in this assessment.

Wetlands

Wetland Monitoring Summary

EGLE has a comprehensive wetland monitoring and assessment strategy (MDEQ, 2015a), that serves as a supplement to this Monitoring Strategy and is guided by the four surface water monitoring goals. The primary focus of Michigan's wetland monitoring effort is to evaluate the success of the state in protecting, managing, and restoring Michigan's wetlands such that they will continue to provide the public benefits defined by the Legislature in Part 303, Wetlands Protection, of the NREPA. Assessment and monitoring of Michigan's wetland resources provides information to address diverse program issues at a variety of scales, from the status and trends of statewide wetland acreage to the detailed evaluation of individual wetland sites.

The evaluation of individual wetlands is also a component of Michigan's regulatory program under Part 303, as well as for watershed-scale planning and in local NPS control programs. Michigan is one of only two states with authority to administer Section 404 of the CWA, which requires annual reporting on statewide regulatory impacts. Land use planners are also increasingly considering wetland functions, wetland quality, and restoration of wetlands to address challenges like loss of flood storage, erosion problems, nutrient inputs, and fish and wildlife habitat.

The following is an overview of the *State of Michigan Wetland Monitoring and Assessment Strategy* (MDEQ, 2015a). To avoid possible inconsistencies that may result from future revisions, details are not included here. Please see the Introduction to

Wetland Monitoring and Assessment for the most recent *State of Michigan Wetland Monitoring and Assessment Strategy* in its entirety.

The USEPA has developed a 3-tiered framework for the assessment and monitoring of wetland resources (USEPA, 2006) that has been adopted by the Michigan's wetlands program. Michigan's Monitoring and Assessment Strategy outlines the following objectives under this 3-tiered framework for monitoring and assessment of Michigan's wetlands.

Level 1 - Landscape Assessment

Objective 1: Complete an inventory of Michigan's wetland resources that provides both basic resource information and a baseline for evaluating gains and losses over time.

Objective 2: Support state and national no net loss/net gain goals for wetlands by cooperating in updating of National Wetlands Inventory maps for use in status and trends reporting.

Objective 3: Assess effectiveness of Michigan's state-administered Section 404 permit program by tracking authorized wetland impacts and mitigation for those impacts, as well as documented unauthorized impacts and restoration measures.

Objective 4: Apply Landscape Level wetland assessment methods to support the protection, management, and restoration of wetlands on a watershed scale.

Level 2 - Rapid Wetland Assessment

Objective 5: Evaluate individual wetland sites using the Michigan Rapid Assessment Method (MiRAM) to quickly assess wetland functions and values regardless of ecological type.

Level 3 - Intensive Site Assessment

Objective 6: Use full-scale biological assessment of wetlands for resource management purposes. Develop and document wetland Indexes of Biotic Integrity and related methods.

Objective 7: In cooperation with other public and private agencies and organizations, provide for the evaluation of Michigan's most outstanding wetland resources, especially Great Lakes coastal wetlands, by supporting long-term monitoring of coastal wetlands through the Great Lakes Coastal Wetlands Consortium and similar cooperative efforts.

Objective 8: Assess statewide wetland quality by establishing a routine wetland monitoring program that parallels other basin-wide water quality monitoring, including the NWCA.

In 2014 Michigan published the Status and Trends of Michigan's Wetlands: Pre-European Settlement to 2005. In addition, Michigan hosts an interactive GIS portal called Wetlands Map Viewer, which includes the National Wetlands Inventory updated for the state of Michigan, the Wetlands Status and Trends Tool, which provides users the ability to compare historic wetland data to current information, as well as allows

statistical data to be generated for acreage and a variety of wetland functions where available, and also displays summarized intensive site assessment data.

To date, net gain or loss of wetlands is a primary indicator of the overall condition of the state's wetland resources. State and federal no net loss/net gain goals address not only the quantity of wetland resources but the quality of those resources. However, goals for wetland quality are not fully defined at the state, regional, or national level. The USEPA, Region 5, Water Division and Great Lakes National Program Office; EGLE; and resource agencies from the other Region 5 states have worked together to develop a set of shared regional water *goals, milestones*, and associated environmental *indicators*. On December 11, 2001, each of these organizations signed a Joint Commitment to Achieve Shared Water Goals, which documents our commitment to the goals.

Site-specific wetland monitoring protocols include NWCA vegetation, assessment area, and point verification, MiRAM, and the Great Lakes Coastal Wetlands Indicators. Great Lakes Coastal Wetland monitoring, implemented through the Great Lakes Coastal Wetland Monitoring Program, incorporates the suite of indicators recommended by the Great Lakes Coastal Wetlands Consortium in the Great Lakes Coastal Wetland Monitoring Plan (2008) to contribute to this long-term, basin-wide initiative.

MiRAM

The WRD-FOSS uses MiRAM to quickly assess wetland functions and values regardless of ecological type. Biological indicators and metrics in this method include: (1) wetland size and distribution; (2) upland buffers and intensity of surrounding land use; (3) hydrology; (4) habitat alteration and habitat structure development; (5) special situations; (6) vegetation, interspersion, and habitat features; and (7) scenic, recreational, and cultural value. Michigan conducts a MiRAM at all sites sampled as part of the statewide Michigan Wetland Monitoring Program Level 3 Intensive Site Assessment, as well as the NWCA cycles. This database of MiRAM scores will provide long-term data on the status and trends of Michigan's wetlands.

NWCA

The NARS NWCA is designed to help the USEPA and its partners provide regional and national statistically valid estimates of the condition of the nation's wetlands. In 2011 the WRD contribution in the NWCA was limited to the participation of a soil scientist on the wetland sites in Michigan. The WRD monitored all wetland sites assigned to Michigan in 2016 and 2021 and sampled additional sites to allow for a state-scale assessment. The WRD-FOSS plans to continue these efforts in 2026 if Section 106 Monitoring Initiative funds are available.

Michigan Wetland Monitoring Program

In addition to participation in the NWCA, Michigan conducts an enhancement project to sample additional sites statewide using the state-specific protocols outlined in the State

of Michigan Wetland Monitoring and Assessment Strategy, including MiRAM. These additional sites are evenly distributed across the three ecoregions of Michigan – Southern Lower Peninsula, Northern Lower Peninsula, and Upper Peninsula. This distribution is intended to ensure an accurate representation of these distinct areas of the state in the data collected and evaluated for the program.

GAP: Without federal funds, the WRD would not have the means to perform a state-scale water quality analysis of wetland condition, which is an assessment that is both promoted by the USEPA through Section 106 Monitoring Initiative grants and part of the WRD's Monitoring Strategy. As part of each Section 106 Monitoring Initiative grant, which includes a NARS assessment and funding to fill monitoring **gaps**, states with insufficient funds are encouraged to use these grants to supplement state-scale water quality analyses. In addition to Section 106 Monitoring Initiative grants, the WRD also leverages National Wetland Program Development grants and Renew Michigan funds to meet this monitoring goal.

AIS

AIS do not recognize boundaries and invade all water body types. Wetlands can be particularly suspectable to AIS as they often provide refugia habitats and can go undetected for extended periods of time. AIS such as phragmites (*Phragmites australis*) and narrow leaf cattail (*Typha angustifolia*) are well suited for wetland habitats and thrive in those ecosystems as seen by the widespread invasions of both those species. More recently species like EFB have invaded wetland ecosystems and pose a significant challenge to control in those habitats.

Wetland AIS monitoring has primarily revolved around EFB early detection to inform response actions. A significant EFB range expansion was detected in 2016 in Kent County. This new detection was over a hundred miles from the nearest known population. As such, monitoring of surrounding waterways ensued and is still ongoing resulting in several new detections of EFB, all in wetland habitats along the west Michigan coastline. Monitoring for EFB in other wetland habitats has increased annually across the state with most of this effort being led by local conservation groups such as Cooperative Invasive Species Management Areas. EGLE-WRD has supported and enhanced these efforts through providing pass-through funding to expand regional networks for EFB monitoring and build local capacity.

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Appendix A. ***Gaps*** *by Monitoring Activity*

Where in Document and Details	General/Overall
Section 1 - Groundwater Monitoring	To date, the WRD has not determined how surface water and groundwater monitoring efforts should be coordinated.
Section 1 - Data Management	The WRD continues to work on public access to data for some monitoring activities.
Section 1 - Equipment	The nature of field work and equipment wear will continue to make equipment replacement an ongoing need.

Where in Document and Details	Water Chemistry – Non-Inland Lakes Eutrophication
Section 2 - PFAS in water in all water body types	Measurement/quantification of total PFAS is increasingly requested by the public; however, discrepancies in quantification/estimation by different methods make comparison difficult. Regardless of water body type, the lack of USEPA-approved methodology for measuring total PFAS within surface water is a gap
Section 2 - PFAS in water in the Great Lakes	In addition, deployment of passive samplers for PFAS analysis could be performed to circumvent the significant impacts of dilution on samples collected in the Great Lakes; however, time and costs associated with passive sampler use is significantly more than what is associated with collecting individual grab samples.
Section 2 - Water chemistry monitoring in rivers and streams	The WRD is evaluating the possibility of reducing the number of fixed sites to 25 (from 50) to allow for the addition of new probabilistic locations. The remaining 25 sites would be randomly selected each year, keeping the annual effort at 50 sites. This redesign would continue to provide trend analysis and would also extend the coverage of water quality assessment throughout the state.

Where in Document and Details	Beaches and Other Recreational Waters -- Pathogens
Section 2 - Beach grant funding	The WRD recognizes that only 50 percent of beach monitoring requests by local health departments are typically funded. This will be further exacerbated if laboratory analysis costs rise unless an increase in federal dollars become available.

Where in Document and Details	Inland Lake Quality and Eutrophication
Section 2 - Potential long-term fixed station effort in inland lakes	The WRD is considering establishing a fixed station inland lake trend monitoring program. Current monitoring has not been adequate to answer questions related to changes in inland lake conditions. The NLA can give a state-scale report every five years on lake quality, but design changes in lake size over the years, implementation of site selection in Michigan, and the relatively wide four-month sampling window limit the comparability across years at the state scale in Michigan. Developing a statistically sound program at the state level to adequately characterize changes in inland lakes is a monitoring activity that the WRD is actively exploring. Possible study design elements include sampling a to-be-determined number of lakes on a regular basis. Consideration would be given to include a range of lake sizes, levels of development, and regions of the state. Some level of public access to the lake will likely be needed to ensure the ability to sample regularly. Additional considerations may include the use of historic data (MDNR-FD status and trend, volunteer data through the MiCorps CLMP, and NLA) in site selection and trend analysis. Sampling design would likely include spring and summer sampling but could be expanded to include Regional Monitoring Network design elements and a broader suite of water chemistry parameters.
Section 2 - Chloride monitoring in inland lakes	Further chloride-focused monitoring is not planned; however, the WRD recognizes the need to identify the scale of chloride pollution and solidify appropriate assessment methods for monitoring chloride in inland lakes and may conduct limited targeted monitoring as resources allow.

Section 2 - Long-term monitoring plan for lakes with TMDLs	The WRD should develop a clear plan for monitoring lakes that have existing TMDLs to evaluate how regulatory programs should work towards meeting TMDL goals.
Section 2 - Remote sensing methods in inland lakes	The WRD is aiming to develop inland lake assessment methods to use both remotely sensed Secchi and chlorophyll-*a* data and deployed chlorophyll-*a* sondes. This assessment may require large-scale data analysis as well as field data collection to enable comparisons or independent evaluations.

Where in Document and Details	**Biological – Non Beaches**
Section 1 - Status and trend monitoring of macroinvertebrate communities in wadeable rivers and streams	Over the next few years there are plans to evaluate the efficacy of this approach for macroinvertebrate community sampling and, if needed, consider alternate sampling designs that may better address the Monitoring Strategy goals.
Section 2 - Biological community indicators in the Great Lakes	The WRD does not have an indicator for monitoring biological condition in the Great Lakes. While the WRD understands this is an important monitoring **gap**, opportunities in other water body types are being prioritized at this time. The WRD looks forward to investigating biological condition in the Great Lakes as time and resources allow.
Section 2 - Coldwater fish community metrics in inland lakes	The WRD considers that refinement is needed to improve Coldwater Fishery designated use assessment. Possible efforts include developing R code to analyze profile data and using additional data sources. The WRD would like to examine how the temperature where the dissolved oxygen concentration drops to 3.0 mg/L (TDO3) compares to the WQS and how it could be considered for assessment. There is also a need to develop assessment methodology to determine if a pollutant, such as phosphorus, is causing dissolved oxygen impairments in coldwater lakes.
Section 2 - Biological community indicators in inland lakes	The WRD does not conduct other biological monitoring in inland lakes. The WRD recognizes that macroinvertebrate and fish community metrics are used by some states for evaluating designated use support in inland lakes and that this is an important monitoring **gap** in Michigan; however, other opportunities are being prioritized at this time. The WRD looks forward to investigating biological condition in inland lakes as time and resources allow.

Where in Document and Details	Biological – Non Beaches
Section 2 - Potential techniques to monitor AIS	The primary gap is the need for additional funding opportunities to expand the work AIS staff conduct with new technologies such as small, unmanned aircraft systems, unmanned underwater vehicles, satellite imagery, and eDNA. Staff is pursuing short-term pilot funding for eDNA analysis through the USFWS National Early Detection and Rapids Response Framework and Interjurisdictional project funding, although the status of that funding is unresolved. Another gap is the need to improve education and outreach about AIS to the public. This could include infographics, brochures, story maps, inland lake maps, etc. Finally, AIS activities would benefit from understanding the impacts of AIS and how to monitor those impacts.
Section 2 - Procedure 51, rapid biological assessment for the fish community in wadeable rivers and streams	Procedure 51 does not have metrics for coldwater fish, and the warmwater metrics would benefit from a review to assess if updates are needed. To prioritize these projects, the WRD has a Section 106 Monitoring Initiative project with the objective of reviewing existing data (Procedure 51, NARS, and MDNR-FD data) and determining whether additional data should be collected (versus already available) to update the fish community metrics.
Section 2 - Procedure 22, nonwadeable river biological assessment for the macroinvertebrate community	The nonwadeable macroinvertebrate scores have not been used to make non-support assessment decisions.
Section 2 - Potential growth to sentinel site monitoring	The Sentinel Site Monitoring Program was launched during the 2024 field season. Since a foundational dataset is still being developed, additional time is needed to confidently identify programmatic **gaps**. However, due to the nature of the site-selection criteria, most sentinel sites are designated coldwater streams. Additional coverage of warmwater streams may be considered for future monitoring.
Section 2 - Wetlands Subsection: Intensive site assessment	Without federal funds, the WRD would not have the means to perform a state-scale water quality analysis of wetland condition, which is an assessment that is both promoted by the USEPA through Section 106 Monitoring Initiative grants and part of the WRD's Monitoring Strategy.

Where in Document and Details	Fish and Wildlife Contaminants
Section 2 - FCMP in all water body types	Aging equipment is a concern for the FCMP. One example is that WRD only has one reliable electrofishing boat, which has been in service for a decade. A second boat would ensure the program would not have to pause for a lengthy period due to equipment failures. Another potentially looming gap is that the WRD receives approximately $800,000 each year from the MDHHS for the analysis of mercury and PFAS in edible portion samples; however, these funds are not guaranteed. The loss of this revenue would mean that the WRD would have to find other sources of funding or the number of samples processed each year would be substantially cut back.
Section 2 - FCMP in the Great Lakes	Numerous collections of carp from Great Lakes bays have been unsuccessful, corresponding with potential population declines noted for some species. Also, current efforts were designed for legacy contaminant trends (e.g., mercury and PCBs), which may not be suitable for emerging contaminants such as PFAS. If it is decided to investigate trends in additional contaminants, other fish species and locations may need to be considered.
Section 2 - FCMP edible portion monitoring in all water body types	The WRD recognizes that GLWARMS staffing for edible fish portion sample collection and tissue analysis by the MDHHS laboratory is operating near capacity based on current funding sources. It is also understood that a significant part of the current budget for this program is shared with all surface water quality monitoring in the WRD, and any changes in programmatic needs could cause a decrease of funding to this program to support other monitoring activities. That possibility, combined with impending increased cost of laboratory expenses likely means this program is currently at its maximum performance without an influx of funding. Given that the WRD receives more monitoring requests each year, and it is expected that demand will increase as PFAS investigations continue and public concern grows, the WRD will have difficult decisions to make in the next few years.

Where in Document and Details	Fish and Wildlife Contaminants
Section 2 - Wildlife Contaminant monitoring	The WRD feels there would be a benefit to evaluating trends in emerging chemicals in archived samples; however, there is no funding available to support that effort currently.
Section 2 - FCMP equipment need in small inland lakes	The WRD has not adequately filled the gap listed in the 2017 Monitoring Strategy Update of a small electrofishing vessel that could be used to sample waters without an improved launch.
Section 2 - FCMP site losses in river impoundments	Long-term stations have been lost to dam removals.
Section 2 - Possible need to increase effort of caged fish or POCIS monitoring in rivers/streams	The USEPA has recently shown more interest in conducting caged fish studies in Michigan's AOCs (e.g., River Raisin, Clinton River); however, the WRD is only able to conduct one or two caged fish studies and a POCIS study each year due to staff constraints and limited equipment. Theft and destruction of cages during deployments has also reduced the number of WRD fish cages in recent years. The WRD looks to the USEPA for support if more studies are desired. Furthermore, the WRD uses hatchery raised channel catfish in its caged fish studies. Michigan-based aquaculture facilities that receive channel catfish from out-of-state suppliers are having issues maintaining levels of these fish needed for the private sector (e.g., farm pond stocking), which makes it increasingly more difficult for the WRD to obtain fish for its caged fish studies. Disease testing requirements and lower production of channel catfish from the out-of-state hatcheries are contributing to this supply chain issue. The use of passive samplers, such as semi-permeable membrane devices, can be used in lieu of caged fish; however, it is currently unknown how these two methods compare in order to maintain the long-term trends WRD has been evaluating with its caged fish studies

Where in Document and Details	Geomorphology
Section 2 - NPS needs regarding geomorphology	**Gaps**. • Geomorphology training for staff:

Where in Document and Details	Geomorphology
	○ Hydrology courses taught by Rosgen are offered through Wildland Hydrology. These classes are expensive and have limited availability. ○ There may be other appropriate hydrology courses for staff to attend. ○ Skills and knowledge from training stay with the individual upon changing jobs or leaving the NPS Program. • Software Licenses for Rivermorph: ○ EGLE uses a shared Rivermorph license paid for by the MDNR, which has limited availability as only one person can use the license at a given time. A dedicated EGLE license or WRD license could be used to ensure access more consistently among GLWARMS staff. • Geomorphology Equipment: ○ While no new equipment is needed currently, electronic equipment for geomorphology surveys is aging. The SP80 GNSS Receiver used for geomorphology surveys is about 15 years old. A newer survey-grade Global Positioning System can make corrections to data in the field, which will reduce post-processing time.

Where in Document and Details	Volunteer Monitoring
Section 2 - Potential use of volunteer monitoring data from inland lakes	The WRD is considering the feasibility of evaluating chloride impacts to inland lakes through this program. Incorporating available technology would also be beneficial, such as using Apps for data collection and modernizing data visualization using GIS. Also, while documenting changes over time is an objective of this effort, analyzing for trends remains a gap for this activity