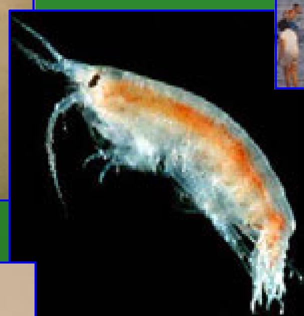
Lake Michigan Lakewide Management Plan (LaMP) 2006



Lake Michigan LaMP 2006
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Lake Michigan Lakewide Management Plan 2006 Status Report

Introduction

The purpose of this Lakewide Management Plan (LaMP) 2006 status report is to provide:

- An executive summary of the status of the Lake Michigan ecosystem;
- A report on the progress in achieving the Lake Michigan LaMP goals and examples of significant activities completed in the past two years since LaMP 2004;
- A summary of the current Lake Michigan mass balance data, findings, and model runs;
- Links to more detailed information in LaMP 2000, 2002, 2004 or other sources;
- An opportunity to comment on targets and plans for pollution reduction and ecosystem restoration;
- An opportunity to identify additional pollutants to be addressed by the LaMP in the future; and
- An overview of the 33 major sub-watersheds that flow into Lake Michigan, and their status.
- A status report on Lake Michigan Areas of Concern (AOCs).

What is the Status of the Lake?

"Lake Michigan is an outstanding natural resource of global significance, under stress and in need of special attention." **LaMP 2000**

Since the release of LaMP 2000, several key indicators point to the continuing concern for the health of the ecosystem.

- Beach season data exhibited a continued number of beach closings.
- Data reveal that a critical layer of the Lake Michigan aquatic food web continues to disappear, and with the discovery of new aquatic nuisance species–there are now a total of 180 (up from 170 4 years ago) in the Great Lakes ecosystem–the integrity of the food web of Lake Michigan is in question.
- Mercury in fish is such a prevalent problem that 44 states now have mercury fish advisories, and a national advisory has been issued for certain ocean fish pointing to a problem of global proportions.
- Climatic pattern changes, whether temporary or permanent, help focus attention about groundwater levels and lake/groundwater interaction and diversion.
- Terrestrial and aquatic animals appear to be rebounding with eagles nesting on the southern shore of Lake Michigan for the first time in 100 years, abundance of wolves lead to proposals to delist it from the endangered list, and a lakewide effort on restocking sturgeon is underway.
- Following the September 11, 2001 terrorist attacks, the issue of protecting the lake's vast supply of fresh drinking water has become a higher priority.

The Lake Michigan-Mississippi River basin divide: Chicago Avenue west of East Avenue in Oak Park, Illinois.

- Ten AOCs still in various stages of remediation are working on delisting target setting.

Despite these concerns, Lake Michigan supports many beneficial uses. For example, it provides drinking water for 10 million people; has internationally significant habitat and natural features; supports food production and processing; supplies fish for food, sport, and culture; has valuable commercial and recreational uses; and is the home of the nation's third-largest population center. Furthermore, significant progress is being made to remediate the legacy of contamination in the basin. Specifically, ongoing actions to restore the AOCs have been successful and have received new resources from the passage of the 2002 Great Lakes Legacy Act. Their status is outlined in Chapter 7. The Lake Michigan Watershed Academy was launched in four states and has brought together the regional planning agencies for the first time to align their work with Lake Michigan trends and Phase 2 of this work is underway.

Background on the LaMP

Under the Great Lakes Water Quality Agreement (GLWQA), as amended in 1987, the United States and Canada agreed " to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem." To achieve this objective, the parties agreed to develop and implement, in consultation with state and provincial governments, LaMPs for open waters and remedial action plans for contaminated AOCs. In the case of Lake Michigan, the only one of the Great Lakes wholly within the borders of the United States, the Clean Water Act (Section 118c) holds the U.S. Environmental Protection Agency (USEPA) accountable for the LaMP.

Work on the Lake Michigan LaMP began in the early 1990s with a focus on critical pollutants affecting the lake. At that time, monitoring data showed that point source regulatory controls established in the 1970s and 1980s were reducing the levels of persistent toxic substances such as polychlorinated biphenyls (PCB), DDT, and other pesticides. Monitoring results also indicated that nonpoint sources of pollution such as runoff and air deposition, as well as aquatic nuisance species, were stressing the Lake Michigan ecosystem. LaMP 2000 states that "pathogens, fragmentation and destruction of terrestrial and aquatic habitats, aquatic nuisance species, uncontrolled runoff and erosion are among the stressors contributing to ecosystem impairments."

Increased water quality protection for the Great Lakes watershed is now being implemented with the adoption of more stringent water quality standards for the Great Lakes basin drainage by each Great Lakes state, with the goal of having the new standards reflected in all permits by 2006.

What remains is a set of difficult, persistent, and multifaceted problems. In response, agencies must develop new tools, refocus their strategies and methods, and continually obtain new data. LaMP 2004 and 2006 recommend using a watershed framework as the most effective scale and structure for working on these problems and provided draft fact sheets for the 33 major Lake Michigan watersheds. Updated versions are provided in Chapter 12.

Linking LaMP Goals to RAPs

Remedial Action Plans (RAP) for Lake Michigan Areas of Concern

The GLWQA amendments of 1987 also called for the development of RAPs for specific Area of Concern. The two Federal governments were directed to cooperate with the state and provincial governments to develop and implement RAPs. The RAPs and LaMPs are similar in that they both use an ecosystem approach to assessing and remediating environmental degradation of the 14 beneficial use impairments outlined in GLWQA, Annex 2, and rely on a structured public involvement process. RAPs, however, encompass a much smaller geographic area, concentrating on an embayment or stretch of a river within a single watershed with contaminated sediments leading to fish advisories.

Forging a strong relationship between the LaMPs and RAPs is important to the success of both efforts. The RAPs serve as point source discharges to the lake as a whole. Improvements in the AOC areas will eventually help improve the entire lake. Much of the expertise and land use control of use impairments, possible remedial efforts and watershed planning reside at the local level. Cooperation between the two efforts is essential in order for LaMPs to remove lakewide impairments and for the RAP watershed to be able to restore integrity. The State of Michigan, with 14 AOCs, has developed, and USEPA has approved, methodologies for setting delisting targets for beneficial use impairments.

LaMP 2000, 2002, and 2004: How and by whom are they used?

The publication of LaMP 2000 documented the beginning of a basinwide dialogue on which pollutants and stressors should be prioritized for control, what reduction targets should be applied to them, and which ecologically rich areas should be identified for restoration and protection. Some issues, such as aquatic nuisance species, legacy sites, and drinking water protection, require immediate attention. Other issues continue to be the subject of public dialogue, and new issues may arise that require additional research. In 2000, the GLWQA Binational Executive Committee determined that an adaptive management approach would guide the LaMP process, making it an iterative approach. LaMP 2006 provides new information since 2004, responds to input received, and provides targets, objectives, and strategies.

Door County, Wisconsin, Lake Michigan Lakeshore
Photograph by Karen Holland, USEPA

The LaMP provides both a lakewide view and local information about each AOC and watershed. The LaMP partners are facilitating watershed literacy efforts, many RAP groups have taken the steps to become watershed groups where the expertise and energy can continue to lead stewardship activities.

What was Accomplished and What Challenges Remain?

Issues that were highlighted in LaMP 2000, 2002 and 2004 that have been accomplished include the following:

- Collaborative monitoring of the basin in 2005
- Setting targets for reduction of critical pollutants and stressors (see Chapter 7 and Chapter 4),
- Reviewing the LaMP list of contaminants and stressors
- Filling data gaps, including the Lake Michigan Mass Balance Project (see Chapter 7),
- Identifying ecologically rich areas and habitats (see Chapter 4 and Chapter 12
- Developing the concept of sustainability and stewardship (see Chapter 6 and Chapter 9)
- Convening public conferences and workshops for beach management, monitoring issues, and watershed management (see Chapter 1, Chapter 4, and Chapter 12)
- Further developing remedial action plans and developing delisting targets

Progress made on accomplishing these objectives is outlined in this status report.

Areas of LaMP Work that Remain a Challenge

Finalization of a monitoring plan and prioritization of indicators are still in progress. A draft monitoring plan was issued along with a set of recommendations in August 2000. To prioritize indicators and gather missing data, two major Great Lakes wide initiatives have begun that are focused on wetlands and the importance of the “coastal area.” The results of these efforts are providing not only new data but also refined indicators for wetlands.

One of the key functions of the LaMP process is to identify pollutants that are or have the potential to adversely affect the Lake Michigan ecosystem. In Appendix A, the process for identifying three categories of Lake Michigan LaMP pollutants on a geographic basis was outlined:

- Critical pollutants,
- Pollutants of concern, and
- Watch List pollutants.

Table i-1: Status of LaMP Pollutants Proposed in LaMP 2002-2004
(For more information on 2006 proposals and pending definitions, see Appendix A)

	Lake Michigan LaMP Pollutants Proposed in LaMP 2002	Lake Michigan LaMP Pollutants in LaMP 2004
Critical Pollutants	PCBs, chlordane, DDT/DDE, mercury, dioxin	PCBs, chlordane, DDT/DDE, mercury, dioxin
Pollutants of Concern	PAHs, lead, cadmium, chromium, copper, zinc, arsenic, cyanide, endrin, heptachlor epoxide, lindane, nickel, nutrients, pathogens, sediments	PAHs, lead, cadmium, chromium, copper, zinc, arsenic, cyanide, endrin, heptachlor epoxide, lindane, nickel, nutrients (a category which includes phosphorus), pathogens, sediments
Pollutant Watch List	atrazine, selenium, PCB substitute compounds	atrazine, selenium, PCB substitute compounds

LaMP 2004 finalized the critical pollutants, pollutants of concern, and watch list pollutants that were proposed in LaMP 2002. (See Table i-1). In addition, pollutants in each category were proposed for finalization in LaMP 2006. See Appendix A from LaMP 2004, especially Table A.6. A more detailed discussion of the LaMP pollutant identification process is provided in Appendix A.

In addition, a list of the pollutants that were proposed for these categories in LaMP 2002 and were made final in LaMP 2004 (see Table 1-1). Information for a new set of Watch List pollutants for LaMP 2004 was also provided in LaMP 2004's Appendix A. The terms "proposed" and "final" are relative and are terms of convenience. There will not be a truly final list of Lake Michigan LaMP pollutants until the LaMP adaptive management process changes or pollutant-caused impairments are remediated. Work on the LaMP pollutants adaptive management process will be the focus of the SOLEC conference lake Michigan workshop, November 2, 2006 in Milwaukee, Wisconsin.

A Focus on the Future: Sustainability and Stewardship

While partnerships can leverage resources, they also must be led and supported. Setting shared goals, objectives, and indicators in alignment helps to conserve resources but does not do away with resource needs. The interdependencies inherent in the ecosystem approach require a balance among three fundamental elements: environmental integrity, economic vitality, and sociocultural well-being. The ability of these elements to function in balance over time is one measure of sustainability. Complex ecological processes link organisms and their environment. These processes are often referred to as "ecological services" because they perform functions that combine to sustain life in the ecosystem. The significant natural features of Lake Michigan, such as its encompassing the world's largest collection of freshwater sand dunes, supporting 43 percent of the Great Lakes' large sport fishing industry, and providing drinking water for over 10 million residents, means billions of dollars not only to the economies of the four states that share the lake but also to the nation as a whole (see Chapter 5 and Chapter 6).

With that in mind, the nomenclature for the "meter" box at the start of each chapter has changed. It has changed from "poor to good" to "not sustainable to sustainable". This requires more discussion to further define these terms.

A Focus on Ecosystems and Watersheds

In 1995, the Federal Interagency Ecosystem Management Task Force defined an ecosystem as "an interconnected community of living things, including humans, and the physical environment with which they interact. As such, ecosystems form the cornerstone of sustainable economies." With regard to ecosystem management, the Task Force explained that "the goal of the ecosystem approach is to restore and maintain the health, sustainability, and biological diversity of ecosystems while supporting sustainable economies and communities. Based on a collaboratively developed vision of desired future conditions, the ecosystem approach integrates ecological, economic, and social factors that affect a management unit defined by ecological–not political–boundaries."

In response to the changing dynamic of environmental management, the Lake Michigan Management Committee adopted the ecosystem approach in 1998. The significance for the Lake Michigan LaMP was the intent to address not only the 10 areas that had been formally designated AOCs by the 1987 GLWQA amendments, but also other areas that were responsible for impairing the lake's ecosystem. The prime example was the Chicago area. Because of the rerouting of the Chicago River into the Mississippi River system, Chicago's surface water has been diverted out of the basin; however, groundwater from the Chicago area has not been diverted, and the city's large airshed has been shown to be a source of pollutants that are deposited in and affect the lake. The watershed/diversion connection is currently critical as steps are underway to prevent invasive or aquatic nuisance species from entering the Lake from the Mississippi River system (See chapter 8).

A Focus on Partnerships, Innovation, and Shared Information

In order to address the goals of a broad-based ecosystem approach requires a new management framework. As LaMP 2000 pointed out, the framework is based on "partnerships of organizations brought together to solve problems too large or complex to be dealt with by one agency with a limited mission. This approach also has the potential to leverage and direct local, state and federal, and private resources into a coordinated effort. The challenge is to create the framework for participating organizations to contribute their expertise and resources, often on an uneven basis, but in a manner that allows all partners to participate in the decision making on an even basis" (see chapter 10).

LaMP 2006 Data and Information

A key to engaging the necessary partners is a common, accessible, and scientifically sound body of knowledge. Lake Michigan protection and restoration requires open dialogue between academia and government agencies, as well as a collaborative monitoring plan to provide a current database. Reporting of current data and conclusions to the public is an important component of this system. This component presents many challenges, as data quality plans improve data accuracy but hinder the speed of reporting. Current management decisions are often made with gaps in both data and interpretation. These gaps may lead to incorrect problem assessments or incorrect response actions. The Lake Michigan LaMP has

Yellow Moccasin, Gibson Woods, Indiana
Photography by Karen Holland, USEPA

formed a basinwide coordinating and monitoring council to coordinate and promote common protocols and comparability in monitoring. The goal is to facilitate data sharing across agencies as well as among academic and research disciplines. Lake Michigan as a studied object is a moving target, and to provide adaptive management, there is a continuing need for monitoring and reporting of the lake's current status (see chapter 11 and Appendix A).

Most, but not all of the data used has been peer reviewed in its original development. The use in the LaMP is considered secondary data. New data is provided by:

- Researchers who publish and present at conferences
- Researchers who receive USEPA grants provide new data and insights
- Volunteer scientists who volunteer and report on Great Lakes indicators every two years at the State of the Lakes Ecosystem Conference

- Monitoring efforts paid for by state, federal, and local governments, universities, volunteer organizations, and non-profit organizations.

Please check the web sites referenced in LaMP 2006 for primary sources.

Great Lakes Regional Collaboration

In October 2003, the Great Lakes Governors identified nine critical environmental priorities for regional action. These were adopted by the Great Lakes Mayors and the Great Lakes Commission. In May 2004, President Bush signed an Executive Order creating a Cabinet-Level task Force to bring an unprecedented level of collaboration and coordination among, State, Federal, and local governments, tribes, and other interests in the United States and Canada to accelerate protection and restoration of the Great Lakes. This led to the development and announcement of a series of recommendations from stakeholders in a final Great Lakes Regional Collaboration Report in December 2005 after a year-long process of research and consensus building.

The recommendations, while not official government policy, reflect the consensus of the wide range of stakeholders involved in the collaboration process. GLRC action items are listed at the beginning of each LaMP chapter and the goals and recommendations at the end of each LaMP chapter as information only. During the next two years, the LaMP management committee will review them and make decisions regarding whether and how they can be applied to the Lake Michigan LaMP process.

Great Lakes Water Quality Agreement Review

The governments of Canada and the United States asked the IJC to seek the public's views on how well the Great Lakes Water Quality Agreement (GLWQA) has worked so far and how effective it has been. In response, the IJC held public meetings in 14 Great Lakes and St. Lawrence cities in Fall 2005, wrapping up its consultations with a Web Dialogue. It also received comments from individuals and organizations by hand, mail, fax, phone, e-mail and online. More than 4000 individuals and organizations took part. The review process is continuing through 2006. More information is available at www.epa.gov/glnpo/glwqa.

Organization of the LaMP and this Status Report for 2006

This document is intended to provide a status report on the health of the Lake Michigan ecosystem and a summary of the activities related to the Lake Michigan LaMP that have occurred during the last 2 years. Each chapter provides reports on current status, challenges, indicators, and next steps.

The LaMP is based upon the vision, goal and subgoals of the Lake Michigan LaMP. The vision and goal were adopted by the Management Committee August 18, 1998. The vision is:

A sustainable Lake Michigan ecosystem that ensures environmental integrity and that supports and is supported by economically viable, healthy human communities.

The LaMP goal is:

To restore and protect the integrity of the Lake Michigan ecosystem through collaborative, place-based partnerships.

Specifically, this report is organized to provide a summary status report on the subgoals identified by the Lake Michigan LaMP. These subgoals are stated as questions and are organized in 11 chapters. The last, 12th chapter, provides information on activities related to these sub-goals in the 33 subwatersheds. The chapters are as follows:

1. Can we all eat any fish?
2. Can we all drink the water?
3. Can we swim in the water?
4. Are all habitats healthy, naturally diverse, and sufficient to sustain viable biological communities?
5. Does the public have access to abundant open space, shorelines, and natural areas, and does

the public have enhanced opportunities for interaction with the Lake Michigan ecosystem?
6. Are land use, recreation, and economic activities sustainable and supportive of a healthy ecosystem?
7. Are sediment, air, land, and water sources or pathways of contamination that affect the integrity of the ecosystem?
8. Are aquatic and terrestrial nuisance species prevented and controlled?
9. Are ecosystem stewardship activities common and undertaken by public and private organizations in communities around the basin?
10. Is collaborative ecosystem management the basis for decision-making in the Lake Michigan basin?
11. Do we have enough information, data, understanding, and indicators to inform the decision-making process?
12. What is the status of the 33 Lake Michigan subwatersheds?

What Does Page One of Each Chapter Explain?

Page one of each chapter provides the current status of the goal and the 2020 target that the states and federal governments are striving to meet. It also lists the indicators that informs the status statement and the challenges and next steps that will be dealt with in the next two years.

What are the "Text" Boxes and What Do They Provide?

Throughout the document, "text" boxes are employed to portray examples of work underway in the basin, or, in some cases, a noteworthy event. They are also used to provide details of what is being discussed in the chapter. They often contain a web address where the reader can follow up if interested. The information does not necessarily imply activity done under the auspices of the LaMP, but provides examples of how LaMP goals can be accomplished.

What is the "Lake Michigan Toolbox"?

The 2006 Lake Michigan LaMP document has a series of "Lake Michigan Toolboxes" that provide links to resources that can be applied to basin problems and exchange shared experiences. They are targeted to assist local government and watershed groups as they work to better manage their local ecosystems. The tools include example and model ordinances, manuals and resources for local officials, planners, developers, individual citizens, and other interested parties.

Where Can I Find LaMP 2000 and the 2002 and 2004 Status Reports? Where Do I Send Public Comments?

Lake Michigan LaMP 2000, 2002, and 2004 are available on line at www.epa.gov/glnpo/michigan.html. For a CD or printed copy of the LaMP or to make a public comment, contact the U.S. Environmental Protection Agency, Mail Code T-17J, 77 West Jackson Boulevard, Chicago, IL 60604. Public comments are factored into LaMP deliberations and will be reflected in LaMP 2008.

Great Lakes Forever Coastal Drink Coasters.
Source: www.biodiversityproject.org

Executive Summary

Details on the Bullets Below are found in the Individual Subgoal Sections for the 2002, 2004 and 2006 LaMP Reports

Goal: To Restore and protect the integrity of the Lake Michigan ecosystem through collaborative place-based partnerships.

Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2006	Next Steps	Long-Term Objectives
	END POINT SUBGOALS			
Human Health Actions that prevent human exposure to pollutants in the ecosystem and prevent or minimize sources SOLEC Indicator Bundles •Human Health •Coastal Zone •Contamination •Land Use/Land Cover	**Subgoal 1** We can all eat any fish ***Status*** • Mixed in 2006 • Mixed/Improving by 2010 • Sustainable by 2020 **Subgoal 2** We can drink the water ***Status*** • Sustainable in 2006 • Sustainable in 2010 • Sustainable in 2020 **Subgoal 3** We can swim in the water ***Status*** • Mixed in 2006 • Mixed/Improving by 2010 • Sustainable by 2020	**2002** • Fish advisories for mercury by USFDA and for dioxin by Michigan and Tribes • Grand Cal and Fox River AOC sediment cleanup plans underway • Sokaogon Chippewa Community Bans Burn Barrels • Grand Traverse Band of Ottawa and Chippewa Indians ban burning trash/garbage on tribal lands • TMDL workshops with regulators and stakeholders held • Mercury Phase-Out proposal proposed • Drinking water monitoring and reporting information available on the web • Great Lakes Beach Conference held • Beaches Environmental Assessment and Coastal Health Act of 2000 • EPA and FDA issue joint mercury fish advisory **2004** • Legacy Act 2002 to clean up sediments passed and $10 million appropriated for FY 2004, $46 million proposed for FY 2005 • Fish consumption advisory outreach programs developed for non-English speakers • Impaired waters strategy under development • Source water assessment programs almost completed • Public Health Security and Bioterrorism Preparedness and Response Act of 2002 being implemented • Drinking water education programs developed • Defense Department Developing Rapid Water Quality Testing Technology • Constructed wetland effectiveness researched • Chicago and Milwaukee to control CSOs • Cladophora alga resurges **2006** • **Great Lakes Fish Monitoring Program Continues** • **Illinois Proposes 90 Percent Mercury Emissions Reduction** • **USEPA Issues New Mercury Rules** • **Source Water Assessment and Protection Program – States Complete All Assessments** • **Water Security Plan Required** • **Pharmaceuticals, Hormones and Other Organic Wastewater Contaminants in U.S. Streams More Identifiable** • **NEEAR Water Study Helps Set New Beach Alert Standards** • **Cladophora Alga Continues to Grow** • **Lake Michigan CSOs Studied** • **Michigan to Clean up Galien River** • **Policy on Peak Wet Weather Discharges from Municipal Sewage treatment Facilities Proposed**	• Develop the Impaired Waters Strategy • Clarify common definition of “open waters” • Cleanup of superfund sites and other PCB contaminated harbors • Support efforts to recycle mercury-containing electronic devices • Continue Watershed Academy • Seek funding to develop a source water protection GIS system. • Enhance local public water supply security • Identify resources for public water suppliers to ensure that by 2011, 80% of the community water systems will be substantially implementing source water protection plans • Help coordinate outreach materials development • Continue support of Great Lakes Beach Association conferences • Report on the latest beach research • Report on research on beach grooming, pathogen tests, and cladophora bloom causes in the LaMP at the State of Lake Michigan Conference	• By 2020, beach, nonpoint source, CSO, CAFO management actions completed so that 90% of monitored high priority beach waters meet bacteria standards 95% of the average swimming season. • By 2011, 80% of the community water systems will be substantially implementing source water protection plans

Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2006	Next Steps	Long-Term Objectives
	END POINT SUBGOALS			
Restoration and Protection Actions that restore, enhance, and sustain the health, biodiversity, and productivity of the ecosystem SOLEC Indicator Bundles •Biotic Communities •Coastal Zone •Aquatic Habitats •Invasive Species •Land use/Land Cover •Resource Utilization •Climate Change	**Subgoal 4** All habitats are healthy, naturally diverse, and sufficient to sustain viable biological communities ***Status*** • Mixed in 2004 • Mixed/Improving by 2010 • Sustainable by 2020	**2002** • Perch population still dropping • Northwest Indiana Advanced Identification of Wetlands Study underway • Keystone species (diporeia) in Lake Michigan food web vanishing • Supreme Court Ruling narrows wetland regulation • Wisconsin passes wetlands protection law • Piping Plover critical habitat designated by USFWS • *Antrim County, Michigan Wetland Protection ordinance rescinded* • Wolf populations recovering • Habitat and Land Use Management Tool Box under development • Established a 1994 baseline for land cover • NIPC "Biodiversity Recovery Plan" document produced • Northwest Indian greenway plan unveiled • Sturgeon restoration efforts begin **2004** • Diporeia density continues to decrease • Dam removals in southeastern Wisconsin improve fish habitat • Nature Conservancy develops Biodiversity Blueprint • Chicago signs migratory bird treaty • Bald eagles return to Little Calumet River • Manistee Watershed grant • Wisconsin non-point source regulation promulgated **2006** • **Little River Ban Release Sturgeon Fingerlings** • **Boardman River Dams settlement Executed** • **Perch Young of the Year larger in number** • **Michigan and Other States Set Wetland Restoration goals** • **USFWS Awards grant to restore Hegewisch Marsh** • **Piping Plover agreement in place** • **Wisconsin DNR works to protect dwarf lake iris** • **Diporeia density continues to decrease** • **Wolves thriving, delisting proposed** • **Chicago Wilderness Report Card released (www.chicagowilderness.org)**	• Develop process to refine targets through public discussion and promote work toward targets • Continue to support components of lake basin biodiversity plan though watershed academy grants • Identify species sensitive to ground and surface water interaction • Provide GIS tools and land use models in workshops to promote knowledge of and protection of key habitat areas and trends in loss and gain • Promote the construction of new stream buffers and wetlands using, federal, state, local, and private resources and monitor loss and gain trends • Promote dam removal studies	• By 2020, 125,000 net acres of wetlands restored and subsequently protected • Dam removal and/or stream buffers lead to restored fisheries in 10 streams • By 2020, 1/3 of watersheds will be unimpaired, 1/3 have reduced impairments, and 1/3 have work underway.

Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2006	Next Steps	Long-Term Objectives

Sustainable Use
 	
Actions that concurrently sustain the health of the environment, the economy, and the communities of the ecosystem
 	
SOLEC Indicator Bundles
• Contamination
• Biotic Communities
• Invasive Species
• Coastal Zones
• Aquatic Habitats
• Human Health
• Land Use/Land Cover
• Resource Utilization
• Climate Change
	Subgoal 5
	Public access to open space, shoreline, and natural areas is abundant and provides enhanced opportunities for human interaction with the Lake Michigan ecosystem
	
	Status
	• Mixed in 2004
	• Mixed/Improving by 2010
	• Sustainable by 2020
	
	Subgoal 6
	Land use, recreation, and economic activities are sustainable and support a healthy ecosystem
	
	Status
	• Mixed in 2004
	• Mixed/Improving by 2010
	• Sustainable by 2020
		2002
		• Governors and Premiers sign Great Lakes Charter Annex 2001
		• Indiana moves into Coastal Zone Management program
		• Wisconsin Smart Growth act
		• Historic Agreement to Manage Fisheries in 1836 Treaty Waters
		• Economic valuation studies by Northeast-Midwest Institute, Lake Michigan Federation, and University of Wisconsin Sea Grant
		• Lake Michigan Potential Damages study continues in sixth year
		• USGS Lake Michigan Trends Project funded
		• USGS Pollutants of Concern list developed
		• Upland Michigan Land Use report
		• Federal two-year ban on drilling under the Great Lakes continued in 2003
		• Michigan moratorium on drilling under the Great Lakes
		• Dams removed in Milwaukee and Muskegon Rivers
		• Menominee tribe purchases proposed Crandon Mine site
		• Groundwater studies document unsustainable withdrawal
		• UIC study shows economic benefits of sediment clean ups
		2004
		• Crandon Mine site purchased by tribes
		• Northwest Indiana mayors join to remake Indiana lakeshore.
		• Lake Michigan water trail proposed
		• Chicago launches new water agenda.
		• Michigan governor outlines comprehensive water agenda.
		• MMSD creates river revitalization program using easement acquisition.
		• Chicago diversion deficit reduced faster than planned
		2006
		• **Marquette Plan to open Indiana shore**
		• **Marquette Plan Phase 1 honored by American Society of Landscape Architects**
		• **Lake Michigan Watershed Trail proposed and under development**
		• **Sleeping Bear Dunes Developing New General Plan**
		• **Great Lakes Governors and Premiers Sign Great Lakes Charter Annex Implementing Agreements**
		• **Michigan passes new water withdrawal law**
		• **Illinois Governor Orders new water supply study**
		• **Lake Michigan diversion "debt" likely repaid in 2004 water year**
		• **Michigan court decree on walkable beaches**
			• Partner with the growing coastal zone management programs in the Lake Michigan basin to ensure that the issue of public access to the lake is balanced with protection of the ecosystem
			• Support *cladophora* research
			• Support a green marina dialogue
			• Determine protection status of world's largest collection of fresh water sand dunes
			• Public involvement in preservation and stewardship of special natural areas with public access for sport and recreational activities should be fostered by the following:
			  • Broaden the dialogue with state and local government land-use planners and decision-makers to balance environmental and recreational needs
			  • Provide tools for local communities to understand the value of the resource from a lakewide perspective and develop long-term management programs
			  • Identify open space multi-use opportunities and tools for such things as flood retention parks, and open space with commuter bike trails, among others
			• Help develop Green Marina, Highway, and Golf Course programs
			• Promote studies that investigate the status of groundwater resources and their impact on water quality and aquatic habitat
			• Support studies to determine sustainable yields for Great Lakes water resources
				• Sustainable management of the basin by 2020:
				  • Slowed withdrawal rates from basin groundwater
				  • Lake level fluctuations based on natural fluctuations with no major anthropogenic factors

Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2006	Next Steps	Long-Term Objectives
	END POINT SUBGOALS			

Remediation and Pollution Prevention
 	
Actions that achieve substantial pollution reduction by remediating sites, controlling pathways, preventing or minimizing sources
 	
SOLEC Indicator Bundles
• Contamination
• Land Use/land Cover
• Invasive Species
	Subgoal 7
	Sediments, air, land, and water are not sources or pathways of contamination that affect the integrity of the ecosystem
	
	Status
	• Mixed in 2004
	• Mixed/Improving by 2010
	• Sustainable by 2020
	
	Subgoal 8
	Aquatic and terrestrial invasive species are prevented and controlled
	
	Status
	• Mixed in 2004, possible deterioration
	• Mixed/Improving by 2010
	• Sustainable by 2020
		2002
		• Lake Michigan Mass Balance (LMMB) findings published
		• PCB levels in lake trout achieving equilibrium
		• U.S. EPA Atrazine Reassessment initiated
		• IADN results consistent with LMMB findings
		• Bush administration announced climate change and "Clear Skies" initiatives
		• 1999 Toxic Air Emissions inventory released
		• U.S. EPA published Air Great Lakes Deposition (GLAD) Strategy
		• PCB/mercury Clean Sweep in Cook County, IL
		• Wisconsin mercury regulations
		• States act to control animal operations
		• New aquatic nuisance species found in Lake Michigan
		• Michigan Ballast Water Bill
		• St. Lawrence Seaway Corporation to incorporate ballast water practices
		• Chicago River invasive species dispersal barrier installed
		• ANS Task Force and Great Lakes Panel on ANS continue work to control ANS
		2004
		• Corps funding secured for building permanent Asian Carp barrier on Chicago River system
		• Wisconsin begins mandatory rural NPS program
		• Michigan and Indiana add animal operation to permits
		• Milwaukee Metropolitan Sewerage District adopts mercury dental program.
		• Michigan proposes new NPDES permit for CAFOs
		• National Aquatic Invasive Species Act of 2003 passed.
		2006
		• **Quagga Mussels Increasing in Number to Compete for Food with Native Mussels**
		• **Sound and Bubble Barrier Could Deter Asian Carp**
		• **PCB, Mercury and Nutrient findings from LMMB:**
		• **Forecasted PCB concentrations in lake trout may permit unlimited consumption as early as 2039 at Sturgeon Bay and 2044 at Saugatuck**
		  • **PCB trends indicate that concentrations are declining in all media**
		  • **Atmospheric deposition is the major current route of PCBs to the lake (from sources inside and outside the basin)**
		  • **Chicago urban area is a substantial atmospheric source of PCBs to Lake Michigan**
		  • **There is a dynamic interaction among water, sediments, and the atmosphere where large masses of PCBs from sediments cycle into and out of the lake via the atmosphere as vapor phase**
		  • **The current major source of mercury to the lake is from atmospheric deposition.**
		  • **Most Lake Michigan lake trout and coho salmon exceed the USEPA guidelines for unrestricted consumption.**
		  • **Modeling results suggest that a significant amount of the existing mercury settling out of water is being recycled back into the system.**
		  • **Lake Michigan phosphorus loads and concentrations are low and below GLWQA and IJC targets**
		  • **Tributaries are the major source of phosphorus to Lake Michigan**
		  • **Highest concentrations can be observed in selected nearshore zones near tributary mouths and in Green Bay**
		  • **There is no evidence of increasing loads or increasing concentrations in the open-water through 2002; forecasts indicate relatively stable phosphorus and chlorophyll-a concentrations into the future**
		• **Green Bay clean-up agreements announced**
			• Education and outreach on aquatic invasive species in order to accomplish
			• Ship and barge-mediated introductions and spread of AIS in the Great Lakes should be eliminated
			• Federal, state, and/or local governments must enact measures that ensure the region's canals and waterways are not a vector for AIS
			• Federal and state governments must take immediate steps to prevent the introduction and spread of AIS through the trade and potential release of live organisms
			• Establish a Great Lakes Aquatic Invasive Species Integrated Management Program to implement rapid response, control, and management programs and assess the effectiveness of those programs
			• Develop a better understanding of the natural dynamics that affect pollutant distribution in the Lake Michigan ecosystem and why near shore and open lake can have wide variances
			• Reduce pollutant loads with effective control and pollution control measures
			• Build on the coordinated monitoring of 2005 and develop a 10-year trend analysis based on the 1994-95 mass balance project
			• Review contaminated sediment sites and their status will be updated for Legacy Act funding or delisting opportunities
			• Investigate nutrient contributions from the agricultural sector and non point sources during wet weather. Determine if nutrient levels are linked to *Cladophora* blooms
			• Hold meetings to discuss Lake Michigan Mass Balance models and implications for Impaired Waters Strategy
			• Develop Impaired Waters Strategy through basinwide meeting
				• By 2010, remediation of 50 percent of AOC sites
				• By 2020, remediation of 70 percent of AOC sites
				• By 2025, remediation of 100 percent of AOC sites
				• By 2010, vessels entering the Great Lakes will discharge ballast water free of invasive species.
				• Eliminate further ANS introductions by 2010.
				• Lake Michigan remains "Asian carp free"
				• By 2020 some, but not all fish will be safe to eat
				• By 2020, nearshore communities will have green harbors

Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2006	Next Steps	Long-Term Objectives
	END POINT SUBGOALS			
Information Sharing, Collaboration and Stewardship Actions that provide data access and exchange, facilitate involvement, and build capacity SOLEC Indicator Bundles • Contamination • Biotic Communities • Invasive Species • Coastal Zones • Aquatic Habitats • Human Health • Land Use/Land Cover • Resource Utilization • Climate Change	**Subgoal 9** Ecosystem stewardship activities are common and undertaken by public and private organizations in communities around the basin ***Status*** • Mixed in 2004 • Mixed/Improving by 2010 • Sustainable by 2020 **Subgoal 10** Collaborative ecosystem management is the basis for decision-making in the Lake Michigan basin ***Status*** • Mixed in 2004 • Mixed/Improving by 2010 • Sustainable by 2020	**2002** • Lake Michigan Forum developing Stewardship trust • State of Lake Michigan Conference held - November 2001 • Forum/Grand Valley State University "Making Lake Michigan Great Tour" continues to educate about Lake Michigan ecosystem during summer cruises • Great Lakes Strategy released in 2002 by U.S. EPA • Great Lakes Human Health Network established • Voluntary monitoring Conference March 2002 • Wingspread Accord signed • Participation by regional councils in watershed planning and water supply conferences **2004** • Watershed Academy training held and 6 regional conferences held or planned • Indiana Coastal Zone program gives out first grants • Illinois Conservation Congress recommends investigation of CZM participation • Great Lakes Cities Initiative launched • Illinois Ecosystem Partnership for Lake Michigan in development • Waukegan recognized as an EPA Environmental Justice community • Great Lakes restoration bill introduced into Congress • EPA utilizes watershed focus • Mona Lake Watershed Stewardship Assessment completed • Illinois-Indiana-Wisconsin planning agencies agree to consistent groundwater planning **2006** • **President signs Executive Order organizing Great Lakes Regional Collaboration** • **Great Lakes Regional Collaboration sees participation by numerous organizations and releases report and recommendation in December 2005** • **Regional planning agencies follow-up on Phase II Watershed Academy activities** • **Lake Michigan Forum performs watershed assessment for Baird Creek** • **NIRPC releases Water Conservation and Protection Toolkit** • **NIPC releases 2040 regional framework plan with tools for decisionmakers** • **Michigan and Indiana Cooperate in Developing the St. Joseph River Watershed Management Plan** • **Great Lakes governors and Premiers sign Great Lakes Charter Annex Implementation Agreements**	• Develop projects utilizing the Lake Michigan LaMP watershed fact sheets and exploration of other needed tools (see Appendix D) • Continue the Lake Michigan Watershed Academy and support GIS and models workshops and small implementation grants to local communities • Provide additional education and outreach materials on water conservation and source water protection • Promote the habitat and land use management tool box • On-line habitat atlas continues to build layers • Hold FY 2007 State of Lake Michigan Conference • Continue the research vessel boat tour – Making Lake Michigan Great • Continue the development and linkage of local watersheds with basin-wide issues and activities through the watershed academy • Coordination of LaMP and GLBTS efforts on PCBs and mercury • LMMCC continues leadership role for collaborative monitoring in 2010 • Meet with the four Coastal Management programs to explore partnership opportunities	• Clean up and delist AOCs • Implement the Lake Michigan Watershed Academy • By 2020, every watershed will be represented and in communication with other watershed groups around the basin • By 2020, watershed literacy will be rated high

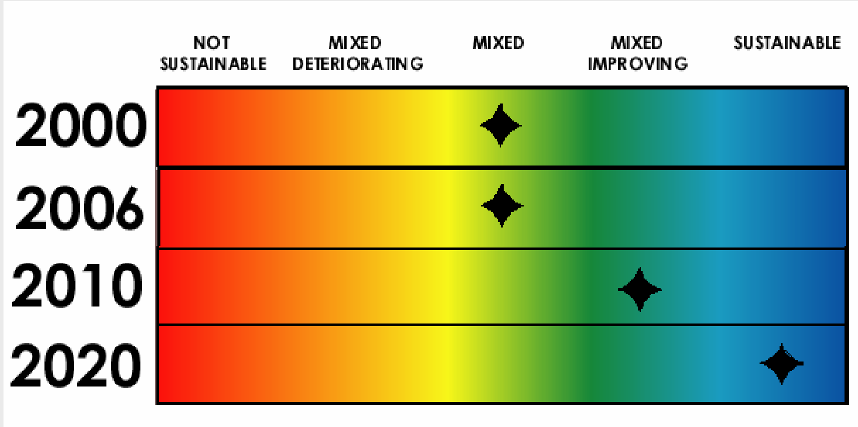
Strategic Action Agenda	Subgoals of the Lake Michigan LaMP	Significant Happenings 2000-2004	Next Steps	Long-Term Objectives
	END POINT SUBGOALS			
Research and Monitoring Actions that monitor the ecosystem, reduce uncertainty, and inform our decisions SOLEC Indicator Bundles ▪ Proposed new "Well-Being" bundle	**Subgoal 11** We have enough information/data/understanding/ indicators to inform the decision-making process ***Status*** • Mixed in 2004 • Mixed/Improving by 2010 • Sustainable by 2020	**2002** • LMMB project findings • Lake Michigan Monitoring Coordinating Council monitoring and assessment inventory • Lake Michigan Monitoring Assessment report released • Beach monitoring program (BEACH) created by U.S. EPA • BEC statement and monitoring conference • IJC/Delta Institute/Lake Michigan Forum Air Deposition Workshop • Great Lakes Wetlands Consortium consolidates wetland information • EPA/ORD wetlands indicators • LaMP pollutant list review • Beach Conference, web site, and manager's group **2004** • National Park Service monitoring begins • Lake Michigan Monitoring Council develops 2005 intensive monitoring year plan • Midwest Spatial Information Partnership formed - Workshop held in conjunction with Lake Michigan Watershed Academy • LMMB data sets available • Ann Arbor Statement on long-range atmospheric transport proposed **2006** • **USGS maintains surface water-quality network for streams in the Lake Michigan basin** • **GLNPO's Aquatic Contaminant Monitoring program completes FY 05 Intensive Year of Monitoring** • **First collaborative Lake Michigan basin-wide FY 05 Year of Intensive Monitoring completed**	• Monitoring and research will be reviewed to identify LaMP pollutants and trends to determine if LaMP pollutants list needs to be changed • A LMMB Study data report completed for each contaminant studied and added to the LaMP online at www.epa.gov/GLNPO/LMMB • Progress will be made in aligning monitoring programs and indicators • The coordinated monitoring results for the lake intensive monitoring year 2005 will be completed, analyzed, and published • Lake Michigan models will be documented further, and additional scenarios will be simulated with results shared through the LaMP and in other ways • Complete Lake Michigan Monitoring Coordinating Council Aquatic Nuisance Species monitoring survey results and recommendations. • Cladophora alga research and development is being supported by the LaMP	• Special effort and emphasis on coordinated monitoring in the Lakes Michigan basin by 2004-05 • By 2010, complete next collaborative monitoring effort • By 2015, complete 20 year revisit of Lake Michigan Mass Balance

Subgoal 1
Can we all eat any fish?

Status

Commercial and sport fishing are important to a sustainable Lake Michigan. The need still exists for all four Lake Michigan states to maintain advisories to warn the public about potential health effects resulting from consuming certain species of sport fish in the lake as well as inland lakes. In 2004, the FDA and USEPA issued AN advisory for Women Who Might Become Pregnant, Women Who are Pregnant, Nursing Mothers, and Young Children concerning levels of mercury in commercial fish (See www.cfsan.fda.gov~dms/admehg3.html for more information). As a result, achievement of the subgoal in Lake Michigan is mixed.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 114 - Contaminants in Young-of Year Spottail Shiners
- 117 - Atmospheric Deposition of Toxic Chemicals
- 118 - Toxic Chemical Concentrations in Offshore Waters
- 119 - Concentrations of Contaminants in Sediment Cores
- 124 - External Anomaly Prevalence Index for Nearshore Fish
- 4177 - Biological Markers of Human Exposure
- 4201 - Contaminants in Sport Fish
- 8135 - Contaminants Affecting Productivity of Bald Eagles

Challenges

- Determine and reduce the source of toxic atmospheric deposition to Lake Michigan
- Uniform fish consumption advice for Lake Michigan
- Secure resources to clean up contaminated sediment sites
- Make fish consumption advisory data widely accessible and user-friendly using multiple languages
- Maintain the health and sustainability of the aquatic food web in Lake Michigan as well as continue the progress of making fish safe to eat.

Next Steps

- Develop the Impaired Waters Strategy
- Clarify common definition of “open waters”
- Cleanup of superfund sites and other PCB contaminated harbors
- Support efforts to recycle mercury-containing electronic devices

Fish Consumption Advisories

Consumers should know that fish and shellfish can be important parts of a healthy and balanced diet. They are good sources of high quality protein and other essential nutrients. Women of child-bearing age, fetuses, and children are more susceptible to the effects of contaminants in fish. State fish consumption advisories include advice specifically targeted to these sensitive populations.

Fishing is one of the most popular forms of outdoor recreation in the Midwest, and Americans are eating more fish as diets shift toward more low-fat foods.

About 40 species of fish currently inhabit Lake Michigan, most of which are native to the lake. Over 43 percent of all Great Lakes fishing in the U.S. is done in Lake Michigan, and both commercial fishing and sport fishing are significant contributors to the economies of the states in the basin. Commercial fish production (both nontribal and tribal) reaches over 14.6 million pounds of fish annually. The commercial fishery is valued at more than $270 million and the recreational fishery at $4 billion.

Fish consumption, however, has been shown to be a major pathway of human as well as wildlife exposure to persistent toxic substances, such as polychlorinated biphenyls (PCBs) and mercury. Contaminants released from many sources are transported through the environment and are carried into streams and lakes. Small organisms absorb these contaminants and are, in turn, eaten by other organisms and small fish. Some of these contaminants bioaccumulate in the fish –and in humans who eat them – to levels that can pose health risks.

GLRC

Great Lakes Regional Collaboration Action Items

Persistent Bioaccumulative Toxic Pollution

Toxic pollutants continue to stress the Great Lakes ecosystem, posing threats to human and wildlife health. Persistent toxic substances such as mercury and PCBs remain present in fish at levels that warrant advisories and restrict consumption throughout the Basin. To address this ongoing problem, actions are needed to:

- reduce and virtually eliminate the discharge of mercury, PCBs, dioxins, pesticides and other toxic substances to the Great Lakes;
- prevent new toxic substances from entering the Great Lakes;
- institute a comprehensive research, surveillance and forecasting capability;
- create consistent, accessible basin-wide messages on fish consumption and toxic reduction methods and choices; and
- support efforts to reduce continental and global sources of toxics to the Great Lakes.

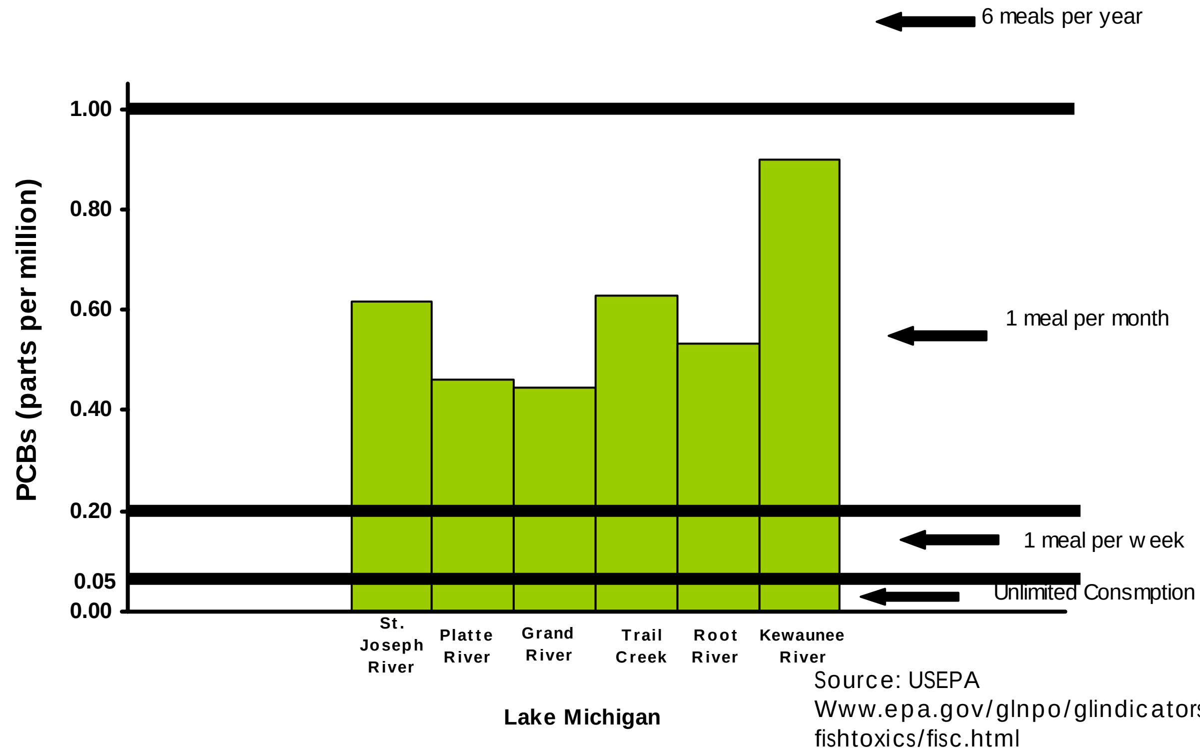
State fish consumption advisories are issued to protect people from potential adverse health effects associated with contaminants found in fish. These advisories recommend amounts and types of fish that are safe to eat. Fish consumption advisories may also include information to educate the public on how to

The Lake Michigan Toolbox
State Fish Consumption Advisories

Illinois: www.idph.state.il.us/envhealth/factsheets/fishadv.htm
Indiana: www.in.gov/isdh/programs/environmental/fa_links.htm
Michigan: www.michigan.gov/mdch/0,1607,7-132--13110--,00.html
Wisconsin: http://dhfs.wisconsin.gov/eh/fish/

A consolidated source for Great Lakes fish consumption advisories as well as information on other standards applicable to the lakes is available on a Great Lakes Information Network site:
http://www.great-lakes.net/envt/flora-fauna/wildlife/fishadv.html

Application of the Uniform Advisory Protocol for PCB concentrations in Lake Michigan Coho Salmon 2002



Source: USEPA
Www.epa.gov/glnpo/glindicators/fishtoxics/fisc.html

minimize exposure to certain contaminants through proper fish preparation and cooking. The advisories are viewed as a temporary measure to protect the public while control measures and site cleanups reduce contamination to safe levels.

PCBs are the primary contaminant behind the fish consumption advisories published by all four Lake Michigan states. There are also advisories for dioxin, chlordane, DDT, and mercury (See Appendix A for more detailed information). Mercury advisories are also issued by each Lake Michigan state for fish of inland lakes and some select Lake Michigan sites. As a rule, mercury is the dominant contaminant behind fish consumption advice from inland lakes due to atmospheric deposition and the lack of elimination of water through streams and or rivers. Dioxins, chlordane, and DDT and many other contaminants are also present in fish but are not in high enough quantity to warrant advice beyond PCB levels.

States frequently use fish consumption advisories (See opposite page) as indicators of whether their waters are meeting designated uses, triggering the need for investigation and setting a total maximum daily load (TMDL) for contaminants. TMDLs for PCB and mercury are therefore required for Lake Michigan. The fish consumption advisories are updated annually and updated on state fish consumption advisory web pages. Locations of specific needed TMDLs related to fish advisories are listed in the watershed fact sheets (See Chapter 12).

PCB Advisories

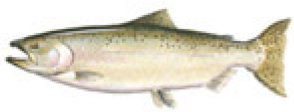
PCBs are a group of more than 200 similar man-made chemicals that were used in a variety of industrial applications as insulating fluid for electrical equipment like capacitors and transformers. They are oily liquids or solids, clear to yellow in color, with no smell or taste. More than 1 billion pounds of PCBs were manufactured in the United States. Because of the health effects associated with exposure, commercial production of PCBs ended in 1977. In 1979, the U.S. Environmental Protection Agency (USEPA) also banned most uses of PCBs; however, PCB removal or replacement was not required for equipment that already contained these chemicals and was in a closed system. PCBs are still present in many products made prior to 1979. Because these contaminants were used so widely and take a long time to break down, they can be found in the fat of people and animals.

Sport Fish Advisory Example
Illinois Lake Michigan Fish Advisory

Cook and Lake Counties (Illinois)

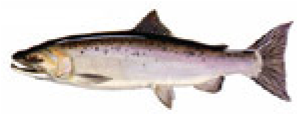
Species and Meal Frequency

Chinook Salmon



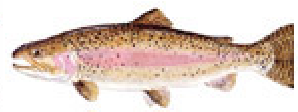
All Waters
Less than 32"
1 meal/month
- or -
Larger than 32"
6 meals/year
Contaminant - **PCBs**

Coho Salmon



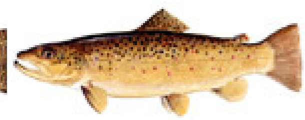
All Waters
All Sizes
1 meal/month
Contaminant - **PCBs**

Rainbow Trout



All Waters
Less than 22"
1 meal/week
-or-
Larger than 22"
1 meal/month
Contaminant - **PCBs**

Brown Trout



All Waters
Less than 22"
1 meal/month
- or -
Larger than 22"
6 meals/year
Contaminant - **PCBs**

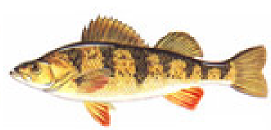
Channel Catfish

All Waters
All Sizes
Do Not Eat
Contaminant - **PCBs**

Lake Trout

All Waters
Less than 23"
1 meal/month
- or -
23" to 27"
6 meals/year
- or -
Larger than 27"
Do Not Eat
Contaminant - **PCBs**

Yellow Perch



All Waters
All Sizes
1 meal/week
Contaminant - **PCBs**

Carp

All Waters
All Sizes
Do Not Eat
Contaminant - **PCBs**

Figure 1-2. Illinois Lake Michigan Fish Advisory
Source: www.idph.state.il.us/envhealth/factsheets/fishadv.htm

Mercury Advisories

Mercury is a metal that occurs naturally in small amounts in the environment. It also enters the environment from burning coal or trash and can then enter the food chain. Mercury gets into lakes and rivers in several ways, in addition to atmospheric deposition, including rain and runoff.

According to the USEPA (Publication EPA-823-F-01-011), once released into the environment, inorganic mercury can be converted to organic mercury (methylmercury) which is the primary form that accumulates in fish and shellfish. Methylmercury biomagnifies up the food chain as it is passed from a lower food chain level to a subsequently higher food chain level through consumption of prey organisms or predators. Fish at the top of the aquatic food chain, such as pike and bass in lakes, and shark and swordfish in oceans, bioaccumulate methylmercury approximately 1 to 10 million times greater than dissolved methylmercury concentrations found in surrounding waters. Methylmercury is stored in the muscle of fish, the part of the fish people eat. Skinning and trimming the fish does not significantly reduce the mercury concentration in the fillet, nor is it removed by cooking processes. Because moisture is lost during cooking, the concentration of mercury after cooking is actually higher than it is in the fresh uncooked fish. In contrast, PCBs adhere to fat, so the removal of skin and fat, as well as broiling the meat, removes up to 90 percent of the contamination.

Great Lakes Fish Monitoring Program

The Great Lakes Fish Monitoring Program (GLFMP) began in 1980 as a cooperative effort by USEPA, U.S. Food and Drug Administration (no longer participating), U.S. Fish and Wildlife Service (now the Biological Resources Division of U.S. Geological Survey), and the eight Great Lakes States, to monitor and better define the fish contaminant problem in the Great Lakes. The program consists of two separate elements to monitor contaminants in whole predator fish and in game fish fillets.

Element 1, Open Lakes Trend Monitoring Program for whole fish, is directed at monitoring contaminant trends in the open water of the Great Lakes, and assisting in evaluating the impacts of contaminants on the fishery. The program provides for collection and analysis of whole-fish composites of lake trout (Salvelinus namaycush) in the size range from 600 mm to 700 mm from Lakes Michigan, Huron, Ontario, and Superior, and of walleye (Stizostedion vitreum) in the size range of 400 mm to 500 mm from Lake Erie. Composites of each species, consisting of five whole individual fish, are analyzed for contaminants to assess temporal trends in organic contaminants in the open waters of the Great Lakes, using fish as biomonitors. These data can also be used to assess the risks of such contaminants on the health of this important fishery and on the wildlife that consume them.

Element 2, Game Fish Fillet Monitoring Program, is directed at monitoring potential human exposure to contaminants through consumption of popular sport species, as well as providing temporal trend data for top predator species, which have shorter exposures than the lake trout collected in Element 1. Coho salmon (Oncorhynchus kisutch) and Chinook salmon (Oncorhynchus tshawytscha) are collected from Lakes Michigan, Huron, Ontario, and Superior, and rainbow trout (Salmo gairdneri) are collected from Lake Erie during the fall spawning run. Composites of each species, consisting of five individual fish fillets, are analyzed for organic contaminants to assess potential human exposure. These data complement those from Element 1. Trends are not meant to be concluded from Element 2, as the voluntary nature of the program does not allow for consistent collection of salmon from year to year. For trend analysis, GLNPO is currently using only the fish tissue contaminant data for coho salmon from Lake Michigan that are larger than 500 mm.

The GLFMP currently collects samples, for both elements of the program, from a set number of sites per lake. Collections alternate on a yearly basis, with even and odd year collections. Element 1 samples consist of 5 whole fish composites for a total of 50 fish collected per site. Element 2 samples consist of 5 skin-on fillets for a total of 15 fish collected per site. All samples are provided to analytical laboratory (currently a university grantee) as approximately 10 grams of frozen homogenate. The GLFMP currently utilizes an established chemical parameter list for analysis, though in recent years emerging contaminants of concern, such as polybrominated diphenyl ethers (PBDEs) and perfluorinated compounds (PFOS, PFOA) have been added.

More information is available at: www.epa.gov/glnpo/glindicators/fish.html.

Mercury is emerging as a growing concern in fish in Lake Michigan, inland lakes in the basin, and in the ocean. To address this concern, the states, U.S. Food and Drug Administration (FDA) and USEPA have issued mercury advisories governing the consumption of fish. In 2004, FDA and USEPA issued a joint advisory on methylmercury in fish and shellfish for reducing the exposure to high levels of mercury in Women Who Might Become Pregnant, Women Who are Pregnant, Nursing Mothers, and Young Children . It advises people in these groups to not eat shark, swordfish, king mackerel, or tilefish. FDA also advises that women of childbearing age and pregnant women may eat an average of 12 ounces of fish purchased in stores and restaurants each week. Therefore, if in a given week such a woman eats 12 ounces of cooked fish from a store or restaurant, she should not eat fish caught by her family or friends that week. It is important to control the total level of methylmercury consumed from all fish. USEPA, FDA, and state officials are working together to ensure the advice is effective and gets to the appropriate audiences.

Collaborative Lake Michigan Strategy to Address Impaired Waters

The purpose of this strategy is reduce and virtually eliminate impairments caused by contaminants such as mercury, PCBs, and certain banned pesticides that have resulted in fish consumption advisories, into the Lake Michigan ecosystem.

The states have primary responsibility for preparing Total Maximum Daily Loads (TMDL) for impaired water bodies and USEPA agrees to provide resources, technical assistance and facilitation to support the states' TMDL development efforts on interstate waters like the Great Lakes. Furthermore, recent changes to USEPA 303(d) list guidance allow the states to address

The Lake Michigan Toolbox
The Mercury Challenge

The National Partnership for Environmental Priorities' (NPEP) Mercury Challenge promotes the voluntary, systematic elimination of mercury-containing equipment from industrial sites. Mercury is a highly toxic chemical designated as one of 31 priority chemicals that USEPA wants to reduce in our nation's products and wastes. Mercury is a documented contaminant of air, land, water, plants, and animals and exposure to mercury can cause serious health problems.

More information on mercury resources is available at the following sites:

- USEPA's mercury program at: www.epa.gov/mercury/
- The Take the Mercury Challenge program at: www.epa.gov/epaoswer/hazwaste/minimize/merc-chal/mc_join.htm
- "Building a Mercury Reduction Plan" http://epa.gov/wastemin/merc-chal/mc_redplan.htm
- Mercury-Free Success Stories http://epa.gov/wastemin/merc-chal/mc_success.htm
- "Mercury: Serious Problem, Practical Solutions" Brochure at: http://epa.gov/wastemin/merc-chal/hg-10-05.pdf

impaired waters that are being remediated by other means in a manner that could delay or possibly eliminate the need for TMDL development.

A strategy to address the impaired waters of Lake Michigan will take time to develop and implement and needs to provide opportunities for the parties to work collaboratively so to effect air quality reductions in mercury that lead to perceptible reductions in state waters and related fish tissues. This raises the question of what a strategy to address the impaired waters of Lake Michigan should be? Any strategy will take time to develop and implement. It should provide opportunities for the parties to work collaboratively and avoid duplication of effort. Such a strategy would be useful to divide the development and possible products from the discussion into stages aligned with the LaMP publications from 2006 through 2010. The stages could include activities and milestones tracked over time to ensure that progress is being made to remediate Lake Michigan. Any strategy would need to be reviewed and mid-course changes considered at each two year interval. If sufficient progress is not made by 2010, work on standard TMDLs for Lake Michigan would need to begin and be completed by 2013 per the current 303(d) schedule and USEPA regulation.

To implement this approach, the following activities should be conducted over the next two years:

- Continue discussion of the Strategy concept
- Clarify common definition of "open waters"
- Finalize the 2005 Intensive Lake Michigan Monitoring Plan and GLNPO Open Lake Organics monitoring with Lake Michigan Mass Balance models
- Develop and share matrix of successful federal, state, and local programs
- If developed, publish the Strategy in LaMP 2008

Illinois Proposes 90 Percent Mercury Emissions Reduction

Illinois Governor Rod Blagojevich announced a proposal that would cut mercury emissions from power plants by 90 percent by June 30, 2009. The state standards would reduce mercury emissions faster than new federal restrictions adopted last spring and aims to achieve the largest overall amount of mercury reduction of any state in the country. The rule was submitted to the Illinois Pollution Control Board in February 2005.

The proposed Illinois rules would require a 90 percent emissions reduction by June 30, 2009, and prohibit power plants from purchasing allowances, or trading emissions credits with other companies. The proposal would require that power plant operators must reduce emissions by an average of 90 percent across their entire fleet of plants by June 30, 2009. Each individual plant must achieve at least a 75 percent reduction by 2009, and 90 percent reduction by December 31, 2012. Illinois' fleet of coal burning power plants is the largest in the nation to be subject to such dramatic emission limits.

The Lake Michigan LaMP 2000, Appendix E, provided an overview of issues and information needs for a full TMDL Strategy for Lake Michigan. LaMP 2002 and 2004 summarized the dialogue and meetings since LaMP 2000 and provided an early draft of a Mercury Phase Out Proposal and also provided data from the Lake Michigan Mass Balance Study and Enhanced Tributary Monitoring Project.

State activities related to mercury reduction are summarized at the end of this chapter. These pages are from the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Status of Mercury TMDLs in the Basin

Based on state submittals of the 2004 303(d) impaired waters lists, there are 217 waters in the Lake Michigan basin listed as impaired for mercury. The 217 impaired waters are located in the Lake Michigan states of Illinois (2), Indiana (81), Michigan (88), and Wisconsin (46). With every 303(d) list submittal, states are required to identify waters targeted for TMDLs in the next two years. In 2004, the Lake Michigan states did not include any mercury-impaired waters on their two-year schedule for TMDL development. However, Michigan did submit a long-term TMDL development schedule that included development of mercury TMDLs beginning in 2011.

There are efforts underway by states outside of the Lake Michigan Basin to address waters impaired by atmospheric mercury. Minnesota is in the process of developing a draft statewide TMDL for mercury-impaired waters. The TMDL would address 214 impaired waters in the Lake Superior Basin and exclude Lake Superior waters.

USEPA is also currently reviewing proposals from Massachusetts and Maine to re-classify waters impaired by atmospheric mercury from category 5 (requiring a TMDL) to Category 4b. TMDLs are not required for waters placed in category 4b, as other required controls (e.g., federal and state efforts to reduce mercury emissions) are expected to achieve water quality standards over time. USEPA has agreed to provide technical assistance to support states efforts to develop mercury TMDLs.

The Lake Michigan Toolbox
Mercury Programs Database

The Mercury Reduction Programs Database was developed and maintained by Region 1 and 2's Northeast Waste Management Officials' Association (NEWMOA). with support and assistance from the Environmental Council of the States (ECOS) and the Pollution Prevention Resource Exchange (P2Rx).

The database can be searched by program, by state, and by agency to find out what mercury reduction programs are taking place nationally. Programs can also be added by organizations.

More information is available at:
www.p2rx.org/Networking/MercuryDB.cfm

Sources of Current Mercury Emissions in the U.S. (2002)

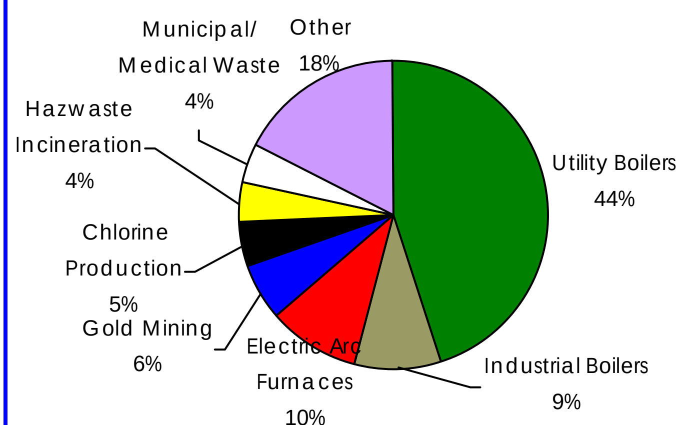


Figure 1-3: USEPA, 2002 National Emissions Inventory

USEPA Issues New Mercury Rules

On March 15, 2005, USEPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants for the first time ever. Additionally, in an action closely related to the Clean Air Mercury Rule, the USEPA has issued a proposal to reconsider certain aspects of its rule to revise the December 2000 finding. USEPA is responding to petitions for reconsideration submitted by 14 states, five environmental groups and four tribes.

More information is available at:
www.epa.gov/air/mercuryrule/.

Sources of Mercury

Air deposition is the dominant mercury pathway for most water bodies. Sources of mercury in the atmosphere are divided roughly at 1/3 natural, 1/3 from past human activity, and 1/3 from current human activity around the world. The current human activity in the U.S. Mercury emissions are shown in Figure 1-3 (See preceding page).

The Great Lakes Regional Collaboration (GLRC) is one potential vehicle for developing a basin-wide mercury product stewardship strategy and basin-wide mercury phase-down program, including a mercury waste management component. The states and the tribes are putting together a workgroup to develop a common strategy.

NPDES Pollutant Minimization Program

In addition the USEPA Region 5 Water Division and states have reached agreement on a draft guidance document for the NPDES Permit Pollutant Minimization Program (PMP) for Mercury. The goal is to aid in meeting the Great Lakes Initiative water quality standards the states adopted for mercury in permits. The PMP guidance was provided in 2004 More information is available at the Pretreatment Website at: www.epa.gov/r5water/npdestek/npdprta.htm.

Next Steps

- Develop the Impaired Waters Strategy
- Clarify common definition of "open waters"
- Cleanup of superfund sites and other PCB contaminated harbors
- Support efforts to recycle mercury-containing electronic devices

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 1

Persistent Bioaccumulative Toxics Group Goals and Recommendations

Goals

Goal 1: Virtually eliminate the discharge of any or all persistent toxic substances (PTS) to the Great Lakes basin ecosystem.

Goal 2: Significantly reduce exposure to persistent toxic chemicals from historically contaminated sources through source reduction and other exposure reduction methods.

Goal 3: Reduce environmental levels of toxic chemicals to the point that all restrictions on the consumption of Great Lakes fish can be lifted.

Goal 4: Protect the health and integrity of wildlife populations and habitat from adverse chemical and biological effects associated with the release of PTS.
Interim Milestones, Goals 1-4:

- By 2008, collect 1million lbs of waste pesticides per year.
- By 2010, 50 percent reduction in Basin-wide household garbage burning.
- By 2010, commence significant reductions in mercury emissions from coal-fired power plants.
- By 2015, full phase-out of as many intentionally added mercury bearing products, as possible.
- By 2025, full phase-out of all PCB equipment in the basin.
- By 2025, significantly reduce PTS inputs from international sources.

Goal 5: Prevent the discharge of toxic substances in toxic amounts.

Interim Milestones, Goal 5:

- By 2008, include pollution prevention and energy efficiency (P2/E2) provisions in federal and state rule making.
- By 2010, implement 200 P2/E2 projects for businesses in the Great Lakes States.

Goal 6: Protect the general public from toxic substances through effective outreach and education, including protective fish consumption advice throughout the Great Lakes Basin Ecosystem.

Interim Milestones, Goal 6:

- By 2007, commence basin-wide PTS public information campaign.
- By 2009, adopt consistent Great Lakes basin fish consumption advisories.

Goal 7: Identify and fill the gaps in our scientific understanding that limit our ability to effectively manage the risks of toxic substances found in the Great Lakes.

Interim Milestones, Goal 7:

- By 2008, initiate a central Great Lakes PTS database.
- By 2010, a basin-wide surveillance program of chemicals of emerging concern at wastewater treatment plants will be established. At least 50 percent of the large in-basin Waste Water Treatment Plants will participate in the program.
- By 2010, implement a Great Lakes human PTS biomonitoring program.
- By 2010, complete an intercomparison study of mercury and PCB models.

Recommendations

1. Reduce and virtually eliminate the principal sources of mercury, PCBs, dioxins and furans, pesticides and other toxic substances that threaten the health of the Great Lakes basin ecosystem, through coordinated, intergovernmental strategies.
2. Prevent new toxic chemicals from entering the Great Lakes basin: Target production, use and sound disposal of toxic chemicals across the Great Lakes basin through strategic deployment of pollution prevention and waste minimization programs.
3. Institute a comprehensive Great Lakes research, surveillance and forecasting capability to help identify, manage, and regulate chemical threats to the Great Lakes basin ecosystem. A Great Lakes basin-wide coordinated program that incorporates and augments current efforts should

be created to better characterize links between PTS sources and exposure. The multiparty program should preferably be housed within an existing program or organization and call upon the combined resources of federal agencies, states, academia, the private sector, and our Canadian neighbors.

4. Protect human health through consistent and easily accessible basin-wide messages on fish consumption and toxic reduction methods and choices.
5. Support efforts to reduce continental and global sources of PTS to the Great Lakes basin.

The pages that follow provide an overview of state activities related to mercury reduction. They were originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Illinois' Mercury Actions

Illinois Environmental Protection Agency ◆ www.epa.state.il.us/mercury/
Contact: Becky Lockart ◆ phone: 217-524-9642 ◆ fax: 217-557-2125 ◆ Becky.Lockart@epa.state.il.us

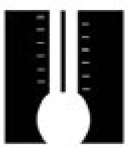
Mercury Strategies & Outcome Measures

Outcome measures used to quantify progress include:
- ✓ Total amount of mercury collected
- ✓ Number of schools that have conducted mercury cleanup
- ✓ Amount of mercury releases

Laws & Policies to Reduce Mercury Use & Releases

Industrial Releases

- ✓ State regulations on mercury releases from hazardous waste.
- ✓ Federal MACT rules and wastewater treatment permit limits are implemented where appropriate.



Mercury Products

- ✓ Phased out the sale of mercury fever thermometers and mercury novelty products.[1]
- ✓ Effective in 2007, sale of selected mercury electrical switches and relays (with exemptions) will be prohibited.[2]
- ✓ Phase out the use of mercury and mercury-containing devices in K–12 schools.
- ✓ Mercury collection programs for elemental mercury, mercury waste, mercury-containing products, and recycling of collected mercury are voluntary. Mercury collection is done by contractors who are required to ship mercury to permitted retorting facilities. Contractors must provide disposition certificates from the reporting facilities prior to the IEPA's approval for payment.
- ✓ IEPA funds 30–45 household hazardous waste collections per year, as well as cleans 200–250 K–12 schools per year through the school waste program.
- ✓ Cooperative initiative with the Illinois Dental Association to collect mercury and amalgams from dentists.
- ✓ Mercury switches and regulators must be removed from appliances before shredding/scrapping.
- ✓ State law restricts the burning of mercury-containing fluorescent bulbs.
- ✓ Universal waste rules adopted to encourage recycling of mercury-containing products.

Fish Consumption Advisory

Statewide Fish Consumption Advisory
Due to Mercury Contamination[3]

- 6,264 lake acres under advisory
- 1,034 river miles under advisory
- 8 lakes and ponds under advisory

Top Intrastate Mercury Sources

State Estimate

1 → coal-fired power plants
2 → industrial boilers
3 → cement kilns

Illinois' Mercury Actions, continued

Mercury Monitoring

- ✓ On-going fish tissue testing and sampling.
- ✓ Also monitor: ambient air, wastewater discharge, fish tissue, and mercury collection (pounds of mercury collected from IEPA household waste collection program is recorded).
- ✓ The Bureau of Water performed a pilot test to compare water sampling techniques to determine if EPA Method 1699, which is resource-intensive, was necessary to obtain reliable results when testing for very low concentrations of mercury.

Public Outreach Efforts

Topics: disposal, cleanup, & reduction progress

Outreach Tools: factsheets, brochures, website, public service announcements, & media events

Vehicle Switches

- ✓ IEPA prepared a report identifying options for mercury switch removal and management from discarded vehicles.
- ✓ Legislation to require automakers to establish a removal and management program for mercury switches from discarded vehicles has been introduced.

Citations

1. Public Act 93-165. Online at: http://www.ilga.gov/legislation/publicacts/fulltext.asp?name=093-0165&GA=093
2. Public Act 93-964. Online at: http://www.ilga.gov/legislation/publicacts/fulltext.asp?093-0964&GA=093
3. Fish Consumption Advisory. Online at: http://www.idph.state.il.us/envhealth/fishadv/fishadvisory05.htm

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Indiana's Mercury Actions

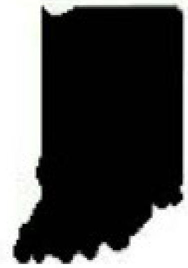
Indiana Department of Environmental Management
Contact: Paula Smith • phone: 317-233-5624 • fax: 317-233-5627 • psmith@idem.IN.gov

Mercury Strategies & Outcome Measures

In Indiana the Air Workgroup, Triennial Streamlined Mercury Variance Workgroup, and the Internal Mercury Workgroup are comprised of a variety of participants that specifically focus on mercury issues.

Outcome measures used to quantify progress include:

- ✓ Air emission reductions
- ✓ Ambient air quality improvements
- ✓ Wastewater discharge reductions
- ✓ Total amount of mercury collected
- ✓ Number of mercury-containing devices collected
- ✓ Reduction in the number of fishing advisories/impaired waters
- ✓ Mercury deposition reductions
- ✓ Number of schools that have conducted mercury cleanup
- ✓ Reduction in the amount of mercury in fish tissue
- ✓ Other—dental mercury collections



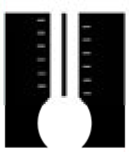
Top Intrastate Mercury Sources

1 → coal-fired power plants
2 → cement kilns
3 → electric arc furnaces

Laws & Policies to Reduce Mercury Use & Releases

Industrial Releases

- ✓ State regulations on mercury releases from sewage sludge incinerators, hazardous waste, municipal solid waste incinerators, medical waste incinerators, cement kilns, and broken mercury-containing products and spills.
- ✓ Adoption of federal MACT for commercial and institutional solid waste incinerators.



Mercury Products

- ✓ Phased out the sale of mercury containing thermometers and novelties. Mercury fever thermometers must be sold behind the counter.
- ✓ Mercury collection programs for elemental mercury, mercury waste, and mercury-containing products. IDEM manages the Mercury Awareness Program that collects and recycles household mercury for all Indiana residents.
- ✓ Collections are made by a licensed hazardous waste contractor and are managed through an IDEM grant program. Household/small business collection/recycling program is funded through recycling and household hazardous waste grant programs and local entities that pick up the remainder of the cost. Indiana has a regulatory mandate for solid management districts to collect recycling.
- ✓ IDEM manages the Indiana mercury pledge for schools.
- ✓ Indiana participates in a thermostat recycling program through Thermostat Recycling Corporation.
- ✓ State has a U.S. Department of Defense mercury stockpile.

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Indiana's Mercury Actions, continued

Fish Consumption Advisory

Statewide Fish Consumption Advisory Due to Mercury Contamination

- 4,007 river miles under advisory in 2004
- 59 coastal wetland miles under advisory in 2004
- 55 lakes and ponds under advisory in 2004
- 68,050 lake acres under advisory (not including Great Lakes) in 2004

Indiana is taking a more comprehensive look at their fish consumption advisory process and will soon be revising their analysis.

Documented Mercury Spills & Releases

Year	# of Spills	Cost
2000	96	N/A
2001	187	N/A
2002	171	N/A
2003	141	N/A

Mercury Monitoring

- ✓ On-going fish tissue testing and sampling.
- ✓ Also monitor: ambient air, mercury deposition, mercury discharge.
- ✓ NESHAP stack testing for medical, hazardous, and municipal solid waste combustors.
- ✓ Indiana participates in the National Mercury Deposition Network.

TMDL Status

- No TMDL's completed, but Indiana has participated in regional and national discussions on mercury TMDL approaches.

Vehicle Switches

- ✓ Indiana is planning to implement voluntary removal of mercury switches from end-of-life vehicles.

Biggest Challenge: Funding for a reward/recovery program.

Public Outreach Efforts

Topics: sources, monitoring, disposal, cleanup, health effects, & reduction progress

Outreach Tools: factsheets, reports, posters, brochures, workshops, emails, press releases, business training, media events, & phone hotlines

Languages: Mercury brochure provided in Spanish.

Targeted Constituencies: subsistence anglers, women of child-bearing age, pregnant women, sport-fishermen, schools, homeowners, & heating ventilation & air conditioning contractors & wholesalers

Unique Outreach: Mercury awareness outreach materials developed to encourage wastewater treatment plants to begin mercury pollution prevention education locally.

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Michigan's Mercury Actions

Michigan Department of Environmental Quality • www.michigan.gov/deqmercuryp2
Contacts: Steve Kratzer • phone: 517-373-0939 • fax: 517-373-3675 • Kratzers@Michigan.gov
Joy Taylor Morgan • phone: 517-335-6974 • fax: 517-214-2915 • Taylorj1@Michigan.gov

Mercury Strategies & Outcome Measures

Michigan has an overall mercury action plan. Major elements of the plan include: medical/dental mercury waste management; limits on mercury discharges into water; reduction of mercury use in consumer products; technical assistance for industries; mercury recycling; and public outreach and education.

A Michigan Mercury Utility Workgroup was convened in August 2003, that includes representatives of industry, non-governmental organizations, government, and academia. The workgroup was tasked to develop a mercury reduction strategy for the state's coal-fired power plants. A full report and recommendations from the workgroup were released in June of 2005.

Outcome measures used to quantify progress include:

- ✓ Air emission reductions
- ✓ Mercury deposition reductions
- ✓ Number of organizations adopting mercury-free purchasing specifications
- ✓ Number of schools that conducted mercury cleanup
- ✓ Number of mercury-containing devices collected
- ✓ Total amount of mercury collected
- ✓ Wastewater discharge reductions
- ✓ Reduction in fish tissue mercury levels
- ✓ Wildlife monitoring

Top Intrastate Mercury Sources

State Estimate

1 → coal-fired power plants

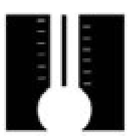
2 → volatilization during solid waste collection and processing

3 → steel manufacturing

Laws & Policies to Reduce Mercury Use & Releases

Industrial Releases

- ✓ State regulations on mercury releases from wastewater treatment and industrial facilities, municipal waste incinerators, and medical waste incinerators.
- ✓ Air permits for certain sources such as shredders and sewage sludge incinerators include mercury specific limits or Best Management Practices (BMP) Requirements.[1]



Mercury Products

- ✓ Mercury-free purchasing policy for state procurement.
- ✓ Phased out the sale of mercury-containing thermometers[2], the use of mercury-containing devices in K–12 schools[3], and the sale of mercury-containing batteries that exceed allowable mercury amounts[4].
- ✓ Mercury collection programs for elemental mercury, mercury waste, and mercury-containing products. Mercury is dropped off at Clean Sweep Sites or Household Hazardous Waste program facilities. Collected mercury and mercury devices are lab packed and transported for recycling by licensed vendors. Recycling of the mercury collected is voluntary. MDEQ encourages Clean Sweep Sites to retain mercury manifests and/or invoices for a minimum of 3 years.

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Michigan's Mercury Actions, continued

Fish Consumption Advisory

Statewide Fish Consumption Advisory Due to Mercury Contamination

- 205,583 lake acres under advisory (does not include Great Lakes)
- 478 river miles under advisory

Mercury Monitoring

- ✓ On-going fish tissue testing and sampling. Tested 304 waterbodies' fish tissue mercury concentrations so far.
- ✓ Also monitor: stack emissions; ambient air & water; wastewater discharge; product and elemental collections; waterbody sediments; and wildlife for mercury.
- ✓ MDEQ-AQD working cooperatively with University of Michigan's Air Quality Laboratory on a mercury monitoring network in Michigan. Six sites in MI collect mercury precipitation (event-based) samples and two of those sites collect mercury-speciated data for estimating both dry and wet deposition.
- ✓ MDEQ-AQD also works cooperatively with the Minnesota Pollution Control Agency and the Wisconsin DNR on assessing fugitive mercury releases with the application of a shared mobile mercury monitoring trailer that houses mercury monitoring and meteorological equipment.

Documented Mercury Spills & Releases[5]

Year	# of Spills
2000	767
2001	1,350
2002	1,261
2003	774

Mercury TMDL Status

- 1 TMDL completed — developed for Hammell Creek in Houghton County, MI. The source of mercury is an abandoned mine discharge.
- 2 corrective action plans in lieu of TMDLs— Newburgh Lake in Wayne County, and unnamed tributary of Wolf Creek in Montcalm County

Public Outreach Efforts

Topics: sources, monitoring, disposal, cleanup, health effects, research, & reduction progress

Outreach Tools: factsheets, videos, reports, posters, brochures, workshops, emails, press releases, business training, citizen training, public service announcements, media events, & phone hotlines

Languages: mercury ritual use brochure & alerts in Spanish

Targeted Constituencies: women of child-bearing age, pregnant women, & sport-fishermen

Unique Outreach: MDCH and MDEQ have conducted training for environmental health professionals and first responders, to build capacity in local areas to respond to spills and promote preventative measures.

Vehicle Switches

- ✓ Voluntary removal of mercury switches (hood lights, trunk lights, & ABS sensor) from end-of-life non-commercial vehicles.
- ✓ Vehicle manufacturers provide training materials, buckets, pick-up and transport.
- ✓ MDEQ recommends that mercury switches be managed as Universal Waste.[6]
- ✓ Biggest Challenge: apportioning out shared responsibilities among industry and government.

Citations

1. Utility Mercury Report at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf
2. 1994 Mich. Pub. Act 451. Available at: www.legislature.mi.gov/mileg.asp?page=getObject&objName=mcl-324-17202
3. 1976 Mich. Pub. Act 451. Available at: http://www.legislature.mi.gov/mileg.asp?page=getObject&objName=mcl-380-1274b
4. 1994 Mich. Pub. Act 451. 324.17105a and 324.17105b www.michiganlegislature.org/mileg.asp?page=Home
5. Data from the Michigan Poison Control Centers
6. Universal waste requirements, Available at: www.deq.state.mi.us/documents/deq-wmd-Universl.pdf

Compendium of States' Mercury Activities

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

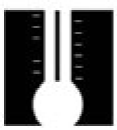
Wisconsin's Mercury Actions

Wisconsin Department of Natural Resources ♦ http://dnr.wi.gov/org/caer/cea/mercury/
Contact: Jon Heinrich ♦ phone: 608-267-7547 ♦ fax: 608-267-0560 ♦ jon.heinrich@dnr.state.wi.us

Mercury Strategies & Outcome Measures

Wisconsin has an overall mercury action plan. Major elements of the plan include: small business, household, medical, and dental mercury waste management; mercury emission limits; limitation of mercury discharges into water; reduction of mercury use in consumer products; technical assistance for industries; mercury recycling; and public outreach and education programs to reduce exposure. The state has statutes, regulations and policies relating to the mercury action plan. The WDNR has a Mercury Team comprised of key agencies including Health and Family Services, Agriculture, and Trade and Consumer Protection.

Laws & Policies to Reduce Mercury Use & Releases

Industrial Releases	✓ State regulations on mercury releases from coal-fired power plants and wastewater treatment facilities.
 **Mercury Products**	✓ Community Mercury Reduction Programs involving 20 communities focusing on medical, dental, school, HVAC thermostat, auto switch, and dairy farming products. ✓ Voluntary mercury collection programs for elemental mercury, mercury waste, and mercury-containing products. Mandatory recycling of collected mercury. All mercury-containing products are classified as universal wastes or are conditionally exempt from hazardous waste rules with the condition that waste be recycled. All public and private mercury collection sites are permitted and inspected by the WDNR. ✓ Local clean sweeps and specific mercury reduction pilot programs receive state or federal grants that subsidize mercury collection and recycling.
 **Vehicle Switches**	✓ Voluntary removal of mercury switches (hood & trunk lights) from end-of-life passenger cars and trucks. ✓ Progress is quantified by pounds of mercury waste collected and number of auto dismantlers and scrap yards participating. ✓ Cooperative effort between WDNR and Auto and Scrap Recyclers trade association: by participating in mercury auto switch removal and recycling, the auto recyclers satisfy the mercury recovery component of required stormwater management plan. Auto dismantlers are voluntarily included as part of Storm Water Permit requirements. ✓ Collection buckets, spill kits, and instructions provided to participating yards by WDNR. Designated consolidation sites were provided proper collection bins and spill kits. Sites must be approved by WDNR. Mercury recycling vendors must be licensed. Records are maintained at each consolidation site and by the recycling vendor who must report to WDNR. ✓ A Great Lakes National Program Office grant funded a mercury collection project from 2001–June 2005 that included educational outreach and free recycling. Biggest Challenge: Improving participation of scrap yards and funding.

Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Wisconsin's Mercury Actions, continued

Fish Consumption Advisory

Statewide Fish Consumption Advisory Due to Mercury Contamination

- 57,000 river miles under advisory
- 15,000 lakes and ponds under advisory

Mercury Monitoring

- ✓ On-going fish tissue testing and sampling. Tested fish from more than 810 water bodies' so far.
- ✓ Also monitor: emissions, ambient air, wastewater discharge, mercury deposition, water body sediment, & wildlife.
- ✓ Wisconsin participates in the National Mercury Deposition Network.
- ✓ Development of an atmospheric modeling system for the Great Lakes Region.

Public Outreach Efforts

Topics: sources, monitoring, disposal, cleanup, health effects, research, & reduction progress

Outreach Tools: factsheets, reports, posters, brochures, press releases, & phone hotlines

Languages: Fish consumption advisory and public health advice in Spanish and Hmong

Targeted Constituencies: women of child-bearing age, pregnant women, subsistence fishers, sport-fishermen, & the general population

Top Intrastate Mercury Sources

State Estimate

1 → coal-fired power plants
2 → dental amalgam
3 → broken mercury-containing products & spills

Citations

1. Available at: http://dnr.wi.gov/org/water/fhp/fish/pages/consumption/index.shtml

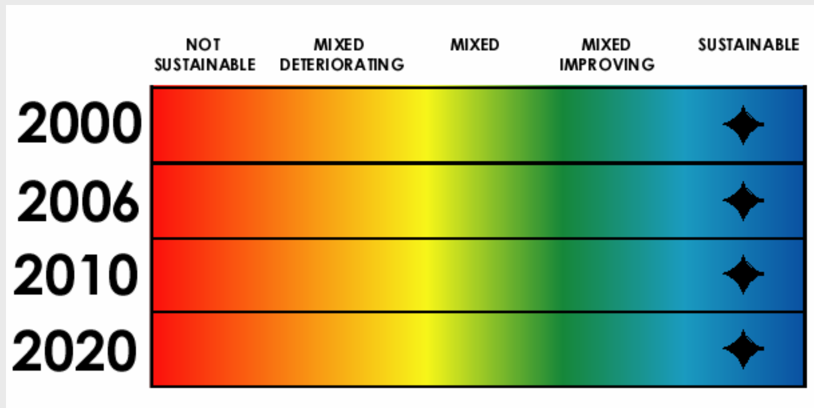
Originally published in the Environmental Council of the States' Quicksilver Caucus report, "Compendium of States' Mercury Activities." The full report can be found at: www.ecos.org/section/2005_mercury_compendium.

Subgoal 2
Can we drink the water?*

Status

The drinking water in the Lake Michigan basin is of good quality, although there have been sporadic outbreaks of illness related to drinking water.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 117 - Atmospheric Deposition of Toxic Chemicals
- 118 - Toxic Chemical Concentrations in Offshore Waters
- 3516 - Household Stormwater Recycling
- 4175 - Drinking Water Quality in Finished Product
- 6063 - Municipal Wastewater Treatment
- 7128 - Sustainable Agricultural Practices

Challenges

- To understand possible vulnerabilities in water sources and prepare protection plans
- To monitor for possible new contaminants
- To understand the implications of and monitor groundwater depletion in the basin as it relates to Lake Michigan
- To educate the public on the hydrological cycle and the need for stewardship of both drinking water quantity and quality
- Need for Operations and Maintenance Plans for infrastructure
- Research need on health efforts of contaminants and safe levels established

Next Steps

- Continue Watershed Academy
- Seek funding to develop a source water protection GIS system.
- Enhance local public water supply security
- Identify resources for public water suppliers to ensure that by 2011, 80% of the community water systems will be substantially implementing source water protection plans

* The original 1998 Lake Michigan Lakewide Management Plan goal referred to water quality. Recent concerns about quantity are discussed in Chapter 6. Both quantity and quality factor into “sustainability.”

Drinking Water Contaminants

The waters of Lake Michigan and surrounding areas are a primary source of drinking water for 10 million people who live in the basin. The Lake Michigan states currently are delegated to run their own drinking water programs. Since LaMP 2000 the issue of ground water depletion has been growing in importance with implications for drinking water sources and habitat (see Chapter 6 for more information on ground water).

Various contaminants can adversely impact drinking water, including microorganisms (e.g., bacteria, viruses, and protozoa such as cryptosporidium), chemical contaminants (including naturally occurring compounds and anthropogenic or synthetic chemicals), and radiological contaminants (including naturally occurring inorganic and radioactive materials and metals). Some contaminants in raw (untreated) water supplies, such as aluminum, arsenic, copper, and lead, can be both naturally occurring and the result of human activities. Other contaminants, such as household chemicals, industrial products, urban storm water runoff, fertilizers, human and animal waste, nitrate (from fertilizers and sewage), and pesticides, may also end up in raw water supplies (EPA, 1999a; Health Canada, 1998).

Certain contaminants pose a concern when present in drinking water because of possible health consequences associated with these substances. These contaminants may be in raw water as a result of industrial and agricultural activities or treated wastewater discharges (Minnesota Pollution Control Agency, 1997). Some may also be present in treated water as a result of chemicals used in the drinking water treatment process (Health Canada, 1998). The impact of contaminants is diluted in a large water body like Lake Michigan but could be more serious in a groundwater source.

In general, drinking water provided by public water suppliers is likely to remain of good quality because of the multiple pollutant barrier approach being implemented across the basin. Not only are treatment systems and operating practices continually improving, increased monitoring is also providing more information about source water supplies and the need for source water protection. In the past two years, greater emphasis has been placed on protecting raw sources of drinking water. Both the source water assessments that were completed for public water supplies and recent data collected from 22 sites around the Great Lakes are providing more information about raw water supplies.

GLRC

Great Lakes Regional Collaboration Action Items

Coastal Health

The **near shore waters and the coastal areas** are the region's largest source of drinking water and experience a variety of recreational activities. To minimize the risk to human health resulting from contact with near shore waters, actions needed include:

- major improvements in wet weather discharge controls from combined and sanitary sewers;
- identify and control releases from indirect sources of contamination;
- implement a "risk-based approach" to manage recreational water;
- protect sources of drinking water; and
- improve the drinking water infrastructure and support source water protection.

Drinking Water Monitoring and Reporting

Continuing efforts must be made to inform health professionals and the public of the results of analyses of drinking water. USEPA requires that public water supplies be monitored for bacteriological, inorganic, organic, and radiological contaminants. The analyses of drinking water include tests for the physical and chemical characteristics of the water as well as for contaminants from natural sources or human activities. In addition, the USEPA Office of Groundwater and Drinking Water (OGWDW) web site at www.epa.gov/OGWDW/ provides detailed information on the nation's drinking water, including

Source Water Assessment and Protection Program Status

The Safe Drinking Water Act Amendments of 1996 established the Source Water Assessment and Protection Program (SWAP) to help States locate and identify existing and potential threats to the quality of public drinking water for the purpose of fostering local efforts to benefit and protect the resource. States are responsible for assessing the condition of source water for all public water systems within their borders. Each assessment must include a delineation of the source water area for each public water system, an inventory of potential contaminant sources, a determination of the system's susceptibility to contamination from those sources, and must be made available to the public. Assessments are intended to be a useful tool in helping water system develop plans and implement measures to protect their water source.

Wisconsin, Illinois, and Michigan have completed all assessments. Indiana expects to complete all assessments by 2006. The focus of this program has now shifted to using the assessments to encourage States and local water utilities to develop source water protection plans and implement protection measures. USEPA and the States will be working to establish partnerships with volunteer and nonprofit organizations, and integrate source water protection with other regulatory programs in order to achieve results.

More information on this program is available at the following internet address www.epa.gov/OGWDW/protect/protect.html.

The Lake Michigan Toolbox
Water Security Resources

Water Security Resources

These resources are available at: http://cfpub.epa.gov/safewater/watersecurity/waterresources.cfm

- Information on training courses, meetings, and workshops / webcasts for utilities, federal and state governments, and utility security officials.
- Tools and technical assistance to assist utilities in developing and updating vulnerability assessments and emergency response plans.
- Information about recently awarded grants and potential financial assistance programs.
- Information form trade/industry organizations, clearinghouses and information centers, state homeland security web sites, state drinking water protection web sites, and USEPA programs.

Drinking Water Security Education Materials

The USEPA has recently developed a collection of useful education and resource materials on drinking water security. The information includes resources on emergency preparedness, drinking water security, and law enforcement. These materials can be found at: www.epa.gov/safewater/watersecurity/index.cfm.

A compendium of laboratories identifying their capabilities to analyze for contaminants of concern can be found at: http://www.epa.gov/compendium and the Water Contaminant Information Tool (WCIT) to assist in identifying unknown contaminants in water can be found at: www.epa.gov/wcit. User registration for these sites is required.

drinking water and health information, drinking water standards, and local drinking water information. Community water suppliers deliver high-quality drinking water to millions of people every day, and a network of government agencies is in place to ensure the safety of public drinking water supplies.

Water Infrastructure Security

Under both the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA), USEPA works closely with partner organizations -- other government agencies, and water utilities and associations (both drinking water and wastewater) to ensure clean and safe water. Industry and government are also working cooperatively to improve drinking water and wastewater security. Building on and supporting long-established relationships with our partners, USEPA helps the water sector to: (1) understand and utilize the best scientific information and technologies for water security; (2) support assessment of utilities'' vulnerabilities to possible attack; (3) take action to improve security; and (4) respond effectively and efficiently in the event that an incident occurs. This commitment is outlined in USEPA's Strategic Plan for Homeland Security.

A number of actions are underway to support development of tools, training and technical assistance for small and medium drinking water, and wastewater utilities and promote information sharing, and research on water security (See the Lake Michigan Toolbox on preceding page).

The Lake Michigan Toolbox
Drinking Water Education

Drinking Water Academy

Established by the USEPA Office of Ground Water and Drinking Water, the Drinking Water Academy (DWA) is a long-term training initiative whose primary goal is to expand USEPA, State, and Tribal capabilities to implement the 1996 Amendments to the Safe Drinking Water Act (SDWA).

In addition to providing classroom and Web-based training, the DWA acts as a resource for training materials pertaining to SDWA implementation. More information is available at: www.epa.gov/safewater/dwa.html.

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 has drinking water utilities facing new responsibilities. While their mission has always been to deliver a dependable and safe supply of water to their customers, the challenges inherent in achieving that mission have expanded to include security and counter-terrorism. In the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, Congress recognizes the need for drinking water systems to undertake a more comprehensive view of water safety and security.

Drinking Water Security in the Lake Michigan Basin

All Community Water Systems in the Lake Michigan Basin have submitted their Vulnerability Assessments as required by the "Public Health Security and Bioterrorism Preparedness and Response Act of 2002". The current focus of drinking water security efforts is to integrate drinking water security into the everyday culture at all levels – local, state and federal. The National Drinking Water Advisory Council (NDWAC) convened a Water Security Work Group (WSWG) that was tasked with identifying the key features of an "active and effective" security program. The NDWAC-WSWG was composed of representatives from water systems, water professional organizations, state drinking water officials and USEPA. The WSWG identified 14 "key" features of an active and effective security program for water systems. USEPA subsequently met with the Association of State Drinking Water Administrators (ASDWA) Water Security Committee and it was agreed that the 14 "key" features should be integrated into the state and federal drinking programs. USEPA will continue to work with its partners to identify and facilitate integration of water security activities at all levels and is working to identify ways of measuring success in these areas. (see the Water Resources Toolbox on the previous page.

Inadvertent Water Contamination

Contamination of drinking water sources can result inadvertently during the production, use, and

Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000:

A National Reconnaissance

To provide the first nationwide reconnaissance of the occurrence of pharmaceuticals, hormones, and other organic wastewater contaminants (OWCs) in water resources, the U.S. Geological Survey used five newly developed analytical methods to measure concentrations of 95 OWCs in water samples from a network of 139 streams across 30 states during 1999 and 2000. The selection of sampling sites was biased toward streams susceptible to contamination (i.e. downstream of intense urbanization and livestock production). OWCs were prevalent during this study, being found in 80% of the streams sampled. The compounds detected represent a wide range of residential, industrial, and agricultural origins and uses with 82 of the 95 OWCs being found during this study. The most frequently detected compounds were coprostanol (fecal steroid), cholesterol (plant and animal steroid), *N*,*N*-diethyltoluamide (insect repellant), caffeine (stimulant), triclosan (antimicrobial disinfectant), tri(2-chloroethyl)phosphate (fire retardant), and 4-nonylphenol (nonionic detergent metabolite). Measured concentrations for this study were generally low and rarely exceeded drinking-water guidelines, drinking-water health advisories, or aquatic-life criteria. Many compounds, however, do not have such guidelines established. The detection of multiple OWCs was common for this study, with a median of seven and as many as 38 OWCs being found in a given water sample. Little is known about the potential interactive effects (such as synergistic or antagonistic toxicity) that may occur from complex mixtures of OWCs in the environment. In addition, results of this study demonstrate the importance of obtaining data on metabolites to fully understand not only the fate and transport of OWCs in the hydrologic system but also their ultimate overall effect on human health and the environment.

A follow-up study by USGS released in 2006 again showed the presence of pesticides in waters, but below regulatory levels. More information is available at: http://ca.water.usgs.gov/pnsp/pubs/circ1291.

disposal of the numerous chemicals used in industry, agriculture, medical treatment, and in the household. Knowledge of the environmental occurrence or toxicological behavior of contaminants has resulted in increased concern for potential adverse environmental and human health effects. For many contaminants, public health experts have incomplete understandings of their toxicological significance (particularly effects of long-term exposures at low-levels). The need to understand the processes controlling contaminant transport and fate in the environment, and the lack of knowledge of the significance of long-term exposures has increased the need to study environmental occurrence down to trace levels. Furthermore, the possibility that environmental contaminants may interact synergistically or antagonistically has increased the need to define the complex mixtures of chemicals that are found in our waters (http://toxics.usgs.gov/regional/emc.html)

Water Quality Tracking

In 2002, USEPA released the Great Lakes Strategy. A key action from this effort was stated: "Beginning in 2002, USEPA, in cooperation with local utilities, will track water quality at the intake points of selected drinking water treatment plans around the Lakes. Findings will be reported to the public through the biennial State of the Lakes Ecosystem Conference (SOLEC) State of the Lakes report." More information is available at: www.epa.gov/glnpo/gls/gls04.html.

As of April 2003, USEPA examined data provided by 114 public water systems in the Great Lakes basin and by the U.S. Safe Drinking Water Information System. Specifically, USEPA has evaluated various contaminants, including the following:

- Atrazine, an agricultural pesticide
- Nitrate and nitrite, which are naturally occurring nutrients found at high levels in fertilizers
- Total coliform bacteria, E. coli, protoza, giardia, and cryptosporidium may contaminate water supplies after sewage spills

USEPA has also examined the turbidity, taste, odor, and organic carbon content of drinking water supplies to assess any other potential health issues. Of the public water systems evaluated between 1999 and 2001, none exceeded drinking water standards for atrazine, and only one exceeded drinking water standards for nitrate and nitrite after treatment. However, atrazine, nitrate, and nitrite are detected at elevated levels in the Great Lakes, which indicates that advanced treatment technologies prevent the entry of significant concentrations of these contaminants from entering drinking water systems. For total coliform and E. coli, only one violation of drinking water standards occurred between 1999 and 2001 in the Great Lakes basin. Finally, public water systems rarely have problems with turbidity, taste, odor, or organic carbon content.

Drinking Water State Revolving Fund

The Nation's water systems must make significant investments to install, upgrade, or replace infrastructure to continue to ensure the provision of safe drinking water to their 240 million customers. Installation of new treatment facilities can improve the quality of drinking water and better protect public health. Improvements are also needed to help those water systems experiencing a threat of contamination due to aging infrastructure systems.

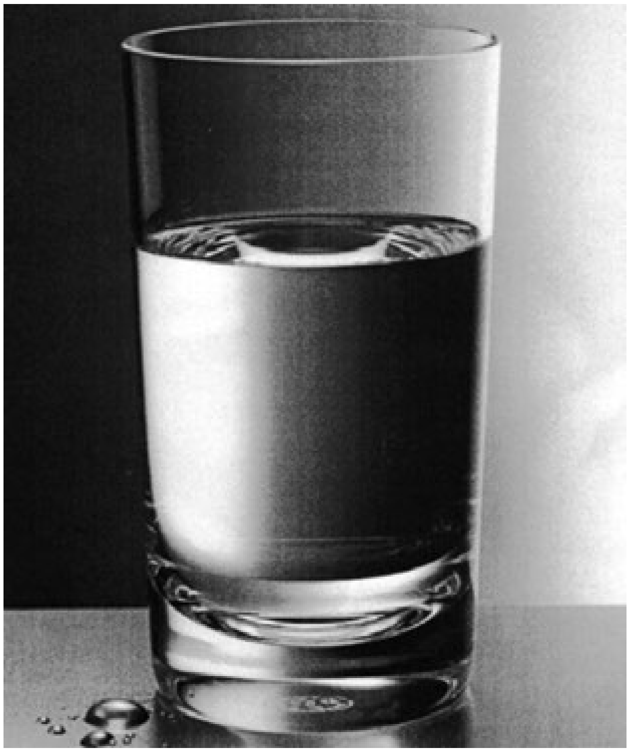
The Safe Drinking Water Act, as amended in 1996, established the Drinking Water State Revolving Fund (DWSRF) to make funds available to drinking water systems to finance infrastructure improvements. The program also emphasizes providing funds to small and disadvantaged communities and to programs that encourage pollution prevention as a tool for ensuring safe drinking water. The funds are passed from USEPA to each state. For more information see www.epa.gov/safewater/dwsrf.html.

Drinking Water Quality Reports

Information on local water quality is available from several sources, including state public health departments and local water suppliers. To inform the public of the results of analyses of drinking water and to demonstrate a commitment to protecting human health, each community public water supplier is required to generate an annual Consumer Confidence Report that is made available to all residents receiving water from the water system. A Consumer Confidence Report provides information about the source of water used, its susceptibility to contaminants, the levels of contaminants detected in the water, the likely sources of contaminants, and potential health effects of any contaminant detected at a concentration above its maximum contaminant level (MCL). Consumer Confidence Reports can be reviewed to get an indication of the overall quality of treated surface water and groundwater and the condition of the drinking water provided. In addition, starting in 2003, the states will distribute information on the status of the source waters used by public water suppliers and the level of susceptibility of those source waters to contamination.

Next Steps

- Continue Watershed Academy
- Seek funding to develop a source water protection GIS system.
- Enhance local public water supply security
- Identify resources for public water suppliers to ensure that by 2011, 80% of the community water systems will be substantially implementing source water protection plans

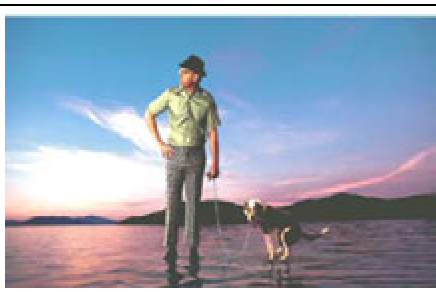


The Lake Michigan Toolbox
USEPA Pollution Prevention Fact Sheets

USEPA has published a series of fact sheets on best management practices (BMP) measures for activities that are likely to impact the sources of water used as drinking water. These fact sheets are also used in conjunction with a source water protection training course (More information is available at: http://www.epa.gov/safewater/dwa/electronic.html). This training course is available to interested states, USEPA Regions, and organizations through the USEPA Drinking Water Academy See box on opposite page). If you are interested in sponsoring a training course, please contact James Bourne at 202-260-5557 or Steve Ainsworth at 202-260-7769. Each bulletin discusses how particular activities can be managed in such a way as to prevent contamination of drinking water. Bulletins available include:

- **Highway Deicing** www.epa.gov/safewater/protect/pdfs/highwaydeicing.pdf
- **Airport Deicing.** www.epa.gov/safewater/protect/pdfs/airportfs.pdf
- **Storm Water Runoff**, www.epa.gov/safewater/protect/pdfs/stormwater.pdf
- **Pet and Wildlife Waste** www.epa.gov/safewater/protect/pdfs/petwaste.pdf
- **Septic Systems** www.epa.gov/safewater/protect/pdfs/septic.pdf
- **Agricultural Fertilizer** www.epa.gov/safewater/protect/pdfs/fertilizer.pdf
- **Above Ground Storage Tanks** www.epa.gov/safewater/protect/pdfs/ast.pdf
- **Turfgrass Application** www.epa.gov/safewater/protect/pdfs/turfgrass.pdf
- **Underground Storage Tanks** www.epa.gov/safewater/protect/pdfs/ust.pdf
- **Large Scale Application of Pesticides** www.epa.gov/safewater/protect/pdfs/lspesticides.pdf
- **Vehicle Washing** www.epa.gov/safewater/protect/pdfs/vehicle.pdf
- **Small-scale Application of Pesticides** www.epa.gov/safewater/protect/pdfs/sspesticides.pdf
- **Livestock, Poultry, and Horse Waste** www.epa.gov/safewater/protect/pdfs/livestock.pdf
- **Sanitary Sewer Overflows and Combined Sewer Overflows** www.epa.gov/safewater/protect/pdfs/ssocso.pdf
- **Managing Small Quantity Chemical Use to Prevent Contamination of Drinking Water** www.epa.gov/safewater/protect/pdfs/chemical_use_fact_sheet.pdf

More information is available at: www.epa.gov/safewater/protect/swpbull.html.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Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 2

Coastal Health Drinking Water Related Goals and Recommendations

Goal: The quality of Great Lakes basin drinking water from coastal and tributary sources will be protected from chronic and episodic threats of chemical and biological contamination that pose unacceptable risk following conventional water treatment.
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Interim Milestones:

- By 2007, amendments to the Safe Drinking Water Act (SDWA) will be adopted to enhance flexibility in how State Revolving Funds may be used for infrastructure system improvements and the Clean Water SRF will be fully funded;
- By 2007, Bioterrorism Act amendments will be adopted to require implementation of security measures that address potential resource/facility vulnerabilities;
- By 2010, states will have strategies for protecting water quality for the intended use of public water supply; and
- By 2010, all states and local municipal water supply systems will complete plans for infrastructure upgrades that address aging system deficiencies and integrate security measures for vulnerable resources/facilities.

Recommendations

- Eliminate to the extent provided by existing regulation inputs of untreated or inadequately treated human and industrial waste to Great Lakes basin waters through implementation of wet weather programs, including improvements to wastewater treatment systems.
- Identify indirect pollution sources capable of adversely impacting Great Lakes coastal health and, upon identification, promulgate and enforce regulations, provide public education, promote research, and initiate remediation to reduce the impact of these sources.
- Standardize, test, and implement a risk-based approach to manage recreational water.
- Protect drinking source water quality.
- Use the Drinking Water State Revolving Fund to improve drinking water infrastructure and support source water protection.

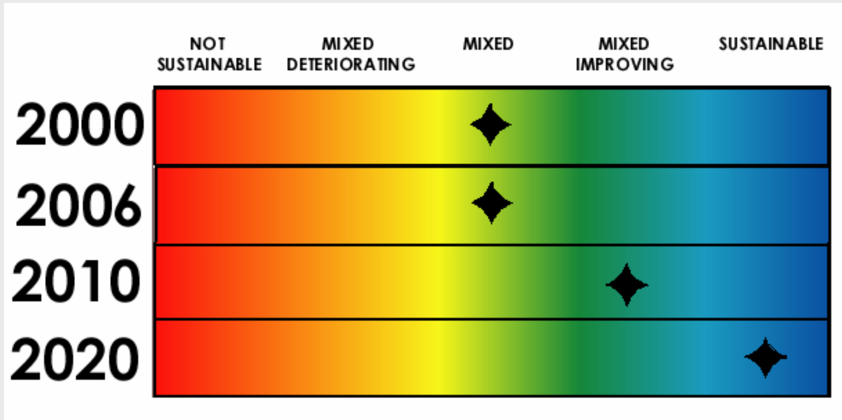
Subgoal 3

Can we swim in the water?

Status

Some Lake Michigan beaches experience episodic beach closures because of elevated levels of *E. coli* bacteria. This may be due to stormwater runoff, sewer overflows or even waterfowl droppings. Recent studies show other factors like geography, water depth, weather, beach grooming practices and nearby animal populations contribute to beach closures. As a result, the current status of the goal is mixed.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 3516 - Household Stormwater Recycling
- 4200 - Beach Advisories, Postings and Closures
- 6063 - Municipal Wastewater Treatment
- 7028 - Sustainable Agricultural Practices

Challenges

- Maintain and not overtax the wastewater control infrastructure
- Build a real-time beach monitoring and reporting system
- Continue research and development on testing systems and beach grooming
- Implement actions outlined in the Great Lakes Regional Collaboration's Coastal Health Strategy

Next Steps

- Help coordinate outreach materials development
- Continue support of Great Lakes Beach Association conferences
- Report on the latest beach research
- Report on research on beach grooming, pathogen tests, and cladophora bloom causes in the LaMP and at the State of Lake Michigan Conference

Background

Lake Michigan contains the world's largest collection of freshwater sand dunes and associated beaches, particularly along its eastern shore. Of a total of 3,100 coastal acres, 1,200 acres are publicly owned and available for use, while an additional 1,200 privately owned acres has significant potential for public use. It is important to note that most shoreline areas along Lake Michigan support swimming and secondary contact recreation.

Beach advisories or closures resulting from high pathogen loads have a negative effect on the lake's significant tourism industry. To improve water quality testing at the beach and to help beach managers better inform the public when there are water quality problems, Congress passed the Beaches Environmental Assessment and Coastal Health (BEACH) Act on October 10, 2000.

The BEACH Act requires adoption of consistent bacterial standards at coastal waters nationwide, research on new pathogens and pathogen indicators, and publication of new or revised water quality criteria for pathogens within five years. The BEACH Act also authorizes USEPA to award grants to eligible states, tribes, and territories to develop and implement a program at coastal and Great Lakes

GLRC

Great Lakes Regional Collaboration Action Items

Coastal Health

The **near shore waters and the coastal areas** are the region's largest source of drinking water and experience a variety of recreational activities. To minimize the risk to human health resulting from contact with near shore waters, actions needed include:

- major improvements in wet weather discharge controls from combined and sanitary sewers;
- identify and control releases from indirect sources of contamination;
- implement a "risk-based approach" to manage recreational water;
- protect sources of drinking water; and
- improve the drinking water infrastructure and support source water protection.

NEEAR Water Study Helps Set New Beach Alert Standards

The National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Study is a multi-year research project evaluating the health effects of persons using recreational waters for swimming, boating, diving, surfing, and other activities. The objectives of the NEEAR Water Study are to (1) evaluate the water quality at two to three beaches per year for three years concurrently with a health study, (2) obtain and evaluate a new set of health and water quality data for the new rapid, state-of-the-art methods, and (3) develop new federal guidelines and limits for water quality indicators of fecal contamination (USEPA Office of Water) so that beach managers and public health officials can alert the public about the potential health hazards before exposure to unsafe water can occur.

The study released its results in September 2005. It found significant trends between increased gastrointestinal illness (GI) and *Enterococcus* at Lake Michigan and Lake Erie beaches. The study observed a positive trend for *Bacteroides* at the Lake Erie beach, but no trend was observed at the Lake Michigan beach. *Enterococcus* samples collected at 8:00 a.m. were predictive of GI illness that day. The association between *Enterococcus* and illness strengthened as time spent swimming in the water increased. It is the first study to show that water quality measured by rapid methods can predict swimming-associated health effects.

More information is available at: www.epa.gov/nheerl/neear/

beaches, and to notify the public when bacteria levels are exceeded.

Progress on Developing and Implementing Beach Monitoring and Notification Plans

Since passage of the BEACH Act, approximately $7.8 million in BEACH grants have been issued to Great Lakes states to implement beach programs, which has resulted in a significant increase in the number of monitoring and notification programs at Great Lakes beaches. All of the Lake Michigan states have beach monitoring and public notification programs in place at most of their coastal beaches and at all of their high priority or frequently used coastal beaches. Following are beach program summaries for Illinois, Indiana, Michigan, and Wisconsin.

Illinois

The Illinois Department of Public Health (IDPH), which licenses bathing beaches in Illinois, has received $983,348 in BEACH Act grants since 2001. Illinois' Lake Michigan beaches are monitored five to seven days a week during the swimming season. IDPH is also working with the Lake County Health Department (LCHD) to validate and implement predictive models to augment the beach water quality monitoring conducted at several Lake Michigan beaches. Because health warnings are generally based on *E. coli* concentrations from samples taken the previous day, predictive models based on continuously measured hydro-meteorological variables provide an excellent alternative to monitoring. In the summer of 2004, predictive modeling equipment was installed by the LCHD to predict *E. coli* levels at two Lake Michigan beaches: Illinois Beach State Park-South Beach (IBSP) in Zion, IL, and Forest Park Beach (FP) in Lake Forest, IL. The models, which measure wind speed/direction, sunlight, rainfall, air/water temperature, humidity, wave height, dissolved solids, clarity, and other variables, accurately predicted whether *E. coli* concentrations were above or below the 235-cfu/100 ml threshold for full body contact 85% of the time during the 2004 swimming season. Utilizing the predictive models created in 2004, SwimCast was 89% accurate at IBSP beach and 95% accurate at FP beach when used in 2005. This project was partially funded through IDPH's BEACH Act grant.

IDPH continues to develop and distribute educational resources to the public of the potential risks associated with water contact activities when the water quality standards are not met. An educational

Cladophora Alga

Cladophora is a branching, green filamentous alga found naturally along the coastline of most of the Great Lakes. Research in the 1960's and 70's linked *Cladophora* blooms to high phosphorus levels in the water, mainly as a result of human activities such as fertilizing lawns, poorly maintained septic systems, inadequate sewage treatment, agricultural runoff and detergents containing phosphorus. Due to tighter restrictions, phosphorus levels declined during the 1970's and *Cladophora* blooms were largely absent in the 1980's and 90's.

There has been a recent resurgence of macroalgae, predominantly *Cladophora*, along the coast of Lake Michigan and other Great Lakes. These algae blooms lead to unsightly and foul-smelling beaches and have negative economic consequences as a result of the lowered beach use. In addition, *Cladophora* blooms result in reduced quality of drinking water and decreased property values. Reasons for the current resurgence are unknown. Possible causes include increased nutrient inputs, increased water clarity, increased water temperature and changing lake level. While there have been some efforts to remove *Cladophora* from beaches, ultimately the solution to the *Cladophora* problem requires the identification of the factors promoting *Cladophora* growth in the lake, and if possible the mitigation of those factors.

It is unknown if there are increased nutrient concentrations entering the lake via streams and rivers or if zebra mussels redistribute existing nutrients from the phytoplankton they consume to the *Cladophora*. Both may be happening. Work on the Milwaukee River indicates that input of the nutrient most likely to foster *Cladophora* growth, phosphorus, has increased in recent years. (Source: Great Lakes Water Institute, University of Wisconsin-Milwaukee)

For more information on cladophora, see chapter 8 and www.uwm.edu/Dept/GLWI/cladophora.

The Lake Michigan Toolbox
Lake Michigan States' Beach Program Web Pages

Illinois

- Illinois Beach Monitoring Home page www.idph.state.il.us/envhealth/beachhome.htm
- Chicago Park District's Swim Report www.chicagoparkdistrict.com/index.cfm/fuseaction/swim_report.home.cfm
- Northern Illinois Lake Michigan beach notification Web site (Lake County Health Department, Wilmette Park District, Winnetka beaches and the City of Evanston). www.earth911.org/waterquality/default.asp?cluster=17

Indiana

- Indiana Department of Environmental Management Beach Home page. www.in.gov/idem/beaches
- IDEM beach water quality notification Web site www.earth911.org/waterquality

Michigan

- Michigan Beach Monitoring home page www.michigan.gov/deq/1,1607,7-135-3313_3686_3730---C1,00.html
- Michigan Department of Environmental Quality – Office of the Great Lakes www.michigan.gov/deq/1,1607,7-135-3313_3677---,00.html
- Michigan Sea Grant
- www.miseagrant.umich.edu/

Wisconsin

- Wisconsin Beach Health Web site www.wibeaches.us
- Wisconsin Sea Grant www.seagrant.wisc.edu/
- The Door County Beach Contamination Source Identification Interim Report http://map.co.door.wi.us/swcd/BeachInterimReport.pdf#search='door%20county%20beach%20contamination'
- Milwaukee Metropolitan Sewerage District. 2003. Deep Tunnel Fact Sheet. www.mmsd.com/tunnelfactsheet.html
- Water Quality Research www.cityofracine.org

beach pamphlet titled, "Why is the beach closed?" was developed and distributed to beach patrons. IDPH also provides beach water quality and program information to beachgoers through signs and Web sites. *Don't Feed the Waterfowl* signs have been posted at several Lake Michigan beaches to discourage visitors from feeding birds, which have the potential to contribute significant fecal loads to beach water.

Indiana

The Indiana Department of Environmental Management (IDEM) administers the Beach Monitoring and Notification Program at Indiana's Lake Michigan beaches. IDEM has received $823,753 in BEACH Act grants since 2001.
The beach program is operated in conjunction with the Lake County Parks and Recreation Department, the Hammond Health Department, the East Chicago Department of Public and Environmental Health, the East Chicago Department of Public and Environmental Health, the Gary Sanitary District, the Town of Ogden Dunes, the Town of Dune Acres, and the LaPorte County Health Department.

Indiana has approximately 23 miles of beaches located along the Lake Michigan shoreline, including the Indiana Dunes National Lakeshore, which has 9 beaches, and the Indiana Dunes State Park, with 2 main sections of beaches, along with 14 other county and city beaches. Prior to the BEACH Act, *E. coli* monitoring occurred only one day per week at Indiana's Lake Michigan beaches. Since receiving funding, Indiana has been able to increase the sampling frequency to five/seven days per week at most of its Lake Michigan beaches.

IDEM has also used BEACH Act grant funds to keep the public informed. Beach managers notify the public of elevated bacteria levels by posting beach advisory or closure signs in English, Spanish and Polish. IDEM hired a contractor to install 25 kiosks at several coastal beaches which provide beachgoers with up-to-date information regarding the status of beach waters as well as additional information about the possible sources and causes of *E. coli* contamination. Recommendations are also provided as to how beachgoers and watercraft operators can reduce the likelihood of causing an *E. coli* release. IDEM hopes to implement a pilot project designed to provide real-time information regarding CSO discharge events to the local beach managers and the public. This project will be linked to Indiana's Beach Program Web site (www.in.gov/idem/beaches).

Current projects

Source identification near Burns Ditch, Indiana.
Several organizations have collaborated to identify sources of contamination at beaches near Burns Ditch, Indiana. There are 13 beaches in Porter County and Lake County, Indiana, west of the Burns Ditch outfall (a major point source of pollution), that are subject to beach closures due to high counts of *E. coli*. IDEM participated in a model project collaborating with USGS, NOAA, the City of Gary Sanitary District, the National Park Service, and local health departments, to characterize the movement of *E. coli* from Burns Ditch and to better understand the relative effect of bacteria contamination on beach waters. They studied the relationship between *E. coli* counts in Burns Ditch and beaches to the west, and hydro-meteorological factors, and this information was used to develop a predictive model for high *E. coli* counts at these beaches.

IDEM has used BEACH Act grant dollars to fund the installation of two predictive models at two Lake Michigan beaches with the goal of increasing the efficiency of the monitoring activities along Indiana's Lake Michigan shoreline. During the 2006 beach season, IDEM will implement project SAFE at the beaches west of Burns Ditch (Portage Beach, Ogden Dunes, West Beach, Wells Street Beach, Marquette Beaches, and Lake Street Beach). IDEM will also fund the second year of predictive model development at Buffington Harbor Beach (Gary) and Jeorse Park Beach (East Chicago). A partnership between IDEM and the City of Gary, made the above predictive modeling efforts possible. The third project developed by IDEM was a beach health brochure.

Michigan

The Michigan Department of Environmental Quality (MDEQ) has received a total of $1,084,966 in BEACH Act funding since 2002 to support monitoring programs for 431 public beaches in 41 counties along the state's 3,200 miles of Great Lakes shoreline. Along Lake Michigan:

- There are 202 public beaches on Lake Michigan in 17 counties (451 total public beaches on all of

The Lake Michigan Toolbox
Beach Health Resources

Federal Government Resources

Assessing and Monitoring Floatable Debris.
www.epa.gov/owow/oceans/debris/floatingdebris/

BEACH Watch. www.epa.gov/waterscience/beaches/

BEACON – Beach Advisory On-line Notification
www.epa.gov/waterscience/beacon/

Great Lakes Monitoring – The Swimmability Index
www.epa.gov/glnpo/glindicators/water/beachb.html

National Beach Guidance and Required Performance Criteria for Grants www.epa.gov/waterscience/beaches/grants/guidance/index.html

National Pollutant Discharge Elimination System (NPDES)
http://cfpub1.epa.gov/npdes/home.cfm?program_id=5

USEPA Report to Congress on Impacts and Control of CSOs and SSOs http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm

USEPA Report to Congress on Implementation and Enforcement of the CSO Control Policy
http://cfpub.epa.gov/npdes/cso/cpolicy_report.cfm?program_id=5

Centers for Disease Control - Healthy Swimming
www.cdc.gov/healthyswimming/

Non-Governmental Resources

Beaches in the Great Lakes Region
www.great-lakes.net/tourism/rec/beach.html#new

Council of Great Lakes Research Managers – Great Lakes-St. Lawrence Research Inventory
http://ri.ijc.org

Great Lakes Beach Association
www.great-lakes.net/glba/

Great Lakes Beach Association Annual Proceedings, Green Bay, WI, November, 2005.
www.great-lakes.net/glba/2005conference.html

Great Lakes BeachCast – Great Lakes Beach Information (many links from this site)
www.great-lakes.net/beachcast/nr_moreinfo.html

Phytoremediation Project in Racine, WI

The City of Racine Departments of Health, Public Works, and Parks, Recreation and Cultural Services, along with several volunteers collaborated on a project to reduce bacterial contamination at North and Zoo Beaches in Racine, Wisconsin. An existing storm water outfall was re-engineered to reduce the impact of bacterial contamination on surface water. In addition to locating the outfall to a point more distant from the shoreline, the re-designed outfall incorporated primary treatment structures for the removal of solid wastes and secondary treatment cells, a series of nine infiltration beds vegetated with indigenous wetland plants.

The goal of the project is to improve water quality, reduce beach closings, and increase protection of public health while enhancing the coastal ecosystem. Other volunteer efforts, while not directly related to the installation of wetland plants, are providing an additional educational component to storm water management in this community. Members of Keep our Beaches Open have undertaken an initiative to mark storm drains in a collaborative effort with local government to improve surface water quality.

Source Identification in Door County, WI

The Door County Public Health Department is responsible for monitoring 28 public beaches in Door County, which are frequented by many tourists during the summer season. The Door County Soil and Water Conservation Department (SWCD) is responsible for identifying the sources of beach contamination at these beaches. In 2003, SWCD began source identification work by mapping the watersheds and surface water conveyance systems (storm drains/pipes, streams) in close proximity to the monitored beaches; determining the physical characteristics of the beaches (slope, % impervious surfaces, substrate, runoff potential), and collecting ambient beach factors at the time of the water sampling (number of birds, weather, wind direction, wave height, and water/air temperatures). SWCD acquired funding to pay samplers and analysts to monitor *E. coli* concentrations at selected beaches, near outfalls, and after rain events. In 2003 and 2004, data were collected at all 28 beaches along both sides of the peninsula, at Washington Island, within Sturgeon Bay, and at three inland lakes. Further analyses of these data are being completed, and will include recommendations for changes to the current monitoring protocols, additional data collection, and recommendations on beach management and planning to reduce non-point pollution and storm water runoff on the beaches. Additional data will be collected in 2006 to strengthen the management recommendations and non point pollution reduction strategies at Door County beaches.

Lake Michigan (Illinois-69, Wisconsin-145, Indiana-30)
- 6 beaches in 4 counties reported 43 closure days due to water quality standards exceedances in 2005
- An estimated $131,113.00 (est. 47% of 2005 BEACH Act grant funds) was distributed to monitor 95 beaches located in 16 Michigan counties on Lake Michigan

The monitoring of beaches in Michigan is voluntary and is conducted by the local health departments, which are required to notify various entities of the test results within 36 hours, and may petition the Circuit Court for an injunction ordering the owners of a beach to close the beach. The MDEQ provides Clean Michigan Initiative-Clean Water Fund (CMI-CWF) and BEACH Act grants to the local health departments to aid in the implementation or enhancement of their beach monitoring programs. The CMI-CWF and BEACH Act grants are designed to fund proposals that determine and report levels of *E. coli* in the swimming areas of public beaches. The objectives of MDEQ's beach program are to:

- Assist local health departments to implement and strengthen beach monitoring programs.
- Determine whether waters of the state are safe for total body contact recreation.
- Create and maintain a statewide database.
- Compile data to determine overall water quality.
- Evaluate the effectiveness of MDEQ programs in attaining water quality standards for pathogen indicators.

Local health departments request an average of $380,000 in BEACH Act funds per year from the MDEQ for local beach monitoring programs for 212 high-priority beaches. Since passage of the BEACH Act, there has been a dramatic increase in the number of monitoring and notification programs at coastal beaches in Michigan. In 2003, the number of Great Lakes beaches in Michigan that were monitored at least once a week more than doubled to 187 from 83 in 2002.

Local health departments provide beach monitoring program information to the public via press releases, brochures, beach signs, beach seminars, and Internet access.

The Michigan Beach Monitoring Web site

CSOs in the Lake Michigan Basin

There are currently 30 CSO communities with 347 CSO outfalls that discharge within the Lake Michigan basin. Eighteen of the Lake Michigan CSO communities are in Indiana, 11 are in Michigan, and one is in Wisconsin.

In the Lake Michigan basin, EPA found:

- In Indiana, all 18 CSO permittees in the Lake Michigan basin discharge in the vicinity of 303(d)-impaired waters. Thirteen of these permittees discharge to waters where pathogens (*E. coli*) and/or siltation were cited as reasons or causes of impairment.
- In Michigan, 10 of the 11 CSO communities discharge to 303(d)-impaired waters. The waters in close proximity to the CSO community of Norway have not been assessed. Three CSO permittees in Michigan (Manistee, Niles, and St. Joseph CSO) discharge to 303 (d)-listed waters that specifically cite "CSO pathogen (Rule 100)" as a source of impairment. In addition, three CSO permittees (East Lansing, Lansing, and Crystal Falls CSO) discharge to waterbodies where pathogens or pathogens and dissolved oxygen are cited as reasons o r causes of impairment.
- In Wisconsin, the Milwaukee Metropolitan Sewerage District (MMSD) operates the only combined sewer system (CSS) in the Lake Michigan basin. MMSD's CSOs discharge to, or in close proximity to, 303(d)-impaired waters where pathogens and/or dissolved oxygen have been cited as reasons or causes of impairment.

Source: USEPA

The proximity of a CSO outfall to an impaired water segment does not in and of itself demonstrate that the CSO is the cause of the impairment. EPA believes the association between CSO location and impaired waters is due to a number of factors in addition to CSO discharges. For example, CSOs are generally located in urban areas where waterbodies also receive relatively high volumes of storm water and other pollutant loads. Nevertheless, the strong correlation between CSO location and impaired waters does suggest that CSOs should be considered as a potential source of pollution when developing a total daily maximum load (TMDL) for an impaired waterbody.

(www.deq.state.mi.us/beach) immediately provides current and historical results for *E. coli* and beach closings/ advisories as they are reported from health departments for all public beaches in Michigan. All public beaches are required to post a sign indicating whether the beach is monitored and where the results can be found.

All beach monitoring data are reported to and evaluated by the MDEQ. The MDEQ incorporates beach monitoring data into other water pollution prevention programs to encourage strategic improvements in water quality. Michigan's Beach Monitoring web site immediately provides current and historical test results for *E. coli* and beach closings/ advisories as they are reported from health departments for all public beaches in Michigan. All public beaches are required to post a sign indicating whether the beach is monitored and where the results can be found.

Beach access signs around Lake Huron provide a consistent message for the public. There are similar efforts to develop consistent signage underway around Lake Michigan.

Michigan to Clean Up the Galien River

The Galien River, which flows into Lake Michigan at New Buffalo in southwestern Michigan, is facing bacterial contamination, agricultural pollution, and the debris that chokes stretches of the river.

The watershed is primarily agricultural, pastoral, or forest. Bacterial contamination from sewage makes the river unsafe for swimming and other recreational activities, such as boating and fishing. Sediment from farming flows into the river and high concentrations of nutrients and fertilizer that encourage algae growth that reduces oxygen levels and harms fish populations.

Governmental agencies, conservation groups, and individuals joined together to develop a watershed plan and have begun carrying out the recommendations. Michigan DEQ has given a three year grant for $590,312 to Chikaming Open Lands. The group will provide $450,720 in matching funds for a total of $1.04 million. The money will be used to contact 200 landowners to discuss conservation easements. Funding will also be used to improve 39 road crossings and reduce erosion.

Wisconsin

The Wisconsin Department of Natural Resources (WDNR) operates Wisconsin's Beach Program. WDNR issues grants to communities along Lake Michigan and Lake Superior to monitor beach water for elevated bacteria levels. Since 2001, WDNR has received $907,196 in BEACH Act grants to develop and implement monitoring and notification programs at these Great Lakes beaches. Passage of the BEACH Act has enabled WDNR to substantially increase the number of coastal beaches it monitors from six to 112.

To design its beach program, WDNR formed a workgroup comprised of state and local environmental and public health officials and community groups. Using GPS technologies, 192 beaches were identified along Lake Michigan and Lake Superior. Maps of the beaches can be found at www.dnr.wi.gov/org/water/wm/wqs/beaches/state-map.htm Additional GPS data layers were added to include the location of all wastewater treatment plant outfalls along with their proximity to the beaches. Additional information was collected for each beach evaluating the potential for impacts from storm water runoff, bather and waterfowl loads, and the location of outfalls and farms. This information was used to rank and classify beaches as high, medium or low priority. These rankings indicate how often the beaches should be monitored to ensure that water quality conditions are safe for swimming.

Wisconsin's beach program workgroup also developed public notification and risk communication measures so water quality monitoring information is made available to the public in order for beach visitors to make informed choices. These measures included development of signs at beaches to give notice to the public that the coastal recreational waters are not meeting, or are not expected to meet, water quality standards. These signs, which are in English, Spanish and Hmong, were designed based on feedback from a beach user survey and public meetings held around the state.

Other public notification and outreach products developed by the workgroup include an automatic e-mail service to which the public can subscribe to receive daily updates on beach conditions; a statewide informational brochure, approximately

100,000 copies of which were distributed at local beaches, parks, and health departments; a Beach Health Web page (www.wibeaches.us) for reporting up-to-date conditions at all coastal beaches; and an internal web site for local health departments to report their daily advisory and monitoring data in the format required for USEPA reporting at the end of the beach season.

Public Communication

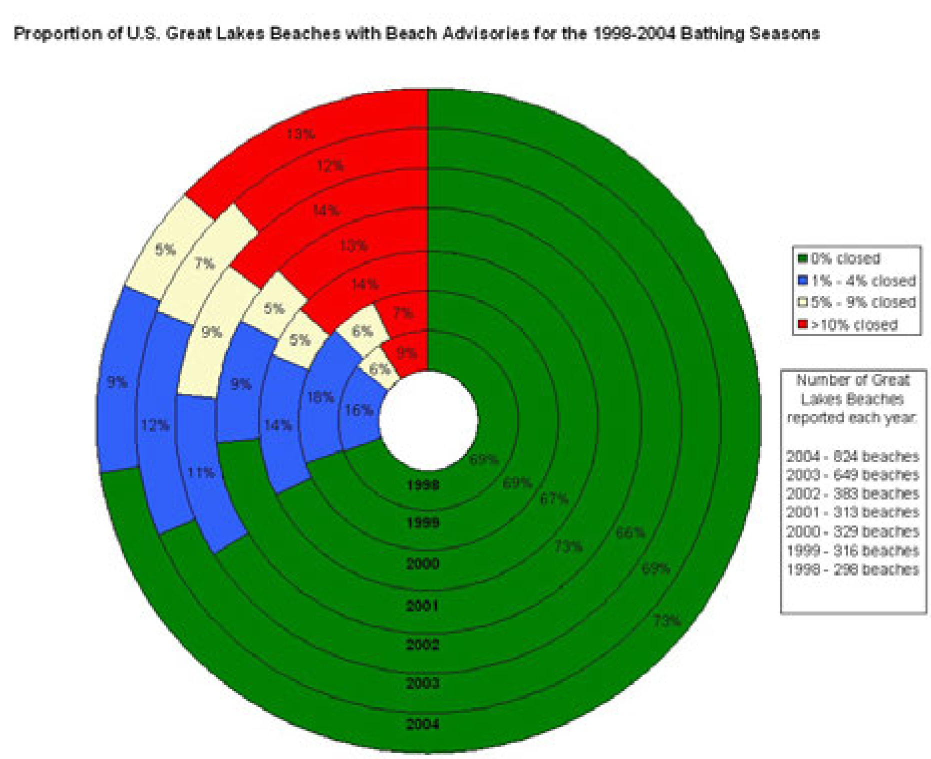
Because it has been shown that people who engage in recreational water sports have a higher incidence of symptomatic illnesses, it has become increasingly more important to make the public aware of the potential health hazards that are associated with recreational waters. Recent progress has been made on the national and local levels to provide the public with useful tools that can provide needed information regarding the use of recreational waters. At the national level, the following public communication tools are available:

BEACH Watch

This website contains information about USEPA's BEACH Program, including grants, USEPA's reference and technical documents including USEPA's *Before You Go to the Beach* brochure, upcoming meetings and events, conference proceedings, links to local beach programs, and provides access to BEACON (Beach Advisory and Closing On-line Notification), USEPA's national beach water quality database. www.epa.gov/OST/beaches.

Annual Great Lakes Beach Association (GLBA) Conference

In February 2001, USEPA, the Lake Michigan LaMP, and the City of Chicago sponsored the Great Lakes Beach Conference to share information on the science and technology of beach monitoring as well as research on exposure, health effects, and water quality indicators. More than 250 environmental and public health officials, beach managers, and regulators attended the 3-day conference. The conclusions of the conference saw the formation of the Great Lakes Recreation Association whose list serve and annual meetings provide quick sharing of research findings. The GLBA is comprised of members from U.S. states, Environment Canada, local environmental and public health agencies, and several universities and NGOs. The GLBA's mission is the pursuit of healthy beach water conditions in the Great Lakes area. Since 2001, the GLBA has held beach conferences annually to bring together beach



Proportion of all Great Lakes beaches with beach advisories.

In 2004, 69 of the 107 beaches in the Great Lakes basin that were closed more than 10 % of the swimming season (June, July, and August) were located in the Lake Michigan basin (almost 65%).

Source: USEPA David Rockwell presentation, November 2005, Great Lakes Beach Association Annual Meeting at the State of the Lake Michigan Conference, Green Bay, Wisconsin

Proposed Policy on Peak Wet Weather Discharges from Municipal Sewage Treatment Facilities

EPA proposed for public comment a new policy for addressing very high or "peak" flow events at municipal wastewater treatment plants that are a result of significant storm events. The policy follows the joint recommendations of the Natural Resources Defense Council (NRDC) and the National Association of Clean Water Agencies (NACWA). The proposed policy describes limited circumstances when certain management techniques may be used by the operator of a municipal wastewater treatment facility to address very high flows that result from storm events. The policy also indicates how the management of peak flows must be documented in National Pollutant Discharge Elimination System (NPDES) permits.

Aging sewer line infrastructure in many communities allows rain and snow melt to enter sanitary sewer systems. During significant storm events, these high volumes can overwhelm certain parts of the wastewater treatment process and may cause damage or failure of the system. Operators of wastewater treatment plants must manage these high flows to both ensure the continued operation of the treatment process and to prevent backups and overflows of raw wastewater in basements or on city streets. The proposed policy encourages municipalities to make investments in ongoing maintenance and capital improvements to improve their system's long-term performance.

The policy outlines the limited circumstances when these management techniques can be used and how they must be documented in NPDES permits. The policy also stipulates that all NPDES permit limits must be met at all times. The policy encourages further public participation via the National Pollution Discharge Elimination System (NPDES) permit process, and provides for public notification when certain management techniques are used.

The proposed Peak Wet Weather policy is substantially different from the November 2003 proposed "blending" policy. It requires that discharges must still meet all the requirements of NPDES permits and that operators demonstrate that all feasible measures are used to minimize wet weather problems. It also prohibits the use of these peak flow management techniques in systems where high peak flows are due to poor system maintenance or a lack of investment in upgrades to improve treatment capacity. The policy is designed to provide greater national consistency while still incorporating flexibility to recognize site-specific issues.

The comment period ended January 23, 2006. More information on the proposed policy and its follow-up can be found at: http://cfpub.epa.gov/npdes/wetweather.cfm?program_id=0.

managers, scientists, and agency officials to exchange information on improving recreational water quality. The next conference is planned for October 2-4, 2006, in Niagara Falls, New York, in conjunction with USEPA's National Beach Conference. www.great-lakes.net/glba/

BEACHNET

An email discussion list that seeks to facilitate communication among people interested in the improvement of recreational beach water quality in the Great Lakes basin. The listserv is sponsored by the GLBA and is hosted by the Great Lakes Information Network (GLIN). Both the GLBA and the listserv are open to anyone interested in improving beach water quality, understanding bacterial contamination, developing better ways to detect and monitor pollution, or monitoring and assuring beach visitors' health. There are currently several hundred subscribers to BEACHNET. www.great-lakes.net/glba.

BeachCast

This website provides Great Lakes beach goers with access to information on Great Lakes beach conditions, including health advisories, water temperature, wave heights, monitoring data, and more. BeachCast is a service of the Great Lakes Commission and its GLIN. www.glc.org/announce/03/07beachcast.html

Adoption of Bacteria Criteria that meet National Standards

One of the provisions of the BEACH Act required coastal and Great Lakes states to adopt for their coastal recreation waters, by April 10, 2004, water quality criteria for pathogens or pathogen indicators as protective as USEPA's 1986 water quality criteria for bacteria. The BEACH Act further directed USEPA to propose and promulgate such standards for states that did not do so.

The Lake Michigan Toolbox
Great Lakes Beach Association

The Great Lakes Beach Association (GLBA) plays an important role in providing a forum for beach managers, researchers, concurrent meeting with the Lake Michigan State of the Lake conference,

More information is available at:
www.great-lakes.net/glba/

USEPA worked collaboratively with all the states and territories that contain coastal recreation waters to identify their existing water quality standards, review them for consistency with the BEACH Act requirements, and determine what steps were needed to meet the BEACH Act requirements. On November 16, 2004, USEPA published in the Federal Register a final rule that promulgated water quality standards for states and territories that had not yet adopted water quality criteria for bacteria that were as protective of human health as USEPA's 1986 bacteria criteria. Information about the promulgation can be found online at: www.epa.gov/waterscience/beaches/bacteria-rule.htm

Next Steps

- Help coordinate outreach materials development
- Continue support of Great Lakes Beach Association conferences
- Report on the latest beach research
- Report on research on beach grooming, pathogen tests, and cladophora bloom causes in the LaMP at the State of Lake Michigan Conference

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 3

Coastal Health Beach Related Goals and Recommendations

Goal: By 2020, or sooner where possible, eliminate inputs of untreated or inadequately treated human and industrial waste to Great Lakes basin waters from municipal wastewater treatment systems and on-site disposal systems.

Interim Milestones:
- By 2006, EPA and the Great Lakes States will actively enforce NPDES authority to ensure pretreatment programs are properly implemented;
- By 2007, U.S. EPA and the Great Lakes States will undertake a thorough review of their ongoing wet weather control programs to identify and correct deficiencies, including adequate staffing and funding, to ensure that programs are achieving the requirements of the Clean Water Act (CWA), including anti-degradation;
- By 2007, watershed planning and applications of best management practices to promote infiltration and reduce impervious cover shall be components of wet weather management implemented by local governments;
- By 2007, Congress should fully fund the Clean Water State Revolving Fund;
- By 2008, U.S. EPA, in cooperation with Great Lakes States, will promulgate rules governing the disbursement of new wet weather management grant funds;
- By 2009, Congress will appropriate grant funds for a wet weather control program;
- By 2009, local governments shall develop ordinances to ensure proper construction, siting, and maintenance of on-site disposal systems, including conducting inspections at the time of property transfer;
- By 2010, or as soon as possible, all municipalities with wet weather overflows in the Great Lakes basin will have adopted and begun to implement comprehensive storm water control programs with the objective of meeting all appropriate state and federal regulations; and
- For communities with wet weather problems that have not proceeded with required planning and implementation by 2010, the States or U.S. EPA will apply necessary enforcement actions (administrative order or judicial action) to require correction of the problems by a date certain with appropriate penalties.

Goal: Achieve a 90-95 percent reduction in bacterial, algal, and chemical contamination at all local beaches. Steps to achieve this include: identify indirect pollution sources capable of adversely impacting Great Lakes coastal health; educate communities regarding their environmental impact; and remediate all potential indirect pollution sources through identification, estimation of relative contribution (based on historical data and sanitary inspection), and remediation of these sources. This will result in 90-95 percent of all Great Lakes public bathing beaches being classified as having "good" water quality.

Interim Milestones:
- By 2005, the BEACH Act will be fully funded to continue routine compliance monitoring of coastal waters;
- By 2006, real-time testing methodologies will be evaluated and trialed at Great Lakes beaches;
- By 2006, coastal states will have complied with the BEACH Act requirements for public notification;
- By 2006, a standardized sanitary survey form will be drafted;
- By 2007, standardized sanitary surveys will be trialed at select coastal communities;
- By 2008, states will add to their existing water quality monitoring programs a standardized tool for conducting sanitary surveys that will identify sources of contamination at the local level in those instances when bacterial indicator levels exceed published standards;
- By 2009, real-time test methodologies will supplant existing test methods (which take in excess of 18 hours before results become available) under the BEACH Act of 2000; and
- By 2010, regional predictive models will be

available using local data and forecasts of water mass movements derived from the Great Lakes Observation System.

Goal: At the local level, individual contamination events will occur no more than five percent of available days per bathing season, sources of these contamination events will be identified through standardized sanitary surveys, and remediation measures will be in place to address these events.

Interim Milestones:

- By 2007, coastal communities will have an education and outreach program in place for K-12, college, the general public, and coastal decision-makers, with assistance of the Great Lakes Sea Grant Network;
- By 2008, enforceable city ordinances will be in place that call for the placement of signs regarding the health risk associated with bather shedding, provision of adequate sanitary facilities for bathers, availability and importance of proper boater waste disposal, and prohibition of practices that attract nuisance wildlife to which fines are attached for violations;
- By 2008, use sanitary surveys to identify 90 to 95% of all indirect pollutant sources resulting in beach closures;
- By 2009, begin to control, manage, and/or remediate pollutant sources identified through sanitary surveys; and
- By 2020, nutrient loading will have decreased as evidenced by a decrease in nuisance algal blooms and ambient water concentrations of nitrogen and phosphorous in coastal areas.

Recommendations

- Eliminate to the extent provided by existing regulation inputs of untreated or inadequately treated human and industrial waste to Great Lakes basin waters through implementation of wet weather programs, including improvements to wastewater treatment systems.
- Identify indirect pollution sources capable of adversely impacting Great Lakes coastal health and, upon identification, promulgate and enforce regulations, provide public education, promote research, and initiate remediation to reduce the impact of these sources.
- Standardize, test, and implement a risk-based approach to manage recreational water.
- Protect drinking source water quality.
- Use the Drinking Water State Revolving Fund to improve drinking water infrastructure and support source water protection.

Sand Dunes with vegetation
Indiana Dunes National Lakeshore Lake Michigan
National Park Service, Indiana Dunes National Lakeshore

Constructed Wetlands Could Help Beach Health

Wetlands and marshes help to clean water naturally before the water makes its way to its lakes and streams. Wetlands that are not ditched or filled in by developers provide this filtering to water. Ditches short-circuit the water from the treatment benefits of being spread out over large areas where the proper conditions of light, plants, and soil filtering take out some unwanted contaminants such as *E. coli.*

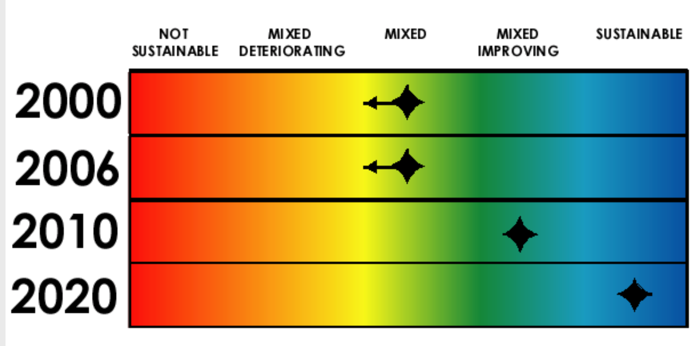
A man-made one-acre wetland is under construction at the Indiana Dunes State Park in the Dunes Creek watershed to help filter runoff before it gets to the beach on Lake Michigan. The constructed wetland will give scientists insights into the dynamics of how wetlands work and may serve as a prototype for building additional wetlands.

Subgoal 4
Are all habitats healthy, naturally diverse, and sufficient to sustain viable biological communities?

Status

The Lake Michigan ecosystem continues to experience profound changes because of development, impacts of nuisance species, and pollutant loading. Many species' habitats rank as globally rare or imperiled based on their restricted distribution, the level of threat, their ecological fragility, and widespread damage or because they are part of the single largest source of fresh surface water in the world.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 6 - Fish Habitat
- 8 - Salmon and Trout
- 17 - Preyfish Populations and Communities
- 93 - Lake Trout
- 104 - Benthos Diversity and Abundance
- 109 - Phytoplankton Populations
- 111 - Phosphorus Concentration and Loadings
- 116 - Zooplankton Populations
- 117 - Atmospheric Deposition of Toxic Chemicals
- 124 - External Anomaly Prevalence Index for Nearshore Fish
- 125 - Status of Lake Sturgeon in the Great Lakes
- 1123 - Benthic Amphipod (Diporeia spp.)
- 4504 - Coastal Wetland Amphibian Diversity and Health
- 4507 - Wetland Dependent Bird Diversity and Abundance
- 4510 - Coastal Wetland Area by Type
- 4858 - Climate Change: Ice Duration on the Great Lakes
- 4861 - Effect of Water Level Fluctuations
- 4862 - Coastal Wetland Plant Community Health
- 7000 - Urban Density
- 7002 - Land Cover- Land Conversion
- 7006 - Brownfield Redevelopment
- 7028 - Sustainable Agricultural Practices
- 7043 - Economic Prosperity
- 7056 - Water Withdrawal
- 7100 - Natural Groundwater Quality and Human Induced Changes
- 7101 - Groundwater and Land: Use and Intensity
- 7102 - Base Flow due to Groundwater Discharge
- 7103 - Groundwater Dependent Plant and Animal Communities
- 8114 - Habitat Fragmentation
- 8129 - Area, Quality, and Protection of Special Lakeshore Communities - Alvars; Cobble Beaches; Islands; Sand Dunes
- 8131 - Extent of Hardened Shoreline
- 8132 - Nearshore Land Use
- 8136 - Extent and Quality of Nearshore Natural Land Cover
- 8137 - Nearshore Species Diversity and Stability
- 8142 - Sediment Available for Coastal Nourishment
- 8146 - Artificial Coastal Structures
- 8150 - Breeding Bird Diversity and Abundance
- 8161 - Threatened Species
- 9003 - Climate Change: Effect on Crop Heat Units

Challenges

- Restore and protect 125,000 acres of wetlands in the basin
- Changes in climate, lake levels, ground water recharge of streams at both the lake basin and sub watershed scale
- To make habitat information on status and value readily available
- To build on the above challenge to promote projects, to identify, enhance, restore, or protect critical ecosystem features and habitat through purchase or voluntary protection or improved management
- Stress on habitats based on predicted growth and development of coastal areas of the basin

Next Steps

- Develop process to refine targets through public discussion and promote work toward targets
- Continue to support components of lake basin biodiversity plan though watershed academy grants
- Identify species sensitive to ground and surface water interaction
- Provide GIS tools and land use models in workshops to promote knowledge of and protection of key habitat areas and trends in loss and gain
- Promote new stream buffers, wetlands, and dam removals using, federal, state, local, and private resources and monitor loss and gain trends

Background

Habitats in the Great Lakes basin are many and varied. This chapter discusses the status and challenges of aquatic, terrestrial, and animal habitats. Each face challenges based on significant changes in land use, invasive species, pollution, and climate change.

Past LaMP Updates have detailed the elements that make up the Lake Michigan basin's many diverse ecosystems- from southern dune and swale to northern forest and the open lake's very significant aquatic food web. For LaMP 2006 we are presenting the lake by its 33 drainage basin watersheds. These watershed fact sheets contain information that resulted from a unique partnership with the Nature Conservancy's Great Lakes Program. They have provided us with the "headlines" of their very detailed work on Great Lakes biodiversity and the Natural Heritage Programs' data and for the first time broken down to the watershed level. Their complete work can be found at www.nature.org/greatlakes or contact them at greatlakes@tnc.org (see Chapter 12).

An important component of the Great Lakes Regional Collaboration was the defining of restoration targets and needed resources for five lakes and eight states. This chapter begins the needed work to define the priorities for protection and restoration for the Lake Michigan basin and portions of the four states. Each of the states has taken a different approach from Illinois's consultation with other state agencies to Wisconsin's series of public sessions across the state and Indiana had an Area of Concern target that had been developed. Michigan's statewide goals then needed to be sub-divided into four lake drainage basins and was probably the most complex.

The following targets are presented for discussion and comment not only as to quantity, but location, priority and tools to accomplish the goals. The LaMP Habitat Committee responded to the GLRC target goals for the Great lakes basin by reviewing habitat losses and proposing to increase net wetlands by 125,000 acres for the Lake Michigan basin. Eighty-nine thousand of these acres would be in Michigan, 30,000 in Wisconsin, and 1,000 acres each for Illinois and Indiana. Additional details are provided in previous LaMP reports.

Great Lakes Regional Collaboration Action Items

Habitat

The plants and animals of the Great Lakes need habitat in order to survive in the future, and there is a need for significantly more **habitat conservation and species management**. The recommendations focus on:

- native fish communities in open waters and near shore habitats;
- wetlands;
- riparian (streams) habitats in tributaries to the Great Lakes; and
- coastal shore and upland habitats.

Threats to the Food Web Foundation

The plankton communities (microscopic plant and animals) of Lake Michigan are the foundation of the aquatic food web and therefore are one of the most critical components of the lake's ecosystem. Changes to these communities may be occurring as a result of the presence of contaminants and/or nutrients in the water and sediment as well as competition from invasive species such as the spiny water flea (*Bythotrephes cederstroemi*) and the zebra mussel (*Dreissena polymorpha*).

The abundance and types of phytoplankton are highly variable within the lake, depending on the time of year, area of the lake, and availability of phosphorus and other nutrients. They are generally found throughout the open lake waters to the depths of light penetration. The amount of phosphorus in the lake is an important man-induced change to phytoplankton communities, especially in nearshore areas. In addition, studies indicate that increased salinity and other (possible climate) environmental changes in Lake Michigan are enabling nonindigenous animals and algae to adapt more readily to the Great Lakes environment.

Zooplankton communities include many different invertebrates and comprise the bulk of the planktivorous fish diet. Because most zooplankton

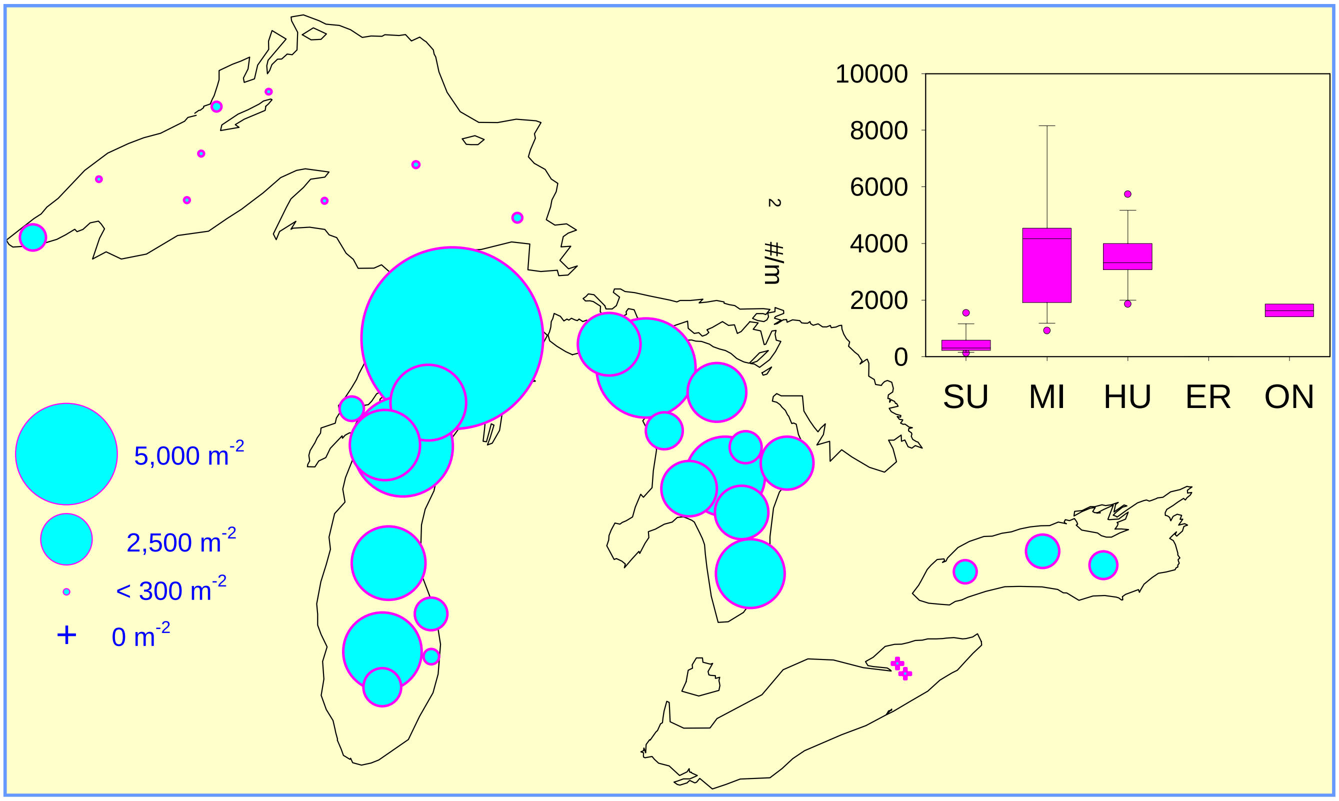


Figure 4-1. Diporeia density in the Great Lakes 1997

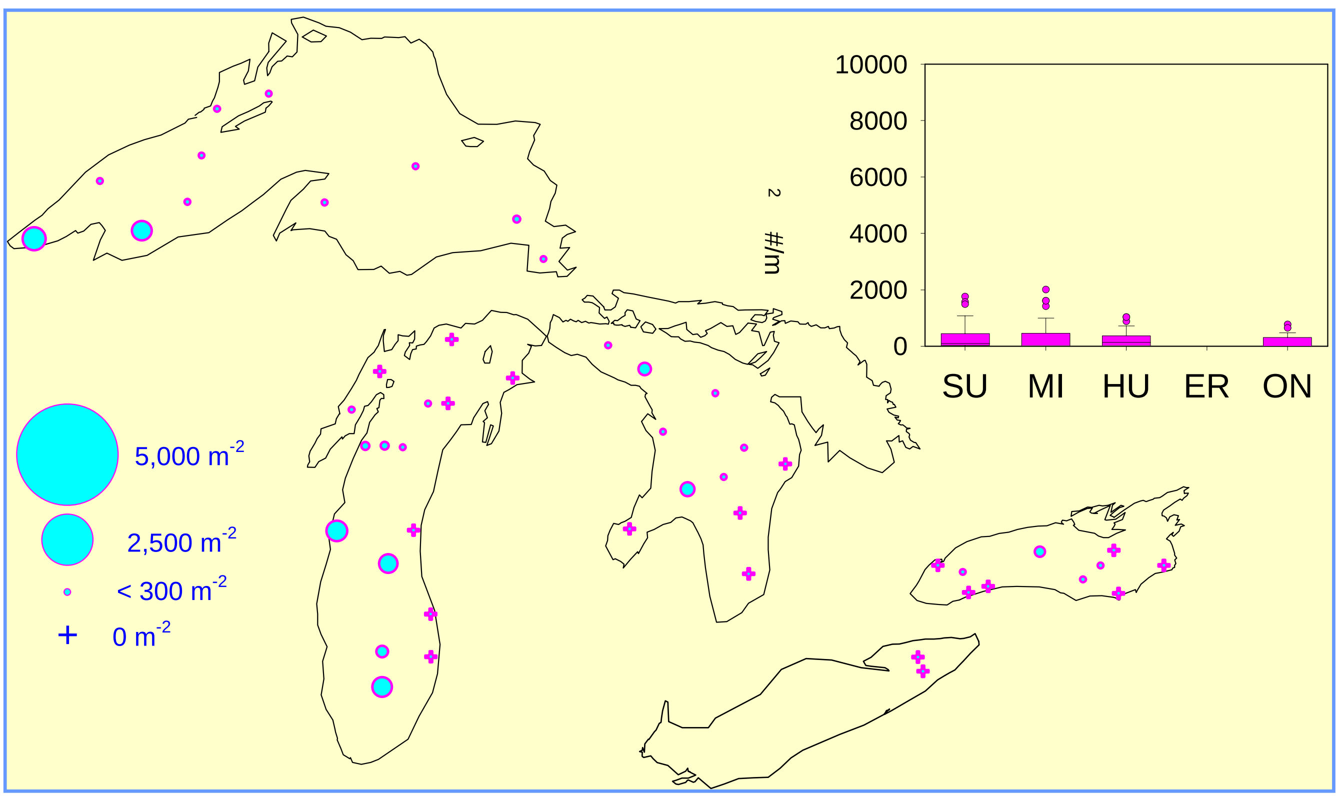


Figure 4-2. Diporeia density in the Great Lakes 2004

Source: David Rockwell, Environmental Scientist, MIRB-GLNPO; Dr. Richard Barbiero, Ph.D., Senior Environmental Scientist, CSC; Thomas Nalepa, Research Biologist, GLERL, NOAA; Dr. Mary D. Balcer, University of Wisconsin-Superior

Little River Band Releases Lake Sturgeon Fingerlings

(From an article by Jennifer Dale in "Protecting Our Resources," CORA newsletter September 2005)

Over 100 people from all walks of life came together on the banks of the Manistee River Aug. 27, 2005 with a common desire to see the Manistee River's lake sturgeon make a comeback. The group circled the streamside home of 50 baby sturgeon to celebrate the release of the youngsters into the river.

"There are children here today," said Jimmy Mitchell, chairman of the Natural Resource Commission. "When they see the sturgeon coming back as adults, they'll remember this day."

Anishinabe call the lake sturgeon "Nmé," and have an ancient relationship with it that has been treasured throughout the centuries. Every spring Anishinabe would reunite on the banks of the Manistee to await the spring run of Nmé. But no longer. The Manistee River lake sturgeon population has dwindled near extinction.

The Little River Band of Ottawa Indians decided to do something about it by developing a Nmé Stewardship Plan for the Manistee River lake sturgeon. The plan, developed by tribal biologists and a cultural taskforce, aims for a population 750 lake sturgeon in the Manistee in 25 years. It takes the wholistic approach toward the seventh generation, working a healthy habitat for Nmé and Anishinabe alike.

The lake sturgeon is considered a cultural indicator species. To lose these particular sturgeon would be to lose a significant element of the Anishinabe community's heritage and cultural identity.

"The sturgeon is an individualistic fish," said Inland Fisheries Biologist Marty Holtgrenz. "Tissue samples show a sturgeon's origin. The sturgeon returns to the river it spawned in. We want to preserve the fish genetically unique to the Manistee River."

A baby sturgeon that, hopefully, will return from Lake Michigan to spawn in the Manistee River some day. (Photo Courtesy of Stephanie Ogren)

Releasing the sturgeon into the Manistee River (photo courtesy of Robert Ogren)

feed on phytoplankton, their abundance and geographic occurrence are similarly dependent upon water temperature, seasonal changes, and food availability. Zooplankton colonize open waters from the surface to the lakebed. Research conducted in the past 15 years indicates that zooplankton populations such as *Daphnia*, may be experiencing changes induced by *Bythotrephes*, an exotic species.

The *Diporeia spp.*, also known as scuds, sideswimmers, beach hoppers, and sand fleas, belong to the group of invertebrates called amphipods and are about 0.5 inch long. *Diporeia* have inhabited Lake Michigan since the Great Lakes were formed 5,000 to 10,000 years ago, and they are environmentally sensitive, thriving only in clean, cold, well-oxygenated water. *Diporeia* are eaten by a variety of Great Lakes fish and provide an important energy source because they contain high amounts of fat.

The numbers and density of these amphipods is decreasing in Lake Michigan. The change between 1997 and 2004 is dramatic (see Figure 4-1 and Figure 4-2). While scientists have not yet determined the exact cause of the disappearance of the amphipods, they suspect it is linked to the

Boardman River Dam Settlement

The East Lansing Field Office of the Fish and Wildlife Service joined several parties, including the Michigan Departments of Environmental Quality and Natural Resources, the Grand Traverse Band of Ottawa and Chippewa Indians and the Traverse City and Light Power Department, in reaching a settlement regarding the future of three dams on the Boardman River. After license surrender and decommissioning, East Lansing Field Office personnel will join other signatories to explore the future of the dams, including the engineering and feasibility of possible dam removal.

This settlement has national implications as there are 79,000 dams nationwide and 2,500 in Michigan. Dam removal is becoming a more cost-effective solution in some cases as a University of Wisconsin study indicated that repairs to dams can cost three to five times more than the costs of removing a dam.

Dam removal in other areas have resulted in native species returning once a free flowing stream is restored.

More information is available at: www.theboardman.org

A dam on the Boardman River
Source: U.S. Fish and Wildlife Service

introduction of zebra mussels in Lake Michigan in 1989, severely limiting the food available to *Diporeia.*

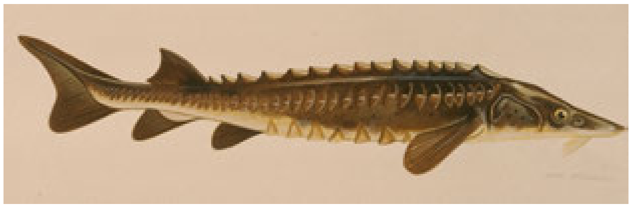
In addition, zebra mussels appear to be having a significant impact on benthic (bottom-dwelling) community structures and plankton abundance. Zebra mussels, which can attach themselves to any hard surface in the lake, have reached densities higher than 16,000/m^2 in southern Lake Michigan. Negative impacts of their presence include increased food competition (at the expense of fish fry) for nearshore fish species (such as yellow perch), increased biomagnification of contaminants in fish eaters feeding on organisms that eat benthic organisms, and possible zebra mussel-induced mycrocystis blooms, which affect taste and odor in the water.

Status of Important Fish Species at the Top of the Food Chain

Lake Sturgeon

Eight species of sturgeon live in American waters today. Four are endangered and another is threatened. Unlike most other fish, sturgeon mature late and reproduce slowly. Sturgeons survive in the Great Lakes only in scattered remnants, even though large-scale commercial fishing for them ended a century ago.

Lake sturgeon populations in Lake Michigan continue to sustain themselves at a small fraction of their historic abundance. Based on available data, an optimistic estimate of the lakewide abundance of adult lake sturgeon is below 5,000 fish, well below 1% of the most conservative estimates of historic abundance. Remnant populations currently are known to spawn in waters of at least 8 tributaries



Lake Sturgeon
Figure Courtesy of the Ontario Department of Fisheries and Oceans

having unimpeded connections to Lake Michigan. Estimates of spawner abundance in these rivers range from just a few fish to several hundred annually. Successful reproduction has been documented in six tributaries to date, though it is suspected in several others.

There are currently 16 agencies and institutions involved with investigations of lake sturgeon in Lake Michigan, including determining the status of known and suspected remnant spawning populations. Reintroduction efforts have been ongoing in upriver reaches of the Menominee and Wolf rivers for several years and were initiated in the Milwaukee and Manitowoc rivers in 2003. Indications are that spawning is increasing in tributary rivers.

A Lake Sturgeon Task Group has been formed under the auspices of the Great Lakes Fisheries Commission Lake Michigan Committee to develop and coordinate the implementation of a lake-wide lake sturgeon rehabilitation plan for Lake Michigan.

The Little River Band of Ottawa Indians is supporting sturgeon restoration efforts in 4 tributaries around Lake Michigan. More information is available at www.fws.gov/midwest/Tribal/LittleRiver.html.

More information about sturgeon restoration activities is available at: www.fws.gov/midwest/sturgeon/.

Lake Trout

Lake trout *(Salvelinus namaycush)* is a North American salmonid that thrives in cold, fresh water. Following the retreat of the last glacier, the lake trout colonized Lake Michigan, and over the subsequent 10,000 years or so, it became the top predator in a complex ecosystem that co-evolved with the other fish species.

Lake Trout
Courtesy of the Ontario Department of Fisheries and Oceans

During the 1800s, Commercial fishing for lake trout also became an industry, and by the beginning of the 20th century, the lake trout population was in decline. The decline continued until the mid-1950s, when predation by sea lamprey, overfishing, and the effects of industrial pollution led to the destruction of lake trout fisheries and the disappearance forever of many of the strains of lake trout that had evolved in the lake.

Currently, federal, state and tribal management agencies around the lake are attempting to re-establish naturally reproducing populations of lake trout by planting yearlings and eggs in historical spawning areas. Assessments indicate that self-sustaining populations of lake trout have yet to be established. Research into the reasons for this failure are ongoing, but may include:

- Loss of suitable spawning habitat
- Environmental contaminants
- Predation on larval lake trout by alewife
- Thiamine deficiency from a diet of alewife
- Loss of genetically distinct strains

Lake trout are again naturally reproducing in Lake Superior.

The Perch
Courtesy of the Ontario Department of Fisheries and Oceans

Perch

The number of yellow perch in Lake Michigan dropped dramatically during the late 1980s through the 1990s. However, recent reports by the Lake Michigan Yellow Perch Task force indicates that the number and size of perch population are increasing. Although more information is needed, these studies may indicate some recovery in the yellow perch population:

- In 2002, the LaMP update reported that the number of yellow perch egg masses found in spawning areas in the lake increased from 0.5 per 1,000 square meters (m^2) searched in 1997 to 7.29 per 1,000 m^2 searched in 2001. That number increased to 11.53 per 1000 square meters in 2002.
- In 1998, a total of 4,512 yellow perch were captured during a spawning assessment, of

which only 221 or 4.9 percent were females. In 2001, a total of 1,431 yellow perch were captured; 993 were males, and 438 (31 percent) were females. The percentage of females captured in 2002 dropped to 11 percent of 1812 total captured.

- The trend to detect the 1998 year-class continued . This year was particularly strong. Trawl surveys on the bottom of the lake and surveys of angler catch show the average yellow perch is now 11 inches in Indiana waters, up from 8 inches before commercial fishing was banned. This indicates that the closure of the fishery has allowed the perch to recover. Perch hatched in 1998, the year after commercial fishery was closed has grown to maturity and spawned new young perch.
- The 2005 year is so far the best ever recorded and the recovery getting stronger.
- The size of the perch population may level off in the next few years due to the amount of food available for the fish.

More information is available at http://dnr.wi.gov/org/water/fhp/fish/lakemich/YELLOWPERCH.htm

Land Use Changes

The Lake Michigan basin is seeing changes in land use over the last several years. According to the National Land Cover database, land is used primarily for agriculture. However, according to the Coastal Change Analysis Program overseen by NOAA, development is encroaching on the farmland. Forest land has decreased by a small amount, but this decrease is being more than offset by an increase in tree farming as evidenced by an increase in shrubland. Wetlands saw a slight increase between 1996 an 2001, indicating that wetland restoration and protection programs have had an effect.

Wetland Programs

Wetland restoration programs have seen a significant increase in activity. The Great Lakes Regional Collaboration set a goal of increasing the net acreage of wetlands Great Lakes basin-wide by 1.1 million by 2020. Michigan set a target acreage for its portion of the Lake Michigan basin at 89,750. Wisconsin has set a target statewide of an increase in 30,000 acres. Both states have developed programs that encourage wetlands restoration using state and private programs.

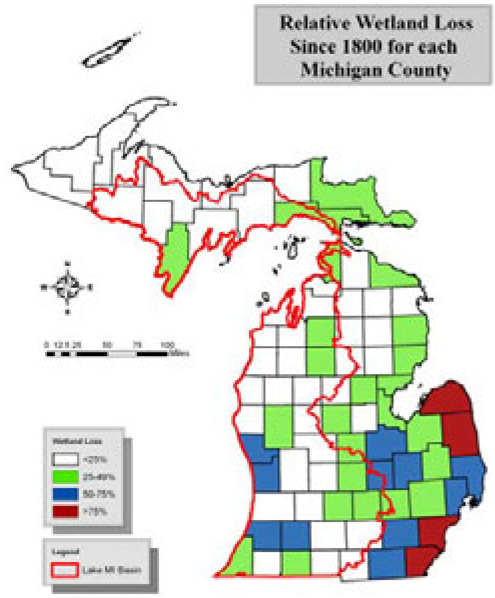
The Lake Michigan Toolbox
Milwaukee Pilot Project Offers Wetland Data Tools

In the last few decades, scientists have confirmed the critical role wetlands play in urban as well as rural areas. Not only do they provide habitat to a wide diversity of valuable plants and animals, wetlands reduce flooding, protect surface water quality, and provide scenic beauty and open space. Many of the wetlands in the Milwaukee River Basin have been destroyed, filled in or drained to create farm fields, cities and roads. The Milwaukee River Basin Wetlands Assessment Project seeks to understand the consequences of these losses and examine options for future planning. Questions the project will consider includes: What wetland resources do we have left and how do they benefit us? Where can former wetlands be restored for the most benefit for people and wildlife in the basin?

The Milwaukee River Basin Wetlands Assessment Project is a pilot project that will develop tools to improve planning wherever wetland resources are a concern. It will provide governments, conservation organizations, and other decision makers these tools to better understand where wetland restorations are most likely to improve habitat or water quality. These tools are a way of analyzing the relative level wetlands in small catchments provide wildlife habitat and water quality treatment (through sediment trapping/ nutrient) to protect downstream waters. They relate more to "ecosystem services" than to wetland biological integrity.

The project is spearheaded by the Wisconsin Department of Natural Resources through a grant from the U.S. Environmental Protection Agency. More information is available at: http://basineducation.uwex.edu/milwaukee/df/3milwetlands.pdf

Wetland Restoration In the Michigan Portion of the Lake Michigan Watershed



The Michigan's Wetland Conservation Strategy (Michigan Department of Environmental Quality, 1997) was developed by Michigan's Wetland Advisory Committee (MWAC) to provide a framework for effective protection and management of Michigan's unique wetland resources. Michigan has experienced an estimated 50% loss of the state's wetland resources since the colonial times including an estimated 70% loss of Michigan's coastal marshes.

The Strategy established a short-term wetland restoration goal of increasing Michigan's wetland base by 50,000 acres by 2010 (one percent of historic losses); and a long-term goal to restore, create, and enhance 500,000 acres of wetlands (ten percent of historic losses). The Strategy also includes a short-term recommendation that wetland restoration efforts should, to the extent feasible, focus on geographic areas, including coastal areas, which have lost the highest percent of wetlands and wetland function. The figure titled, "Relative Wetland Loss Since 1800 for each Michigan County" identifies wetland loss percentage for Michigan counties.

The Strategy acknowledged that it was not feasible to fund the restoration of the wetlands needed to meet the established goals through a new and distinct program. Rather, implementation would occur largely by taking advantage of opportunities presented through a variety of ongoing resource management initiatives designed to enhance fish or wildlife habitat, protect or improve water quality, provide increased flood control, or for related purposes. The Strategy also acknowledged that wetland restoration was dependent upon the coordinated efforts of numerous ongoing resource management programs and on the interest of individual landowners.

The Michigan Department of Environmental Quality has estimated historical wetland acres and current vegetated wetland acres in the Michigan portion of the Lake Michigan basin as 4,412,700 and 3,515,200 acres respectively. That means a total historical loss of 897,500 acres, or 20 percent.

Michigan is on schedule to meet the 50,000 acre short term goal on or shortly after the target date of 2010. Statistics for the major federal wetland restoration programs for the years 1999 through 2003 reveal that approximately 3,800 acres of wetlands are being restored in Michigan each year. The Michigan Department of Natural Resources (MDNR), Ducks Unlimited (DU) and other conservation organizations also have wetland restoration programs

Federal Agency	Program	Average Annual Acres of Wetlands Restored since 1999
USDA Natural Resource Conservation Service	Wetland Reserve Program	2,500
US Fish and Wildlife Service	Partners for Fish and Wildlife Program	700
USDA Farm Service Agency	Continuous Conservation Reserve Program	
USDA Farm Service Agency	Conservation Reserve Enhancement Program	600*
Total		3,800

From this data, MDEQ estimated both wetlands lost and the portion of the Michigan Wetland Conservation Strategy goals that relate specifically to the Michigan portion of the Lake Michigan basin. As a result, the Lake Michigan portion of the Michigan wetland restoration goals are restoring 1% of the lost wetlands (or 8,975 acres) and in the long term, 10% (OR 89,750 acres)

As anticipated in the Strategy the State of Michigan is on course to meet its established short term wetland restoration goal in large part because of the variety of wetland restoration programs available and the cooperation and coordination between the agencies and organizations involved.

A wetland restoration project tracking database and pilot collection system maintained by NRCS, USFWS and WDNR is working to help track wetland loss. This project involves collecting a uniform set of data to track wetland restoration projects done by the major organizations responsible for wetlands. The project also involves establishing a geospatial database that contains the tracking data. The objective in this project is to plug a major gap in reporting wetland "gains" achieved through voluntary restoration projects and to resolve the problem of double and triple counting the acres involved when these players collaborate on a restoration project. Many wetland losses are not known because we have no way of accounting for illegal losses and those which do not require a permit. The project will report wetland losses and gains that are captured through the wetland permit tracking and compensatory mitigation databases to generate an overall status report on known wetland activities.

Buffer Strips

Stream bank buffer strips not only provide buffers against nonpoint pollution, they protect aquatic and stream bank habitat and provide for more natural flow of streams.

Well managed riparian buffers generally support larger populations of wildlife because the buffer provides many habitat requirements. In a stratified forest, different habitat zones exist vertically, including the soil-air interface, herbs and shrubs, intermediate height trees, and the canopy. Included with the leaf litter and rotting logs at the soil-water interface are insects, These organisms are a food source for reptiles, amphibians, small field mammals, and birds. The herbs and shrubs provide habitat for insects, birds, and mammals. The intermediate zone and the canopy serve as habitat for birds, bats, squirrels, opossums, and raccoons. Bird habitat may be highly stratified and birds generally show a preference for certain layers that differ in habitat characteristics and food sources. See Chapter 7 for information

The Great Lakes Regional Collaboration set goals for the Great lakes basin at 1.1 million new acres of buffer strips. The states are beginning to set targets for buffer strips for Lake Michigan streams.

Next Steps

- Develop process to refine targets through public discussion and promote work toward targets
- Continue to support components of lake basin biodiversity plan though watershed academy grants
- Identify species sensitive to ground and surface water interaction
- Provide GIS tools and land use models in workshops to promote knowledge of and protection of key habitat areas and trends in loss and gain
- Promote new stream buffers wetlands, and dam removals using, federal, state, local, and private resources and monitor loss and gain trends

USFWS Awards Grant to Bring Back Hegewisch Marsh

The U.S. Fish and Wildlife Service awarded a $750,000 grant to the City of Chicago to help restore Hegewisch Marsh. The money will pay for removing invasive plants and restoring wetlands back to preindustrial conditions of more than a century ago. The goal is to make the marsh more attractive to birds that nest there or use it as a stop on the migratory flyway that follows the shore of Lake Michigan. These include yellow-headed blackbirds and black-crowned night herons, both of which are on the state's endangered list. The project partners, including the State of Illinois, the City of Chicago and the Chicago Field Museum and the Conservation Fund are providing an additional $510,000 for the restoration effort.

The marsh, located in the Lake Calumet region, is part of 4,800 acres of protected wetlands and woodlands near mostly unused industrial buildings and factories. Plans for the site include trails through woods, and sedges and meadows surrounding the marsh. Observation platforms will be built for bird watchers and other tourists from the nearby Ford Calumet Environmental Center.

National Coastal Wetlands Conservation grants are awarded to states through a competitive process. The program is funded under provisions of the 1990 Coastal Wetlands Planning, Protection and Restoration Act, with money generated from excise taxes on fishing equipment and motorboat and small engine fuels. Including the 2006 grants, the Service has awarded more than $165 million in grants to states and territories since the program began. More than 200,000 acres nationwide have been protected or restored through the program. The Hegewisch Marsh project is one of three projects in the Midwest Region to receive funding from the program this year. The other two projects are in Michigan:

The Lake Michigan Toolbox
Great Lakes Basin Landscape Ecology Metric Browser

USEPA designed a Great Lakes Basin Landscape Ecology Metric Browser. The principal focus of this project is the mapping and interpretation of landscape scale (i.e., broad scale) ecological metrics among hydrologic units and within 1 km, 5 km, and 10 km regions of coastal land in the Great Lakes Basin (GLB). Much is still unknown about the ecological relationships between human activities, surface water quality, and the biological characteristics with the GLB. This browser is an important step toward understanding the distribution of these phenomena and the analyses of their interrelationships.

The browser is designed to present some key ecological metrics to the GLB public and research communities at a landscape scale and will be updated as additional analyses are completed. For additional information regarding the topic of landscape ecology, visit the following web site: www.epa.gov/nerlesd1/land-sci/intro.htm. This is the initial presentation of landscape metrics for the GLB; for current applications of these metrics and results from other related topics in the Great Lakes, visit the following web site: www.epa.gov/nerlesd1/land-sci/wetlands.htm.

The Browser is located at: www.epa.gov/nerlesd1/land-sci/glb_browser/GLB_Landscape_Ecology_Metric_Browser.htm

The Lake Michigan Toolbox
WildLink Program Helps Landowners Keep Space Open for Wildlife

The WildLink Program is overseen by the Conservation resource Alliance and assists volunteer land owners in managing private-property corridors used by wildlife for travel between one large parcel of land (such as state-owned wildlife areas) to another. Its aim is to preserve the rural character of northwestern Michigan for outdoor recreation, hunting and wildlife watching in natural surroundings.

Wild Link focuses on parcels which fall within ecological corridors, or pathways of habitat. These privately owned corridors provide the critical connections between larger protected public properties.

The program, funded by the U.S. Fish and Wildlife Service, assists land owners in outlining a five to ten-year voluntary program for developing or modifying land use in order to keep wildlife corridors open for animal movement.

www.rivercare.org/wildlink/wildlink.php

U.S. Fish and Wildlife Service Coastal Programs in the Great Lakes

Monitoring protection, and captive rearing of the Great Lakes Population of the Piping Plover

The objectives of this multi-party cooperative effort on behalf of the endangered Great Lakes piping plover population include:

- To estimate total number of nesting Piping Plover pairs, eggs laid, eggs hatched and chicks fledged.
- To document breeding distribution.
- To determine, when possible, cause of mortality of eggs, chicks and or adults.
- To determine spatial use of piping plover breeding habitat.
- To implement and evaluate protection/recovery strategies (e.g. nest exclosures, beach closure, salvage, rear and release abandoned eggs).
- To make recommendations to improve nesting success, long-term plover population persistence, and ultimately, population recovery.

Partners include University of Minnesota Coop Unit of the USGS, Zoos, and volunteers.

Managing and Monitoring the Pitcher's Dune Thistle and the Dwarf lake Iris

Under this project, the Wisconsin DNR will collect and compile updated status information for Pitcher's dune thistle and dwarf lake iris populations in Wisconsin. The goal is to:

- Develop and implement long-term dune thistle management and monitoring;
- Write management recommendations for private land.
- Continue landowner contact efforts to promote the protection of biological diversity of Great Lakes coastal ecosystems.
- Obtain voluntary protection agreements to protect dwarf lake iris at Idlewild Alvar and Sand Bay sites.

A Dune thistle and dwarf lake iris status table and photo CD was submitted to the Wisconsin Natural Heritage Inventory program and USFWS Green Bay ESFO. Management plans for at least 2 properties were prepared as outlined in Measurable Results section of application and management recommendations were completed for 2 privately owned dune thistle sites. Additionally, three outreach and education initiatives have been completed.

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 1

Habitat Goals and Recommendations

Open/Nearshore Waters

Long-term goals:

- Open and nearshore waters possess a full array of safe and healthy natural habitats required to meet the growth and reproductive needs of fish and wildlife, in accordance with the Joint Strategic Plan for the Management of Great Lakes Fisheries.
- Open and nearshore waters harbor self-sustaining fish and wildlife communities that
- Include reproducing native fish species, especially lake herring, deepwater ciscos, lake trout, yellow perch, walleye, lake whitefish, coaster brook trout, lake sturgeon, American eel, and Atlantic salmon as a significant component.
- Self-sustaining populations of non-native game fish contribute to stabilize fish communities. Competition for habitat, predation, and disruptions to the food webs from invasive species are eliminated or neutralized by preventing new introductions and managing existing invasive populations.
- Food webs are free of toxic contaminants.
- Healthy fish communities support sustainable commercial, subsistence, and recreational fisheries.

Short-term actions:

- Develop and evaluate lake trout restoration efforts through strategies such as a 40 percent increase in the number of lake trout stocked, using guidance from existing fishery management plans .
- Develop an initiative to re-establish native lake sturgeon and coregonines in five areas of the Great Lakes from which they have been extirpated.
- Refine or develop techniques or models to improve assessment and exploitation strategies and management protocols for important fish species such as yellow perch, lake whitefish, lake trout, and walleye stocks.
- Develop an understanding of factors involved in recruitment of lake trout and other important native species, and remove or mitigate major impediments to recruitment.

Wetlands

Long-term goals:

- Wetland conditions should be sufficient to provide a full range of ecosystem services including hydrologic retention, nutrient and sediment trapping, spawning, nesting, and nursery habitats, and other habitat needs of fish and wildlife.
- Fish, wildlife, and plant communities and their habitats are protected and conserved.
- Wetlands in hydrologically modified environments are maintained and improved.
- Non-native plant and animal species are managed or prevented.
- One million acres of high quality wetlands in the basin are protected or restored.
- Self-sustaining non-endangered population levels for all currently listed wetland wildlife species, as determined by the state Departments of Natural Resources.

Short-term actions:

- Restore or protect 550,000 acres of wetlands and associated uplands (1.1M acres).
- Achieve at least 1.54 million breeding pairs of waterfowl (annual breeding population under average environmental conditions).
- Update inventory and mapping of wetland habitat types in the Great Lakes basin.
- Acknowledge, develop and enhance federal and state regulations and enforcement for coastal and inland wetland protection that also facilitate and accelerate wetland restoration.

Riverine Habitats and Related Riparian Areas

Long-term goals:

- Lakes, streams, rivers, wetlands, and connecting channels are conserved or restored to ensure their connectivity to floodplains.
- Intact stream corridors sustain native and migratory fishes, other aquatic biota, and wildlife.
- Barrier-free access to cold and warm water tributary spawning and nursery habitats is sufficient to sustain migratory fishes.
- Rivers and streams are adequately buffered to reduce sedimentation and nutrient inflow.
- Natural flow regimes (including groundwater infiltration) are restored or emulated.

Short-term actions:

- Restore ten Great Lakes tributaries (five tributary barrier projects and five riparian habitat projects).
- Restore coaster brook trout and lake sturgeon in Great Lakes tributaries.
- Adopt a method to characterize or classify watersheds based on degree of altered hydrology.

Coastal and Upland Habitats

Long-term goals:

- Coastal shore habitats and natural processes that sustain them—such as sediment transport, lake-level fluctuation, and wetland migration—are protected, restored and/or managed.
- Coastal and upland habitats sustain long-term diverse and abundant populations of native resident and migratory fish and wildlife species, especially those that are threatened and endangered.
- Sufficiently large and connected inland habitats are protected and restored, contributing to ecosystem health and biodiversity, and providing migration corridors for species.
- Highly altered environments are managed to emulate natural ecosystems.
- New invasions of non-native species are prevented and existing non-native populations are eliminated or controlled.
- Erosion is controlled and groundwater is recharged.
- The vitality of these habitats provides a broad range of social, cultural, and economic benefits.

Short-term actions:

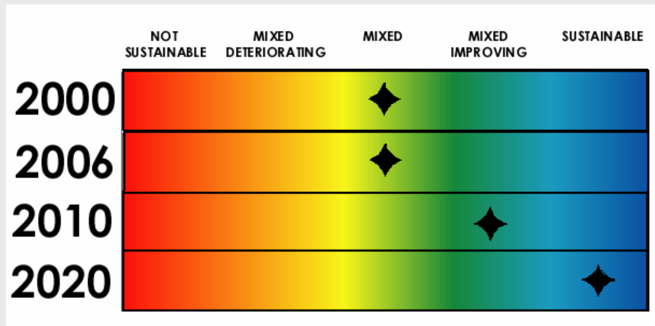
- Inventory and assess all Great Lakes coastal habitats and prioritize them for protection and restoration.
- Protect or restore 10,000 acres of high priority coastal and upland habitats per year across the basin.
- Conduct detailed monitoring of Areas of Concern in coastal shore areas.
- Protect and restore 1,100,000 acres of upland associated with wetlands.

Subgoal 5
Does the public have access to abundant open space, shoreline, and natural areas, and does the public have enhanced opportunities for interaction with the Lake Michigan ecosystem?

Status

Currently, the status of the goal is mixed due to the competing needs of the public and the ecosystem.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 7000 - Urban Density
- 7001 - Brownfield Redevelopment
- 7002 - Land Cover- Land Conversion
- 7053 - Green Planning Process
- 7054 - Extent of Hardened Shoreline
- 8114 - Habitat Fragmentation
- 8129 - Area, Quality, and Protection of Special Lakeshore Communities - Alvars; Cobble Beaches; Islands; Sand Dunes
- 8132 - Nearshore Land Use
- 8136 - Extent and Quality of Nearshore Natural Land Cover
- 8149 - Protected Nearshore Areas
- 8163 - Status of Protection of Special Places, Species

Challenges

- Fish advisories for sport caught fish
- Recreation harbor maintenance needs and funding shortfalls
- Land cost driven by sprawl makes purchase for preservation more costly
- Diminishing federal resources (land and water conservation funding) for purchasing land for open space and recreation
- Prevent recreation users from spreading invasive species (See chapter 8)
- Funding for recreation harbors

Next Steps

- Partner with the growing coastal zone management programs in the Lake Michigan basin to ensure that the issue of public access to the lake is balanced with protection of the ecosystem
- Support *cladophora* research
- Support a green marina dialogue
- Determine protection status of world's largest collection of fresh water sand dunes
- Public involvement in preservation and stewardship of special natural areas with public access for sport and recreational activities should be fostered by the following:
  - Broaden the dialogue with state and local government land-use planners and decision-makers to balance environmental and recreational needs
  - Provide tools for local communities to understand the value of the resource from a lakewide perspective and develop long-term management programs
  - Identify open space multi-use opportunities and tools for such things as flood retention parks, and open space with commuter bike trails, among others

Background

To move to mixed/improving status by 2010 and finally to sustainable status by 2020, there is a need to find a better balance between public access and ecosystem protection. The Lake Michigan LaMP focuses on the health of the Lake Michigan ecosystem, so management actions implemented under the LaMP are to take an ecosystem approach to remediation and protection. The 1994 SOLEC Integration Paper developed by USEPA and Environment Canada states that "Governments have traditionally addressed human activities on a piecemeal basis, separating decision making on environmental quality from decision making on natural resource management or on social or economic issues.... An ecosystem approach to management is a holistic approach that recognizes the interconnectedness of and addresses the linkages occurring among air, water, land, and living things."

Interacting with the Ecosystem

For thousands of years, the abundant natural resources of the Great Lakes system attracted inhabitants to its shores. The fresh water, abundant

The Marquette Plan to Open the Indiana Shoreline

In 1985, U.S. Congressman Pete Visclosky developed a plan for Northwest Indiana to reclaim former industrial lands for public use in a paper titled "The Marquette Project." The vision, now called the Marquette Greenway Plan, has three guiding principles: (1) a transformation of 75 percent of the Lake Michigan shoreline for public use, (2) a minimum 200-foot setback from the shoreline for all new structures and facilities, and (3) a continuous pedestrian/bicycle trail along the shoreline. An agreement was facilitated between the mayors of East Chicago, Gary, Hammond, Portage, and Whiting. All five cities signed a memorandum of understanding to collectively pursue a master plan for the Lake Michigan shoreline. The master plan will provide the cities with a detailed map analysis and evaluation of the shoreline and its potential for public recreational use.

The first phase of the project, completed in January of 2005, developed a study of the land that will serve as a guide for future regional planning efforts and implementation of the Marquette Plan. It focused on the Indiana shoreline from the Illinois/Indiana state line to the Port of Indiana-Burns Harbor. Implementation of the Plan will begin in 2006 in Portage with a project to demolish Midwest Steel's former water treatment plant. The project will be accomplished in cooperation with the Army Corps of Engineers and the National Park Service. Once demolition is complete, the city plans to build a lakefront park on the site. Phase II of the Plan was launched in February of 2006 and will continue development of the Plan from the Port of Indiana-Burns Harbor to the Michigan/Indiana state line.

In November of 2005, it was announced that the Marquette Plan received a $20 million federal funding authorization in the Energy & Water Appropriations Act of 2006 for projects that will reclaim sites along the Lake Michigan shoreline for public recreational use. Under the legislation, the $20 million will be cost-shared, with 65 percent coming from the federal government and 35 percent coming from a non-federal funding source.

Marquette Plan Honored by American Society of Landscape Architects

The American Society of Landscape Architects awarded the Marquette Plan design with an Honor Award. It received the award in recognition of the vision to build a long-term reinvestment strategy on a broad scale, but with the recognition that a critical component of the effort is to implement shorter term projects. The success of these projects will help build the support necessary for the "achievement of the plan's longer term goals.

More information is available at: www.il-asla.org/awards_2005_honor_jjr.html.

Proposed Lake Michigan Water Trail

The creation of Great Lakes automobile and bike trails around Lake Michigan and the creation of several water trails around the lake has led to discussions of linking the emerging water trails into a larger system of water trails by the U.S. National Park Service (NPS) and LaMP committees.

The Lake Michigan Water Trail program would encourage coordination among lakefront communities to develop a water trail segment that links their communities and provide a safe, educational, and legal access experience to Lake Michigan. Water trail creation brings together a broad coalition of interested groups including public land managing entities, self-powered boating interests, environmental and historical groups, private property owners, tourism offices, and physical activity advocates. The Rivers and Trails Program of the NPS will provide technical assistance to communities who wish to participate in water trail development.

In the Great Lakes, NPS Wisconsin staff assisted in developing three water trails in Lake Superior (one in ; Minnesota, Wisconsin, and Michigan), one in Lake Huron, and are currently embarking on one in northwestern Lake Michigan.

Creating a water trail on the northwest shore of Lake Michigan raises the challenge of how to link with an existing water trail segment on Lake Michigan's southwest shore and to expand around the lake. Spearheaded by the Northeastern Illinois Planning Commission, Openlands Project, and the Illinois Paddling Council, the Northeastern Illinois Regional Water Trails Plan was developed in 2002 and includes the Lake Michigan shore from Indiana to Wisconsin. Wisconsin has 365 miles in planning; Michigan has 735 miles needed; and Indiana identified 42 miles.

For more information, contact Angie Tornes at angie_*tornes@nps.gov*.

Lake Michigan Water Trails

There are many existing water trails in the Lake Michigan basin. Information about them can be found online at the resources listed below.

Illinois

- Northeastern Illinois Watertrails: www.openlands.org/watertrails.asp and http://gorp.away.com/gorp/location/il/pad_chic.htm
- Chicago Portage Canoe Trail: http://users.rcn.com/clonk/CCFPD/MINI/#Canoe_trail.htm
- Illinois DNR Canoeing Opportunities: http://dnr.state.il.us/lands/Landmgt/Programs/Canoe_trail.htm

Indiana

- Indiana's Canoe Trails: www.in.gov/dnr/outdoor/canoe/index.htm

Michigan

- Michigan's Canoe Trails: http://gorp.away.com/gorp/resource/us_river/mi.htm
- Kewaunee Water Trail: www.kewaunaw.org/watertrail.htm
- Hiawatha Watertrail: www.hiawathawatertrail.org

Wisconsin

- Wisconsin Lake Michigan Watertrail:www.kayakwisconsin.net/watertrail
- Capitol Water Trails, Inc., Madison, Wisconsin: www.capitolwatertrails.org/index.htm

and diverse fishery, stands of trees, mineral wealth, and fertile soils formed the basis for the quality of life and the economy. The opportunity of using water for drinking, power, and transportation was a key element in the economic equation of the time. The magnitude and diversity of the Great Lakes adds a challenging dimension to most endeavors.

The interaction of Lake Michigan residents with their ecosystem today is still based on natural resources but is less "hands-on", for while the plows still till the soil, the pork belly futures get sold in the Chicago Commodities Exchange pits far removed from the resource. More interaction is now self-selection of activities in which residents are seeking quality of life by being outdoors, often on or near the water. The interaction termed "recreation" is so highly valued by society that special purpose governmental units on the federal, state, tribal, and local levels are charged with protecting natural resources by providing and promoting recreation services utilizing public funds. Recreation takes place on the land, and on, in, and under the water. Scuba diving at old ship wrecks and other natural phenomenon in the lake is a growth sport and opportunities abound to discover other natural and cultural sites.

An entire industry exists to entice visitors to share the region's natural resource-based activities. Studies document that these nature-based tourism activities provide a significant net positive gain for the health of the residents and to the regional and national economy. To sustain this interaction with a positive net gain to the economy, the environment, and society, critical coastal areas must be open and accessible; water must be of high quality and sufficient quantity; sensitive cultural, habitat and biodiversity areas protected; and attention paid to climate change and lake level interaction.

The Green Infrastructure movement is becoming more widespread as a way to educate and inform communities of the important values of open space. Stated simply, green infrastructure is the system of connected parks, trails, and stream corridors that provide conservation and recreation benefits to a community. This connected system is as important as the more traditional infrastructure such as roads and utility corridors for electric power transmission, water and sewer and public safety.

Benefits in communities with well developed green infrastructure include a higher quality of life for

Fast Facts

- The Land and Water Conservation Fund 2004 survey reports that the Fund has seen shrinking appropriations for the last several years.
- A 2005 study by the Great Lakes Commission and the U.S. Army Corps of Engineers on Great Lakes recreational boating values that industry at $22 billion.
- Of 27 National Park Service Heritage Areas, only 3 are in the Lake Michigan basin.

The Lake Michigan Circle Tour
Courtesy of The Great Lakes Commission

residents. Healthy green infrastructure also minimizes non-point source pollution problems, provides transportation alternatives, and improves overall environmental quality, public health, and quality of life. If collocated where possible, it can benefit open space and trails.

Development pressures within the Great Lakes basin will continue to increase. Great Lakes communities need to consider growth management planning to ensure that future community expansion, whether residential, commercial, or industrial, does not have negative impacts on the important resources values of the Great Lakes.

Local, state, tribal, and federal government agencies have widely varied natural resource ethics and cannot deliver all that is needed to ensure a sustainable future of protection for the Great Lakes. Ultimately, local stewardship of important resources will cumulatively protect the Great Lakes.

Sleeping Bear Dunes Developing New General Plan

The Sleeping Bear Dunes National Lakeshore announced the beginning of a General Management Plan/ Wilderness Study/Environmental Impact Statement process. The General Management Plan will establish the overall direction for the park, setting broad goals for managing the area over the next 20 plus years. The plan will develop the desired resource conditions and visitor experiences that are to be achieved and maintained throughout the park.

These will be based on such factors as the park's purpose and significance, applicable laws and policies, resource and impact analysis, and public expectations and concerns. The plan also will outline the kinds of resource management activities, visitor activities, and developments that would be appropriate in the park in the future.

The Wilderness Study will evaluate the wilderness characteristics and values of lands within Sleeping Bear Dunes National Lakeshore using definitions found in the Wilderness Act of 1964. The study may result in an entirely new configuration of lands recommended for possible designation as wilderness.

The General Management Plan and Wilderness Study will be accompanied by an Environmental Impact Statement, which will evaluate the potential impacts of the alternative management approaches and the possible designation of wilderness within the park.

More information is available at: www.nps.gov/slbe

Public Interaction with the Lake Michigan Watershed

According to the Federal Interagency Ecosystem Management Task Force, an ecosystem is defined as: "... an interconnected community of living things, including humans, and the physical environment with which they interact. As such, ecosystems form the cornerstones of sustainable economies. The goal of the ecosystem approach is to restore and maintain the health, sustainability, and biological diversity of ecosystems while supporting sustainable economies and communities" (1995). Based on a collaboratively developed vision of desired future conditions, the ecosystem approach integrates ecological, economic, and social factors that affect a management unit defined by ecological—not political—boundaries. The foundation of the ecosystem approach is relating human beings and their activities to the ecosystems that contain them.

As access to Lake Michigan increases, so does the pressure for development. Growth of summer homes and year-round homes on the shoreline leads to more road construction, pollution from increased use of automobiles, and human use of areas that interrupts the natural web of basin life. In response, Smart Growth policies are being developed and pursued by many communities, and resources such as the "Wisconsin Planning Guide for Smart Growth" (see www.dnr.state.wi.us/org/es/science/landuse/smart_growth/index.htm for more information) and the Northeastern Illinois Planning Commission's "Environmental Considerations in Comprehensive Planning: A Manual for Local Officials" (see www.nipc.org for more information), and the Northwest Indiana Regional Planning Commission's "Water Resources Protection and Conservation Toolkit" (see www.nirpc.org for more information) are becoming more widely available.

Outdoor Recreation Opportunities

Outdoor recreation in the Great Lakes basin is an important component of the region's economy. The region offers outstanding tourism and recreational opportunities ranging from wilderness activities in pristine national parks to swimming at beaches in major cities. A well-defined four-season climate supports many types of recreation ranging from ice fishing, skiing, and snowmobiling in the winter to golf, fishing, boating, and swimming in the summer. There are approximately 40 state parks in or near the Lake Michigan basin as well as national lakeshore parks and fish and wildlife refuges. These can be visited by following the Circle Tour route around Lake Michigan. The Great Lakes Commission, in cooperation with the Great Lakes states and provinces in the 1980s and 1990s, coordinated the creation of the Circle Tours along existing roadways. The Lake Michigan Circle Tour route is marked by signs that feature Lake Michigan and the four surrounding states. In addition, guides prepared by states and localities that highlight enjoyable areas are important tools for promoting public access as well as critical ecosystem protection.

The Many Benefits of Open Space

Open space plays an important role in supporting the economy. According to the National Association of State Park Directors, use of geologically or environmentally sensitive areas as open space or for recreational purposes can reduce potential property damage costs. Hazards that can be mitigated through conservation of open space include flooding, slope instability, and structural fire damage. The combination of habitat protection and recreation is often the highest and best use of lands that are too fragile for development. The cost of not protecting such assets as slopes, aquifers, woodlots, wetlands, fens, alvars, floodways is incredibly high in the long run.

The eight Great Lakes states have about 3.7 million registered recreational boats, or about a third of the nation's total. Michigan is second in the nation in the number of boat registrations and six Great Lakes states rank in the nation's top ten in total registrations.

Recreational Fishery and Parks Valued

The Great Lakes recreational fishery is valued at $4.6 billion. The National Park Service (NPS) estimates expenditures related to visits at national and state parks at $22 billion (1993 dollars). The NPS 2004 survey of states estimated demands for recreational facilities and open space acquisition for three-quarters of the states have unmet needs of 50%.

Next Steps

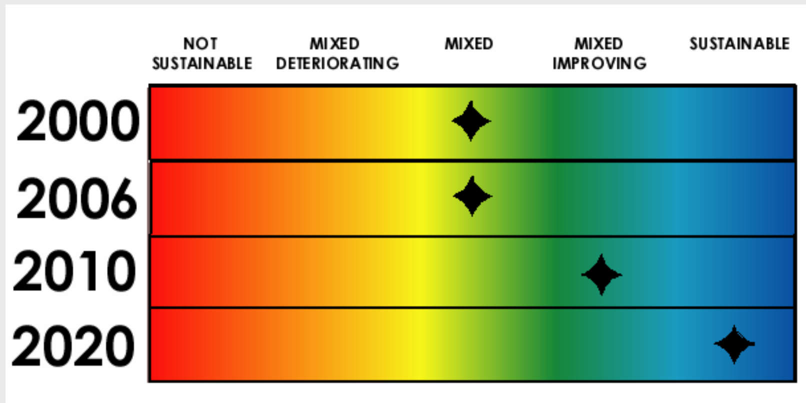
- Partner with the growing coastal zone management programs in the Lake Michigan basin to ensure that the issue of public access to the lake is balanced with protection of the ecosystem
- Support *cladophora* research
- Support a green marina dialogue
- Determine protection status of world's largest collection of fresh water sand dunes
- Public involvement in preservation and stewardship of special natural areas with public access for sport and recreational activities should be fostered by the following:
  - Broaden the dialogue with state and local government land-use planners and decision-makers to balance environmental and recreational needs
  - Provide tools for local communities to understand the value of the resource from a lakewide perspective and develop long-term management programs
  - Identify open space multi-use opportunities and tools for such things as flood retention parks, and open space with commuter bike trails, among others

Subgoal 6
Are land use, recreation, and economic activities sustainable and supportive of a healthy ecosystem?

Status

Land use, recreation, and economic activities are more sustainable, healthy and supportive of a healthy ecosystem, but there is significant work that needs to be done. There is more information available on critical ecosystems, significant activity in better managing water resources and determining the true value of a healthy ecosystem. There is danger, however, that the ecosystem could deteriorate if the knowledge is not shared widely and translated into actions.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 3514 - Commercial / Industrial Eco-Efficiency
- 3516 - Household Stormwater 4863 - Land Use Adjacent to Wetlands (Coastal Wetlands)
- 7002 - Land Cover - Land Conversion
- 7000 - Urban Density
- 7006 - Brownfield Redevelopment
- 7028 - Sustainable Agriculture Practices
- Recycling
- 7043 - Economic Prosperity
- 7054 - Ground Surface Hardening
- 7056 - Water Withdrawal
- 7064 - Vehicle Use
- 7057 - Energy Consumption
- 7060 - Solid Waste Generation
- 7061 - Nutrient Management Plans
- 7062 - Integrated Pest Management
- 7100 - Natural Groundwater Quality and Human-Induced Changes
- 7101 - Groundwater and Land: Use and Intensity
- 7102 - Base Flow due to Groundwater Discharge
- 7103 - Groundwater Dependent Plant and Animal Communities
- 8114 - Habitat Fragmentation
- 8132 - Nearshore Land Use
- 8136 - Extent and Quality of Nearshore Natural Land Cover
- 8501- Maintenance and Productive Capacity of Forest Ecosystems
- 8502 - Maintenance and Forest Ecosystem Health and Vitality
- 8503 - Forest Lands - Conservation and Maintenance of Soil and Water Resources

Challenge

- Land use and human activities are undertaken by individuals aware of the lake ecosystem's capacity to support human and environmental activities

Next Steps

- Help develop Green Marina, Highway, and Golf Course programs for the basin
- Promote studies that investigate the status of groundwater resources and their impact on water quality and aquatic habitat
- Support studies to determine sustainable yields for Great Lakes water resources

Great Lakes Regional Collaboration Sustainability Vision Statement

Sustainability is not a government program or a spectator sport, it is a balancing act that requires full involvement of all Lake Michigan basin citizens. Until recently there were many published materials on" what is" sustainability and "how to" but we have now reached the point where we can begin to measure our progress or lack there of. It is essential we track the use of our resources: climate, water, energy, land, industrial and municipal waste, water run off, flora and fauna.

Vision Statement

A sustainable Great Lakes ecosystem that ensures environmental integrity and that supports, and is supported by, economically viable, healthy communities.

The United Nations Bruntland Commission report defined sustainability as: development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In alignment with this sentiment is the Anishinaabeg Seventh Generation Principle that each generation considers the impact of its decisions on the next seven generations.

Sustainability

The interdependencies inherent in the ecosystem perspective require a balance between three fundamental elements: environmental integrity, economic vitality, and sociocultural well-being. The ability of these elements to function in balance over time is a measure of sustainability. The ecosystem perspective requires a shift of focus from resource programs to resource systems and in some cases their interaction. It places human activities and communities within an ecosystem and consequently, within ecosystem management.

The LaMP helps to identify the activities, partnerships, and locations where ecosystem management needs adjustment in order to attain a sustainable Lake Michigan basin. Sustainable landscapes are local ecosystems that are healthy enough to provide a range of valuable benefits and services, both now and in the future. Such benefits and services to humans include the following:

- Moderating natural events and human activities. Healthy landscapes can make communities safer and more livable by tempering the effects of natural events and human activities. For example, wetland systems can absorb and store storm waters, thereby aiding in flood control and ensuring more predictable stream flows and water levels and often providing for recharging local ground water.
- Enhancing social well-being. Healthy landscapes provide services that make communities more enjoyable and rewarding. For example, they provide opportunities for outdoor recreation, while also providing habitat for diverse plant and animal species. Plantings along stream banks can also provide buffers to filter pollutant runoff.
- Supporting local economies through tourism and sustainable natural resource use.

GLRC

Great Lakes Regional Collaboration Action Items

Sustainable Development

Ensuring the long term **sustainability** of the Great Lakes resource will require a number of significant changes in the way we approach such things as land use, agriculture and forestry, transportation, industrial activity, and many others. To start this process, we need to:

- adapt and maintain programs that promote sustainability across all sectors;
- align governance to enhance sustainable planning and management of resources;
- build outreach that brands the Great Lakes as an exceptional and competitive place to live, work, invest, and play; and
- provide leadership for sustainable development through implementation of the Strategy recommendations.

Water-Resources Issues

The Great Lakes basin, which encompasses Lakes Superior, Michigan, Huron, Erie, and Ontario, contains 95 percent of the fresh surface water in North America and 18 percent of the fresh surface water in the world. Ground water underlying the basin constitutes another large volume of freshwater. Humans, animals, and plants have adapted to this abundance in water resources. Yet, even in this water-rich area, water withdrawals, diversions, and use sometimes conflict with the needs of other users and ecosystems in the basin. For example, pumping of large water-supply wells in Wisconsin and Illinois has lowered ground-water levels in the area, increasing pumping costs and levels of such contaminants as radium. Because the Great Lakes basin contains so many communities, industries, and ecosystems that depend on present quantity sources of water, and because competition for available water is intensifying, there is a need to quantify the region's water resources and the trends affecting them so that the potential for possible future water-use conflicts can be reduced or avoided.

In recent years, numerous government agencies, commerce, industry, and the general public all have expressed concern about potential large withdrawals of water within the Great Lakes basin. In response, the Great Lakes States and Canadian Provinces signed the Great Lakes Charter Annex Implementing Agreements in December 2005. These multi-state and binational agreements commit the States and Provinces to more effective water-resources management. This commitment requires a more detailed understanding of the region's water resources and a synthesis of available data and information.

Great Lakes Water Availability and Use

At the request of Congress, the U.S. Geological Survey (USGS) is assessing the availability and use of the Nation's water resources to gain a clearer

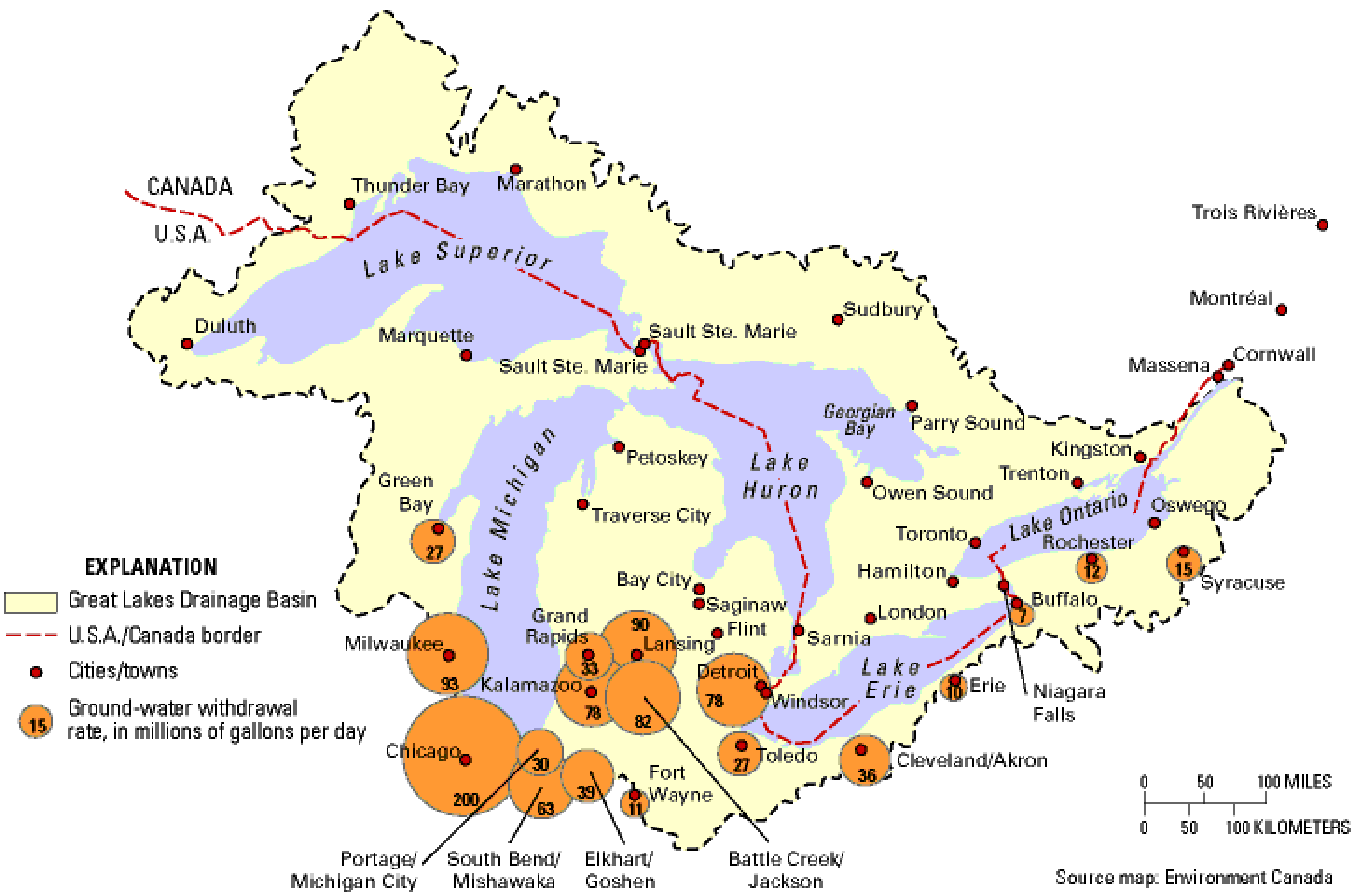


Figure 6-1 Groundwater Withdrawals in the Great Lakes Region

The Lake Michigan Toolbox
Milwaukee Metropolitan Sewerage District Protects Land to Store Stormwater

The Milwaukee Metropolitan Sewerage District is purchasing and protecting land to reduce the impact of development on stormwater overflows. The program, Greenseams, formerly known as the Conservation Plan, is a, flood management program that permanently protects key lands containing water absorbing soils. The program also aims to preserve land along stream corridors that connects the region's supply of public properties. Greenseams provides added support and protection for MMSD's structural flood management projects - infrastructure investments worth hundreds of millions of dollars. Greenseams identifies and purchases undeveloped, privately owned properties in areas that are expected to have major growth in the next 20 years and parcels of open space along streams, shorelines and wetlands. Sales are completely voluntary.

MMSD hired The Conservation Fund (TCF) to run Greenseams. TCF is a national non-profit conservation organization that forges partnerships to protect America's legacy of land and water resources. TCF performs high volume real estate transactions for local land trusts and government agencies throughout the country. All land acquired will remain as open space, protecting water and providing the ability to naturally store rain and melting snow in critical areas. Wetlands maintenance and restoration at these sites will provide further water storage.

In addition, preserving the properties also saves wildlife habitat and creates recreational opportunities for people living in the region. Where applicable, the properties can be used by the public for hiking trails, bird watching, and other passive recreation.

More information is available at: www.mmsd.com/floodmanagement/greenseams.cfm.

The Lake Michigan Toolbox
Smart Growth Information Sources

Smart growth is development that serves the economy, the community, and the environment. It changes the terms of the development debate away from the traditional growth/no growth question to "how and where new development should be accommodated."

Smart Growth answers these questions by simultaneously achieving:

- Healthy communities -- that provide families with a clean environment. Smart growth balances development and environmental protection -- accommodating growth while preserving open space and critical habitat, reusing land, and protecting water supplies and air quality.
- Economic development and jobs -- that create business opportunities and improve local tax base; that provide neighborhood services and amenities; and that create economically competitive communities.
- Strong neighborhoods -- which provide a range of housing options giving people the opportunity to choose housing that best suits them. It maintains and enhances the value of existing neighborhoods and creates a sense of community.Transportation choices -- that give people the option to walk, ride a bike, take transit, or drive.
- A sample of smart growth information sources include:
    - www.epa.gov/smartgrowth/
    - www.cwp.org/index.html
    - www.lowimpactdevelopment.org/

understanding of the status of our water resources and the land-use, water-use, and natural climatic trends that affect them. The goal of the National Assessment of Water Availability and Use Program is to improve our ability to forecast water availability for future economic and environmental uses. Simply put, the assessment will help characterize how much water we have now, how water availability is changing, and how much water we can expect to have in the future.

Currently, the assessment is focused on the Great Lakes basin (See Figure 6-1) to determine the best methods to evaluate water resources, both surface and to develop strategies for delivering information about water availability and use. Planned activities for the pilot study include estimation of: (1) recent monthly streamflows; (2) spatial and temporal trends in streamflow characteristics, ground-water recharge, groundwater flow, and ground-water storage; (3) basin ground-water divides; and (4) consumptive water use. Other water-resources regions will be added to the assessment as evaluation methods improve and as funding permits. More information is available at: http://water.usgs.gov/ogw/gwrp/activities/wateravail_pilot.html.

Ground-Water-Flow Models in the Lake Michigan Basin

Application of ground-water-flow models is one of the most comprehensive ways to synthesize ground-water data and to analyze the response of a ground-water system to changes in the system, such as increased pumping rates, changes in pumping locations, changes in recharge, and climate variations. Regional models that simulate ground-water flow will greatly improve the overall understanding of ground-water conditions in the Great Lakes basin and provide a quantitative framework to help manage water resources in ways consistent with the Great Lakes Charter Annex agreements. Comprehensive ground-water-flow models are complex and time consuming to develop; therefore, the entire Great Lakes basin could not be modeled for this study. Instead, a ground-water-flow model of the Lake Michigan subbasin is being developed because (1) the entire watershed is in the United States, and many datasets already are available within the USGS; (2) ground water is withdrawn from bedrock and glacial-deposit

Great Lakes Charter Annex 2001 Implementing Agreements Approved and Signed

On December 13, 2005, the Great Lakes Governors and Premiers signed agreements at the Council of Great Lakes Governors' (CGLG) Leadership Summit that will provide unprecedented protections for the Great Lakes–St. Lawrence River basin. The historic agreements, which include a ban on new diversions of water outside the basin with limited exceptions, were approved by the Governors of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin and the Premiers of Ontario and Québec.

The agreements detail how the States and Provinces will manage and protect the Great Lakes—St. Lawrence River basin and will provide a framework for each State and Province to enact laws protecting the basin. The agreements include the following points:

There will be a ban on new diversions of water from the basin. Limited exceptions could be allowed, such as for public water supply purposes in communities near the basin, but exceptions would be strictly regulated.

- The States and Provinces will use a consistent standard to review proposed uses of Great Lakes water.
- The collection of technical data will be strengthened, and the States and Provinces will share the information, which will improve decision-making by the governments.
- Regional goals and objectives for water conservation and efficiency will be developed, and they will be reviewed every five years. Each State and Province will develop and implement a water conservation and efficiency program.
- Lasting economic development will be balanced with sustainable water use to ensure Great Lakes waters are managed responsibly.
- The waters of the basin are recognized as a shared public treasure and there is a strong commitment to continued public involvement in the implementation of the agreements.

Additional information regarding the Agreements may be found at the Council of Great Lakes Governors' web site at: www.cglg.org/projects/water/annex2001Implementing.asp.

The Lake Michigan Toolbox
Green Infrastructure Overview Resources

Green infrastructure is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. The following are a series of resources for further protecting and developing green infrastructure.

- USEPA Low Impact Development page: www.epa.gov/owow/nps/lid
- Low Impact Development Center: www.lowimpactdevelopment.org
- Conservation Design Resource Manual: Language and Guidelines for Updating Local Ordinances, www.chicagowilderness.org/pubprod/miscpdf/CD_Resource_Manual.pdf
- Nonpoint Education for Municipal Organizations Network, http://nemo.uconn.edu/national/index.htm
- Center for Watershed Protection, An Introduction to Better Site Design www.cwp.org/better_site_design.htm
- Town of Franklin, Massachusetts, The Franklin Best Development Practices Guidebook www.franklin.ma.us/town/planning/HANDBOOK.PDF
- U.S. Department of Housing and Urban Development, The Practice of Low Impact Development, www.huduser.org/Publications/PDF/practLowImpctDevel.pdf.
- Prince George's County Low Impact Design Strategies, www.epa.gov/owow/nps/lid/lidnatl.pdf
- Planning with Power, Purdue University, www.planningwithpower.org
    - The Relationship Between Land Use Decisions and the Impacts on Our Water and Natural Resources, www.planningwithpower.org/pubs/id_260.pdf
    - Impacts of Development on Waterways, www.planningwithpower.org/pubs/id-257.htm

The Lake Michigan Toolbox
Wisconsin Sea Grant Develops Online Planning Guide for Coastal Communities

The University of Wisconsin Sea Grant program developed an online planning guide for communities located on the Great Lakes. Communities situated on the Great Lakes in Wisconsin face a variety of challenges in developing comprehensive plans to guide future growth and development. In addition to all the elements of a comprehensive plan that inland communities must address (e.g., housing, transportation, infrastructure, land use, etc.), coastal communities also must tackle the preservation and sustainable use of coastal amenities, and the reduction of coastal hazards.

The Great Lakes Coastal Communities section of the Community Planning Resource Website provides a toolkit to support comprehensive planning and sustainable development along the Lake Michigan and Lake Superior coasts of Wisconsin. The website includes:

- A Planning Guide
- Information on Hazards Planning
- Plan Examples
- Laws and Regulations
- Training Materials
- Additional Links
- Maps and Data
- News and Events

More information is available at:
http://planning.lic.wisc.edu/new_Coastal/Coastal_Home.htm

The Lake Michigan Toolbox
Index of Sustainability Web Pages

The USEPA Sustainability web site examines sustainability and provides links to USEPA programs and tools in four key areas: the Built or Human-created Environment; Water, Ecosystems and Agriculture; Energy and the Environment; and Materials and Toxics. Links to the programs and tools are organized in three categories: Policies and Programs; Research, Tools and Technologies; and Assessments and Performance Measures.

More information is available at: www.epa.gov/sustainability/index.htm and www.epa.gov/sustainability/links.htm

The Lake Michigan Toolbox
Managing Stormwater for Sustainability

Overviews

- Catching the Rain: a Great Lakes Resource Guide for Natural Stormwater Management, American Rivers www.amrivers.org/doc_repository/Stormwater_Guide_Book_FINAL2.pdf
- An Eight-Step Approach to Stormwater Retrofitting: How to Get Them Implemented, Center for Watershed Protection, www.cwp.org/retrofit_article.htm.
- Watershed-Based National Pollutant Discharge Elimination System Permitting Implementation Guidance, USEPA www.epa.gov/npdes/pubs/watershedpermitting_finalguidance.pdf.
- Stormwater BMP Design Supplement for Cold Climates, Center for Watershed Protection, www.cwp.org/cold-climates.htm.
- Lake County Stormwater Management Commission Technical Reference Manual, Lake County, Illinois, www.co.lake.il.us/smc/regulatory/tac/refmanual.asp

Example Stormwater Ordinances

- Stormwater Ordinances, www.stormwatercenter.net
- Stormwater Manual Builder, www.stormwatercenter.net
- Watershed Development Ordinance, Lake County Illinois, www.co.lake.il.us/smc/regulatory/wdo/default.asp
- Post-Construction Stormwater Management Ordinances, USEPA www.epa.gov/owow/nps/ordinance/postcons.htm.
- Post-Construction Stormwater Management Ordinances, Stormwater Center, www.stormwatercenter.net/Model%20Ordinances/Post%20Construction%20Stormwater%20Management/post_construction_runoff_control.htm.
- Operation and Maintenance Criteria for Stormwater Practices, www.stormwatercenter.net/Model%20Ordinances/Operation%20&%20Maintenance.htm
- Grand Traverse County, Michigan Soil Erosion and Stormwater Runoff Control Ordinance, including construction and post-construction runoff control. www.stormwatercenter.net/Model%20Ordinances/Post%20Construction%20Stormwater%20Management/grand_traverse_county_soil_erosi.htm

aquifers, both of which are important aquifer systems throughout the Great Lakes basin; (3) important issues related to ground-water and surface-water interaction can be simulated with the model; (4) ground-water withdrawals in the Lake Michigan subbasin may affect the locations of ground-water divides with Lakes Superior, Huron, and Erie; and (5) problems caused by large-scale ground-water withdrawals have been documented in the subbasin. In addition, one or more separate models within the Lake Michigan subbasin will be developed specifically to simulate ground-water and surface-water interaction in smaller watersheds because this is an important component of the water balance not only here but elsewhere in the Great Lakes basin. These models will be used to test new techniques for simulating the interactions of ground water and surface water at the appropriate scale. More information is available at http://pubs.usgs.gov/fs/2005/3113.

Lake Levels

The water-level elevations of Lakes Michigan, Huron, Erie, and Ontario have varied about 6 feet since 1860, when accurate records of lake levels were first recorded. Water levels in Lake Superior varied about 3 feet during the same interval. Prehistoric variations were much greater and were strongly correlated with climate change. Changes in water levels of the Great Lakes constitute the largest changes in the amount of water in the region. The Great Lakes basin study will summarize what is known about lake levels over the past 4,700 years. This analysis of lake levels will help put recent low lake levels into perspective, especially given the prospect of future global warming.

Lake Michigan was measured at 2 feet below the long-term average in 2001, having dropped more

The Lake Michigan Toolbox

LEED Certification of Green Buildings

The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. LEED standards include:

- New commercial construction and major renovations
- Existing building operations
- Commercial interiors projects
- Core and shell projects
- Homes
- Neighborhood development

LEED was created to:
- define "green building" by establishing a common standard of measurement
- promote integrated, whole-building design practices
- recognize environmental leadership in the building industry
- stimulate green competition
- raise consumer awareness of green building benefits
- transform the building market

LEED provides a complete framework for assessing building performance and meeting sustainability goals. LEED emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

The U.S. Green Building Council is currently working with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); and the Illuminating Engineering Society of North America (IESNA) to develop proposed Standard 189, Standard for the Design of High-Performance Green commercial Buildings.

Scheduled for completion in 2007, the proposed standard will apply to new commercial buildings and major renovation projects, addressing sustainable sites, water use efficiency, energy efficiency, a building's impact on the atmosphere, materials and resources, and indoor environmental quality.

Standard 189P will be an ANSI-accredited standard that can be incorporated into a building code. It is intended that the standard will eventually become a prerequisite under LEED.

More information is available at: www.usgbc.org/

than 40 inches since 1997 when it was at near record highs. Levels increased for the 2002, but were still below average. The decrease in precipitation over the last five years resulted in Lake Michigan hitting its lowest point since 1966. Lake levels rose between the mid 1960s and the late 1990s.

The lower lake levels cause problems for the shipping and boating industry. Cargo ships are forced to lighten their loads, and many boat ramps became inaccessible. According to the U.S. Great Lakes Shipping Association, for every inch of water that Lake Michigan loses, a cargo ship must reduce its load by 90 to 115 metric tons, leading to losses of between $22,000 and $28,000 per trip.

Early reports for 2006 indicate that the lake remains below average. The fluctuation may be part of a 30 year cycle but deserves closer monitoring. Levels have remained lower for longer than they have in recorded history and may reach its lowest levels recorded since the drought of the 1930s.

There are other potential factors affecting the levels. The International Joint Commission has proposed a study to investigate possible physical changes in the upper St. Clair River that may be causing water level changes in Lakes Michigan and Huron. this work would revise its upper Great Lakes Plan of study.

Lake Level Monitoring

Current Lake Michigan levels can be monitored online through a new National Oceanographic and Atmospheric Administration website, http://glakesonline.nos.noaa.gov. The site provides immediate water level and meteorological data from water level stations. There is a six minute interval between data readings and plans for real time wind speed and direction data, in addition to barometric pressure and air temperature data. This augments the U.S. Army Corps of Engineers website that provides water level information http://huron.lre.usace.army.mil/levels/hmpglv.html.

Land Use Impacts Water Quality

The urbanized land area in the United States has quadrupled since 1954. To compound the problem, populations in coastal areas, which contain some of the most sensitive ecosystems, have been increasing even faster than in the rest of the country. From 1982 to 1996, the population in the Chicago-Northwest Indiana area grew by 10.9 percent but consumed 44.2 percent of the land. (Urban Roadway Congestion: Annual Report 1998) Wetlands, which naturally help control runoff from urban areas by storing flood and surface water and slowly releasing and filtering it, have been destroyed in the Lake Michigan basin to a greater degree than elsewhere in the country.

USEPA's Office of Environmental Information states that "the construction of impervious surfaces such as roads and rooftops leads to the degradation of water quality by increasing runoff volume, altering regular stream flow and watershed hydrology, reducing groundwater recharge, and increasing stream sedimentation and water acidity." A 1-acre parking lot produces a runoff volume 16 times as large as that produced by an undeveloped meadow. Many impervious construction materials have higher surface temperatures that may cause ambient air temperatures to rise. When combined with a decrease in natural vegetation, areas are subject to what is called the urban heat island phenomenon, which may increase utility bills, cause health problems associated with heat stress, and accelerate formation of harmful smog. Clearly the effect of urban development on our communities and environment is a cross-cutting issue.

Oil and Gas Drilling in the Great Lakes

With the energy "crisis" in California in 2001 came renewed interest in tapping oil and natural gas reserves. In the Great Lakes basin, much of these resources lie under the lakes themselves. Drilling under the lakes raises concerns because a spill would lead to harm of the world's single largest source of freshwater providing drinking water to 33 million people.

Due to this concern, an amendment to the Energy and Water Development Appropriations Act of 2002

Michigan Governor Granholm Signs 2006 Water Withdrawal Law

Michigan Governor Jennifer Granholm signed legislation managing all water withdrawals over 100,000 gallons per day. The bipartisan package provides an important framework for comprehensive water management in Michigan. It allows the state to manage large quantity water withdrawals of over 100,000 gallons per day and prohibits withdrawals that would have an adverse impact on the water resource.

The legislation also requires all new or increased bottled water operators with withdrawals of over 250,000 gallons per day to meet high standards, including no adverse resource impact, no impact on riparian rights or common water law, and must address hydrologic impacts.

Illinois Governor Blagojevich Orders Comprehensive Water Supply Study

Governor Rod Blagojevich issued an Executive Order to develop a comprehensive, statewide water supply planning and management strategy. The Department of Natural Resources will oversee the process in conjunction with the State Water Survey.

While Illinois is on the shores of Lake Michigan and also has significant groundwater and surface water resources, portions of the state face legal and physical restraints to increasing water supplies. Shortages, like the one faced in 2005, are rare, but the growing population and increasing demand will strain current sources.

Lake Michigan Diversion to Chicago Water Deficit Reduced Faster than Planned

During the late 1990s, the diversion of water from Lake Michigan to the Chicago River exceeded the U.S. Supreme Court consent decree limit (2.1 billion gallons per day) by nearly 15% because of leakage at the Chicago River control works. Following a Memorandum of Agreement among the Great Lakes states, Illinois agreed to reduce its annual diversion over 14 years to pay off its water debt caused by the leakage. Repairs to the Chicago River locks and construction of new control works were completed in 2000.

The Chicago District of the U.S. Army Corps of Engineers completed work for an independent review of the current accounting procedures. Based on a preliminary analysis it is expected that the State of Illinois' cumulative diversion deficit (-1,858 cfs-years as of Water Year 2001) will likely be paid off by Water Year 2004. The Technical Committee's review reports can be accessed through the USACE Chicago District's internet web site at: www.lrc.usace.army.mil.

The general pace for repayment of the water debt has been faster than required under the memorandum of understanding signed by the Great Lakes states in 1996. This is due to the repairs at the river locks and the lower water levels. At one point during the 1990s, the locks did not fully close, allowing the water to flow freely from Lake Michigan. The lower water levels have decreased the amount of water that flows between the lake and the river when the Chicago locks are opened.

prohibits all federal and state governments from issuing leases or permits for new oil and gas directional or offshore drilling in or under the Great Lakes for two years. An extension of this moratorium is pending. Michigan's legislature passed legislation that would ban all direct and directional drilling in its portion of the Great Lakes basin. Furthermore, a proposed natural gas pipeline for lake bed of Lake Michigan from Wisconsin to Indiana was withdrawn in 2001.

Currently in the Lake Michigan basin, only Illinois has never issued an oil or gas mineral lease for Lake Michigan bottomlands. Indiana has permitted limited exploratory drilling, but no oil or gas has been produced. Wisconsin allows drilling for oil and gas in certain circumstances and, in the past, Michigan has allowed drilling that begins on land with the pipes "slanting" under the lake.

Next Steps

All of the LaMP subgoals are interconnected with this chapter. For example, subgoal 9 addresses stewardship and is the response to the sustainability challenge. See Chapter 9 for needed steps, and as well as Chapter 2 for source water assessment needs.

Over the next 2 years, the LaMP is also targeting the following for completion:

- Help develop Green Marina, Highway, and Golf Course programs for the basin
- Promote studies that investigate the status of groundwater resources and their impact on water quality and aquatic habitat
- Support studies to determine sustainable yields for Great Lakes water resources

Clean-up of Sediments Could Raise Property Values

Early results from a study by University of Illinois professor John Braden indicates that contaminated sites reduce property values between 9 and 27 percent. The study is sponsored in part by the Sheboygan River basin Partnership. If Sheboygan area waterways were cleaned of PCBs, it could mean an increase in overall property values by as much as $36 million.

Dr. Braden's earlier study of Waukegan, Illinois found that properties within five miles of the contaminated harbor were 9 to 19 percent lower in value than similar properties not near contaminated waterways.

Energy Sustainability Potential

- USEPA's Green Resource Conservation Challenge calls for 35% of total annual municipal waste generated to be recycled by 2008 yielding benefits of 1.72 quadrillion BTUs or 13.7 billion gallons of gas and the attendant positive impacts on the climate.
- In an April 2005 preliminary Briefing Paper by Scott Pryor, Mark Shahinian and Matt Stout of the University of Michigan School of Natural Resources and Environment for the Michigan Renewable Energy Program, "Offshore Wind Energy Development in the Great Lakes" the researchers indicate that Lake Michigan is ranked second behind Lake Superior in Offshore Wind Power Potential.
- Wisconsin Governor Jim Doyle signed a law mandating that at least 10 percent of the state's power come from renewable fuels by 2015, and ordering state agencies to reach 20 percent by 2010. Industry insiders expect wind to make up the bulk of that new investment.

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 6

Sustainability Goals and Recommendations

The goal is a Great Lakes basin where human activities support a strong and vibrant economy, meeting societal and cultural needs in balance with a diverse and resilient ecosystem. A sub-goal that is essential to this desired state is a Great Lakes community that has fully embraced and routinely applies sustainability in all decisions and actions. While the near-term actions recommended herein will have specific milestones, the adoption and use of sustainability as a guide to local and regional decision making will take time. As sustainability becomes embedded in the fabric of individual, corporate and governmental thinking, the return on that investment should continue indefinitely.

Recommendations

1. **Adapt and maintain programs that promote sustainability across all sectors**

- Action (a): States should incorporate sustainable criteria into sewer and water infrastructure loan and grant programs in the Great Lakes as a means of prioritizing those projects that pursue sustainable objectives.
- Action (b): Federal agencies should review existing grant, loan and subsidy programs applicable to the Great Lakes basin and incorporate sustainable criteria to provide priority for those projects that pursue sustainable objectives.
- Action (c): Local communities should re-use brownfields to revitalize lakeside and tributary waterfronts, with emphasis on public access and recreational opportunities. Federal and state grant programs should give increased funding priority for these projects.
- Action (d): Conduct a review of examples of sustainable practices, evaluate their effectiveness and applicability to the Great Lakes basin, and develop potential criteria for “green” certification and potential criteria for prioritizing proposals for funding programs.

2. **Align governance to enhance sustainable planning and management of resources**

- Action (e): Conduct a three-year demonstration project in three to four Great Lakes major metropolitan areas for development of a consistent, sustainable land use plan that uses best available new technologies to integrate with regional transportation plans and other public infrastructure plans including extensive public participation and local involvement. The regional 2040 framework plan of the Northeast Illinois Planning Commission provides a model.
- Action (f): In order to start to address two critically inter-related issues, transportation and invasive species (aquatic and terrestrial), authorize and fund a comprehensive study that integrates long-term invasive species control and management with sustainable intermodal transportation for Great Lakes-St. Lawrence basin.
- Action (g): Identify, expand, and enhance existing online clearinghouses to provide additional capacity for education and outreach, tourism projects and products, and local watershed planning initiatives
- Action (h): Enhance the capacity of local communities to apply sustainability through training and technical assistance provided with priority funding from multiple federal and state grant and assistance programs.
- Action (i): Initiate two new and maintain two existing watershed or regional partnerships with emphasis on rural, multi-ecosystem watersheds that incorporate sustainable criteria and local government capacity enhancing programs into a comprehensive strategic planning initiative.
- Action (j): Enhance the capacity of Great Lakes ports and marinas to implement best management practices in partnership with the outreach initiative of the American Association of Port Authorities

3. **Build outreach that brands the Great Lakes as an exceptional, healthy, and competitive place to live, work, invest, and play**

- Action (k): Develop and implement a marketing strategy for the Great Lakes targeted at a national audience that delivers messages of the region's ecological and economic importance to the nation/world

- Action (m): Develop additional education and outreach modules on sustainability (such as WET and Water Riches curricula for water conservation) and promote their incorporation into school curriculum (K-12)

4. Provide leadership for sustainable development through the implementation of the

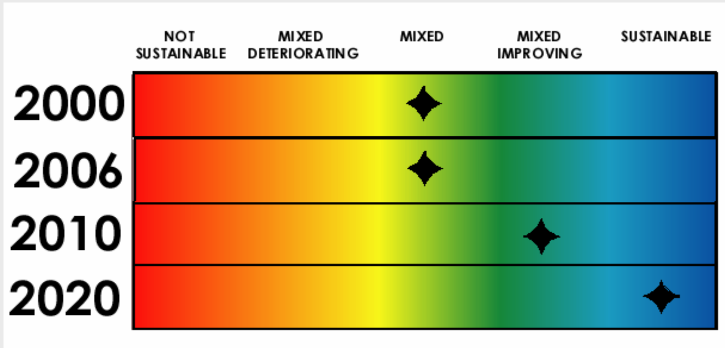
- Action (n): Congress should authorize and appropriate funding for development of a phased implementation plan for the recommendations in the Strategy that provides a scientifically sound process for prioritization, sequencing, development of detailed cost data, evaluation of alternatives, and assignment of responsibilities, utilizing sustainable development as the overarching guide
- Action (o): The Great Lakes Regional Collaboration should amend its Framework to provide oversight of the development, approval, and application of a phased implementation plan for the Great Lakes Strategy using sustainable development as the overarching guide. The Collaboration should also monitor and report on the status of implementation.
- Action (p): The Governors, Mayors, and Tribal leaders of the Great Lakes should renew and expand their commitments to the sustainable use, development and conservation of Great Lakes resources and utilize the Great Lakes Commission and Great Lakes and St. Lawrence Cities Initiative as a proactive advocates for

Subgoal 7
Are sediments, air, land, and water sources or pathways of contamination that affect the integrity of the ecosystem?

Status

Sediments, air, land, and water continue to be sources or pathways of contamination that affect the integrity of the Lake Michigan ecosystem. While regulatory and remediation programs reduce pollutant sources, ongoing releases and the region's legacy of contamination continue to serve as sources of pollutants. As a result, the status of this goal is mixed. There has been significant activity that will assist in changing the status to mixed/improving over the next decade. In particular, the findings of the Lake Michigan Mass Balance Study will allow decision-makers to better understand pollution pathways and adopt policies to address pollutant sources. Please also see Chapters 1 and 11.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Indicators by Number)

- 106 - Nutrient Management Plans
- 111 - Phosphorus Concentrations and Loadings
- 114 - Contaminants in Young-of-the-Year Spottail Shiners
- 115 - Contaminants in Colonial Nesting Waterbirds
- 117 - Atmospheric Deposition of Toxic Chemicals
- 118 - Toxic Chemical Concentrations in Offshore Waters
- 119 - Concentrations of Contaminants in Sediment Cores
- 121 - Contaminants in Whole Fish
- 124 - External Anomaly Prevalence Index for Nearhore Fish
- 4177 - Biologic Markers of Human Exposure to Persistent
Chemicals
- 4201 - Contaminants in Sport Fish
- 4202 - Air Quality
- 4506 - Contaminants in Snapping Turtle Eggs
- 4860 - Phosphorus and Nitrogen Levels (Coastal Wetlands)
- 8135 - Contaminants Affecting Productivity of Bald Eagles
- 8147 - Contaminants Affecting the American Otter
- 4175 - Drinking Water Quality
- 9000 - Acid Rain

Challenges

- Regional growth leading to demands for new power generating plants and emissions
- Research on phosphorus sources and near shore effects
- Research on conversion of mercury to methyl mercury
- Additional monitoring and data needed on emerging contaminants
- Clean-up and delisting of 10 Areas of Concern

Next Steps

- Develop a better understanding of the natural dynamics that affect pollutant distribution in the Lake Michigan ecosystem and why near shore and open lake can have wide variances
- Reduce pollutant loads with effective control and pollution control measures
- Build on the coordinated monitoring of 2005 and develop a 10-year trend analysis based on the 1994-95 mass balance project
- Review contaminated sediment sites and their status will be updated for Legacy Act funding or delisting opportunities
- Investigate nutrient contributions from the agricultural sector and non point sources during wet weather. Determine if nutrient levels are linked to *Cladophora* blooms
- Hold meetings to discuss Lake Michigan Mass Balance models and implications for Impaired Waters Strategy
- Develop Impaired Waters Strategy through basinwide meeting

Lake Michigan Mass Balance Project

What It Tells Us

The Lake Michigan Mass Balance (LMMB) Project is an enhanced monitoring and modeling project that is working to develop a scientific base of information to inform LaMP policy decisions and better understand the science of pollutants within an ecosystem (USEPA 1995; 1997a; 1997b; 1997c; 1997d; 1997e; Richardson et al. 1999; USEPA 2001d) . The LMMB Project's specific objectives are:

- To identify relative loading rates of four categories of pollutants (PCBs, mercury, trans-nonachlor, and atrazine) entering Lake Michigan from major media (air, tributaries, and sediments);
- To establish baseline loading estimates in 1994-95 against which to gauge future information;
- To develop the predictive ability through the use of models to determine the environmental benefits of specific load reduction scenarios for toxic substances and the time required to realize those benefits;
- To improve our understanding of key environmental processes governing the movement of pollutants through and out of the lake (cycling) and fish and plant life (bioavailability) within this large freshwater ecosystem.
- In addition, 11 tributary mouths were sampled for nutrients.

The LMMB Project focused on sampling and constructing mass balance models for a limited group of pollutants. Polychlorinated biphenyls (PCBs), atrazine, phosphorus, trans-nonachlor, and mercury were selected for inclusion in the LMMB Project because these pollutants currently or potentially pose a risk to aquatic and terrestrial organisms (including humans) in the Lake Michigan ecosystem and on the LaMP pollutant lists. These pollutants were also selected to cover a wide range of chemical and physical properties and represent other classes of compounds which pose current or potential problems. Once a mass budget for selected pollutants is established and a mass balance model calibrated, additional contaminants can be modeled with sufficient data. For the LMMB Study, models were calibrated using samples collected and analyzed for such purposes by numerous partners and collaborators (Hornbuckle et

GLRC

Great Lakes Regional Collaboration Action Items

Nonpoint Source Pollution

Non point sources of pollution contribute significantly to problems in the Areas of Concern, as well as to other locations in the Great Lakes, including the open waters. Actions to address these problems include:

- wetland restoration;
- restoration of buffer strips;
- improvement of cropland soil management;
- implementation of comprehensive nutrient and manure management plans for livestock operations; and
- improvements to the hydrology in watersheds.

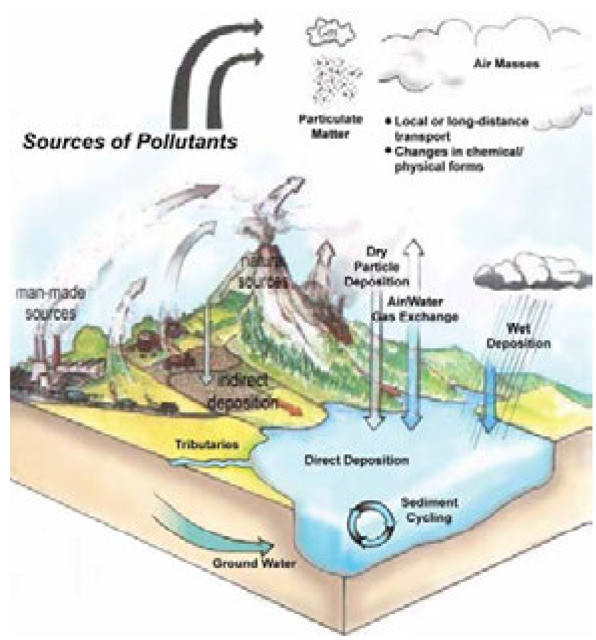


Figure 7-1 Pollutants enter and leave Lake Michigan through several pathways
Source: www.epa.gov/owow/oceans/airdep
Augmented by Joseph F. Abboreno, LaMP 2002

All graphics, with the exceptions of Figures 7-1 and 7-10, were created by USEPA/Office of Research and Development based on information from the publications referenced in the text of this chapter.

al 1995; Hall and Robertson 1998; Hall et al 1998; Hawley 1999; Robbins et al 1999; Green et al 2000; Van Hoff 2000; Miller et al. 2001; USEPA 2001a; 2001b; 2001c; 2001e, 2002a, 2002b).

What It Does Not Tell Us

The data and models provide insights to the whole lake ecosystem which may not represent data in any given specific near shore area. The relationship of the near shore to the open waters remains a topic needing additional research.

Pathways of Pollution

Sediments, air, land, and water continue to be sources or pathways of contamination that affect the integrity of the Lake Michigan ecosystem. In the Lake Michigan system, pollutant inputs may come from atmospheric deposition, tributary loads, or sediments. Pollutants may leave the system through volatilization to the atmosphere, or discharge through the Straits of Mackinac. Pollutants within the system may be transformed through degradation or stored in ecosystem compartments such as the sediments, water column, or biota, including humans.

The LMMB Study used an integrated, multimedia mass balance modeling approach (USEPA 1995; 1997a; Richardson et al. 1999) to evaluate the sources, transport, and fate of contaminants in the Lake Michigan ecosystem (Figure 7-2). The modeling framework is a series of coupled and/or linked models which integrates the physical, chemical, and biological components of the system and accounts for the dynamic interactions and processes in the system. The mass balance approach is based upon the principle of conservation of mass, which states that the mass of a chemical contained in the lake is equal to the amount entering the system, less the amount leaving and chemically changed in the system. In the Lake Michigan system, pollutant inputs may come from atmospheric deposition, tributary loads, and from sediments within the system. Pollutants may leave the system through discharge through the Straits of Mackinac, permanent burial in bottom sediments, and volatilization to the atmosphere. Pollutants within the system may be transformed through degradation or stored in the ecosystem compartments such as the sediment, water column, or biota, including humans.

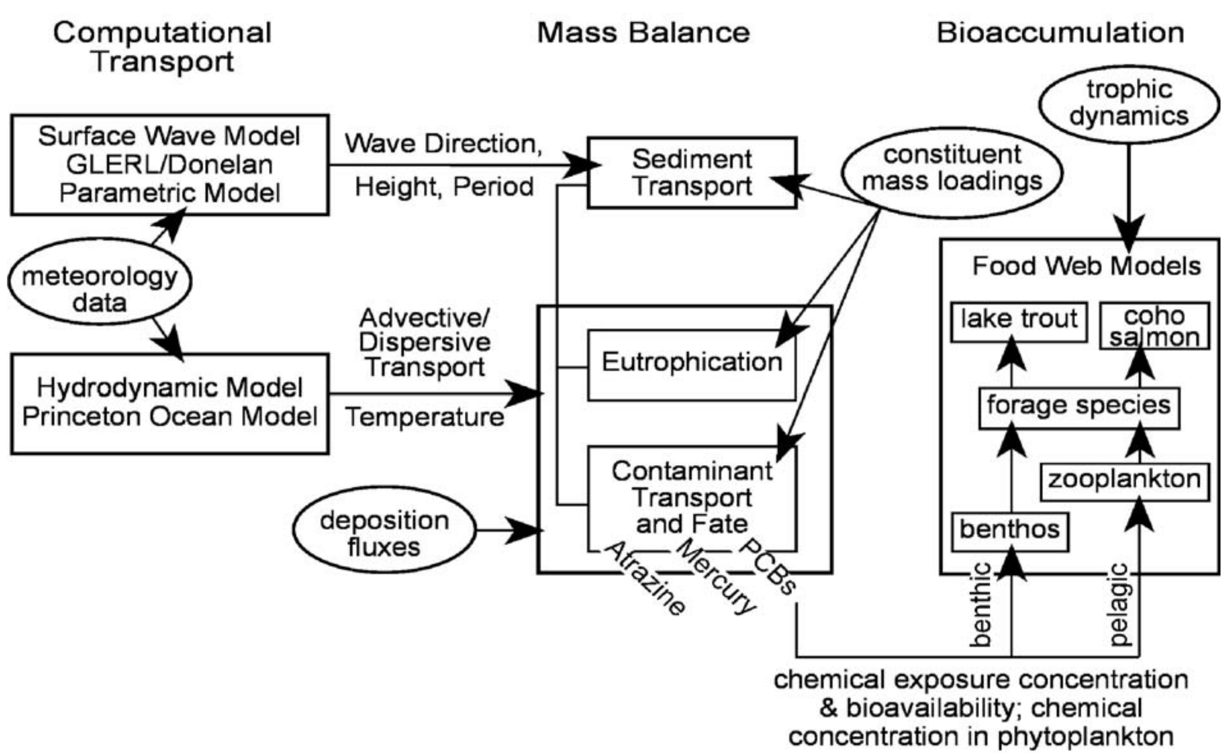


Figure 7-2. Lake Michigan Mass Balance Modeling Framework

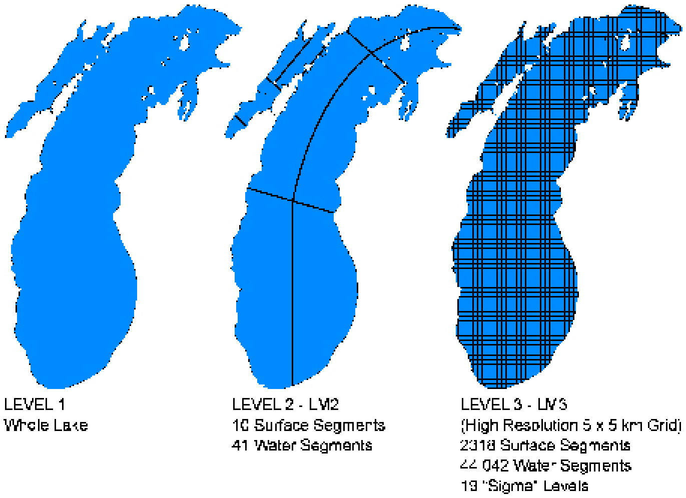


Figure 7-3. Lake Michigan Mass Balance project water

The mass balance models rely on data and output from multiple sources and were compiled into a LMMB Study database (USEPA 2001e). Computational transport includes a hydrodynamic model for advective/dispersive transport and temperature and a surface wave model for wave direction, height, and period; both use meteorological data for input. The mass balance components include sediment transport, eutrophication, and contaminant transport and fate. These models integrate atmospheric deposition and tributary mass loadings. The food web models receive chemical exposure concentrations and bioavailability (chemical concentration in phytoplankton) from the mass balance models and are used to simulate and forecast contaminant concentrations in the food web.

The modeling construct was applied to the study contaminants, where appropriate, and used three different spatial resolutions (Figure 7-3). Modeling results will be provided for each of the contaminants at the highest resolution that is presently available. The mass balance was primarily designed to provide a lakewide perspective of contaminant sources, fate, transport and effects. However, with the present spatial resolution design, selected aspects of the contaminants can be addressed on a finer scale. Information regarding Lake Michigan tributaries will be provided from samples collected only from tributary mouths.

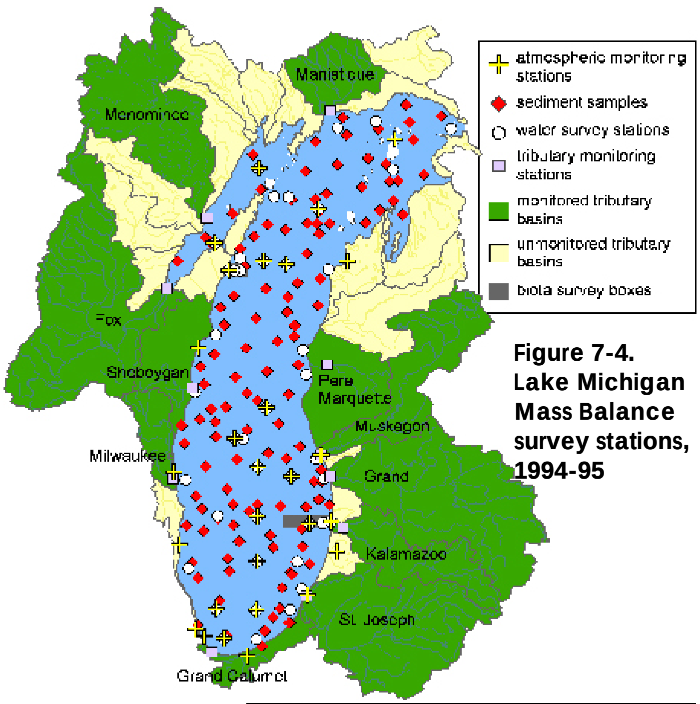


Figure 7-4. Lake Michigan Mass Balance survey stations, 1994-95

Sample Design and Sample Collection

To characterize Lake Michigan, over 200 locations (stations) were sampled during the course of the project (Figure 7-4). Samples were collected for air, water, sediment, tributary mouths, and biota. Over 35,000 samples were collected for the Lake Michigan Mass Balance during the 1994 and 1995 sampling seasons. The study produced approximately 1,000,000 analytical data points.

The field sample collection methods and the laboratory methods used in analyses are documented in the Lake Michigan Mass Balance Methods Compendium (USEPA 1997b; 1999c; 1997d) and elsewhere (www.epa.gov/glnpo/lmmb/methods/index.html).

In addition to the atmospheric, sediment, and water survey stations, the study intensively collected biota at the Saugatuck and Sturgeon Bay collections zones. The eleven (11) major monitored tributary mouths sampled were the Fox, Sheboygan, Milwaukee, Grand Calumet, St. Joseph, Kalamazoo, Grand, Muskegon, Pere Marquette, Manistique, and Menominee Rivers. The above monitored tributaries had direct measurements

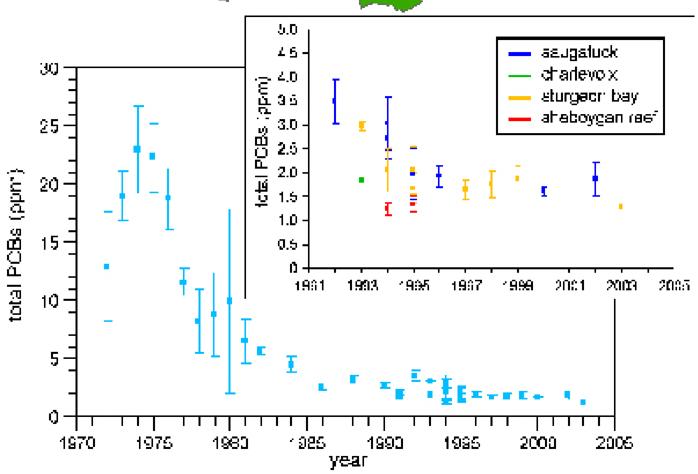


Figure 7-5. Total PCB concentrations in Lake Michigan Lake Trout

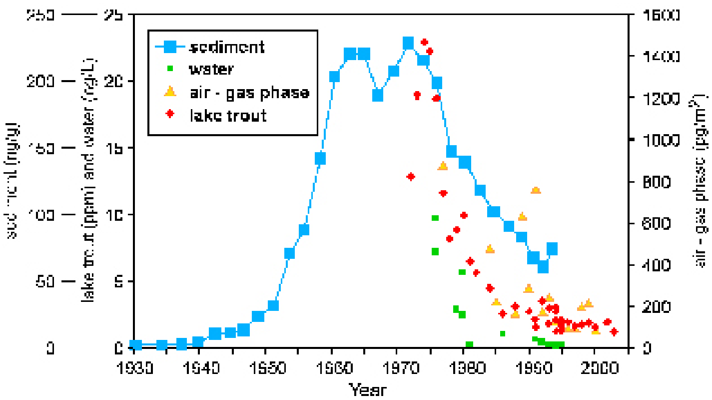


Figure 7-6. Trends of Total PCBs in Various Lake Michigan Media.

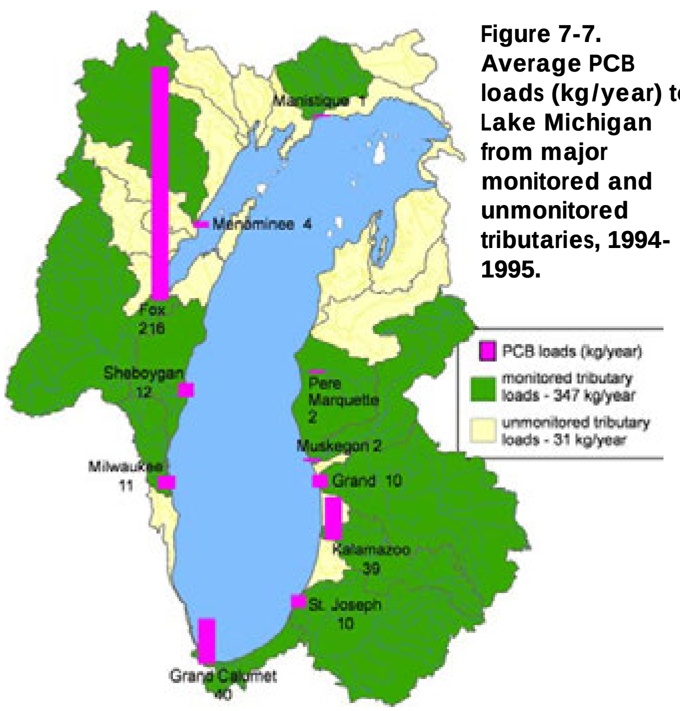


Figure 7-7. Average PCB loads (kg/year) to Lake Michigan from major monitored and unmonitored tributaries, 1994-1995.

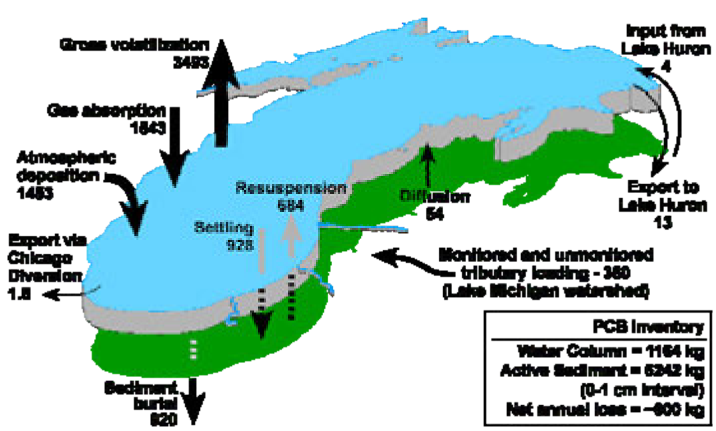


Figure 7-8. Total PCB Mass Balance (kg/yr) for 1994-1995

made over a time series at river mouths and had constituent loadings calculated directly from the data. Loading information for the unmonitored tributaries used watersheds of like characteristics and loadings were estimated through extrapolation (Hall and Robertson 1998).

Lake Michigan PCBs

Polychlorinated biphenyls (PCBs) are a class of manmade, chlorinated, organic chemicals that include 209 congers, or specific PCB compounds. The highly stable, nonflammable, non-conductive properties of these compounds made them useful in a variety of products including electrical transformers and capacitors, plastics, rubber, paints, adhesives, and sealants. PCBs were produced for such industrial uses in the form of complex mixtures under the trade name "Arochlor" and were commercially available form 1930 through 1977, when the USEPA banned their production due to environmental and public health concerns (2001b).

PCB concentrations in fish over the past 30 years (USEPA 2002a) show a downward trend from peak levels in the 1970s (Figure 7-5). The most recent data also exhibit a decline, however, this indicates that the rate of decline is slowing and concentrations in lake trout remain above desired levels. Similar trends are occurring for other species. Declining concentrations (IADN 2000; USEPA 2001b; 2001e; 2002a) are also observed for other media (Figure 7-6). Although PCB concentrations have been dramatically reduced in all media since the 1970s, PCBs continue to bioaccumulate above desired levels in fish as well as other species. The LMMB Study was undertaken, in part, to investigate this problem in detail and to develop mathematical models that could be used to project future concentrations in water, sediment, and biota, with and without future remedial and/or regulatory efforts (USEPA 1995; 1997a; Richardson et al. 1999; USEPA 2001d).

Figure 7-7 shows a summary of PCB loads from tributaries in 1994-1995 Hall and Robertson 1998; Hall et al. 2001). Total tributary loads of PCBs are approximately 400 kg/yr for the study period. The largest loads are from the Fox River, followed by the Grand Calumet and Kalamazoo Rivers.

The relative importance of sources and losses of PCBs in the entire system is provided in Figure 7-8 and is the result from the LM2 PCB model (Ambrose et al 1983;

1988; 1993; Thomann and Connolly 1984; Wanninnkhoff 1992; USEPA 1993; Hornbuckle et al 1995; Hydroqual 1996; Beletsky et al 1997; Franz et al 1998; Schwab and Beletsky 1998; Richardson et al 1999; Bamford et al. 2000; 2002; Green et al. 2000; Miller et al 2001; Velleux et al 2001; USEPA 2004; Endicott 2005; Endicott et al. 2005; Pauer et al 2006). The largest source of PCBs to Lake Michigan is gas phase absorption from the atmosphere to the surface of the lake water. The next largest source is from atmospheric deposition (wet and dry deposition) followed by tributary loading. The largest loss of PCB from the system is from gross volatilization to the atmosphere. Permanent burial of PCBs in sediment is also a major loss pathway. Most other sources and losses are generally minor. However, the pool of PCBs cycling between the sediment and water column through resuspension and settling is substantial. The PCB inventory suggests that a large reservoir of PCBs still exist in the upper level of sediment.

Model forecast scenarios to evaluate alternative futures are provided in Figure 7-9). Scenarios are provided for 5 to 6-year old lake trout at Sturgeon Bay.

Removing Contaminated Sediments at Ruddiman Creek and Ruddiman Pond

Ruddiman Creek and Ruddiman Pond are part of the Muskegon Lake “Areas of Concern” . Contaminants are present at high enough concentrations that they can affect human health, wildlife and aquatic life. Currently the main branch of Ruddiman Creek is posted as a no swimming, fishing or recreation area due in part to contaminated sediment. EPA and Michigan DEQ, in partnership with the AOC local public advisory council, have developed a contaminated sediment removal and site cleanup project for the creek and the pond.

The $10.6 million project is expected to take nine months to remove about 80,000 cubic yards of contaminated sediment . Under the Great Lakes Legacy Act of 2002, $6.9 million, or 65 percent of cleanup costs, are paid for with federal funds. The other $3.7 million must be non-federal, in this case, funds from the state’s Clean Michigan Initiative.

The main contaminants of concern include cadmium, found in the sediment with a maximum level of 25 ppm; chromium, found at 5,900 ppm; PCBs, found at 6 ppm; and lead, found at 1,200 ppm. This project will remove a substantial amount of these contaminants: an estimated 2,800 pounds of cadmium, 320 pounds of PCBs, 204,000 pounds of chromium and 126,000 pounds of lead.

More information is available at: www.epa.gov/glnpo/glindicators/sediments/remediateb.html

Results are from the LM2 (toxic PCB) model and Lake Michigan Food Chain Model. For comparative purposes, lake trout PCB concentrations are provided from the monitoring program and the Lake Michigan Mass Balance Study at Sturgeon Bay.
The first scenario is a constant load condition which holds PCB load to the same as at the 1994-1995 levels. The constant load scenario can also be characterized as no further action. The constant load scenario forecast shows a decline starting from 1994-1995 as result of past management actions and cleanups, however, then responds to the constant load with fish tissue concentrations ultimately leveling off at about 2012.

A second forecast is provided which encompasses a range based upon two rates of atmospheric declines (slow and fast) with a decline in tributary loads. These ranges of decline over the past decade are from long term monitoring programs and are described in peer-reviewed literature. These scenarios assume that recovery from past actions and present pollution prevention efforts, as well as remedial activities, will continue at approximately the same pace as in the past. The forecast range indicates that continued decreases in lake trout tissue concentrations into the foreseeable future. The lowermost portion of the range decreases to a lake trout PCB concentration, lower than the Uniform Great Lakes Sport Fish Consumption Advisory Level of 0.05 ug/g (ppm), in the year 2039. This is the most optimistic forecast for lake trout PCB concentration recovery, given the assumptions of continued recovery rate. The uppermost portion of the range does not fall below the advisory level in the model forecast through the year 2055. It appears that a decline in PCB lake trout

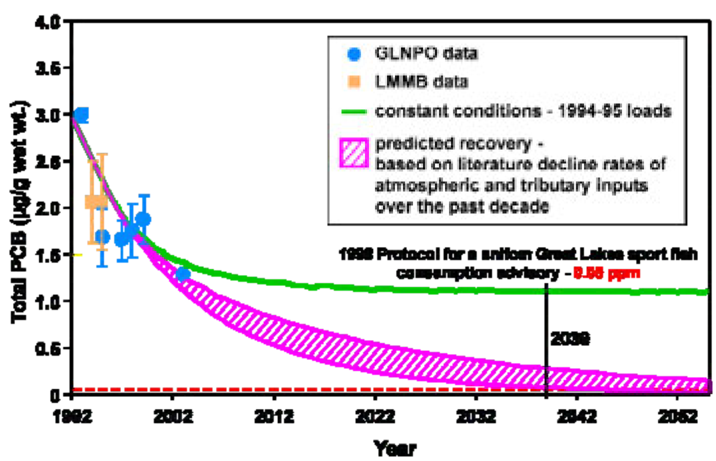


Figure 7-9. Predicted PCB Concentrations in Age 5.5 Lake Michigan Lake Trout at Sturgeon Bay

concentrations can be accelerated through management actions, for example, regarding pollution prevention efforts, land-based cleanups, and remediation of tributary sediments.

LMMB Major Findings: PCBs

- Forecasted PCB concentrations in lake trout may permit unlimited consumption as early as 2039 at Sturgeon Bay and 2044 at Saugatuck
- PCB trends indicate that concentrations are declining in all media
- Atmospheric deposition is the major current route of PCBs to the lake (from sources inside and outside the basin)
- Chicago urban area is a substantial atmospheric source of PCBs to Lake Michigan
- There is a dynamic interaction among water, sediments, and the atmosphere where large masses of PCBs from sediments cycle into and out of the lake via the atmosphere as vapor phase

Lake Michigan Atrazine

Atrazine is one of the chloro-triazines, which also include simazine and cyanazine. Atrazine is a widely used herbicide for control of broadleaf and grassy weeds in corn, sorghum, rangeland, sugarcane, macadamia orchards, pineapple, turf grass sod, forestry, grasslands, grass crops, and roses. In the Lake Michigan basin, atrazine is used primarily on corn crops and is usually applied in the spring before or after emergence of the crop. Trade names for atrazine include Aatrex, Alazine, Crisazina, Malermais, Primatol, and Zeapos. Atrazine has been widely used in the agricultural regions of the Great Lakes basin since 1959 when it was registered for commercial use in the United States. Atrazine was estimated to be the most heavily used herbicide in the United States in 1987 to 1989 with heavy use in Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska, Ohio, Texas, and Wisconsin (Figure 7-10). Peak total annual U.S. usage of atrazine occurred in 1984 at 39.9 million kilograms. Usage has been dropping since then and was estimated at 33.8 million kilograms in 1995.

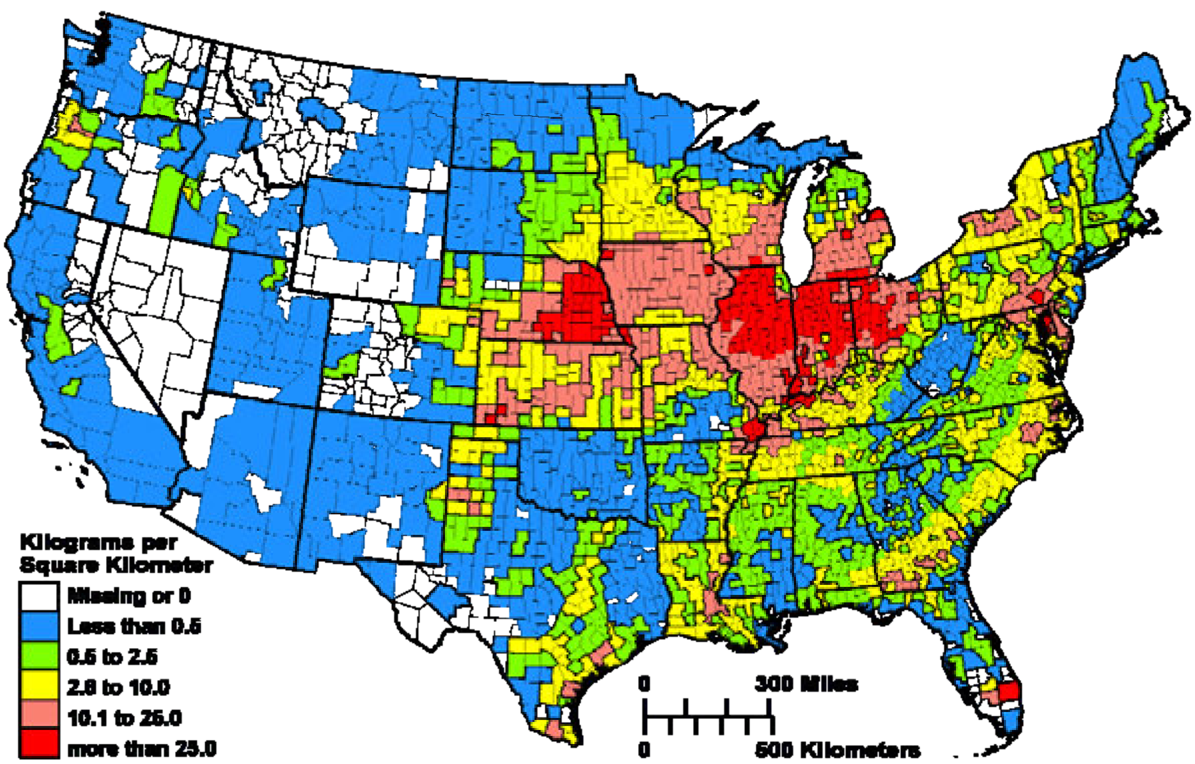


Figure 7-10. Atrazine Use- Kilograms per Square Kilometer (U.S. Geological Survey, 1991)

Unlike PCBs, the herbicide atrazine does not bioaccumulate in organisms but does remain in the water column. The two single-most important atrazine loads to Lake Michigan are tributaries and wet deposition (rain and snow). Historical loading estimates of atrazine from both tributaries and wet deposition to Lake Michigan are depicted in Figure 7-11. Decreases in loadings from the tributaries are evident starting in 1985. A decreasing trend of loadings from the atmosphere in the form of wet deposition is not as evident. All of the estimates of tributary loadings assumed that 0.6% of the applied active ingredient (atrazine) reached Lake Michigan. This 0.6% is often referred to as the Watershed Export Percentage (WEP). Tributary loadings for 1989, 1992, 1993, 1994, 1995, and 1998 were based on actual records of amounts applied per each county in the basin, and calculating what portions of the amount applied in those counties falls within a Lake Michigan Hydrologic Unit Code area that eventually drains into the lake. Tributary loading estimates for other years depicted were based on total annual U.S. usage for those years. For 1991, 1994, and 1995 wet deposition load estimates were based on actual precipitation data collect in the basin. Wet deposition loading estimates for other years were based on total annual U.S. usage for those years. Atmospheric loadings to the lake are higher in the southern portions than in the northern areas. The higher loadings in the south are likely due to the close proximity of this area to corn growing regions in the southern basin (Rygwelski et al. 1999).

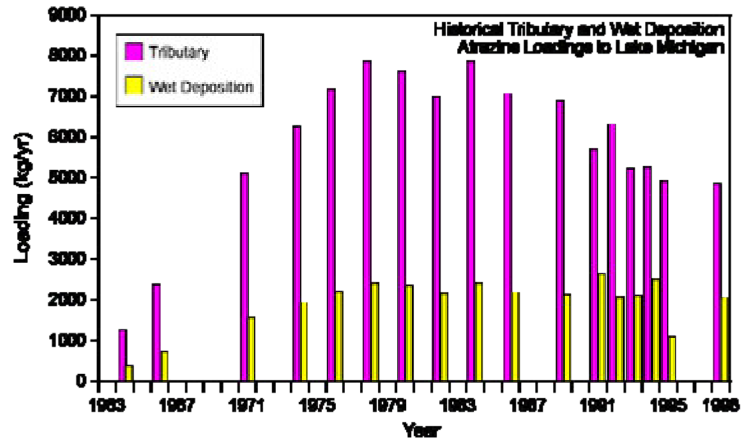


Figure 7-11. Historical Tributary and Wet Deposition Loadings of Atrazine to Lake Michigan.

Tributaries are the most significant source of atrazine to the lake. Figure 7-12 illustrates atrazine loadings from the eleven major rivers monitored from the LMMB Study (Hall 2000a). The largest load of atrazine to the lake in 1994 and 1995 was the St. Joseph River followed by the Grand River.

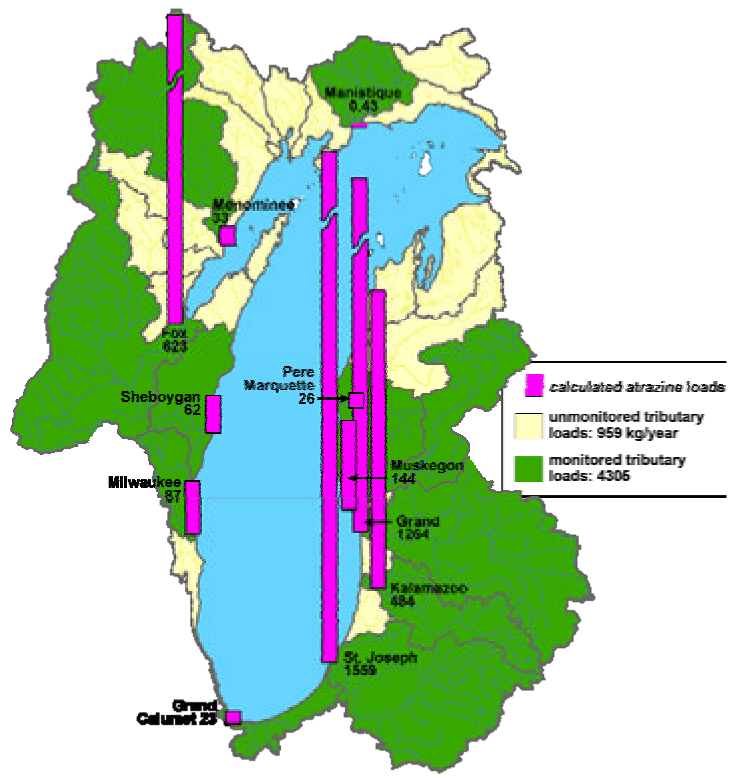


Figure 7-12. Atrazine loads (kg/yr) to Lake Michigan from major monitored and unmonitored tributaries, 1994-1995

In order to understand the impact of the atrazine loadings to Lake Michigan, a modeled mass balance was developed from the LM2 model (Figure 7-13). From these model results (Rygwelski et al. 1999; Rygwelski et al. 2006), one can note that the largest load to the lake is from the watersheds, followed by wet atmospheric deposition. Dry deposition to the lake is negligible. Input from Lake Huron and atmospheric absorption to the lake's surface are modest. The largest flux out of the system is the gross export to Lake Huron through the Straits of Mackinac. Export through the Chicago diversion and loss to the atmosphere through volatilization are small. In water, atrazine is primarily in the dissolved state and, therefore, any processes that involve sediment or suspended particle interactions are of minor significance.

The results from the modeling effort indicate the primary sources and pathways of atrazine within Lake Michigan. It also indicates that atrazine in water is

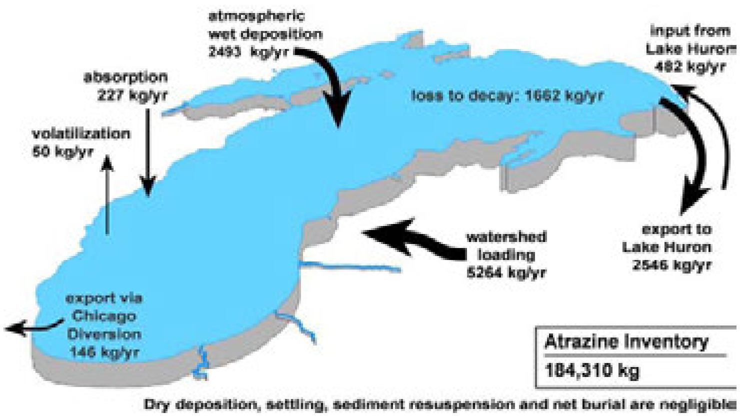


Figure 7-13. Lake Michigan Atrazine Mass Balance (including Green Bay) 1994

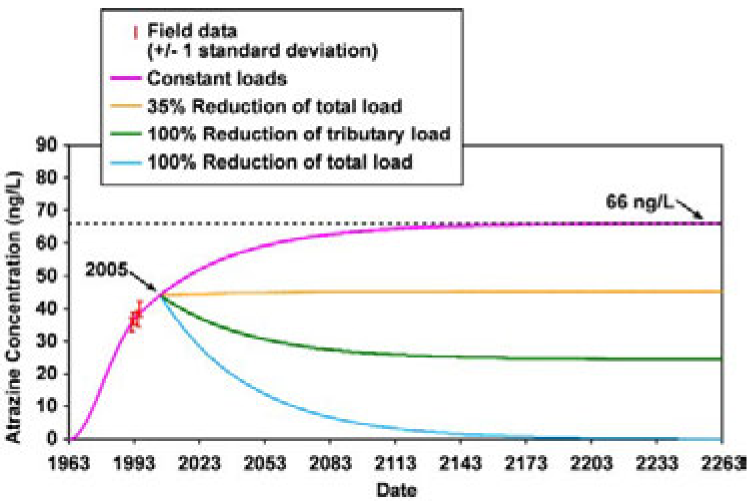


Figure 7-14. Lake Michigan Atrazine Forecasts (LM2 – Toxic Model)

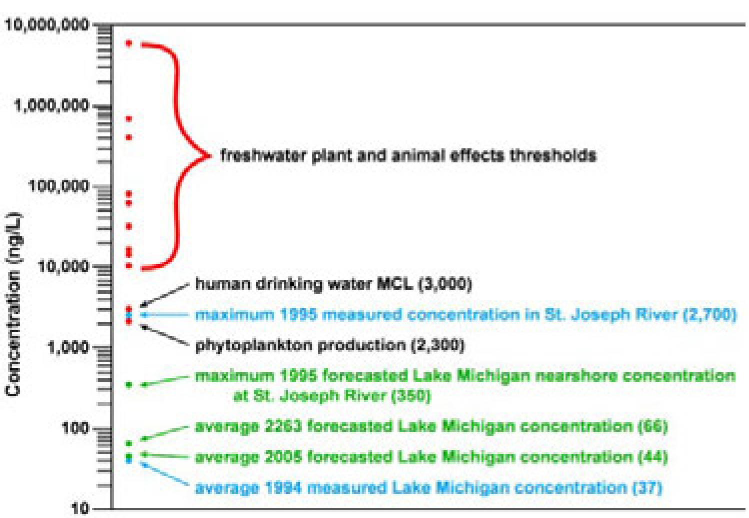


Figure 7-15 Atrazine Effects Thresholds Compared to Observations and Model Predictions

decaying only at an estimated rate of less than 1% of the total water column inventory. This translates into a half-life which exceeds 50 years. The literature suggests that atrazine decay is moderately rapid on soils and is can be at a moderately fast rate in shallow, warm freshwater systems that have high suspended solids, high dissolved organic carbon, low pH, and high concentrations of nitrate ions. The cold, deep, high pH, oligotrophic waters of Lake Michigan, together with a long retention time, do not appear to support considerable decay of atrazine.

Long-term simulations under various loading scenarios from LM2 are depicted in Figure 7-14. The constant load scenario (all loadings set at the 1998 loading level) indicates that the lake wide concentration continues to increase fairly rapidly through the end of the century and levels to 66 ng/L after the year 2200. This scenario can be regarded as the no action scenario. To maintain the lake concentration observed at the present (no further degradation), the second scenario indicates that a total load reduction (tributary and atmospheric) of 35% would be required. Two additional scenarios are also provided which show the response of Lake Michigan to 100% reductions in tributary and total loads, respectively. These scenario concur with the previous finding of tributary and atmospheric load importance.

Results of LMMB atrazine measured data and modeling forecasts is compared to effects thresholds in Figure 7-15. Note that the thresholds are on a logarithmic scale and that additional effects thresholds are known but are at greater values than those presented in the comparison. The comparisons indicate that measured and forecasted lakewide concentrations of atrazine, all fall below the presently know effects thresholds. However, one measured concentration in the St. Joseph River in 1995 was greater than the threshold for phytoplankton production.

LMMB Major Findings: Atrazine

- Observed and forecasted lake-averaged concentrations of atrazine are well below USEPA biological effects thresholds.
- Tributaries are the major source of atrazine to the lake.
- Atrazine is very persistent in Lake Michigan – decay is estimated at less than 1% per year.

- Atrazine concentrations are forecasted to increase in the lake under present loads (1994-1995 constant load).

Lake Michigan Mercury

Mercury is a naturally-occurring metal in the environment. Mercury is used in products such as battery cells, barometers, thermometers, switches, fluorescent lamps, and as a catalyst in the oxidation of organic compounds. Global releases of mercury to the environment are both natural and anthropogenic (caused by human activity). Sources of mercury releases include: combustion of various fuels such as coal; mining, smelting and manufacturing activities; wastewater; agricultural, animal and food wastes. As an elemental metal, mercury is extremely persistent in all media. Mercury also bioaccummulates in fish tissue. Mercury is also a possible human carcinogen and causes the following human health effects: stomach, large intestine, brain, lung, and kidney damage; blood pressure and heart rate increase, and fetus damage (USEPA 2001c).

Because of the possible human and ecological effects of mercury, mercury was selected for study in the Lake Michigan Mass Balance Study as a bioaccumulative metal. The objective of the mercury investigation was to provide a mass balance for total mercury (USEPA 1995; 1997a; 1997b; 1997c; 1997d; 1997e; Richardson et al. 1999; USEPA 2001d). Methylmercury was not directly measured for the LMMB Study, however, some information on this parameter will be discussed.

Results of a dated sediment core provide a historical perspective of mercury in Lake Michigan (Figure 7-16). Results from a depositional basin indicate that concentrations of mercury peaked in the mid 1940s and have been declining since that time (USEPA 2001e).

A long term record of total mercury in Lake Michigan lake trout (USEPA 2001e; 2002a), from limited data, is provided in Figure 7-17. Similar to the mercury profile in sediment, greatest concentrations were observed in the 1970s, with lower fairly stable concentrations stable concentrations thereafter. However, all concentrations reported in the long term record for Lake Michigan are well above the target for unrestricted consumption (USEPA 2000). A further examination of lake trout and coho salmon collected during the LMMB Study, indicated that only a few of the samples collected were below the target for unrestricted consumption (Figure 7-18). Only the younger fish were below the target. Total mercury was detected in all of the fish samples collected for this study (USEPA 2001c; 2001e). Mercury concentrations in adult lake trout ranged as high as 396 ng/g and averaged 139 ng/g. In coho salmon, mercury

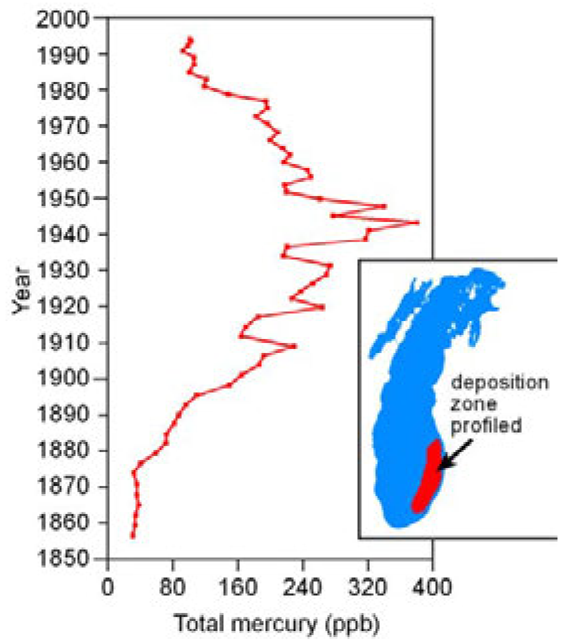


Figure 7-16. Sediment Profile of Lake Michigan Mercury.

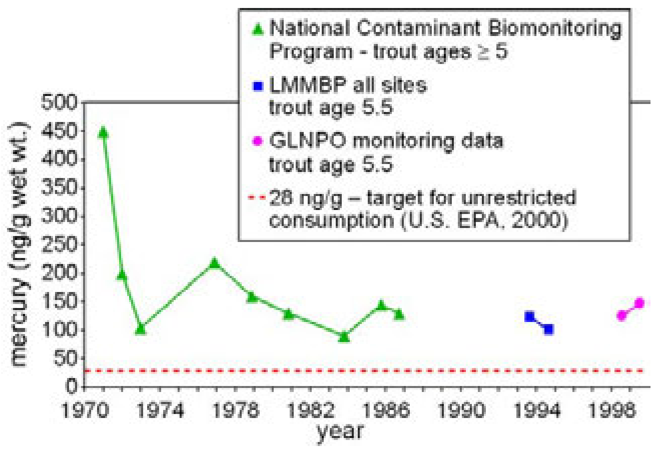


Figure 7-17. Total Mercury in Lake Michigan Lake Trout (Median of Composites).

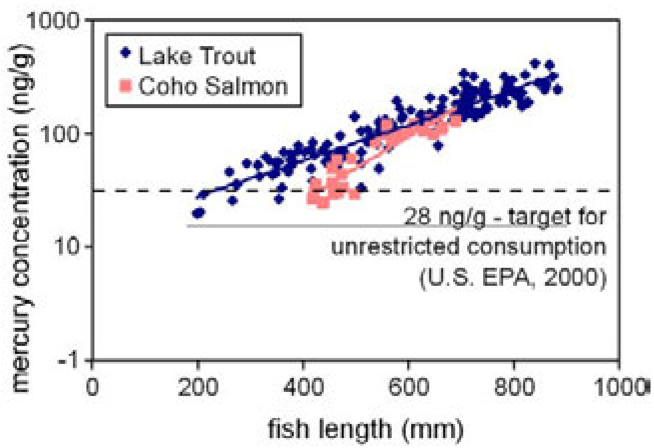


Figure 7-18. Relationship of Fish Length and Mercury in Lake Michigan (1994-1995).

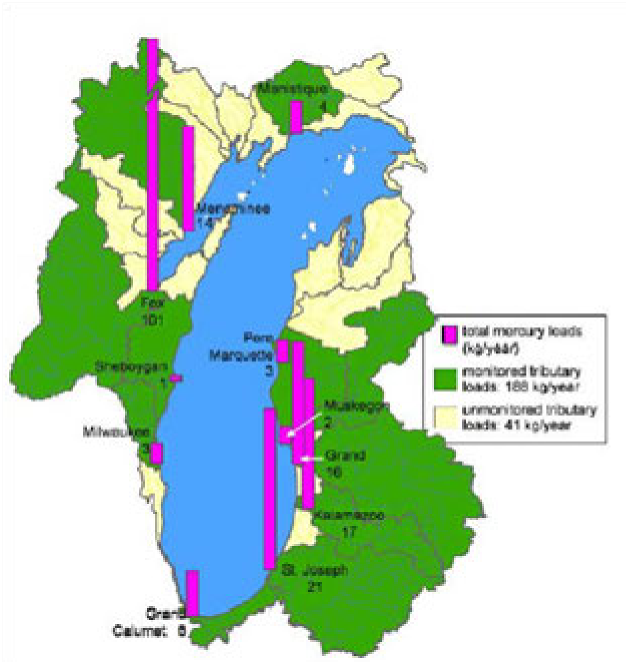


Figure 7-19. Total mercury loads (kg/year) to Lake Michigan from major monitored and unmonitored tributaries.

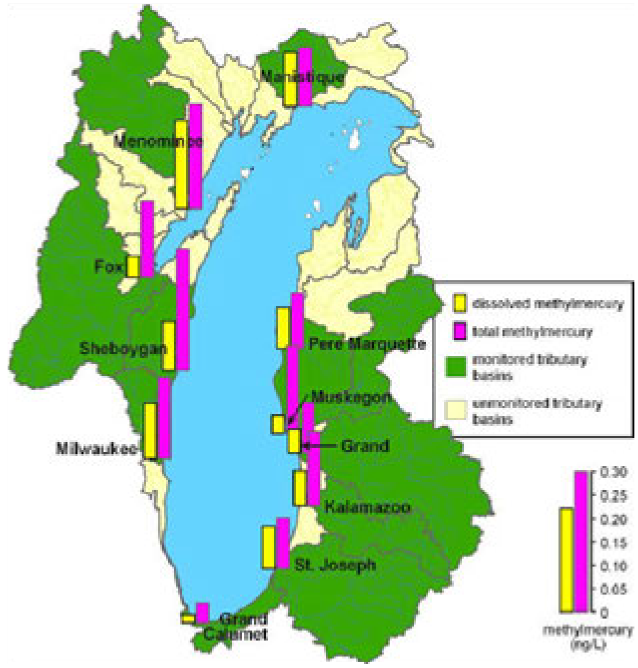


Figure 7-20. Dissolved and Total Average Methylmercury Concentrations in Monitored Tributaries.

concentrations ranged as high as 127 ng/g and averaged 79.9, 20.6, and 69.0 ng/g in hatchery, yearling, and adult salmon, respectively. Mercury concentrations in lake trout were significantly higher than in adult or yearling coho salmon. Adult coho salmon also were significantly higher in mercury concentrations than yearling coho, which contained the lowest mean concentration of mercury (USEPA 2001c).

The loadings of total mercury from the major monitored and unmonitored tributaries are provided in Figure 7-19. The total mercury load from tributaries is approximately 230 kg/year. The greatest load of total mercury is contributed by the Fox River. Other tributaries such as the St. Joseph, Kalamazoo, Grand, and Menominee Rivers generally contributed comparable loads to Lake Michigan, but considerably less than the Fox River (Hall and Robertson 1998; Hall 2000d).

Dissolved and total average methylmercury concentrations have been measured because methylmercury is believed to be the most bioavailable form of mercury to fish and to supplement the total mercury analyses of the LMMB Study (Hurley 2004). Methylmercury concentrations at the rivermouths of the major monitored tributaries is provided in Figure 7-20. Generally, methylmercury concentrations are fairly consistent over all tributaries,

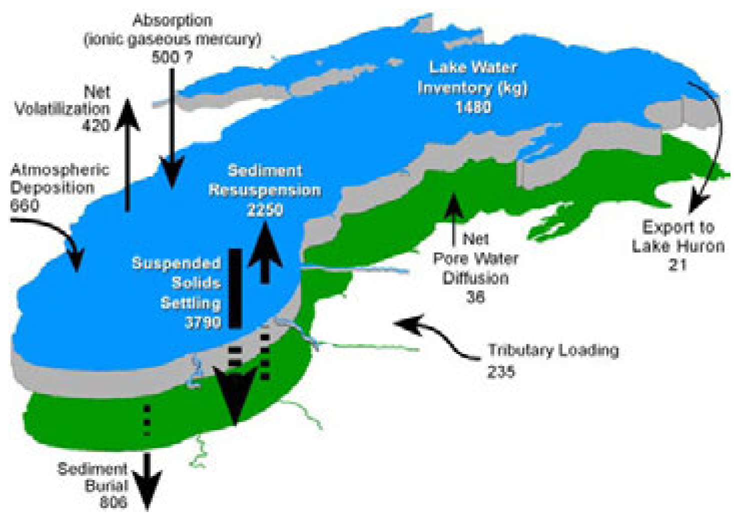


Figure 7-21. Total Mercury Mass Balance for 1994-1995.

with the exception of the Grand Calumet. Wetlands are known to convert total mercury to the methyl form and it is believed that the many of the riverine systems in the northern sector of the basin have a greater proportion of wetlands in their watersheds.

A screening level, Level 1 model, was conducted to examine the mass balance of total mercury in Lake Michigan (Ambrose et al. 1993; Zhang and Rygwelski 2000). As in other mass balance constructs, atmospheric and tributary loading are the primary external loads and the primary losses are volatilization, outflow, and sediment burial. Total mercury enters the system in both ionic and organic forms. Methylation and demethylation are modeled in both the water column and sediment. Particle setting and resuspension, as well as diffusive exchange are accounted for between these two media.

A schematic showing the results of the total mercury mass budget of Lake Michigan is given in Figure 7-21 (See preceding page). Results indicate that the greatest input of mercury to Lake Michigan from external sources is via atmospheric deposition, followed by tributary loading. Although not measured in this study, it is believed that absorption of ionic gaseous mercury to the surface of the lake is a considerable input and would even further increase the total loading through atmospheric sources. A large reservoir of total mercury exists in the sediment and a very large internal flux of mercury from the sediments to the water column can be observed. The greatest loss of total mercury from the system is from permanent sediment burial, followed by a considerable loss through net volatilization back to the atmosphere.

LMMB Major Findings: Mercury

- The current major source of mercury to the lake is from atmospheric deposition.
- Most Lake Michigan lake trout and coho salmon exceed the USEPA guidelines for unrestricted consumption.
- Modeling results suggest that a significant amount of the existing mercury settling out of water is being recycled back into the system.

Nutrients - Eutrophication

Eutrophication from excessive nutrient loads and nutrient concentrations has been under investigation and has received control strategies in the Great Lakes for the past 30 years.

Reducing Sediment by Stabilizing Stream Banks in Michigan's Big Sable River

The Michigan Department of Environmental Quality (DEQ) awarded the Conservation Resource Alliance (CRA) a Clean Michigan Initiative (CMI) grant of $142,000, and the CRA committed $48,000 in matching funds, for a project to reduce sediment inputs to the Big Sable River by stabilizing eroding stream banks and repairing eroding stream crossings, from October 2000 through September 2003. Excess sediment had been identified as a concern in the DEQ approved watershed management plan. The Big Sable River flows 24 miles through Lake and Mason counties, draining 178 square miles and discharging to Hamlin Lake north of Ludington.

Project accomplishments included the following:

- Six stream banks and one road crossing were repaired reducing sediment by 109 tons per year.
- The project facilitated the creation of a restoration committee that continued beyond the project. Approximately 150 people are on the committee mailing list and quarterly meetings commonly have 20 people in attendance.
- A $1,000 award from the local Fin and Feather Club was used to purchase 10 in-stream temperature data loggers that were used for a watershed temperature analysis. Data are collected by volunteers and the effort is expected continue for several more years.
- The Michigan Department of Natural Resources modified fish planting techniques in the Big Sable River. Committee members constructed fish distribution boxes so trout could be planted over a long stretch of river.
- The CRA established a Big Sable endowment fund under their River Care Fund program.
- The project created a strong link between the river restoration committee and the Hamlin Lake Improvement Board.

More information is available at: www.deq.state.mi.us/documents/deq-ess-nps-big-sable-fact-sheet.pdf

The Lake Michigan Toolbox

Catalog of Federal Funding Sources for Watershed Protection and Nonpoint Source Control

U.S. EPA has compiled a Catalog of Federal Funding Sources for watershed protection and nonpoint source control at http://cfpub.epa.gov/fedfund/. The web site is a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects. Examples of funding sources include the U.S. EPA administered Section 319 Nonpoint Source grant program under the Clean Water Act and the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Easement Program (CREP) administered by the U.S. Department of Agriculture.

Phosphorus is the primary limiting nutrient in the Great Lakes and if loads and concentrations are sufficiently great, nitrogen and silica become secondarily limiting nutrients. Some of the symptoms of nutrient over-enrichment include excessive algal growth, species composition changes, taste and odor problems, and changes in aesthetics, among others.

The eutrophication model is an important component of the Lake Michigan mass balance modeling framework to examine relationships between nutrients and algal production but also for hydrophobic contaminants, because it simulates the dynamics of a significant sorbent particle class (phytoplankton) in the water column. For this reason, the eutrophication model was applied as part of the overall modeling framework for toxics. It generated and accounted for the different forms of carbon and thus coupled toxics and nutrients via eutrophication/carbon sorbent modeling frameworks (USEPA 1995; 1997a; 1997b; 1997d; 1997e; Richardson et al. 1999; USEPA 2001d). The eutrophication model has also been applied as a stand alone model to specifically examine nutrient and phytoplankton relationships, provide a phosphorus mass balance, and alternative futures using model forecasts.

Total phosphorus has been measured and monitored in the Great Lakes due to its' importance in algal nutrient dynamics, algal species composition, and in the formation of hypoxia (USEPA 2002b). The long-term phosphorus loading record to Lake Michigan is provided in Figure 7-22 (IJC 1989; D. Dolan, personal communication). The record indicates very high phosphorus loads during the 1970s through 1980, with considerably lower total phosphorus loads since that time. The high loads observed in the 1970s exceeded the Great Lakes Water Quality Agreement (GLWQA 1987) target of 5600 mt/year; whereas more recent loading data suggests loads below and the target and in many cases, substantially lower. In response to the trend in phosphorus loads, total phosphorus in the offshore waters of Lake Michigan (USEPA 2002b) has exhibited a similar trend (Figure 7-23). In particular, total phosphorus concentrations have been below the International Joint Commission (IJC 1980) target of 7.0 ug/L for most of the period of record and have primarily ranged between 4.0 and 6.0 ug/L.

Phosphorus loads to Lake Michigan as determined during the Lake Michigan Mass Balance Study (Hall and Robertson 1998; Hall 2000b; 2000c) are provided in Figure 7-24. The Fox River contributed the greatest

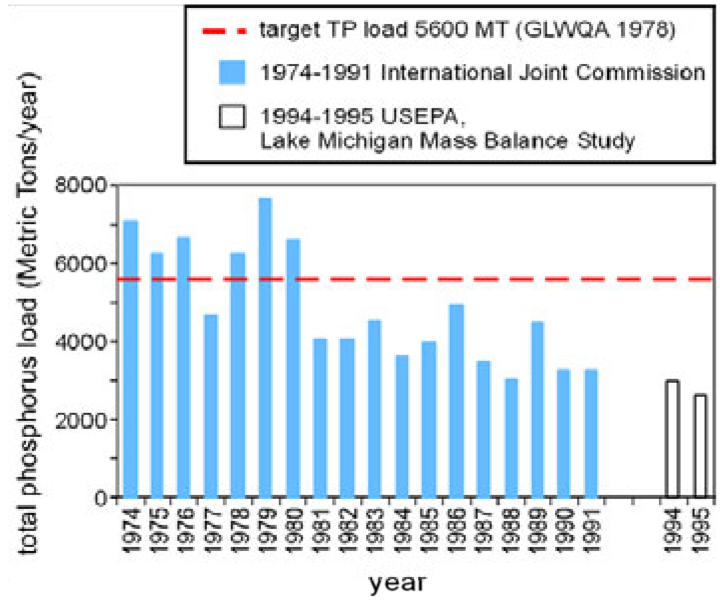


Figure 7-22. Historical Lake Michigan Annual Phosphorus Loading.

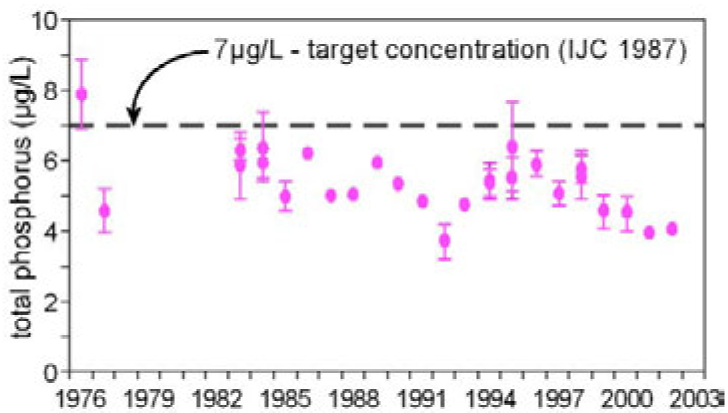


Figure 7-23. Lake Michigan Whole Lake Total Phosphorus – USEPA Great Lakes National Program Office (1974-2002).

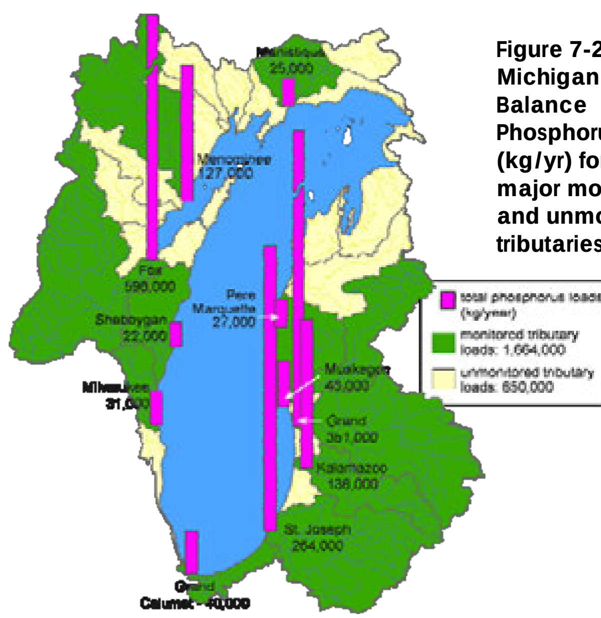


Figure 7-24. Lake Michigan Mass Balance Phosphorus loads (kg/yr) for the major monitored and unmonitored tributaries, 1995.

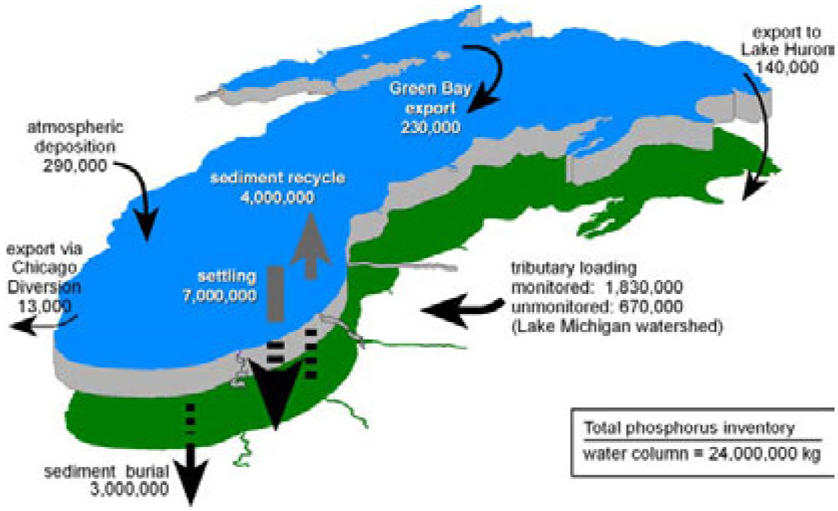


Figure 25. 1994-1995 Lake Michigan Total Phosphorus Mass Balance (kg/year).

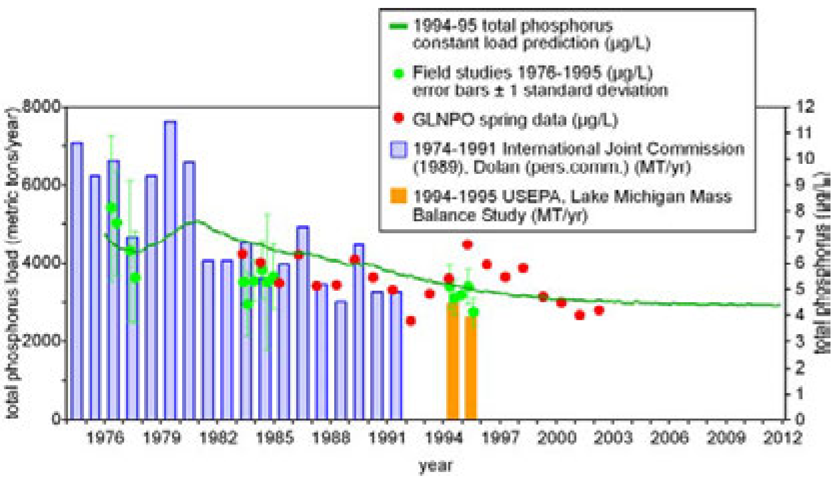


Figure 26. Total Phosphorus Model Prediction 1976-2011 and Annual Lake Michigan Phosphorus Loads 1974-1995.

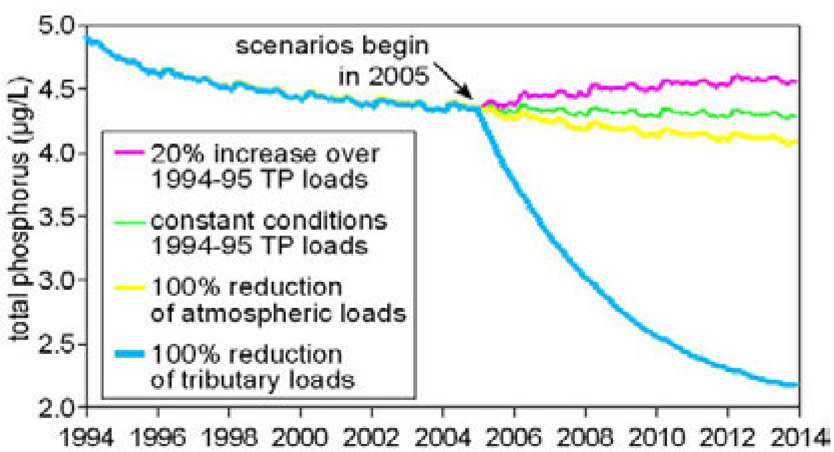


Figure 27. Lake Michigan Total Phosphorus Forecasts.

total phosphorus load to Michigan. Other tributaries with sizeable phosphorus contributions were the Grand and St. Joseph Rivers followed by the Kalamazoo and Menominee Rivers.

The modeled total phosphorus mass balance for Lake Michigan (1994-1995) is presented in Figure 7-25 (Rodgers and Salisbury 1981; Ambrose et al. 1993; USEPA 2004; Pauer et al. 2006). Results indicate that phosphorus is a traditionally-delivered substance with the greatest loads being contributed from tributaries. Atmospheric deposition (Miller et al. 2000) of phosphorus is only about 10% of the total load. The primary loss of phosphorus is through deep burial to the sediments; losses through the Straits of Mackinac and the Chicago diversion are relatively smaller. Of particular note is the large mass of phosphorus which cycles between the water column and sediments through resuspension and deposition, and a fairly sizeable load which enters the main lake from Green Bay.

A 20-year model hindcast and a forecast for total phosphorus concentrations through the year 2011 is presented in Figure 7-26. The hindcast-forecast is plotted along with total phosphorus loads and offshore Lake Michigan total phosphorus concentrations for reference. The model hindcast agrees reasonably well with measured total phosphorus concentrations, given the inter-annual variability of the measured data. The hindcast generally agrees with the decreasing trends exhibited by total phosphorus concentrations and annual lake-wide loads. The forecast uses a constant load scenario, equivalent to holding loads the same as measured in 1994-1995 into the future. The resulting forecast indicates very stable total phosphorus concentrations into the foreseeable future.

Further Lake Michigan total phosphorus concentration forecasts (2005-2014) are presented in Figure 27. In these forecasts, alternative futures are examined using different total phosphorus loading scenarios starting in the year 2005. The base line or constant load scenario (held at 1994-1995 loads) shows very stable phosphorus concentrations into the future. A 20% increase in load scenario is shown which would increase the total phosphorus concentration from approximately 4.3 to 4.6 ug/L in 2014, compared to the constant load scenario. Similarly, a scenario which reduces atmospheric load by 100%, exhibits a decrease in total phosphorus of approximately 4.3 to 4.2 ug/L. The last scenario represents a 100% decrease in total phosphorus loading from tributaries and exhibits a substantial decrease in total phosphorus concentrations by the year 2014. The forecast scenarios examining the 100% reductions in atmospheric and tributary loads, respectively, indicate that the model forecasts are consistent with the relative magnitude of loading from each source category.

LMMB Major Findings: Eutrophication

- Lake Michigan phosphorus loads and concentrations are low and below GLWQA and IJC targets
- Tributaries are the major source of phosphorus to Lake Michigan
- Highest concentrations can be observed in selected nearshore zones near tributary mouths and in Green Bay
- There is no evidence of increasing loads or increasing concentrations in the open-water through 2002; forecasts indicate relatively stable phosphorus and chlorophyll-a concentrations into the future

Pollutants and Pathways to Lake Michigan

While the LMMB study focused on four pollutants to develop a better understanding of pollutant fate and transport within the Lake Michigan ecosystem, many other pollutants are entering the ecosystem through a variety of pathways. The following discussion addresses recent investigations of four of these pathways:

- Atmospheric deposition,
- Nonpoint source runoff, including combined sewer overflows (CSO)
- Sediment
- Groundwater

Coordinating Phosphorus Reduction in the Kalamazoo River/Lake Allegan Watershed

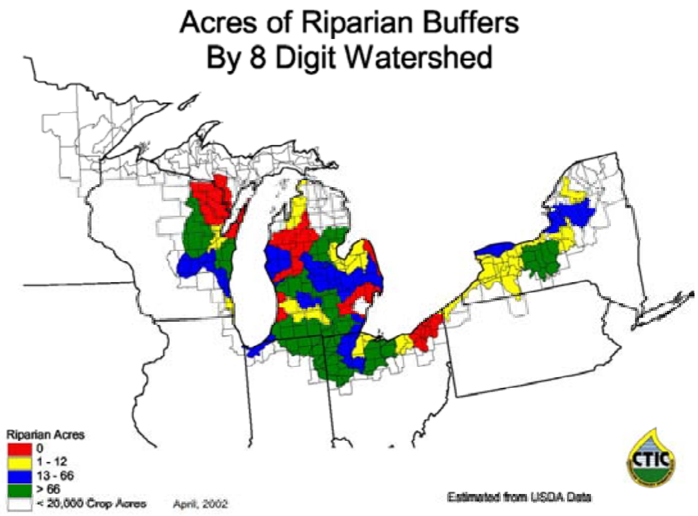
Excessive phosphorus in waterways can increase the growth of algae, decreasing the amount of oxygen in the streams, causing fish and other aquatic life to die.

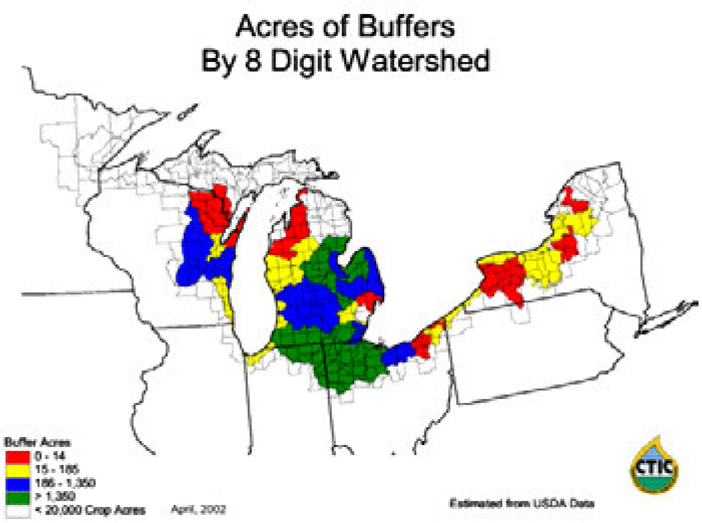
Stakeholders in the Kalamazoo River/ Lake Allegan watershed came together between 2001 and 2005 to coordinate their efforts to reduce phosphorus loads in the watershed. The waterways are impaired and required a Total Maximum Daily Load (TMDL) model that identified safe target phosphorus levels. The project used the TMDL as a starting point to reduce pollution from the multiple, hard to trace sources. It included coordination, communication and education efforts for extremely multi-faceted implementation activities of the Kalamazoo River/ Lake Allegan phosphorus TMDL. A TMDL Implementation Committee coordinated these efforts. Accomplishments include:

The Implementation Committee
Source: www.deq.state.mi.us/documents/deq-ess-nps-kazoo-lake-allegan.pdf

- Michigan State University Extension (MSUE) organized and facilitated the TMDL Implementation Committee, Leadership Team and 17 subcommittees.
- Stakeholder-led subcommittees are continuing discussions and developing strategies for phosphorus reduction.
- General education campaign increased awareness of Kalamazoo River/Lake Allegan issues and the TMDL.
- Kanoe the Kazoo involved hundreds of stakeholders and watershed residents. The event gained excellent media attention, helping to emphasize issues as well as the river's recreational value.
- During Super Soils Saturday, hundreds of landowners tested their soil and learned about phosphorus issues.
- A web-based tracking system, www.kbs.msu.edu/kzoonps, includes information and data about phosphorus reduction activities in the watershed.
- A day-long workshop was conducted to explore alternatives for organizing on a watershed basis to sustain TMDL and other conservation efforts.

More information is available at: www.deq.state.mi.us/documents/deq-ess-nps-kazoo-lake-allegan.pdf





Source: Conservation Technology Resource Center, Midwest No Till/Buffers Project

Buffers and Other Nonpoint Pollution Management Strategies

Filter or buffer strips are land areas of either planted or indigenous vegetation, situated between a potential, pollutant-source area and a surface-water body that receives runoff. Runoff may carry sediment and organic matter, and plant nutrients and pesticides that are either bound to the sediment or dissolved in the water. A properly designed and operating filter strip provides water-quality protection by reducing the amount of sediment, organic matter, and some nutrients and pesticides, in the runoff at the edge of the field before runoff enters the surface-water body. Filter strips also provide localized erosion protection since the vegetation covers an area of soil that otherwise might have a high erosion potential.

Installation of buffers is just one strategy for protecting waterways from pollutants. In areas where drain tile is used to drain fields of wetlands to increase the size of arable land, pollutants drain underneath buffers and directly into waterways, carried by stormwater runoff.

Use of no-till or low-till planting and effective application of pesticide and fertilizer management programs are other ways to protect water sources from pollution.

The GLRC has called for 335,000 new buffer acres, based on land drainage equals approximately 77,050 new acres in the Lake Michigan basin. See Chapter 4 for more information.

More information is available at: www.ctic.purdue.edu/CTIC/BuffersProject/index.html

Atmospheric Deposition

The role of air pollution as an important contributor to water pollution has long been recognized and has been the subject of growing scientific study and concern in recent years. Over the past three decades, scientists have collected a large and convincing body of evidence showing that toxic chemicals released into the air can travel great distances before they are deposited on land or water. Most notably, PCBs and some persistent pollutants (including several pesticides that have not been used in significant amounts in the United States since the 1970s) have been widely distributed in the environment and are now part of the global atmospheric background. Section 112 of the Clean Air Act required congressional reports of the effect of air deposition on the "Great Waters" of the United States, including the Great Lakes where this pathway was documented.

Loadings of pesticides whose use has been canceled or restricted in the United States to Lake Michigan are primarily from atmospheric sources that is impossible to regulate or control. Although there are no current commercial sources of banned pesticides in the United States, loadings continue from use of remaining consumer stocks, evaporation from soils, resuspension of contaminated sediments, and atmospheric transport from other countries that continue to apply these substances. Further pesticide reductions can only be achieved through cleanup of contaminated sites, collection and disposal of existing stockpiles ("clean sweeps"), and use reduction in other countries. Between 1988 and 2001, USEPA Region 5 estimates that agricultural clean sweeps have removed 1.9 million pounds of pesticides from the Great Lakes basin.

While long-range atmospheric transport is an important pollutant source for Lake Michigan, recent studies also point to the influences of local sources, particularly from urban areas. For example, air sampling over Lake Michigan when the wind is blowing from the southwest shows contributions of PCBs, PAHs, and mercury from the Chicago area to the lake. The relative importance of each pollutant source to the overall loadings is variable depending on the season and local weather conditions.

Nonpoint Source Pollution

According to the USEPA National Water Quality Inventory Reports to Congress, states, tribes, and other jurisdictions consider siltation and the over enrichment of nutrients two of the three most significant causes of impairment in many of the streams throughout the Nation. Siltation alters aquatic habitat and suffocates fish eggs and affects other bottom dwelling organisms. Excessive nutrients have not only been linked to hypoxia in the Gulf of Mexico, but also to eutrophication and *Cladophora* blooms in many of the bays and beaches around Lake Michigan. Research in the 1960's and 70's linked *Cladophora* blooms to high phosphorus levels in the water, mainly as a result of agricultural runoff, detergents containing phosphorus, inadequate sewage treatment, and other human activities such as fertilizing lawns and poorly maintained septic systems (More information is available at *www.uwm.edu/Dept/GLWI/cladophora*). Due to tighter restrictions, phosphorus levels declined during the 1970's and *Cladophora* blooms were largely absent in the 1980's and 90's. Recently *Cladophora* blooms are again a common occurrence along the coast of Lake Michigan; however, the cause of these blooms is unknown.

USEPA identifies polluted runoff as the most important remaining uncontrolled source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources. Previous technology-based controls, such as secondary treatment of sewage, effluent limitation guidelines for industrial sources, point sources and management practices for some nonpoint sources, have dramatically reduced water pollution and laid the foundation for further progress. However, nonpoint source loads continue to turn rivers and streams into pollutant pathways to the lake. Total maximum daily load (TMDL) studies are needed for impaired tributaries to identify the management measures needed to bring them back into compliance with water quality standards. Over the next several years, states will be developing many TMDLs for pollutants entering into water bodies from both point and nonpoint sources. TMDLs will provide data to help manage water quality on a watershed scale. See the watershed fact sheets in Chapter 12.

Major sources of nonpoint pollution include urban stormwater runoff, discharges from animal feeding operations, cropland runoff, and episodic combined sewer overflows. In addition, pollution can arrive via air from outside a watershed.
Urban nonpoint source stormwater is water from rain or snow that runs off city streets, parking lots, construction sites, and residential yards. It can carry sediment, oil, grease toxicants, pesticides, pathogens, and other pollutants into nearby storm drains. Once this polluted runoff enters the storm sewer system, it is discharged, usually untreated, into local streams and waterways. It can contaminate drinking and recreational waters and remains a major source of beach closures.

In late 1999, USEPA promulgated rules to reduce stormwater runoff from construction sites between 1 and 5 acres and municipal storm sewer systems in urbanized areas serving populations of less than 100,000 through the issuance of permits. These controls were required to be in place by 2003 and build on the existing program to control stormwater runoff from municipalities with populations greater than 100,000 and 11 industrial categories, including construction disturbing over 5 acres. Under the expanded program, sediment discharges from approximately 97.5 percent of the acreage under development across the country will be controlled through permits. Many communities have passed ordinances to address the regulation with more being added every month.

The Lake Michigan basin has a high concentration of agricultural enterprises where animals are kept and raised in confined environments. Polluted runoff from animal feeding operations is a leading source of water pollution in some watersheds. Potential impacts include the absence or low levels of dissolved oxygen in surface water, harmful algae blooms, fish kills, and contamination of drinking water from nitrates and pathogens and beach closures.

For the vast majority of animal feeding operations (AFO), voluntary efforts will be the principal approach to assist owners and operators in developing and implementing site-specific management plans. Impacts from higher risk, concentrated animal feeding operations (CAFO), such as sites with the equivalent of 1,000 beef cows, are now addressed through National Pollutant Discharge Elimination System (NPDES) permits under the authority of the Clean Water Act. About 5 percent of all animal feeding operations are expected to need permits.

Areas of Concern: Legacy of Contamination and Community Stewardship

LaMP 2000 explained: In 1987 the Great Lakes Water Quality Agreement (GLWQA) between the US and Canada was expanded to address critical stressors affecting the basin's ecosystem. The intersections of major tributaries and the Lakes are areas where human activity by-products and collected river deposits concentrate. " The Parties recognize that there are areas in the boundary waters of the Great Lakes system where, due to human activity, one or more of the general or specific objectives of the Agreement are not being met. Pending virtual elimination of the persistent toxic substances in the Great Lakes system, the Parties, in cooperation with the State and Provincial Governments and the Commission, shall identify and work toward restoring and protecting beneficial uses in Areas of Concern or in open waters." (GLWQA)

For each AOC a stakeholder group was convened to work with federal and state agencies to develop remedial action plans that defined the problem and suggested remedial actions. This program has been very successful in capturing the energy and creativity of the communities. Unfortunately, agency funding and resources have been uneven and have never approached the scale needed for remediation of large-scale legacy sites. Federal authorities like Superfund, Resource Conservation and Recovery Act Corrective Action Program and the Clean Water Act have provided USEPA the tools to address some of the large-scale actions needed. The U.S. Army Corps of Engineers has been given specific program authority for AOCs.

GLRC

Great Lakes Regional Collaboration Recommendations

Areas of Concern

The United States identified the 31 most contaminated locations on the Great Lakes under the Great Lakes Water Quality Agreement with Canada more than 15 years ago. None of them have been restored to date. To remedy this situation, a dramatic acceleration of the cleanup process at these **areas of concern** (AOC) is needed. The actions recommended are:

- amend the Great Lakes Legacy Act to increase funding and streamline the process;
- improve federal, state, and local capacity to manage the AOC cleanups;
- create a federal-state AOC coordinating committee to work with local and tribal interests to speed cleanups; and
- promote clean treatment and disposal technologies as well as better beneficial use and disposal options.

Federal and State agencies and the AOC communities want to move ahead, remediate and restore impairments and delist their AOC. Matching authorities to specific impairment sources and the recovery time needed for the remediation actions to "take" in the environment are lengthy procedures. A number of new tools are now available:

- Delisting guidance finalized by Michigan and approved by USEPA GLNPO in January 2006.
- Delisting Principles and Guidelines- adopted by the U.S. Policy Committee in December 2001
- The Legacy Act of 2002- providing funding and new authorities for putting remediation partnerships together

Great Lakes Legacy Act

From 1997-2004, approximately 3.7 million cubic yards of contaminated sediment were remediated from the U.S. Great Lakes Basin. Results from a survey of all Great Lakes States indicates that roughly 76 million cubic yards of contaminated sediment remain in 77 sites within 25 Great Lakes AOCs. Estimated costs to remediate this amount range from $1.6 billion to $4.4 billion.

It is apparent that while significant progress has been made to date, much more work needs to be done. To address this problem, Congress passed the "Great Lakes Legacy Act of 2002" (GLLA) on November 12, 2002 and President George W. Bush signed the Legacy Act into law on November 27, 2002 (Public Law No. 107-303). The GLLA authorizes $50 million annually for fiscal years 2004-2008 for contaminated sediment remediation projects and provides USEPA with a unique approach for addressing contaminated sediment problems in Great Lakes AOCs. Under the GLLA a project is to be carried out in an AOC located wholly or partially in the United States, and the project:

1. monitors or evaluates contaminated sediment;
2. implements a plan to remediate contaminated sediment; or
3. prevents further or renewed contamination of sediment.

The GLLA also authorizes $3 million to conduct research on the development and use of innovative approaches, technologies, and techniques for the remediation of contaminated sediments in AOCs. Additionally, the Act also authorizes $1 million to carry out a public information program to provide information relating to the remediation of contaminated sediment to the public in AOCs.

Congress appropriated $9.9 million to the GLLA in FY04, $22.3 million in FY 05, and $29 million in FY 06. The FY 07 President's budget request calls for $49.6 million. As of March 1, 2006 GLNPO has obligated all of the FY 04 funds and either committed or obligated approximately 45% of the FY 05 funds. USEPA anticipates expended the remaining 55% of these funds by September 06.

One of the key objectives outlined in the 2002 Great Lakes Strategy, is to "accelerate the pace of contaminated sediment remediation, working to overcome barriers to progress identified at each site. Bringing together complementary Federal and State authorities, and/or government and private resources to address the contaminated sediment problem and its sources, so that by 2025, the cleanup of all known sites in the Basin will be completed." We believe that with the Great Lakes Legacy Act, USEPA now has a program in place that can make steadier progress toward addressing the 77 sites and 76 million cubic yards of contaminated sediment in the Great Lakes Basin.

This GLLA implementation plan directly supports the following strategic targets of the Agency's Strategic Plan:

Cubic yards (in millions) of contaminated sediment remediated in the Great Lakes. Every cubic yard of sediment remediated through the Legacy Act supports this target. Other programs in the Agency, which contribute toward this target, make significant contributions; however, they are not focused specifically on this target. Their contributions vary significantly from year to year. Reporting in 2007 is expected to show that USEPA and its partners will have remediated a cumulative total of 4.2 million cubic yards of contaminated sediments since tracking began in 1997. Remediation from GLLA projects will contribute to this growing total. 200,000 cubic yards were remediated through the Legacy Act in 2004 and 2005, and USEPA estimates that in 2006 and 2007, GLLA projects will remediate over 650,000 cubic yards of contaminated sediments.

Restore and delist AOCs within the Great Lakes basin. The GLLA targets resources to clean up contaminated sediments, a significant source of Great Lakes toxic pollutants that can impact human health via the bioaccumulation of toxic substances through the food chain. Contaminated sediments are the cause of or significantly contribute to as many as 11 of the 14 impairments to beneficial uses (including restrictions on fish consumption due to high contaminant levels in fish tissue) in AOCs. Most AOCs can thus not be de-listed without first addressing the contaminated sediments which are contributing to their beneficial use impairments.

Periodically starting in 2006, GLNPO proposes to develop a fresh Request for Projects, soliciting new GLLA projects. GLNPO will thus be best positioned to ensure that all potential projects have a fair opportunity to be considered, whether or not they directly result from direct contact with GLNPO staff. More information is available at www.epa.gov/glnpo/legacy.

The LaMP Pollutant List

There are a number of pollutants that could be placed on the LaMP pollutant list. These were identified in LaMP 2004. The process for identifying LaMP pollutants, the 2004 pollutants list, potential pollutants to be added in 2006, and information on pollutant management activities completed since 2002 are presented in Appendix A.

Next Steps

- Develop a better understanding of the natural dynamics that affect pollutant distribution in the Lake Michigan ecosystem and why near shore and open lake can have wide variances
- Reduce pollutant loads with effective control and pollution control measures
- Build on the coordinated monitoring of 2005 and develop a 10-year trend analysis based on the 1994-95 mass balance project
- Review contaminated sediment sites and their status will be updated for Legacy Act funding or delisting opportunities
- Investigate nutrient contributions from the agricultural sector and non point sources during wet weather. Determine if nutrient levels are linked to *Cladophora* blooms
- Hold meetings to discuss Lake Michigan Mass Balance models and implications for Impaired Waters Strategy
- Develop Impaired Waters Strategy through basinwide meeting

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 7

Persistent Bioaccumulative Toxics Goals and Recommendations

See Chapter 1 for specific recommendations.

Nonpoint Source Pollution Goals and Recommendations

Goals

Goal: Protect existing wetlands and restore wetlands in both urban and rural areas so that rivers, streams, and lakes across the Great Lakes region function as healthy ecosystems.
Interim Milestones:
- By 2010, restore, recover, and protect a net increase of 550,000 acres of wetlands within the Great Lakes basin.
- By 2015, restore, recover, and protect a net increase of 1,000,000 acres (450,000 additional) of wetlands within the Great Lakes basin.

Goal: Measurably reduce at least hundreds of thousands of tons of sediment, pounds of phosphorous loading, and pounds of nitrogen loading in to the Great Lakes basin.

Interim Milestones:
- By 2010, create 335,000 new acres of buffer strips within the Great Lakes basin.
- By 2020, create 1,000,000 new acres (665,000 additional) of buffer strips within the basin.

Goal: Reduce the amount of sediment reaching the Great Lakes through installation and continued use of management practices on cropland, especially those that increase crop residue left on the surface.

Interim Milestones:
- By 2010, have 2,000,000 new acres of Great Lakes basin cropland under appropriate residue management. This increase corresponds to 40 percent decrease in soil loss.
- By 2015, extend to 2,800,000 new acres (800,000 additional new acres) of Great Lakes basin cropland under appropriate residue management.

Goal: Reduce livestock agriculture's contribution to nonpoint source loading by 40-70 percent through comprehensive nutrient management planning (CNMP) and practice implementation.

Interim Milestones:
- By 2008, 70 percent of all livestock farmers will attend education programming regarding nutrient management.
- By 2010, all acreage utilized for livestock production in a major phosphorous-impaired Great Lakes watershed in each Great Lakes State will be covered by certified CNMPs.
- By 2010, triple the number of certified CNMP providers in the basin that directly assist farmers.
- By 2015, 70 percent of all livestock production in the U.S. portion of the Great Lakes basin will be covered by certified, phosphorous-based CNMPs.

Goal: Improve flow regimes to meet sediment reduction goals and restore sustainable biological communities.

Interim Milestones:
- By 2010, in all watersheds classified as severely or moderately impacted based on degree of altered hydrology and ecological sensitivity using scientifically defensible indicators: develop better understanding of baseline conditions (appropriate time frame, natural vs. human influences) and relationship between stressors and ecological endpoints (water quantity as stressor, effectiveness of BMPs, cumulative impacts); develop appropriate assessment criteria (numeric vs. narrative; relate to societal values); develop/refine new methods (decision support systems, monitoring technology); and apply most strategic remediation alternatives to foster goal of restoring natural flow regime.
- By 2015, restore/manage the hydrologic regime in ten select watersheds to restore sustainable biological communities and reduce excessive

sediment loadings.

- By 2020, document improvements in: measurable changes in hydrology (reduction in peak flow and volume); measurable reduction in bank erosion and sediment loading; and measurable improvement in the health of the biological community in significant portions (stream orders 1-3) of ten urban watersheds and/or sediment loading into areas where these watersheds discharge to the Lakes.

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Recommendations

In general, programs need coordination at a higher level and a focus on mitigating specific problem areas, such as Areas of Concern. Although agencies offer grants to states, tribes, and local groups to address these concerns, the grants are given without any overall, interagency focus or strategy. Effectively targeting and addressing problems will require not only federal agency budget enhancements, but also coordination of efforts and data so that agencies at all levels concentrate their energies on the same priority problems. To this end, the NPS Strategy Team suggests designating or establishing an organization to coordinate efforts, roles, and initiatives among federal, state, and local agencies and private organizations in the Great Lakes basin.

1. **Between $77 million and $188.7 should be provided annually over five years to fund restoration of 550,000 acres of wetlands.**

2. **$335 million should be provided to restore 335,000 acres of buffers over five years.**

3. **$120 million should be allocated by 2010 to achieve a 40 percent reduction in soil loss in ten selected watersheds.**
   Critical Geographies: Land areas draining to western and central Lake Erie, the Maumee River watershed, Green Bay, Saginaw Bay, Lake St. Clair, nearshore waters of Lake Michigan, and AOCs.

4. **$106 million in funding should be provided to support the development and implementation of comprehensive nutrient and manure management on livestock farms.**

5. **$18 million should be provided annually over five years to hydrologically improve ten urban watersheds of various sizes.**
   Critical Geographies: The new program should focus on urbanized areas where runoff from development and the associated impairments directly affect natural waterways and their confluence with the Great Lakes or connecting waters. Likely candidates include smaller watersheds or sub-watersheds within the Duluth, Milwaukee, Green Bay, Gary, Detroit, Cleveland, Toledo, and Buffalo metropolitan areas.

Areas of Concern Goals and Recommendations

Goals

The goal of the Great Lakes Regional Collaboration is to restore all the U.S. Great Lakes AOCs.

Milestones toward this ultimate goal include:

- By the end of 2006, U.S. EPA should expand the existing U.S. EPA-State RAP Workgroup into a Federal-State AOC Coordinating Committee to better coordinate efforts and optimize existing programs and authorities to advance restoration of the AOCs;
- By the end of 2007, Congress should revise and reauthorize the Great Lakes Legacy Act;
- By the end of 2008, delisting targets for each U.S. AOC should be developed collaboratively by federal, state, local, and tribal partners;
- By the end of 2010, 10 AOCs should be delisted (restored to target goals); and
- By 2020, all known contaminated sediment sites in the AOCs should be remediated.
- Coupled with restoration measures identified in other chapters, this will facilitate complete restoration of the AOCs.

Recommendations

1. **Great Lakes Legacy Act Funding, Amendments, Reauthorization and Guidance**
   - Over the next five years, the Administration should request and Congress should appropriate $150 million annually for the Great Lakes Legacy Act to remediate contaminated sediment sites in the AOCs. Congress should amend the Legacy Act to allow for more efficient implementation of the program
   - The “maintenance of effort” language in the

Legacy Act should be dropped because it is not appropriate in the context of sediment remediation where costs often vary widely from year to year and, as a result, it can lead to inadvertent disqualification of otherwise eligible and valuable projects. The life of appropriated Legacy Act funds should be extended beyond two years (as envisioned by the Legacy Act) to accommodate both responsible remediation and long-term monitoring of the effectiveness of implemented remedies, which is consistent with the 2002 *Great Lakes Strategy*.

- The current 35 percent level of matching funds/ in-kind services required under the Legacy Act from the nonfederal sponsor at "orphan sites" should be adjusted to 25 percent, or at a minimum, Legacy Act funds should be available for planning and design work with no match or reduced match, in order to "tee-up" projects and maintain momentum.
- The current limitation in the Legacy Act which requires exclusive federal agency project implementation precludes disbursal of funds to other entities to assume the lead in project implementation. This requirement restricts the efficient implementation of remedial work in some cases, and should be amended to allow direct disbursal of project funds, which would allow for greater flexibility in implementing the program.

2. AOC Program Capacity

- The Administration should request and Congress should appropriate $10 million annually to the Great Lakes states and community-based coordinating councils in the AOCs; and $1.7 million to U.S. EPA's Great Lakes National Program Office for regional coordination and program implementation.
- Furthermore, the U.S. Army Corps of Engineers Great Lakes Remedial Action Plan Program, authorized in Section 401 of the Water Resources Development Act of 1990, should be included in the President's budget to enable the Corps to participate in the Federal-State AOC Coordinating Committee and to request funding for projects that advance restoration of the AOCs.

3. Federal-State Collaboration

- The existing U.S. EPA/State RAP Work Group should be expanded to a Federal-State AOC Coordinating Committee to better coordinate efforts and optimize existing programs and authorities to advance restoration of the AOCs.

4. Promote Development of Environmentally-Sound Sediment Treatment and Destruction Technologies, Beneficial Re-Use of Sediments, and Best Available Disposal Options.

- U.S. EPA, the U.S. Army Corps of Engineers, the states, and the tribes should actively examine innovative approaches to the ultimate disposition of contaminated sediments as an alternative to the current practice of disposing of them in Confined Disposal Facilities (CDFs) or landfills. Congress should fully fund, at $3 million annually over the next five years, the research and development program authorized in Section 306 of the Great Lakes Legacy Act.

Areas of Concern Overview

There is an increasingly strong focus on remediating the problems of areas of concern (AOCs). The ultimate goal is to ensure the effective clean-up of these contaminated areas and protect them by utilizing watershed stewardship activities as a means of ensuring their on-going protection.

The following matrix provides summary information for the Lake Michigan AOCs. It provides information regarding:

- AOC Name and Beneficial Use Impairments (BUIs)
- Primary Contaminants
- Geographic Area
- Stressors
- Programs
- Clean-Up Actions
- Key Activities Needed
- Challenges
- Next Steps

The Great Lakes Water Quality Agreement calls for Remedial Action Plans (RAPs) to restore and protect 14 beneficial uses in Areas of Concern. An impaired beneficial use means a change in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause any of the impairments listed below (BUIs are listed in the AOC name column using the following numeration).

I. **Restrictions on fish and wildlife consumption** - When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines, or public health advisories are in effect for human consumption of fish and wildlife.

II. **Tainting of fish and wildlife flavor** - When ambient water quality standards, objectives, or guidelines for the anthropogenic substance(s) known to cause tainting are being exceeded or survey results have identified tainting of fish and wildlife flavor.

III. **Degraded fish and wildlife populations** - When fish or wildlife management programs have identified degraded fish or wildlife populations. In addition, this use will be considered impaired when relevant, field-validated, fish and wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.

IV. **Fish tumors or other deformities** - When the incidence rates of fish tumors or other deformities exceed rates at unimpacted control sites or when survey data confirm the presence of neoplastic or preneoplastic liver tumors in bullheads or suckers.

V. **Bird or animal deformities or reproductive problems** - When wildlife survey data confirm the presence of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species.

VI. **Degradation of benthos** - When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity (as defined by relevant, field-validated bioassays with appropriate quality assurance/quality controls) of sediment-associated contaminants at a site is significantly higher than controls.

VII. **Restrictions on dredging activities** - When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.

VIII. **Eutrophication or undesirable algae** - When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication.

IX. **Restrictions on drinking water consumption or taste and odor problems** - When treated drinking water supplies are impacted to the extent that: 1) densities of disease- causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances exceed human health standards, objectives or guidelines; 2) taste and odor problems are present; or 3) treatment needed to make raw water suitable for drinking is beyond the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).

X. **Beach closings** - When waters, which are commonly used for total-body contact or partial-body contact recreation, exceed standards, objectives, or guidelines for such use.

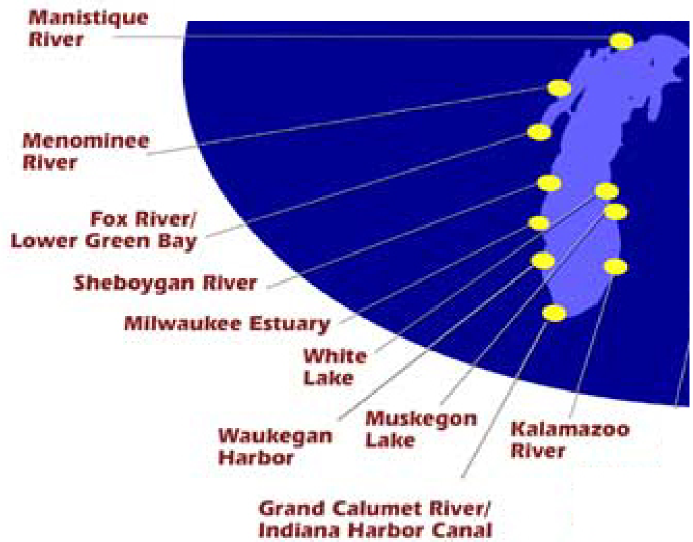
XI. **Degradation of aesthetics** - When any substance in water produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).

XII. Added costs to agriculture and industry - When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).

XIII. Degradation of phytoplankton and zooplankton - When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when relevant, field-validated, phytoplankton or zooplankton bioassays (e.g. Ceriodaphnia; algal fractionation bioassays) with appropriate quality assurance/quality controls confirm toxicity in ambient waters.

XIV. Loss of fish and wildlife habitat - When fish or wildlife management goals have not been met as a result of loss of fish or wildlife habitat due to a perturbation in the physical, chemical or biological integrity of the Boundary Waters, including wetlands.

Lake Michigan Areas of Concern



Lake Michigan Areas of Concern Summary Matrix   For more information, see http://www.epa.gov/glnpo/aoc

AOC Name and BUIs	Primary Contaminants	Geographic Area	Stressors	Programs	Clean-Up Actions	Key Activity Needed	Challenges	Next Step
Grand Calumet River **Indiana** I, II, III, IV, VI, VII, VIII, IX, X, XI,XII, XIII, XIV	• PCBs • PAHs • Mercury • Cadmium • Chromium • Lead • Pathogens • Biochemical oxygen demand • Suspended solids • Oil and grease	Grand Calumet River: Lagoon, East Branch and West Branch Indiana Harbor and Ship Canal, The Lake George Branch of the Canal, Wolf Lake, George Lake and Nearshore Lake Michigan.	• Contaminated Sediments • Combined Sewer Overflows • Contaminated groundwater • Contaminated land sites • Habitat Fragmentation • Fire Suppression • ANS	• Superfund • RCRA • Clean Water Act • WRDA • Navigational Dredging • Natural Resource Trustee's Damage Assessment	• USX dredging • West Branch Remediation – 14,200 cubic yards of sediment remediated • U.S. Steel Gary Works dredging of 5 river miles on the East Branch complete. • GSD Sed. Remediation • Navigational dredging • LTV cleanup • U.S. Lead - 19,000 cubic yards of sediment have been remediated • A total of 700,000 cubic yards of sediment have been remediated • IDEM is including additional CSO requirements in discharge permits as they are renewed in the basin pursuant to a state CSO Strategy.	• Dredging • CSO Long Term Control Plans • Issue NPDES Permits • BUI Indicator Monitoring • TMDL underway • West Branch assessment • Coordination with RAP program for AOC delisting purposes	• Public concern regarding location of contaminated material disposal • Local funding and match for federal projects • Legal concerns • Permitting • Monitoring resources • The draft Water Quality Component of Stage Two includes some provisions being implemented through indirect methods; direct resources for implementation have been limited	• Dredging at USX complete • NRDA- Complete PRP negotiations. • ACOE- WRDA Diagnostic Feasibility Study • USX-Build Corrective Action Management Unit • GSD-Site Characterization • TMDL-Resolve modeling issues • Monitor BUI Indicators • ECI slurry wall • The RAP process has developed and obtained funds for a Toxic Pollution Prevention (TPP) Program

Lake Michigan Areas of Concern Summary Matrix **For more information, see http://www.epa.gov/glnpo/aoc**

AOC Name and BUIs	Primary Contaminants	Geographic Area	Stressors	Programs	Clean-Up Actions	Key Activity Needed	Challenges	Next Step
Kalamazoo River **Michigan** I, III, V, VI, VII, X, XI, XIV	• PCBs • Phosphorus • Sediments	From Morrow Dam, which forms Morrow Pond and extends 80 miles downstream to Lake Michigan.	• Nonpoint pollution • Sediments • Contaminated sediment landfills	• Superfund • Clean Water Act • Brownfields • Natural Resource Trustee's Damage Assessment	• Superfund removal of 150,000 cubic yards of PCB-contaminated sediments from Bryant Mill Pond • Nonpoint pollution projects Erosion control programs, and stormwater management projects • A phosphorus TMDL for Lake Allegan and the river upstream has been established; measures are being implemented to reduce phosphorus pollution from point and nonpoint sources • Remedial action at several Operable Units (OUs) along the river • Watershed management projects in several sub-basins reduce pollutant inputs and develop beneficial land use measures	• Dredging/ Excavation • Superfund site cleanup decision action • Stream buffers • Dam removal • Coordination with RAP program for AOC delisting purposes	• PRP court case • Local funding match for federal projects • Decisions on the remediation of this Superfund Site have effectively been on hold for the past several years	• Continue NRDA assessment • Finish remedial investigation/ remedial action • Investigate strategy and determine action • RAP to be revised in 2006 • Kalamazoo River/ Lake Allegan TMDL (Total Maximum Daily Load) program pursuing water-quality data collection
Lower Fox River/ Southern Green Bay **Wisconsin** I, III, V, VI, VII, VIII, IX, X, XI, XIII	• PCBs • Phosphorus • Suspended solids • Mercury	The lower 40 miles of the Fox River and Green Bay	• Urban and rural runoff • Sediments • Aquatic exotic species • Wetland loss • Habitat alteration	• Clean Water Act • Superfund • Natural Resource Trustee's Damage Assessment	• Watershed NPS abatement • Remedial investigation completed remedial action nearly ongoing. Dredging and PCB removal (Deposit in 7,200 cubic yards of sediment removed and Deposit 56/57: 50,000 cubic yards of sediment removed) • Dissolved oxygen wasteload • Deposit N, 56, 57 • Cumulative sediments remediated from 1997-2002 – 87,500 cubic yards • Consent Decree for Phase I Fox River clean-up announced 4/12/06	• Dredging • Pollution Prevention • Stream buffers • Habitat protection and restoration • Coordination with RAP program for AOC delisting purposes	• Rapid land development • Contaminated material disposal • Seeing through completion of cleanup for OUs 2-5	• Implement 4/12//06 Consent Decree • Removal of 10 million cubic yards of sediment. • Completed dredging and implementation of cleanup plan for OU 1, expected to take 3-6 years • OUs 2-5 final cleanup plan implementation, expected to take 15 years

Lake Michigan Areas of Concern Summary Matrix

For more information, see http://www.epa.gov/glnpo/aoc

AOC Name and BUIs	Primary Contaminants	Geographic Area	Stressors	Programs	Clean-Up Actions	Key Activity Needed	Challenges	Next Step
Manistique River **Michigan** I, VI, VII, X, XIV	• PCBs • Heavy metals • Pathogens	The last 1.7 miles of the river to the mouth of the harbor at Lake Michigan	• Combined sewer overflow • Sediments • PCB-contaminated sawdust • Wastewater discharges	• Superfund	• Dredging of contaminated sediments completed in 2000 (190,000 cubic yards) • Manistique Wastewater Treatment Plant made improvements to its system toward elimination of CSOs	• Sampling and monitoring follow-up to confirm downward trends of contamination • Coordination with RAP program for AOC delisting purposes	• Navigational dredging • CSO to be closed by 2020 • Coordination with RAP program for AOC delisting purposes	• Sampling and monitoring continuing as part of delisting process
Menominee River **Michigan/ Wisconsin** I, III, VI, VII, X, XIV	• Arsenic • Mercury • PCBs • Oil and grease • Pathogens	Lower 4.8 km of river to the mouth and 5 km north and south of the mouth along the bay shore	• Sediments • Coastal wetlands habitat loss • Nonpoint pollution • Historic shoreline developments to support harbor activities	• RCRA Corrective Action • Superfund	• Arsenic remediation (33,000 cubic yards) • Combined sewer overflow project	• Dredging • Protect riparian and coastal habitat • Pollution prevention • Coordination with RAP program for AOC delisting purposes	• Woody debris is present at the WPSC Marinette MGP Site, which may have hindered accurate determination of the sediment thickness • Coordination with RAP program for AOC delisting purposes; bi-state coordination issues	• Arsenic dredging completed • Paint sludge deposit cleanup above river mouth
Milwaukee Estuary **Wisconsin** I, III, IV, VI, VII, VIII, X, XI, XIII, XIV	• Phosphorus • Pathogens • PCBs • Metals • PAHs	The lower 5 km of the Milwaukee River ; the lower 4.8 km of the Menominee River; the lower 4 km of the Kinnickinnic River; the inner and outer Harbor and the nearshore waters	• Urban and rural runoff • Wastewater discharges • Sediments • Habitat loss • Dams	• Clean Water Act • Clean Air Act • Superfund • Brownfields • Navigational dredging	• Water pollution abatement • Pollution prevention education begun • Dam removal • 7,000 cubic yards remediated	• Dredging • Nonpoint source pollution control • Stream buffers • Pathogen source research • Coordination with RAP program for AOC delisting purposes	• High urban density and rapid development • Historic developed sites which could be restored to improve floodplain functions and wetland function	• Complete assessment for Kinnickinnic River • Estabrook Impoundment remediation needed • Research into pathogen sources • Watershed analysis to assess water quality impacts and options for restoration

Lake Michigan Areas of Concern Summary Matrix

For more information, see http://www.epa.gov/glnpo/aoc

AOC Name and BUIs	Primary Contaminants	Geographic Area	Stressors	Programs	Clean-Up Actions	Key Activity Needed	Challenges	Next Step
Muskegon Lake **Michigan** I, V, VI, VII, VIII, IX, XIV	• PCBs • Mercury	The entire 4149 acre lake and several tributaries.	• Sediments • Nonpoint pollution	• Brownfields • Navigational dredging • Great Lakes Legacy Act	• Wastewater treatment upgraded • Some tributary remedial actions underway • Removal of about 80,000 cubic yards of contaminated sediment in Ruddiman Creek	• Dredging • Stream buffers • More assessment • Coordination with RAP program for AOC delisting purposes	• PCB disposal • Local funding match for federal projects	• Remediation of brownfields and sediments • Complete assessment of contaminated sediment in Ryerson Creek and in Muskegon Lake at the Division Street Outfall.
Sheboygan River **Wisconsin** I, III, V, VI, VII, VIII, XIII	• Suspended Solids • PCBs • PAHs • Heavy Metals • Pathogens • Phosphorus	The lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and nearshore waters	• Industrial & agricultural runoff • Habitat restoration on streambanks and wetland areas	• Superfund • Clean Water Act #319	• Partial removal of PCB-contaminated sediments • Agency decision (2001) • 2004 Municipal stormwater permits for the Village of Kohler, Town of Sheboygan and Town of Wilson.	• Completion of PCB remediation • Completion of PAH remediation at Camp Marina coal gasification site • Control buffers • Habitat protection • NPS controls for urban and rural pollution • Coordination with RAP program for AOC delisting purposes		• Complete dredging started in 2004 • Complete site clean-up and removal of preferential pathways • groundwater monitoring
Waukegan Harbor **Illinois** VI, VII, X, XIII, XIV	• PCBs	1.2 square kilometers of industrial, commercial, municipal and open lands.	• Sediments	• Superfund • Brownfields	• Approximately 1 million pounds of PCBs dredged from the harbor • Soil removal activities completed at Waukegan Manufactured Gas and Coke site in 2005; extraction and treatment of contaminated groundwater to continue at the site for several years • Removal and disposal of large amounts of acids, bases, paints, solvents, hydraulic oil, machining oil, compressed gases, metals, sludge and PCB-containing transformer fluid from the Waukegan lakefront site	• Dredging • Brownfield development • Habitat restoration • Coordination with RAP program for AOC delisting purposes	• Corps navigation dredging Phase II Sediment removal • Contaminated material disposal • Funding to fulfill local match for U.S. Army Corps of Engineers dredging of the shipping channel	• Final dredging and disposal of inner harbor extension sediments • OMC building clean up • Pursuit of a dredging plan for the removal of PCB contaminated sediments from Waukegan Harbor -- expected release of an Alternatives Analysis in early 2006 • 319 grant will develop watershed plan to reduce nonpoint source pollution and improve water quality in the Waukegan River watershed

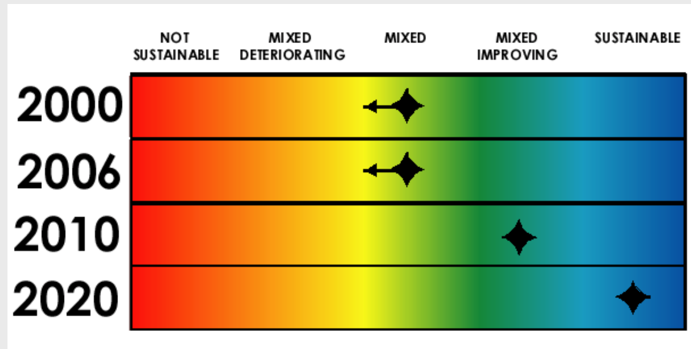
Lake Michigan Areas of Concern Summary Matrix   For more information, see http://www.epa.gov/glnpo/aoc

AOC Name and BUIs	Primary Contaminants	Geographic Area	Stressors	Programs	Clean-Up Actions	Key Activity Needed	Challenges	Next Step
White Lake **Michigan** I, III, VI, VII, VIII, IX, XI, XIV	• Heavy metals • Stormwater nonpoint pollution • Arsenic • Chromium	Includes White Lake and a one-quarter mile wide zone around the lake.	• Sediments • Industrial contamination • Groundwater contamination	• Superfund • RCRA	• Dredging in ATannery Bay@ (2002) – 73,000 cubic yards of waste (hides, chromium, arsenic • Cleanup of Occidental Chemical site in 2002 • Potential sources of groundwater contamination to White Lake and its tributaries have been identified and remediation efforts are underway • Some eutrophication has been alleviated by improvements to the sewage collection and treatment systems • Contaminated groundwater venting to the lake is being intercepted by purge wells and treated prior to discharge	• Assessment and further study of contaminated sites • Stream buffers • Coordination with RAP program for AOC delisting purposes	• Funding to pinpoint locations having greatest impact to eutrophication	• Further study of the extent of contamination from the Whitehall Leather Company is needed, in addition to possible remediation funds. • Assessment is needed of sediments at discharge points for other contaminated sites

Subgoal 8
Are aquatic and terrestrial nuisance species prevented and controlled?*

Status

Lake Michigan Target Dates for Sustainability



The Lake Michigan ecosystem is in a state of flux due to changing populations of aquatic nuisance species and their resulting interactions with native species. Increases in zebra and quagga mussels are altering the way energy is transferred from the base of the food chain to top predators. Populations of alewife, a long-established non-indigenous fish, have crashed, resulting in less food for Pacific salmon and native lake trout. *Diporeia,* or scud, an important native shrimp-like crustacean that is food for many other fish, has nearly disappeared from Lake Michigan. Populations of round goby, a species transported from Europe in the ballast tanks of ocean-going ships, continue to rise and spread throughout Lake Michigan. European ruffe, also introduced via ballast water, continue to be found in Bay de Noc near Escanaba, Michigan, but do not appear to be spreading at this time. Although Asian carp have not been seen in Lake Michigan, they remain a threat and are held back by an electric barrier in the Illinois Waterway Sanitary and Ship Canal. Once established, aquatic nuisance species (ANS) are very difficult and sometimes impossible to control. The best example of control is the case of sea lamprey. The Great Lakes Fishery Commission, with participation by State, Tribal and Federal agencies, has a mandate to assess and control sea lamprey populations in the Lake Michigan basin.

Indicators (State of the Lakes Ecosystem Indicators by Number)

- 18 - Sea Lamprey Scars and Population
- 9002 - Non-Native Species (aquatic introductions)
- 9002 - Non-Native Species (terrestrial introductions)

Challenges

- Prevention of aquatic invasive species introductions by ships through ballast water and other means
- Stopping invasions of species through canals and waterways
- Restricting trade in live invasive organisms
- Passage of comprehensive federal aquatic invasive species legislation
- Establishing a program for rapid response and management

Next Steps

- Education and outreach on aquatic invasive species in order to accomplish
  - Ship and barge-mediated introductions and spread of AIS in the Great Lakes should be eliminated
  - Federal, state, and/or local governments must enact measures that ensure the region's canals and waterways are not a vector for AIS
  - Federal and state governments must take immediate steps to prevent the introduction and spread of AIS through the trade and potential release of live organisms
  - Establish a Great Lakes Aquatic Invasive Species Integrated Management Program to implement rapid response, control, and management programs and assess the effectiveness of those programs

* The title for this subgoal has been changed to reflect the importance of prevention as the most valuable goal in the fight against invasive species.

National Developments

The 2004 Lake Michigan LaMP update reported on the introduction of legislation in the U.S. Congress to re-authorize and strengthen the National Invasive Species Act. Neither this proposed legislation nor subsequent introductions of similar bills have been passed.

ANS Task Force

The Aquatic Nuisance Species (ANS)* Task Force is an inter-governmental body created by the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990. The Task Force is co-chaired by the US Fish and Wildlife Service and National Oceanic and Atmospheric Administration. Via regional panels and issue specific committees, the Task Force coordinates governmental efforts dealing with ANS in the United States with those of the private sector and other North American interests. The following Task Force programs are very relevant to preventing introductions of ANS to Lake Michigan:

Great Lakes Panel on Aquatic Nuisance Species

The Great Lakes Panel on Aquatic Nuisance Species was officially convened in late 1991 by the Great Lakes Commission in response to section 1203 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646). The Panel is directed to perform the following tasks:

- Identify Great Lakes priorities
- Assist/make recommendations to a national Task Force on Aquatic Nuisance Species (also established via P.L. 101-646)
- Coordinate exotic species program activities in the region
- Advise public and private interests on control efforts
- Submit an annual report to the task force describing prevention, research and control activities in the Great Lakes Basin

The panel membership is drawn from U.S. and Canadian federal agencies, the eight Great Lakes states and the province of Ontario, regional agencies, user groups, local communities, tribal authorities, commercial interests, and the university/research community.

Great Lakes Regional Collaboration Action Items

Aquatic Invasive Species

Immediate action to stop the introduction of more **aquatic invasive species** (AIS) can prevent significant future ecological and economic damage to the Great Lakes. The steps needed include:prevention of AIS introductions by ships through ballast water and other means;

- stopping invasions of species through canals and waterways;
- restricting trade in live organisms;
- passage of comprehensive federal AIS legislation;
- establishing a program for rapid response and management; and
- education and outreach on AIS introduction and prevention.

In 2003 and 2004, the 3 committees of the Panel, Information and Education, Research and Monitoring, and Legislation and Policy, all initiated an update of priorities for prevention and control of ANS in the Great Lakes region. The committee reports will be available on the Panel's web site in 2004.

Further information about the Panel, its activities, and its membership can be found at: www.glc.org/ans/

U.S. Coast Guard's Ballast Water Management and Regulatory Program

Section 1101 of the Act provided authority to The Department in which the U.S. Coast Guard is operating to regulate and issue guidance for the management ballast water as a vector for introduction of aquatic invasive species. The U.S. Coast Guard's Ballast Water Management Program accomplished the following activities in Fiscal Year 2004:

- **Penalties for Non-submittal of Ballast Water Reports.** On June 14, 2004, the Coast Guard

*** The terms "Aquatic Invasive Species" and "Aquatic Nuisance Species" are used interchangeably throughout this chapter. They both refer to species that are non-indigenous to Great Lakes waters.**

The Lake Michigan Toolbox

Keeping Exotics out of the Water Through Public Awareness Campaigns

Habitattitude

Federal agencies and the pet industry are teaming up to help consumers prevent the release and escape of nonnative plants and animals through Habitattitude, a new public education and outreach effort launched in September 2004. This government-industry coalition is formed from the Pet Industry Joint Advisory Council, the U.S. Fish and Wildlife Service and the Great Lakes Sea Grant Network. The campaign encourages aquarium owners and water gardeners to avoid unwanted introductions of nonnative species by adopting simple prevention steps when faced with an unwanted aquatic plant or fish. Habitattitude campaign materials will be displayed in aquarium stores, aquatic retail outlets, hobby magazines and nursery and landscape businesses across the country, as well as on packaging of related products.

More information is available at: www.habitattitude.net.

Stop Aquatic Hitchhikers!

Stop Aquatic Hitchhikers! is the first national public awareness campaign developed by the ANS Task Force. It brings public, private and nonprofit organizations together from the local, State, regional, and national levels to promote a single, straight forward, empowering message via a compelling brand that focuses on preventing the continued spread of aquatic nuisance species. The campaign targets all recreational water users to raise their awareness about aquatic invasive species and empowers them to adopt prevention procedures that limit the spread of aquatic invasive species to unaffected waters of the U.S.

More information is available at: www.protectyourwaters.net.

Michigan Decal to Fight Invasive Species

The Michigan Great Lakes Protection Fund is selling a $35 decal to help fight the spread of zebra mussels and other invasive aquatic species. Order forms for the decal are included in the 2006 watercraft renewal notices. The decal is for decoration only and does not replace required stickers.

More information is available at www.michigan.gov/sos/0,1607,7-127--101483--,00.html

"New and improved" Bait Bucket Sticker

Illinois-Indiana Sea Grant, in association with several Great Lakes partners, has revised their "Don't Dump Bait!" bait bucket sticker. The revised sticker maintains the look and message of the original, but incorporates two key changes: 1) the new directive is now "Dispose of Bait in the Trash" to address some states' concerns that the words "on land" violated littering regulations, and 2) for additional information anglers are now directed to *www.ProtectYourWaters.net*, which readily provides additional actions anglers can take to prevent spreading and introducing invasive species.

If you are interested in purchasing these stickers, buying into the print run, or want more information contact Pat Charlebois (charlebo@uiuc.edu).

Lake Michigan Toolbox
Sea Grant Programs

Sea Grant is a nationwide network (administered through the National Oceanic and Atmospheric Administration [NOAA]), of 30 university-based programs that work with coastal communities. The National Sea Grant College Program engages this network of the nation's top universities in conducting scientific research, education, training, and extension projects designed to foster science-based decisions about the use and conservation of aquatic resources.

Michigan Sea Grant, Illinois Indiana Sea Grant and Wisconsin Sea Grant programs have ANS educational and outreach programs relevant to Lake Michigan.

These resources can accessed at the Sea Grant websites:

- National Sea Grant: www.seagrant.noaa.gov/colleges/colleges.html
- Michigan: www.miseagrant.umich.edu/
- Illinois and Indiana: www.iisgcp.org/
- Wisconsin: www.seagrant.wisc.edu/

Shedd Aquarium Opens Invasives Exhibit

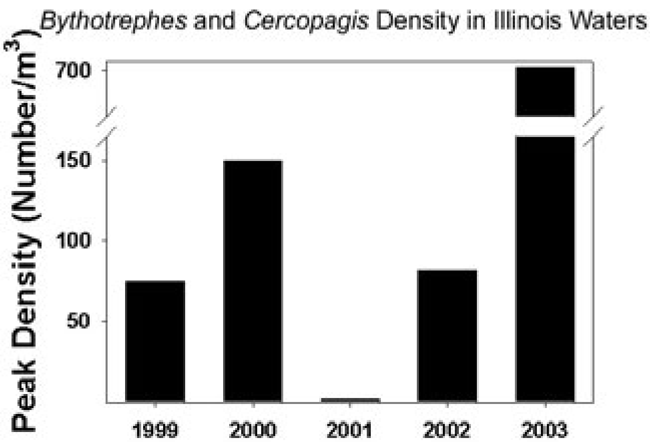
Chicago's Shedd Aquarium opened a new permanent exhibit featuring many of the invasive species found in the Great Lakes. It is the first time in Chicago that the public has the opportunity to see many of these live animals and plants in person. The exhibit is part of Shedd's Great Lakes Conservation Initiative, which aims to draw public attention to the value and vulnerabilities of the Great Lakes.

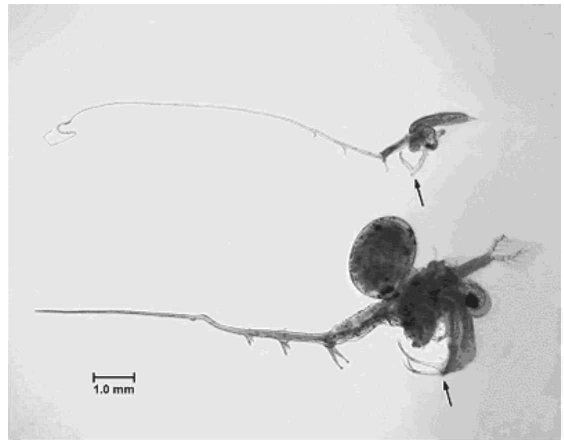
Photograph Courtesy of the John G. Shedd Aquarium

More information is available at www.sheddaquarium.org.

published regulations establishing penalties for ships headed to the U.S. that fail to submit a ballast water management reporting form, as well as vessels bound for the Great Lakes or portions of the Hudson River that violate mandatory ballast water management requirements.

- **Mandatory Ballast Water Management Program for U.S. Waters.** On July 28, 2004, the U.S. Coast Guard published regulations establishing a national mandatory ballast water management program for all vessels equipped with ballast water tanks that enter or operate within U.S. waters.
- **New Ballast Water Management Equivalent Reporting Program.** The Coast Guard and the National Ballast Information Clearinghouse launched the new Equivalent Reporting Program for vessels operating exclusively in the U.S. Exclusive Economic Zone. The program offered an alternative for an Owner, Operator, Master, Agent, Person-in-Charge or Charterer of a vessel to submit required Ballast Water Management Reports in a single batch report on a monthly basis, instead of on a port-to-port, pre-arrival schedule as required under 33 CFR 151.204(b).
- **Shipboard Testing and Evaluation Program (STEP).** The purpose of the Shipboard Technology Evaluation Program is to facilitate the development of effective ballast water treatment technologies, through experimental systems, thus creating more options for vessel owners seeking alternatives to ballast water exchange. The STEP is available to all foreign and domestic vessels subject to the Coast Guard's Ballast Water Management regulations, 33 CFR 151 Parts C and D.
- **International Maritime Organization (IMO).** Seven Federal Departments, led by the U.S. Coast Guard, actively participated in meetings of the International Maritime Organization and its Marine Environment Protection Committee. In 2004, the IMO adopted the "International Convention for the Control and Management of Ships' Ballast Water and Sediments."
- **Environmental Technology Verification (ETV) Program.** The USCG partnered with the USEPA's ETV program to develop protocols for third party verification of new ballast water management systems. The USCG made progress on the ETV BWM system test protocols. These protocols included further development of a list of surrogate species for the standardized water (or challenge





Spiny Water Flea (*Bythotrephes*) and Fishhook Water Flea (*Cercopagis*) Density in Illinois Waters of Lake Michigan
Source: INHS Sampling, Witt et al. (in review)

water) for land based testing.

- **Ballast Water System Test Facility.** The USCG partnered with the Naval Research Lab in constructing a ballast water system test facility in Key West, FL. This facility will provide the country's first testing platform to evaluate new ballast water treatment technologies in accordance with the testing protocols developed by the USEPA's ETV program.

State Efforts to Prevent the Spread of ANS

The states which share Lake Michigan's resources, (Illinois, Indiana, Michigan and Wisconsin) know all too well the negative effects that ANS have had on their industries, tourism and lifestyles. The states, collectively, are sharing the burden of controlling the ANS already established in Lake Michigan but they also share the desire to prevent further introductions. The following efforts are being conducted to prevent and control ANS on a state by state basis:

Illinois

Illinois New Law to Limit Spread of Invasive Species

On August 15th, 2005, Governor Blagojevich signed a new law that helps prevent the spread of exotic invasive species by bait dealers and the public, as well as prohibiting the release of unwanted species in Illinois waters. House Bill 1181 includes three major provisions: 1) clarification of the definition of minnow to exclude common carp, goldfish, bighead carp, black carp, grass carp and silver carp; 2) increased penalties for those who release injurious species into

Quagga Mussels Increasing in Number to Compete for Food with Native Mussels

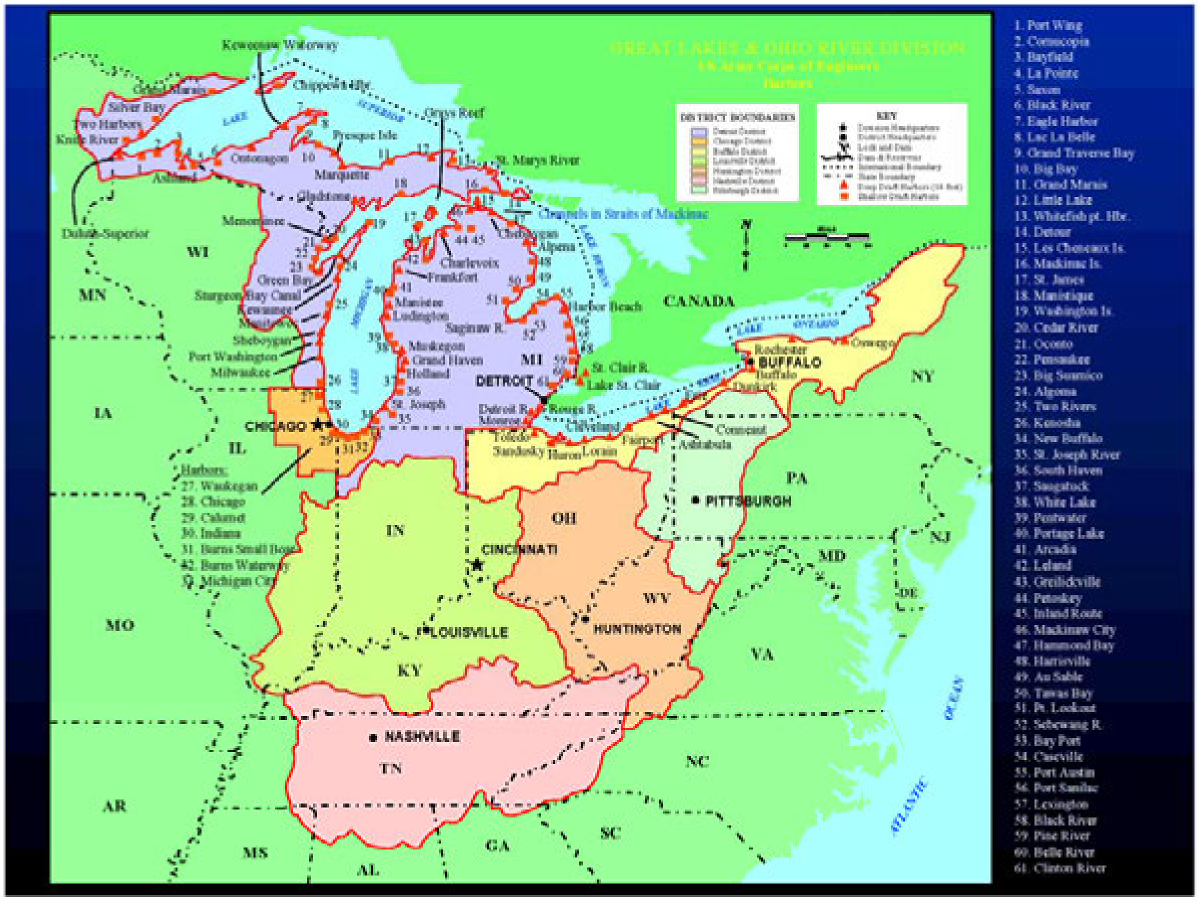
Quagga mussels, like zebra mussels, filter plankton from the water at fast pace. This allows more sunlight to penetrate the water and cause an increase in algae inedible to fish. But while zebra mussels are sensitive to water temperature and need a hard surface on which to colonize, quaggas can adapt quickly to extreme environmental changes. They thrive in any temperature, can survive turbulence, and are able to colonize both hard and soft substrate, even sand.

A pair of quagga mussels side by side, showing the change in coloration that has occurred as populations moved into shallower water.
Unlike zebra mussels, they can be found at any depth of Lake Michigan. Researchers believe that the quagga's impact on the lake's food chain could be greater than the zebra mussel due to its greater hardiness.

Source: University of Wisconsin-Milwaukee

The mussels are competing for food with the diporeia at all depths, and there is speculation that the increase in the numbers of quagga is quickening the pace of the decline of the diporeia.

More information is available at: www.uwm.edu/News/Features/04.12/quaggas.html



Great Lakes Harbors, Shallow and deep. Ocean-going vessels generally dock in deep ports where ballast water IS often discharged.
Source: U.S. Army Corps of Engineers

Illinois waters, and 3) regulation of the sale, transportation, stocking on private property, live sale and distribution of all aquatic life. To see the full version of the law, visit www.ilga.gov , search for HB1181 (lower left corner of home page), and then click on full text.

Illinois Nurserymen's Association Adopts New Code of Conduct

The Board of Directors of the Illinois Nurserymen's Association unanimously approved to adopt the Missouri Botanical Garden voluntary code of conduct developed in December, 2001. By adopting this code of conduct, association members will:

- ensure that invasive potential is assessed prior to introducing and marketing plant species new to North America;
- work with regional experts and stakeholders to determine which species in the region are either currently invasive or will become invasive;
- Identify plants that could be suitable alternatives for the region;
- develop and promote alternative plant material through plant selection and breeding;
- phase out existing stocks of those specific invasive species in regions, where agreement has been reached among nursery associations, government, academia and ecology and conservation organizations, that are considered to be a threat;
- follow all laws on importation and quarantine of plant materials across political boundaries; and encourage customers to use, and garden writers to promote, non-invasive plants.

Sound and Bubble Barrier Could Deter Asian Carp

Mark Pegg and John Chick of the Illinois Natural History Survey found that an underwater acoustic barrier is effective in deterring Asian carp. These researchers tested sound-bubble technology in fish raceways where it proved 95 percent effective in causing bighead and silver carp to turn around. Continued work should get the effectiveness closer to 100 percent. If funding becomes available and the technology continues to prove effective, an acoustic barrier may augment the electric barrier at its site, or downstream where it can protect the Chicago Sanitary and Ship Canal as well as the Des Plaines River.

For more information contact Dave Bender dbender@ina-online.org or visit www.centerforplantconservation.org/invasives/ .

Gobies Rounded-up and Asian Carp Corralled

The U.S. Fish & Wildlife Service (USFWS) conducted its 10th annual Goby Round Up and 4th annual Carp Corral in the Chicago Waterways/Illinois River in June, 2005. The primary objective of this annual event is to determine the farthest downstream (from Lake Michigan) distribution of the round goby and farthest upstream distribution (from the Illinois River) of silver and bighead carp. With the help of 8 other federal, state and non-governmental agencies and organizations, USFWS sampled almost 200 miles of Illinois' waterways over 4 days. The sampling revealed good and bad news. The good news is that the round goby was no farther downstream than reported last July (by the Illinois Natural History Survey) and the bighead and silver carp had traveled no farther upstream than previously found. The bad news is that the goby has traveled downstream 170 miles, and is already half of the distance to the Mississippi River; Asian carp are only 21 miles below the electrical barrier and only 50 miles from Lake Michigan. For more information contact Pam Thiel (pam_thiel@fws.gov).

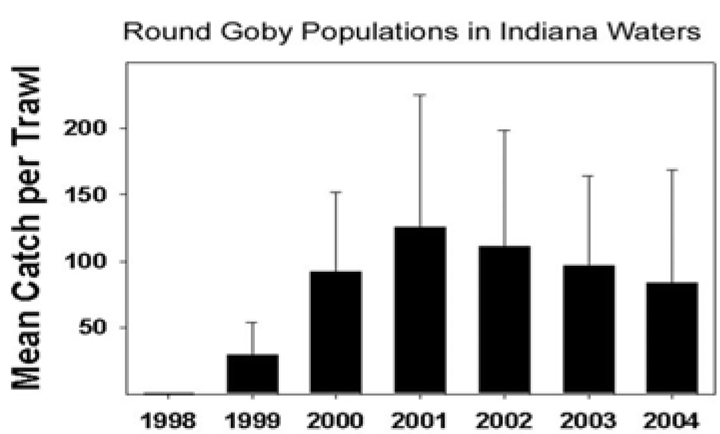
Update on the Sanitary and Ship Canal Electric Barrier

The electrical barrier that currently is in place in the Sanitary and Ship Canal was installed with the understanding that it was temporary. Therefore, a second electrical barrier is being constructed. This barrier will have 2 sections, each creating its own electrical field. Having 2 separate fields would allow the barrier to continue operating in case one of the fields malfunctions. The first phase of the second barrier (Barrier IIA) should be completed by September 2006. Barrier IIB should be constructed and on-line early in 2006. Meanwhile, Barrier I (the temporary barrier) is operating well and will continue to operate until Barrier II A & B are fully operational. Full funding of the operation and maintenance of the barrier has not been finalized. For more information visit www.seagrant.wisc.edu/AIS/Default.aspx?tabid=393.

Illinois-Indiana Sea Grant Partners with the City of Chicago

Illinois-Indiana Sea Grant is partnering with the City of Chicago on new AIS outreach initiatives via the city's facilities and activities. Illinois EPA participated in Illinois-Indiana Sea Grant's AIS-HACCP (Aquatic Invasive Species. Hazard Analysis and Critical Control Point) workshop in March, 2005, and has written and adopted an AIS-HACCP plan for its northern surface

The Round Goby



Round Goby Populations in Indiana Waters of Lake Michigan
Source: Ball State University (Lauer et Al., 2004)

The Lake Michigan Toolbox

Controlling Invasive Species

Controlling the numbers and distribution of existing nonindigenous species in the Great Lakes is still extremely important in the ongoing battle against invasive species. There are a variety of methods of controlling existing populations. Some examples include:

- **Biocides:** Chemicals, such as the lampricide TMF (used to control sea lamprey populations) and herbicides on aquatic plants, are sometimes used to reduce or eradicate local populations of exotic species.
- **Barrier construction:** Barriers use a variety of methods, including sound waves, electrical impulses, and visual and physical deterrents. These barriers can help prevent the spread of exotics in smaller waterways like canals and streams.
- **Physical removal:** Harvesting small populations of aquatic plants, for instance, can act as a temporary control in smaller inland lakes and waterways.
- **Biological control:** Very carefully selected non-native species, usually predators, are introduced to control population growth of another invasive species. A good example of this is work done with insects that specialize in eating purple loosestrife.
- **Public education**

More information is available at: www.great-lakes.net/teach/pollution/ans/ans_5.html

water sampling. Illinois' ANS Management Plan is already 5 years old and currently is being updated and revised. More information is available by contacting Pat Charlebois (charlebo@uiuc.edu).

Indiana

New ANS Management Plan

Indiana's ANS Management Plan was developed by D.J. Case and Associates under contract to Indiana DNR, Division of Fish and Wildlife. The plan was developed by a multi-agency task force. Indiana's ANS Management Plan was completed and approved by Governor Kernan in November 2003. The plan was approved by the National ANS Task Force at their November 2004 meeting. An Aquatic Invasive Species Coordinator was hired in January 2005 to implement the Indiana ANS Plan. To view the Indiana ANS Management Plan, please visit: http://www.in.gov/dnr/invasivespecies/inansmanagementplan.pdf

The goals of the Indiana ANS Management Plan are:

- Coordinate all efforts among agencies and organizations both within Indiana and with other states and nations to manage aquatic nuisance species.
- Prevent new introductions of nuisance aquatic species into the Lake Michigan and Mississippi River basins of Indiana.
- Conduct monitoring programs to enhance early detection of introductions or invasions.
- Institute rapid response objectives to limit the cost of controlling new introductions.
- Limit the spread of established populations of aquatic nuisance species into uninfested waters of the state.
- Mitigate harmful ecological, economic, social, and public health impacts resulting from infestations of aquatic nuisance species.
- Evaluate the effectiveness of the plan and use adaptive management strategies to update the plan during initial implementation and after the five-year period of use.

Ballast Water Legislation Proposed

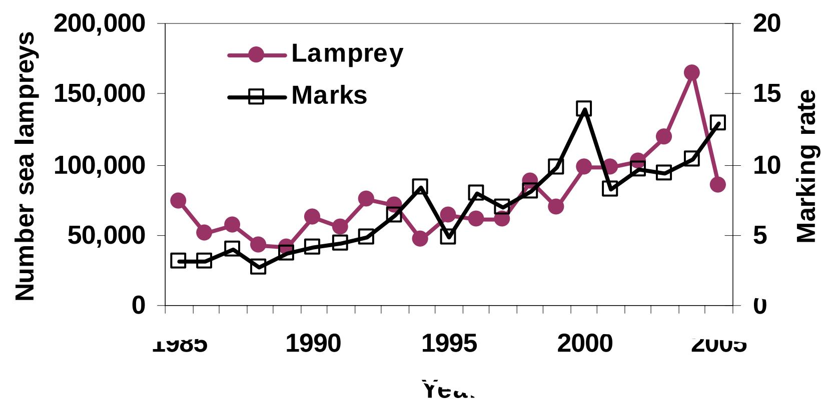
Ballast water legislation for Indiana's portion of Lake Michigan has been proposed in the 2006 Legislative short session. This legislation is very similar to that which passed in Michigan in 2005.

Brazilian Elodea Threatening to Spread

Besides Asian carp, which are widespread throughout Indiana's large rivers, the greatest threat to the Lake Michigan watershed is the recent invasion of Brazilian elodea (Egeria densa) into a public impoundment in south-central Indiana. The species has also been identified in a few southern Indiana private ponds. Control strategies are being developed for all bodies of water where it is currently known and should be implemented by the spring of 2006 with the goal of completely eliminating this exotic plant from the state.

The Lake and River Enhancement Program

appropriated over $600,000 for aquatic invasive plant control in 2005. That is a great leap in project funding over previous years due to an increase in revenue for the program. Most projects targeted either Eurasian watermilfoil or curlyleaf pondweed. Brazilian elodea control will also be funded from the program in the future.



Number of Sea Lampreys and marking rate in Lake Michigan
Source: Great Lakes Fishery Commission

Funding for Electric Barrier

As with the other states bordering the Great Lakes, Indiana contributed nearly $68,000 to assist in funding the Chicago Sanitary and Ship Canal permanent dispersal barrier.

Monitoring for Snakehead

The Indiana Lake Michigan field staff participates in a joint monitoring program to conduct surveillance for snakehead. The surveillance is conducted in conjunction with field collections during the spring and fall as part of the GLNPO, fish consumption advisory program in Trail Creek and Burns waterway.

Michigan

State Management Plan

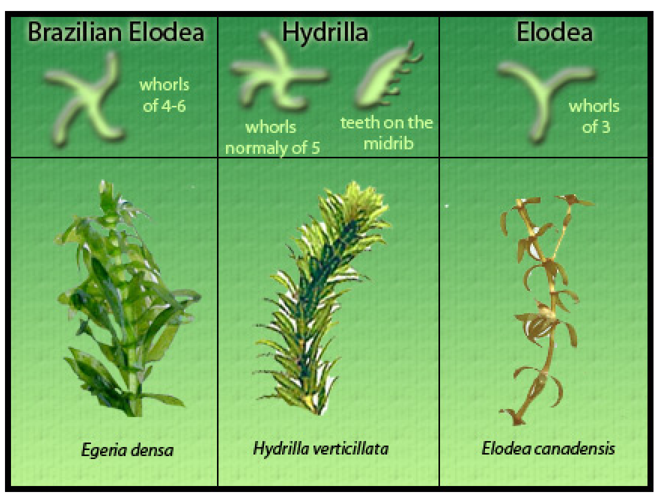
Michigan's Aquatic Nuisance Species State Management Plan was updated in 2002 and includes key recommendations for legislation and policy, research and monitoring, and information and education. Implementation of the plan is coordinated by Michigan's Aquatic Nuisance Species Council, established by Executive Order No. 2002-21 in November 2002. Michigan's Aquatic Nuisance Species State Management Plan Update, information regarding Michigan's Aquatic Nuisance Species Council, and information about the programs listed below are available at www.michigan.gov/deq in the Water section under Great Lakes, Aquatic Nuisance Control. Most of the recommendations in the 2002 update have been implemented and the plan will be revised in the near future.

Publications

Several publications, including the Aquatic Nuisance Species Handbook for Government Officials, that provide information regarding identification, management, and environmental impacts of exotic species in Michigan and in the Great Lakes area are available through the state.

Awareness Week

Michigan has implemented an annual Aquatic Invasive Species Awareness Week each year in June, proclaimed by the Governor and implemented by Michigan's Office of the Great



Indiana is working to prevent the spread of Brazilian elodea which has been found in the southern part of the state. This diagram shows how to identify Brazilian elodea from other nuisance aquatic plants.

More information is available at:
http://explorebiodiversity.com

Lakes. A wide variety of educational activities occur throughout the state during the week in support of prevention and control for invasive species.

Small Grants Program

A small grants program for aquatic invasive species education and awareness is offered each year. Projects have included boat launch inspections, boat washing demonstrations, AIS prevention workshops, and AIS awareness campaigns for inland lakes.

State Legislation

State legislation enacted in 2005, including Public Acts 74-81, provide new state prevention and control mechanisms. These laws establish lists of prohibited and restricted species and penalties for possession. They also created an Invasive Species Council addressing both terrestrial and aquatic species and establish an Invasive Species Fund to be used for administration and information/education. They require publishing a web site for public information about aquatic invasive species. The Department of Natural Resources is the lead agency.

Ballast Water

The discharge of ballast water is a significant contributor to the introduction of aquatic invasive species to Michigan. The state has 3 ballast water regulation laws to prevent introduction of aquatic invasive species to waters of the state via ballast water discharge.

Michigan's Office of the Great Lakes is implementing Public Act 114 of 2001 that requires ships on the Great Lakes to report to the Michigan Department of Environmental Quality (MDEQ) on use of certain best management practices (BMPs) for ballast water. The legislation, BMPs, and list of ships complying with reporting are available at www.michigan.gov/deq in the Assistance and Support Services section under Environmental Reporting, Ballast Water Reporting.

The MDEQ's Water Bureau is implementing Public Acts 32 and 33 of 2005. These laws require a state permit from ocean-going vessels to conduct port operations in Michigan beginning January 1, 2007. The permit is under development in 2005-2006 and will require treatment of ballast water prior to discharge in Michigan to prevent release of aquatic invasive species.

Wisconsin

Watercraft Inspection

This effort involves dissemination of information to anglers and recreational boaters to make them aware of what invasive species look like and what precautions they should take to avoid spreading them. It also involves visual inspection of boats to make sure they are "clean" and demonstrating to the public how to properly clean their boats, trailers, and boating equipment. Watercraft inspectors also install signs at boat landings informing boaters of the infestation status, state law, and steps to prevent spreading invasive species. About $56,000 was spent in FY 03 and $174,900 in FY 04 on watercraft inspection efforts.

Monitoring

Purple Loosestrife
Source: Lake Koshkonong Wetland Association

This effort involves monitoring for aquatic invasive species, including zebra mussels, Eurasian water milfoil, spiny waterfleas, and rusty crayfish. For zebra mussels, it involves collecting samples for veliger (larval zebra mussel) analyses and deployment of substrate samplers to monitor for the adults. More recently, specific sampling procedures were developed for spiny waterfleas and rusty crayfish, and in 2004 the DNR has begun sampling for these invasive species as well. For Eurasian water milfoil, monitoring efforts involve inspection of watercraft for invasive plants and visual shoreline inspections. About $56,000 was spent in FY 03 and $128,600 in FY 04 on monitoring efforts on inland waters.

Information and Education

In close cooperation with UW Extension and Wisconsin Sea Grant, education efforts focus on working with resource professionals and citizens statewide to teach boaters, anglers, and other water users how to prevent transporting aquatic invasive species when moving their boats. Efforts also involve addressing other potential mechanisms of introduction, including aquarium pet release and water gardening. Many educational tools are used to reach the public--brochures and publications, watch cards and wild cards, public service announcements and displays at parks, sport shows, convention and symposiums. Mandy Beall, education and outreach coordinator with UW-Extension, is funded through this program. This position is responsible for disseminating information and coordinating the statewide education efforts. About $97,800 was spent in FY 03 and $221,800 in FY 04 on information and education/outreach efforts.

Purple Loosestrife Biological Control

This is a citizen-based project that emphasizes using two safe, purple loosestrife foliage-feeding beetle species, in combination with traditional methods, for controlling this invasive plant. Citizens of all ages make up the backbone of this cooperative program by rearing and releasing these insects in their local wetlands—and learning about these unique resources in the process. Brock Woods with UW-Extension is the purple loosestrife bio-control coordinator and directs the program. This position is funded through the program. A total of $68,000 was spent in each fiscal year, FY 03 and FY 04, to support purple loosestrife biocontrol efforts in the state.

Clean Boats, Clean Waters Volunteer Program

Sponsored by DNR, UW Extension, and the Wisconsin Association of Lakes, this program was initiated in the fall of 2003 and offers training on how to organize a watercraft inspection program, how to inspect boats and equipment, and how to interact with the public. Volunteers are also encouraged to help monitor for aquatic invasive species. Workshops are open to adults and youth, and adult groups are encouraged to work with local youth partners. Laura Felda-Marquardt, with UW-Extension, coordinates the volunteer efforts and is funded through the program. About $75,000 was spent in FY 04 to support the Clean Boats, Clean Waters Volunteer Program.

Research efforts

The DNR has contracted with the UW-Madison Center for Limnology to develop monitoring protocols for rusty crayfish and spiny water fleas. DNR field staff are utilizing the draft protocols for these two species. Other activities that will be completed as part of the proposal include: 1) databases on the distribution of rusty crayfish, spiny water fleas, and rainbow smelt; 2) models predicting which waters are most vulnerable to invasion from these species; and 3) assessment of impacts and control strategies for Wisconsin, including development of a rapid response strategy. A total of $20,300 was spent on the FY 04 on the contract with the Center for Limnology to conduct the research efforts. A total of $29, 719 is allocated in FY 05 for this proposal to complete this work effort.

Aquatic Invasive Species (AIS) Grants

New in FY 04 is a $500,000 annual appropriation from the Water Resources Account of the Conservation Fund that the DNR administers as a cost share grant program to local units of government. The grants can be used for work that prevents the spread of aquatic invasive species into uninfested waters. The grants can also be used for eradicating non-native species and/or controlling their impact and working to re-establishing biological integrity. In FY 04, approximately $515,000 was encumbered for aquatic invasive species control and planning & education projects. At a glance, here are the highlights of the grant program:

- A 50% local match is required which can be cash, donated labor or materials.
- Local units of governments are eligible, including towns, cities, villages, counties, tribes, lake and sanitary districts. Lake associations or nonprofit conservation organizations (NCOs) are also eligible for any funds not spent on municipal projects.
- Projects should emphasize prevention, planning, education and boat launch inspections; control practices are limited to projects in DNR approved plans.
- The DNR completed writing permanent rules to administer the program .

The DNR, through the FY 05 -07 biennial budget process, is seeking to amend the statutes to include a 25% local match and also make grant funds equally available to lake associations and nonprofit conservation organizations. Both of these changes would make the AIS grants consistent with existing lake grants.

Next Steps

- Education and outreach on aquatic invasive species in order to accomplish
  - Ship and barge-mediated introductions and spread of AIS in the Great Lakes should be eliminated
  - Federal, state, and/or local governments must enact measures that ensure the region's canals and waterways are not a vector for AIS
  - Federal and state governments must take immediate steps to prevent the introduction and spread of AIS through the trade and potential release of live organisms
  - Establish a Great Lakes Aquatic Invasive Species Integrated Management Program to implement rapid response, control, and management programs and assess the effectiveness of those programs

Michigan DEQ Report Outlines Impacts of Beach Maintenance

A report released in March 2006 by the Michigan Department of Environmental Quality found negative impacts to coastal areas where "beach grooming" had occurred. The report, developed by a team of scientists from Michigan State University and Grand Valley State University, compared groomed beaches with similar, nearby natural beaches, allowing the researchers to measure how fish populations, other animals, and marsh plants are affected.

The study showed that clearing vegetation through a coastal marsh alters the chemical and physical conditions of nearshore waters, reducing or eliminating habitat for Michigan's important game fish including yellow perch, smallmouth bass, and largemouth bass.

According to the Michigan DNR, approximately 90% of the 200 fish species living in the Great Lakes rely on coastal wetlands during some part of their life cycle. The report found negative impacts to several important game fish including yellow perch, smallmouth bass, and largemouth bass. The study also found that beach grooming destroyed stands of important plants and helped invasive species colonize the groomed areas.

In light of this research, MDEQ Director Steven Chester has recommended to the Legislature that the provisions created through 2003 wetlands legislation be allowed to expire according to the sunset dates in the law.

More information is available at: www.michigan.gov/deq/0,1607,7-135-3313_3687-10202--,00.html.

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 8

Aquatic Invasive Species Goals and Recommendations

Goals

Goal: Prevent all new introductions of AIS into the Great Lakes.
Goal: Stop the spread of AIS within the basin, extirpate harmful AIS, or if impossible, then control to levels that ensure sustainable ecosystems and the social, economic and cultural uses they support.

Interim Milestones: A complete list of all milestones developed to measure progress through 2010 toward reaching the goals is included in AIS appendix A. The most important interim milestones supporting the recommendations are to:

- Enact comprehensive federal legislation (*specifically* legislation that would incorporate all of the terms contained in S. 770, H.R. 1591 and 1592 as introduced in the 109th Congress; collectively the *National Aquatic Invasive Species Act*—NAISA; with modifications as outlined in recommendation #3) to authorize and fund AIS programs;
- Provide expanded federal support for AIS research and outreach programs; and
- Develop a binational plan of action to prevent additional species invasions, and control established populations of the most damaging AIS.

Recommendations

1. Ship and barge-mediated introductions and spread of AIS in the Great Lakes should be eliminated, through the immediate promulgation of environmentally protective standards for ballast water, and the implementation of effective ship-board treatments and management measures. Specifically:

   - Immediately require, verify, and enforce (in the current shipping season under existing authorities) that ocean-going vessels in the no ballast on board condition (NOBOB) implement practices that are an improvement over current practices;
   - Immediately require, verify, and enforce best performing ship-board ballast water treatment and hull management methods for ocean-going vessels (with a set approval period), with continued upward ratcheting of the treatment floor as treatment performance improves. Approved treatment must be to an environmentally protective standard by 2011;
   - Immediately require monitoring, reporting, and public dissemination of all ballasting activities, prevention practices, and outcomes such that progress toward the goal is measurable and enforcement practical;
   - Review and apply best-performing ballast water management practices to non-oceangoing vessels operating exclusively within the Great Lakes (including application of ballast water treatment for new ships) to eliminate the spread of AIS already introduced into the system; and
   - Immediately and significantly expand research, testing, and evaluation of policies and technologies as alternatives to on-board treatment. Alternatives to be investigated should include (but not be limited to) cargo transfer, shore-based treatment, use of Clean Water Act discharge permits, and state/regional actions. Programs under which these investigations can be conducted include the Ballast Water Technology Demonstration Program and the Environmental Technology Verification Program. These investigations will hasten development of effective shipboard treatment systems. If ship-board treatments are shown to be inadequate, the team recommends implementation by 2011 of effective alternatives that prohibit ballast water from ocean-going ships from being discharged into the Great Lakes.

2. Federal, state, and/or local governments must enact measures that ensure the region's canals

and waterways are not a vector for AIS, including full federal funding of the Chicago San-Ship Canal barrier and the sea lamprey control program. Specific recommendations are:

- Complete construction of barrier II, make barrier I permanent, provide federal funds to operate both dispersal barriers in the Chicago Waterway system, and complete a study of options for permanent hydrological and/or biological separation of the Great Lakes and Mississippi River systems;
- Fully examine options and their economic benefits and costs to prevent the spread of AIS via the Lake Champlain Canal and other canal systems linking the Great Lakes with other basins;
- Close or modify, through the use of physical barriers or control structures, canals that have fallen into disuse or disrepair—if rebuilt, prevent passage of aquatic invasive species;
- Prohibit development of new cross-drainage basin connections;
- Address intermittent flood-related connections;
- Initiate measures to prevent or reduce the movement of AIS into stream segments opened up by dam/impediment removal or culvert construction, and fully consider benefits to native species and impacts from AIS when evaluating cost-benefit of proposed fish passage projects;
- Develop and implement AIS monitoring plans to provide comprehensive monitoring and reporting of AIS through the canal vector; and
- Fully fund the Great Lakes Fishery Commission's sea lamprey control program.

3. Federal and state governments must take immediate steps to prevent the introduction and spread of AIS through the trade and potential release of live organisms. Specifically:
   - Develop a list of species of concern for the Great Lakes basin and an immediate moratorium by the States on the trade of species on that list, until the species are screened and approved for trade ;
   - Implement provisions of the pending NAISA legislation, as introduced, that establish a federal screening process for organisms proposed for trade;
   - Modify the pending NAISA legislation mandating that the screening process should classify species proposed for trade into three lists—prohibited, permitted, and conditionally prohibited/permitted;
   - Modify NAISA to clearly state that the screening process established must place the burden of proof of non-injuriousness on the importer;
   - Allocate sufficient resources to heighten the number of species under the Lacey Act as "injurious," to prevent the interstate transportation of harmful species;
   - the Fish and Wildlife Service FWS should list black, bighead, and silver carps as injurious under the Lacey Act;
   - Significantly increase resources for the enforcement of laws governing the trade of live organisms; and
   - Develop and implement risk models for organisms in aquaculture.

4. Establish a Great Lakes Aquatic Invasive Species Integrated Management Program to implement rapid response, control, and management programs and assess the effectiveness of those programs. This program, which will require authorization, must:
   - Allocate funds for development and implementation of State and Interstate Aquatic Nuisance Species Management Plans through the Aquatic Nuisance Species Task Force, with a particular emphasis on the immediate use of techniques to control or slow the spread of AIS
   - Encourage investigation of economic requirements and incentives (e.g., bonds or insurance) to prevent new introductions;
   - Establish a revolving fund for rapid response actions; Establish an interagency, Great Lakes Federal Rapid Response Team, that will conduct activities on federal lands, and in other locations with State, Tribal, and local cooperation; and Allocate funds to implement a system of

enhanced monitoring and ecological surveys in the Great Lakes;

- Support additional research to develop and implement new control methods for uncontrolled species of concern; Establish a coordinated data management system, through the Smithsonian Institution, the Great Lakes Environmental Research Laboratory, or other suitable entity, to develop an accessible, integrated, and centralized database that allows for the reporting and tracking of AIS infestations; and
- Ensure overall coordination and accountability through the Invasive Species Council, including developing regular and comprehensive reports summarizing the status of AIS activities (including those of the Aquatic Nuisance Species Task Force and the Great Lakes Panel on ANS in implementing the National Invasive Species Management Plan), formulating a complete AIS federal budget request, overseeing progress in addressing AIS, evaluating the collective response to AIS, and communicating AIS needs and problems to Congress and the public. The National Invasive Species Management Plan should include specific focus on AIS in the Great Lakes.

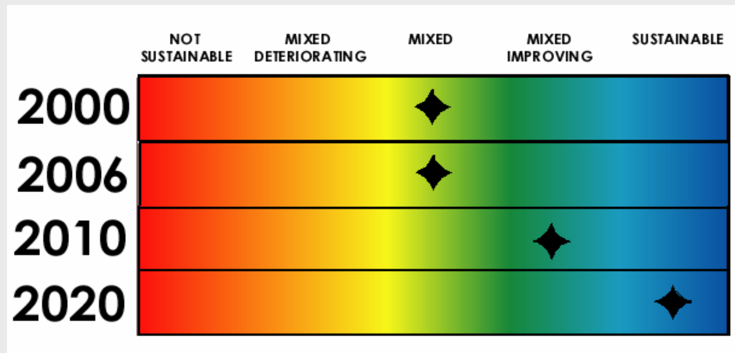
Subgoal 9

Are ecosystem stewardship activities common and undertaken by public and private organizations in communities around the basin?

Status

Each government, institution, organization, and individual within the Lake Michigan basin has a potential role in ecosystem stewardship; however, no single government, institution, organization, or individual has the ability to implement stewardship activities and achieve sustainability in the basin unilaterally. The watershed fact sheets in Chapter 12 are tools created to encourage the recognition of the linkage between local watersheds and Lake Michigan. The current status of stewardship is mixed but will improve as more Lake Michigan watershed partnerships are formed.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 3514 - Commercial/Industrial Eco-efficiency
- 3516 - Household Stormwater Recycling
- 4863 - Land Use Adjacent to Wetlands (Coastal Wetlands)
- 7000 - Urban Density
- 7002 - Land Cover - Land Conversion
- 7006 - Brownfield Redevelopment
- 7043 - Economic Prosperity
- 7028 - Sustainable Agriculture Practices
- 7053 - Green Planning Process
- 7056 - Water Withdrawal
- 7057 - Energy Consumption
- 7060 - Solid Waste Generation
- 7061 - Nutrient Management Plans
- 7062 - Integrated Pest Management
- 7064 - Vehicle Use
- 7063 - Municipal Wastewater Treatment
- 7101 - Groundwater and Land: Use and Intensity
- 8132 - Nearshore Land Use
- 8136 - Extent and Quality of Nearshore Natural Land Cover
- 8500 - Forest Lands - Conservation and Maintenance of Soil and Water Resources
- 8501 - Maintenance and Productive Capacity of Forest Ecosystems
- 8502 - Maintenance and Forest Ecosystem Health and Vitality
- 8114 - Habitat Fragmentation
- 8163 - Status and Protection of Special Places and Species

Challenge

- To create a framework of goals and activities tailored to the watershed and community level while promoting Lake Michigan basin-wide interaction and partnerships.

Next Steps

- Develop projects utilizing the Lake Michigan LaMP watershed fact sheets, land use management tool box and exploration of other tools and Provide additional education and outreach materials on water conservation and source water protection
- Continue the Lake Michigan Watershed Academy and support GIS and models workshops and small implementation grants to local communities
- On-line habitat atlas continues to build layers
- Hold FY 2007 State of Lake Michigan Conference
- Continue the research vessel boat tour – Making Lake Michigan Great

The Importance of Partnerships

The past decade of ecosystem management in the basin has seen a profound shift from a top-down, command and control, government-dominated approach to a bottom-up, partnership-based, inclusive approach. This evolution is the manifestation of a number of developments, including changes in federal, state, tribal and local relationships; local community empowerment; increased focus on local partners; and watershed-based institution building. If a sustainable Lake Michigan ecosystem is to be achieved, it falls to us to rearrange ourselves, our interest groups, and our governments into a new institutional framework—a framework that consists of existing organizations and governments “rafted” together as full partners in the pursuit of the LaMP goals.

Effective place-based partnerships are the result of the rafting of “full partners.” Full partnership implies moving beyond the stakeholder model, wherein citizen committees (stakeholder groups) are briefed about agency plans and projects, to a model based on full collaboration in the definition of basin-wide goals and the sharing of resources to achieve these goals.

Lake Michigan’s Watershed Academy

The challenge of translating Lake Michigan scale watershed data and planning to local governments divided by political boundaries is being undertaken through the development of the Lake Michigan Watershed Academy. In 2000 and 2002, the Lake Michigan Lakewide Management Plan highlighted the need to promote a series of dialogues with local decision makers about the status of their watersheds and their impact on Lake Michigan. Monitoring data and Geographic Information System presentations clearly show the interconnected aspects of the basin and the need to plan and cooperate across political boundaries in order to conserve habitat and sustain biodiversity.

The Lake Michigan Watershed Academy was launched in March 2003 when the Academy hosted a three-day event for staff, commissioners, and local officials from six regional planning commissions that operate on the shores of Lake Michigan. The purpose of the sessions was to introduce many of them to the watershed planning concept and provide an overview on how the approach can be implemented on the local level. The meeting was co-sponsored by Western Michigan University’s Institute for Water Sciences. The participating regional planning commissions from the four Lake Michigan states include the Bay Lakes Regional Planning Commission, the Southeastern Wisconsin Regional Planning Commission, the Northeastern Illinois Regional Planning Commission, the Northwest Indiana Regional Planning Commission, West Michigan Regional Shoreline Development Commission, and the Northwest Michigan Regional Planning Commission.

The Academy meeting provided an opportunity to present perspectives from USEPA Region 5, USEPA headquarters, other federal agencies, tribal, state, and environmental perspectives on clean water

Lake Michigan Toolbox

Watershed Management On-line Tools

The Midwest Partnership for Watershed Management was launched in 2002 by the Wisconsin DNR and USEPA Region 5 Water Division to provide access to free, coherently organized, scientifically-based watershed–based information for local officials and planners, natural resource managers, and the general public. The partnership aims to provide the maximum information and analytic tools to those levels of government closest to the actual problems. It offers both direct access to its own free web-based decision support tools and road maps to other sites where additional tools can be found. The effort has been working closely with the Lake Michigan Watershed Academy.

Many communities cannot afford even the most basic approach to, or initial screening of, their environmental problem and need cost effective, user friendly tools to assist them. Existing information and analytic tools, properly presented and freely accessible, can help meet this challenge. Watershed management data and decision support tools can allow informed screening and preliminary selection of alternatives, eliminating large amounts of preliminary "leg work".

More information is available at www.epa.gov/waterspace.

issues and their relationship to watershed planning. The regional planning commissions then followed up with conferences in their respective areas tailored for their communities. In addition to two pilot conferences in South Bend, Indiana, and Kalamazoo, Michigan, conferences were held in Green Bay, Wisconsin, Traverse City, Michigan, Muskegon, Michigan, and Milwaukee, Wisconsin. Additional conferences in northwest Indiana and northeastern Illinois were held since 2004.

The concept of a Lake Michigan Watershed Academy is to provide a "packaging and delivery system" that brings together the tools, data, and expertise of many federal, state, local, and tribal agencies as well as NGOs and environmental organizations to explore opportunities for new partnerships, thereby impacting the quality of the land use plans and partners in the Lake Michigan watershed.

The Lake Michigan Watershed Academy Phase II began in Spring 2004 and will provide start up funding for efforts to implement projects resulting from the regional conference discussions. See page 10-4 for a summary of Phase II activities. For more information contact Kerry Leigh at the Northeastern Illinois Planning Commission at kleigh@nipc.org.

USEPA Utilizes Watersheds for Regulatory Focus

In December 2002 USEPA's Assistant Administrator for Water issued a policy memorandum entitled: "Committing EPA's Water Program to Advancing the Watershed Approach." The memorandum not only reaffirmed USEPA's commitment to the watershed approach, but also reenergized efforts to ensure that USEPA as a whole fully integrates the watershed approach into program implementation. The memorandum established an USEPA Watershed Management Council (WMC) to accelerate efforts to develop and issue National Pollutant Discharge Elimination System (NPDES) permits on a watershed basis. The USEPA issued final guidance on watershed permitting in December 2003 (EPA 833-B-03-004).

Watershed-based NPDES permitting is an approach to developing NPDES permits for multiple point sources within a defined geographic area. The primary difference between this approach and the

Lake Michigan Toolbox
USEPA Watershed Academy On-Line

Training materials and tools have been developed including USEPA's Watershed Academy Web-Based Training, Drinking Water Academy, American Water Works Association Source Water Training, Land Trust Alliance training materials, other existing videos and state and local training materials such as Michigan's Department of Environmental Quality's "Developing a Watershed Management Plan for Water Quality."

These and others are available at: Many can be accessed at www.epa.gov/OWOW/watershed/wacademy

The Lake Michigan Toolbox
Draft Handbook for Developing Watershed Plans

This draft handbook is intended to help communities, watershed organizations, and state, local, tribal and federal environmental agencies develop and implement watershed plans to meet water quality standards and protect water resources. It was designed to help any organization undertaking a watershed planning effort, and it should be particularly useful to persons working with impaired or threatened waters. USEPA intends for this handbook to supplement existing watershed planning guides that have already been developed by agencies, universities, and other nonprofit organizations. The handbook is generally more specific than other guides with respect to guidance on quantifying existing pollutant loads, developing estimates of the load reductions required to meet water quality standards, developing effective management measures, and tracking progress once the plan is implemented.

USEPA is making this draft document widely available with the purpose of having it used and tested by a variety of watershed partnerships. USEPA will be seeking advice from such organizations in developing the final version. A mailbox for emailed comments, suggestions, and corrections has been created. Please address them to watershedhandbook@epa.gov. Submissions should be received by June 30, 2006

Making Lake Michigan Great 2005 Update

The *Making Lake Michigan Great 2005* Tour of the W.G. Jackson research and education vessel reached three ports in southern Lake Michigan in 2005. Over 340 people participated in events. The tour was funded by the Great Lakes National Program Office. On its way to Indiana, the vessel docked at the South Haven Municipal Marina and almost 100 people attended a dockside open house.

Activities in the Port of Indiana – Burns Harbor included an educator workshop and two cruises for the general public. A three-day educator workshop, *Great Lakes Institute*, was planned around the *Jackson* visit. Partners for this stop included the Indiana Dunes National Lakeshore, Indiana Dunes Environmental Learning Center, and the Alliance for the Great Lakes. Kim Swift of the Indiana Dunes National Lakeshore took the lead in organizing the workshop. Mark Gleason from Michigan Tech brought an ROV onboard the *Jackson* to view underwater life. Originally one public cruise was planned, but another was added since there was a waiting list. Over 80 people were on the *Jackson* at Burns Harbor.

Illinois Department of Natural Resources and Indiana Department of Environmental Management gave presentations during the two-day stop in Hammond, Indiana. Illinois DNR arranged a day-long workshop at the Hammond Marina that included Illinois and Indiana educators. IDEM was responsible for managing the public tours. About 162 people were able to get out into Lake Michigan on the *Jackson.*

Grand Valley State University also sponsored a trip to the White Lake Area of Concern for Celebrate White Lake. More information is available from Dr. Janet Vail at Grand Valley State University at vailj@gvsu.edu.

The *Making Lake Michigan Great* Tour. Photos Courtesy of Janet Vail, Grand Valley State University

current approach to permitting is the consideration of watershed goals and the impact of multiple pollutant sources and stressors, including nonpoint source contributions. Watershed-based permitting may encompass a variety of activities ranging from synchronizing permits within a basin to developing water-quality based effluent limits using a multiple discharger modeling analysis. The type of permitting activity will vary from watershed to watershed, depending on the unique circumstances in the watershed and the sources affecting watershed conditions. The ultimate goal of watershed-based NPDES permitting, however, is to develop and issue NPDES permits that consider the entire watershed, not just an individual point source discharger.

Although significant water quality improvements have been made during the past three decades, water quality problems remain. Many of the remaining problems involve complex mixtures of sources and impacts that require integrated, holistic solutions. Over the past decade, the number of sources subject to the NPDES program has increased almost tenfold. There is a pressing need for innovative and efficient solutions to permitting these point sources that will result in further water quality gains. As a mechanism to help integrate other water program activities and to target the most pressing environmental issues within a watershed, a watershed-based approach to NPDES permitting can serve as one innovative tool for achieving new efficiencies and environmental progress.

The Lake Michigan Forum

The Lake Michigan Forum provides input on the LaMP to USEPA from representative stakeholders of the Lake Michigan basin. In recognition of the LaMP statement that every basin resident is a "Lake Michigan Manager," the forum seeks opportunities to foster ecosystem stewardship through multi-organizational initiatives and partnerships, looking for LaMP implementation opportunities beyond what can be achieved by government efforts.

As the nongovernmental component of the Lake Michigan LaMP, the Forum has a number of responsibilities, including:

- Representing the diverse interests and geography of the Lake Michigan basin and creating a communication link between the forum members' constituents and the LaMP process
- Providing input to and review of LaMP updates and assisting in their completion and implementation
- Identifying targets of opportunities for demonstration projects relating to LaMP goals and recommendations
- Promoting the LaMP to the public and building a constituency for its implementation
- Serving as a forum for regional and watershed approaches to accomplish LaMP goals;
- Serving as a forum for identifying, discussing, and conveying critical/priority issues
- Serving as a conduit for public concerns and input to the LaMP process

The forum's membership consists of representatives of local governments, industry, environmental groups, sport fishing interests, academia, agriculture, Native American tribes, sewerage districts, and AOCs. Interested parties should go to www.lkmichiganforum.org.

The forum holds public meetings quarterly at different locations around the Lake Michigan basin and, in partnership with USEPA and Grand Valley State University, sponsors an education and outreach tour. Each summer since 1998, the ship *W.G. Jackson* has made its way around Lake Michigan on the Making Lake Michigan Great Tour, spreading the word about the Lake Michigan LaMP. The tour provides hands-on experience in water issues for the public aboard a research vessel operated by the Robert B. Annis Water Resources Institute of Grand Valley State University in Muskegon, Michigan. The event includes cruises for students and the public, open houses, and community activities. Since it began, thousands of people have participated in the tour at 26 ports of call around Lake Michigan. For more information, visit the forum web site at www.lkmichiganforum.org.

Baird Creek Watershed Assessment

As part of a broader effort to conduct similar assessments as a model for analysis, planning, and design in other watersheds around the Lake Michigan Basin, the Forum performed a stewardship assessment process in Baird Creek, a tributary to the lower Fox River AOC through the East River. Though this sub-watershed is rapidly urbanizing eastward from the city of Green Bay toward agricultural areas in the east, it nevertheless contains in its eastern portion an ecologically significant 350-acre wooded riparian greenway corridor within the city. The corridor provides bike and foot access from diversely populated urban concentrations to high quality natural resources and open space areas, and could serve as the basis for development of a model integrated shoreline pedestrian system in Green Bay. This greenway corridor and other opportunities in the Baird Creek watershed serve as a focal point for local discussion among public officials, non-government organizations, business interests, and the general public. The stewardship assessment completed a report in November 2004. The Forum recommended that officials, citizens, and interested groups cooperate to:

- Develop plans and ordinances to protect environmentally sensitive areas, map more flood plains, protect wetlands, increase riparian buffers, and increase inspections and enforcement of home septic systems, increase conservation easements, consider local guidelines for impervious surfaces, implement local ordinances that encourage low-impact conservation development, and increase intergovernmental communication.
- Create partnerships among agencies, universities, local government, landowners and watershed organizations to protect critical wetlands in the upper reaches of the Baird Creek watershed, increase regional educational and assistance programs to promote best management practices in the Baird Creek headwaters, promote demonstration projects, and conduct monitoring of buffer effectiveness
- Designate the Northeast Wisconsin Stormwater Consortium (NEWSC) as the central organizational body to address the Phase II compliance and more effectively address stormwater issues.
- Ensure that Build-out Scenario efforts include sustainable redevelopment in urbanized areas of the watershed, as well as low-impact and new development in less urbanized areas.
- Follow comprehensive plans closely for local governments in the watershed, and review and update them periodically, encourage adoption of Conservation Subdivision ordinance, pursue sustainable redevelopment of urban areas, encourage public participation in subdivision planning and design, require local government staff to visit the site with the developer to review possible environmental issues or agricultural conflicts. Involve WDNR or Land Conservation staff if possible, and conduct outreach to developers, policy makers, and the public about the benefits of Conservation Design and smart growth.
- Expand watershed monitoring initiatives in the Baird Creek to include broader participation from schools, residents, and other stakeholders.

State of Lake Michigan Conference

In November 2005, USEPA, the Lake Michigan Forum, the Sea Grant Program, University of Wisconsin-Green Bay, and the Great Lakes Beach Association hosted the biennial State of Lake Michigan conference in Green Bay, Wisconsin. The Conference brought together over 300 attendees and presenters to discuss the status of the lake. Presentations from the conference inform and are often incorporated into the next LaMP publication. For a CD of the presentations, contact, Laura Evans at evans.laura@epa.gov.

The next conference is planned for October 2007 in Traverse City, Michigan.

Next Steps

- Develop projects utilizing the Lake Michigan LaMP watershed fact sheets and exploration of other needed tools (see Appendix D)
- Continue the Lake Michigan Watershed Academy and support GIS and models workshops and small implementation grants to local communities
- Provide additional education and outreach materials on water conservation and source water protection
- Promote the habitat and land use management tool box
- On-line habitat atlas continues to build layers
- Hold FY 2007 State of Lake Michigan Conference
- Continue the research vessel boat tour – Making Lake Michigan Great

LAKE MICHIGAN PARTNERSHIP DIRECTORY

United States Environmental Protection Agency
Great Lakes National Program Office
Lake Michigan Lakewide Management Plan
77 West Jackson Boulevard
Chicago, Illinois 60604

Overview

The desire to protect and restore the Great Lakes has created a number of governmental programs at the international, national, state, tribal and local levels. The intent of this directory is to present some of the international, federal, state, and tribal government partners involved in Lake Michigan issues, provide brief descriptions of their roles, and list contacts for further information. Partners at the local level are key to any successful effort. Unfortunately, all of the possible partners are too numerous to list. Links to local watershed groups are listed in the watershed fact sheets found in the 2004 Lake Michigan Lakewide Management Plan update report.

There has been renewed efforts in fostering greater coordination to better protect, conserve, and restore the Great Lakes. A 2004 Presidential Executive Order calls for collaboration among regional, state, local, tribal, and other interests to develop an overall strategy for protecting the Great Lakes. This work was conducted between December 2004 and December 2005, providing both short and long term recommendations. The final strategy will be found at www.epa.gov/glnpo. In addition, the Great Lakes Water Quality Agreement (GLWQA) of 1978 is up for review triggered by the International Joint Commission's 12th Biennial Report on the GLWQA. To participate, visit the IJC's website bulletin board at www.ijc.org.

Lake Michigan–Lakewide Management Program: Meetings and Reports

- Lakewide Management Plans are updated every two years. The next update will be completed in April 2006.
- The State of Lake Michigan conference is held every two years. The next meeting will be held in Fall 2007.
- The Lake Michigan Forum, an EPA sponsored stakeholder group holds quarterly meetings around the basin.
- The Lake Michigan Monitoring Council meets twice per year around the basin.
- The International Joint Commission (www.ijc.org) holds a Great Lakes public conference every two years. The next meeting will be held in 2007.
- The State of the Lakes Ecosystem Conference (SOLEC) (www.epa.gov/glnpo/solec) is held every two years. The next conference will be held in 2006 in Milwaukee, Wisconsin.

More Information on Federal Resources and Grants

There are many federal resources listed in this document. A new website, www.grants.gov, contains information for finding and applying for all federal grant programs. It creates a centralized process to find and apply for over 900 federal grant programs. This site provides information in a standardized format across agencies and includes:

- A "Find Grant Opportunities" feature to help applicants find potential funding opportunities.
- An "Apply for Grants" feature that allows applicants to download, complete, and submit applications for specific grant opportunities from any federal grant-making agency.
- A "Receive Grants Opportunity Notification" feature that allows you to subscribe to receive announcements of both new grants and modifications of existing grant announcements.

International and Regional Partners

International Joint Commission — www.ijc.org

The International Joint Commission (IJC) prevents and resolves disputes between the United States of America and Canada under the *1909 Boundary Waters Treaty*. It rules upon applications for approval of projects affecting boundary or transboundary waters and may regulate the operation of these projects; assists the two countries in the protection of the transboundary environment, including the implementation of the *Great Lakes Water Quality Agreement* and the improvement of transboundary air quality; and alerts the governments to emerging issues along the boundary that may give rise to bilateral disputes. The IJC operates a Great Lakes Office in Windsor, Ontario.

Great Lakes Commission — www.glc.org

The Great Lakes Commission is an interstate Compact Commission that promotes the orderly, integrated, and comprehensive development, use, and conservation of the water and related natural resources of the Great Lakes basin and St. Lawrence River. Its members include the eight Great Lakes states and associate members from the Canadian provinces of Ontario and Québec.

Great Lakes Fishery Commission — www.glfc.org

The Great Lakes Fishery Commission (GLFC) was established in 1955 by the Canadian/U.S. Convention on Great Lakes Fisheries. The GLFC coordinates fisheries research, control measures for the invasive sea lamprey, and facilitates cooperative fishery management among the state, provincial, tribal, and federal management agencies. On the basis of its research findings, the commission recommends measures that will permit the maximum sustained productivity of stocks of fish of common concern.

Council of Great Lakes Governors — www.cglg.org

The Council of Great Lakes Governors is a private, non-profit corporation established in 1982 and charged by its member governors and associate member premiers to encourage and facilitate environmentally responsible economic growth in the Great Lakes region. This is done through public-private efforts among the ten jurisdictions to address common environmental and economic challenges.

Great Lakes and St. Lawrence Cities Initiative — www.nemw.org/glci

The Great Lakes and St. Lawrence Cities Initiative (GLSLCI) is a binational coalition of mayors and other local officials that works actively with federal, state, and provincial governments to advance protection and restoration of the Great Lakes. The GLSLCI helps mayors and other local officials develop and advocate programs to improve the resource.

Great Lakes Protection Fund — www.glpf.org

The Great Lakes Protection Fund is a private, nonprofit corporation formed in 1989 by the Governors of the Great Lakes States as a permanent environmental endowment that supports actions to improve the health of the Great Lakes ecosystem. The Fund seeks projects that lead to tangible improvements in the Great Lakes ecosystem; promote the interdependence of healthy ecological and economic systems, and are innovative, creative, and venturesome.

Great Lakes Fishery Trust — www.glft.org

The Great Lakes Fishery Trust (GLFT) provides funding to enhance, protect and rehabilitate Great Lakes fishery resources. The GLFT manages its resources to compensate for lost use and enjoyment of the Lake Michigan fishery resulting from the operation of the Ludington Pumped Storage Plant.

Lake Michigan Forum — www.lkmichiganforum.org

The Lake Michigan Forum provides public input to U.S. EPA on the Lake Michigan Lakewide Management Plan (LaMP) and is a medium for direct involvement in the LaMP process from representative stakeholders of the Lake Michigan basin. The Forum also identifies and implements non-governmental activities that can help meet the LaMP goals.

Lake Michigan Monitoring Coordination Council — http://wi.water.usgs.gov/lmmcc

The Lake Michigan Monitoring Coordination Council fosters cooperation and coordination among groups involved in all types of Lake Michigan Lakewide Management Plan monitoring activities. It works toward developing a systematic and comparable approach to the collection, management, interpretation, and dissemination of environmental data related to environmental monitoring in the Lake Michigan Drainage Basin.

Great Lakes Beach Association — www.great-lakes.net/glba

The Great Lakes Beach Association's (GLBA) mission is to pursue healthy beach water conditions in the Great Lakes through communication and coordination of Great Lakes beach managers and researchers. It is made up of members from state and local governments in Ohio, Michigan, Indiana, Illinois, and Wisconsin, Environment Canada as well as several mid-west universities, non-government, regulatory and coordinating agencies, and environmental groups. It oversees BEACHNET, a communication network/listserv, and holds an annual beach conference.

United States Federal Partners

United States Environmental Protection Agency (EPA) — www.epa.gov

EPA administers educational and regulatory programs designed to protect the environment. EPA works mainly with state, federal, regional, tribal, and local agencies on pollution control and prevention efforts. EPA oversees the revolving loan fund program and brownfield grants. It conducts environmental assessments, water quality monitoring, regulations and regulatory oversight, education, planning, technical, assistance, and grants. The agency may provide staff, information, and data; laboratories and research facilities; grants and loans for pollution control; educational materials; and monitoring equipment.

Office of Research and Development - www.epa.gov/ord/

The Office of Research and Development (ORD) is the scientific research arm of EPA. ORD's leading-edge research helps provide the solid underpinning of science and technology for the Agency. ORD conducts research on ways to prevent pollution, protect human health, and reduce risk. The work at ORD laboratories, research centers, and offices across the country helps improve the quality of air, water, soil, and the way resources are used.

Great Lakes National Program Office (GLNPO) — www.epa.gov/glnpo

GLNPO brings together federal, state, tribal, local, and industry partners in an integrated, ecosystem approach to protect, maintain, and restore the chemical, biological, and physical integrity of the Great Lakes. The program monitors Lake ecosystem indicators; manages and provides public access to Great Lakes data; helps communities address contaminated sediments in their harbors; supports local protection and restoration of important habitats; promotes pollution prevention through such activities as the Canada-U.S. Binational Toxics Strategy; and provides assistance for community-based Remedial Action Plans for Areas of Concern and for Lakewide Management Plans. GLNPO uses its funding to assist Great Lakes partners through grants, interagency agreements, and contracts.

United States Department of Commerce

National Oceanic and Atmospheric Administration (NOAA) — www.noaa.gov
Great Lakes Environmental Research Laboratory (GLERL) — www.glerl.noaa.gov
Lake Michigan Field Station — www.glerl.noaa.gov/lmfs
Great Lakes Bathymetric Data — www.ngdc.noaa.gov/mgg/greatlakes/greatlakes.html

NOAA administers programs in cooperation with states to inventory and manage coastal resources. It funds and performs basic research and assessment relating to coastal eutrophication, and maintains data bases for agricultural pesticides and nutrient loadings. NOAA provides funds to state coastal programs; staff for technical assistance; data, reports, and educational materials; and special demonstration projects.

NOAA Office of Ocean and Coastal Resource Management — www.ocrm.nos.noaa.gov/czm
Illinois Lake Michigan Coastal Management Program — www.dnr.state.il.us
Indiana Lake Michigan Coastal Program — www.in.gov/dnr/lakemich
Michigan Coastal Management Program — www.michigan.gov/deq/0,1607,7-135-3313_3677_3696---,00.html
Wisconsin Coastal Management Program — www.doa.state.wi.us/section_detail.asp?linkcatid=108

The Coastal Zone Management Program (CZM) is housed under the Office of Ocean and Coastal Resource Management. CZM administers a quasi-regulatory coastal protection program (in cooperation with EPA) that sets performance-based management measures for control and prevention of nonpoint source pollution in coastal areas for land-use activities. CZM provides technical assistance and grant funds for plan development.

NOAA Sea Grant — www.nsgo.seagrant.org
Illinois-Indiana Sea Grant (IISG) — www.iisgcp.org
Michigan Sea Grant — www.miseagrant.umich.edu
Wisconsin Sea Grant — www.seagrant.wisc.edu

University-based program designed to support greater knowledge and wise use of Great Lakes resources. The Sea Grant program provides a staff network of advisory agents, researchers, and educators, and offers grant funds for research and workshops.

United States Department of Homeland Security
United States Coast Guard — www.uscg.mil/USCG.shtm
Hazardous Waste National Spill Response Center — www.nrc.uscg.mil/nrcrpttxt.htm

The U.S. Coast Guard is responsible for spill response and ballast water sampling and water intake protections. It has implemented ballast water sampling in Lake Michigan under the Nonindigenous Aquatic Nuisance Species Prevention and Control Act of 1990 and the National Invasive Species Act of 1996.

U.S. Department of Defense, www.defenselink.mil
U.S. Army Corps of Engineers, Detroit District www.lre.usace.army.mil/
U.S. Army Corps of Engineers, Great Lakes and Ohio River Division, www.lrd.usace.army.mil/

The Army Corps of Engineers (COE) oversees construction and operation of flood control and public water supply reservoirs, conducts water-quality monitoring on lakes, regulates in-lake activities and shoreline development, administers the wetlands dredge and fill permit program with EPA and FWS. COE enforces permit requirements for wetland BMPs or other mitigation measures. The Water Resources Development Acts authorize environmental restoration by the COE at certain Great Lakes sites. Offices are located in Washington D.C., the Great Lakes and Ohio River Division, and Detroit District offices.

United States Federal Partners (continued)

United States Department of the Interior (DOI) — www.doi.gov

The DOI conducts oversight, management, and monitoring of national natural and cultural resources, including land, water, and wildlife. Offices located in Washington D.C. and regional centers with field offices in each management area. The DOI provides staff, maps, reports, demonstration sites, educational materials, and monitoring equipment.

Bureau of Indian Affairs (BIA) — www.doi.gov/bureau-indian-affairs.html

The BIA provides technical assistance to tribes on tribal lands mainly for social services and assistance for assistance for conservation work and educational programs, natural resource inventories and monitoring of ground and surface water. The BIA offers funds for special projects, staff for technical assistance to tribes, and maps and natural resource inventories of tribal lands.

United States Fish and Wildlife Service (FWS) — www.fws.gov
U.S. Fish and Wildlife Service Great Lakes-Big Rivers Region — www.fws.gov/midwest
U.S. Fish and Wildlife Service Coastal Program — www.fws.gov/coastal/CoastalProgram

FWS oversees and regulates the nation's wildlife resources, manages national wildlife refuges, enforces federal game and fish laws, administrates the national wetlands program with the Corps of Engineers and EPA, and participates in cooperative projects to enhance wildlife habitat and special studies including fisheries investigations. FWS provides staff for enforcement of the Endangered Species Act and other laws on public and private land; reports and data on habitat, populations, and management of wildlife; and funds for cooperative projects, educational materials, teacher training, curricula, and maps.

National Park Service (NPS) — www.nps.gov

The National Park Service (NPS) administers and manages national parks for preservation of natural and cultural resources and recreation. NPS provides staff for oversight and administration, and funds for special studies and occasionally cooperative projects on land adjoining park boundaries.

Great Lakes Inventory and Monitoring Network — www1.nature.nps.gov/im/units/glkn

The Great Lakes Inventory & Monitoring Network is an office of the National Park Service that helps the nine Great Lakes national park units inventory and monitor significant natural resources. The units extend from the boreal forests of northern Minnesota to the sand dunes of southern Lake Michigan and represent the major freshwater ecosystems of the Upper Midwest.

United States Geological Survey (USGS) — www.usgs.gov
Great Lakes Science Center Research Programs — www.glsc.usgs.gov
Water Resources of Illinois — http://il.water.usgs.gov
Water Resources of Indiana — http://in.water.usgs.gov
Water Resources of Michigan — http://mi.water.usgs.gov
Water Resources of Wisconsin — http://wi.water.usgs.gov

USGS conducts long-term baseline monitoring of water resources, hydrologic and geologic investigations and data, and special intensive short- term studies. USGS provides maps, data, and information on hydrology and water-quality status and trends, and staff for technical assistance in designing a monitoring plan.

U.S. Department of Health and Human Services — www.hhs.gov
Agency for Toxic Substances and Disease Registry — www.atsdr.cdc.gov

The Agency for Toxic Substances and Disease Registry (ATSDR) provides health information to prevent harmful exposures and disease related to toxic substances. ATSDR performs specific functions concerning the effect on public health of hazardous substances in the environment. These include public health assessments of waste sites, health consultations concerning hazardous substances, health surveillance and registries, response to emergency releases of hazardous substances, research in support of public health assessments, information development and dissemination, and education and training concerning hazardous substances.

U.S. Food and Drug Administration — www.fda.gov

The FDA works with EPA to develop national fish advisories that provide important food health safety information for consumers of fish. FDA assists in identifying the information regarding how much of specific fish species can be consumed safely by different groups at risk to toxins that accumulate in fish tissues.

United States Federal Partners *(continued)*

United States Department of Agriculture (USDA) — www.usda.gov
Natural Resources Conservation Service (NRCS) — www.nrcs.usda.gov
Farmers Services Agency (FSA) — www.fsa.usda.gov
Cooperative State Research, Education, and Extension Service (CSREES) — www.csrees.usda.gov
Cooperative Extension Service (CES) — www.csrees.usda.gov/Extension/USA-text.html

USDA is the steward of our nation's 192 million acres of national forests and rangelands. It is the country's largest conservation agency, encouraging voluntary efforts to protect soil, water, and wildlife on the 70% of America's lands that are in private hands. Responsibilities and resources within the following programs are divided among USDA departments:

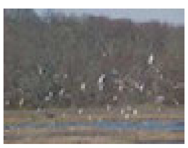
USDA Forest Service — www.fs.fed.us

Established in 1905, the Forest Service manages public lands in national forests and grasslands, which encompass 193 million acres of land — an area equivalent to the size of Texas. The Forest Service provides technical and financial assistance to state and private forestry agencies, and manages national forests for additional multiple uses and benefits and for the sustained yield of renewable resources such as water, forage, wildlife, wood, and recreation.

Conservation Reserve Program (CRP) — www.nrcs.usda.gov/programs/crp

CRP is a program to conserve and protect highly erodible or other environmentally sensitive land from production by putting it in vegetative cover through easements and annual rental payments. CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement.

Wetlands Reserve Program — www.nrcs.usda.gov/programs/wrp



The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The program's goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. NRCS provides technical and financial support to help landowners with their wetland restoration efforts. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

National Association of Conservation Districts (NACD) — www.nacdnet.org

The NACD is the nonprofit organization that represents the nation's 3,000 conservation districts. Conservation districts are local units of government established under state law to carry out natural resource management programs at the local level. Districts work with more than 2.5 million cooperating landowners and operators to help them manage and protect land and water resources on nearly 98% of the private lands in the U.S. NACD supports voluntary, incentive-driven natural resource conservation programs that benefit all citizens.

Sustainable Agricultural Research and Education Program (SARE) — www.sare.org

SARE is a practical research, education, and grant program to promote lower input methods of farming. The program has helped advance farming systems that are profitable, environmentally sound and good for communities through a nationwide research and education grants program. The program funds projects and conducts outreach designed to improve agricultural systems.

U.S. Department of Transportation, Federal Highway Administration — www.fhwa.dot.gov

The National Scenic Byways Program is a grass-roots collaborative effort established to help recognize, preserve, and enhance selected roads throughout the United States. Since 1992, the program has provided funding for almost 1500 state and nationally designated byway projects in 48 states. The U.S. Secretary of Transportation recognizes certain roads as All-American Roads or National Scenic Byways based on one or more archeological, cultural, historic, natural, recreational, and scenic qualities.

Great Lakes Maritime Research Institute (GLMRI) — www.glmri.org/glmri/main.htm

GLMRI was established in 2004 as a consortium of the University of Wisconsin-Superior Transportation & Logistics Research Center and the University of Minnesota Duluth College of Science & Engineering and Labovitz School of Business & Economics to oversee and coordinate research on Great Lakes maritime issues.

State and Local Partners

State Water Quality Agencies

Illinois Environmental Protection Agency — www.epa.state.il.us
Indiana Department of Environmental Management — www.state.in.us/idem
Michigan Department of Environmental Quality — www.michigan.gov/deq
Wisconsin Department of Natural Resources — www.dnr.state.wi.us

State water quality agencies administer many programs for protection of water quality in ground and surface waters, including the National Pollutant Discharge Elimination System (NPDES) permit program, water-quality standards regulations, the nonpoint source program, and ambient statewide monitoring programs. Agencies provide staff for technical assistance to local governments and individuals implementing BMPs; water-quality monitoring, data, and reports; and funds for pollution control projects, educational materials, and programs.

National Association of Regional Councils — www.narc.org
Northeastern Illinois Planning Commission (Chicago) — www.nipc.org
Northwestern Indiana Regional Planning Commission (Gary) — www.nirpc.org
Michiana Area Council of Governments (MACOG) — www.macog.com
St. Joseph River Basin Commission (housed within MACOG) — www.sjrbc.com
West Michigan Shoreline Regional Development Commission — www.wmsrdc.org
Northwest Michigan Council of Governments — www.nwm.org
Southeastern Wisconsin Regional Planning Council (Milwaukee) — www.sewrpc.org
Bay-Lake Regional Planning Commission — www.baylakerpc.org

Planning commissions work with local governments and organizations to promote sensible growth, and conduct regional planning related to transportation, the environment, and economic and community development. Commissions provide geographic and demographic information such as forecasts of population, employment, and other socio-economic indicators. These commissions listed above participate in the Lake Michigan Watershed Academy overseen by USEPA's Lake Michigan program.

Tribal Partners

United Indian Nations of the Great Lakes (UINGL) — www.anishinabek.ca/uoi/greatlakes.htm

Several First Nations from Ontario and Quebec and tribes from New York, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, and Minnesota joined to create the UINGL. They came together to sign the Great Lakes Water Accord in which a number of united principles, values, concerns, and demands are identified. They have been active in the Great Lakes Regional Collaboration.

Chippewa-Ottawa Resource Authority (CORA) — www.1836cora.org

CORA regulates most Indian fishing in portions of Lake Michigan 1836 Treaty waters. A 1985 Consent Agreement allocated the fishery resource among user groups, such as the tribes, sports fishers, the state, and the federal government. Disputes are settled by an Executive Council comprised of CORA chairmen and state and federal representatives.

Individual Tribes in the Lake Michigan Basin — www.epa.gov/Region5/tribes/r5tribes.htm

Michigan
Grand Traverse Band of Ottawa and Chippewa — www.gtb.nsn.us
Hannahville Indian Community — (No web site)
Little River Band of Ottawa Indians — www.lrboi.com
Little Traverse Bay Bands of Odawa Indians — www.ltbbodawa-nsn.gov
Pokagon Band of Potawatomi — www.pokagon.com

Wisconsin
Forest County Potawatomi Community — www.fcpotawatomi.com
Menominee Indian Tribe — www.menominee-nsn.gov
Oneida Nation of Wisconsin — www.oneidanation.org
Sokaogon Chippewa Community — www.sokaogonchippewa.com
Stockbridge-Munsee Band of Mohicans — http://unr.edu/homepage/shubinsk/mohican.html

LAKE MICHIGAN

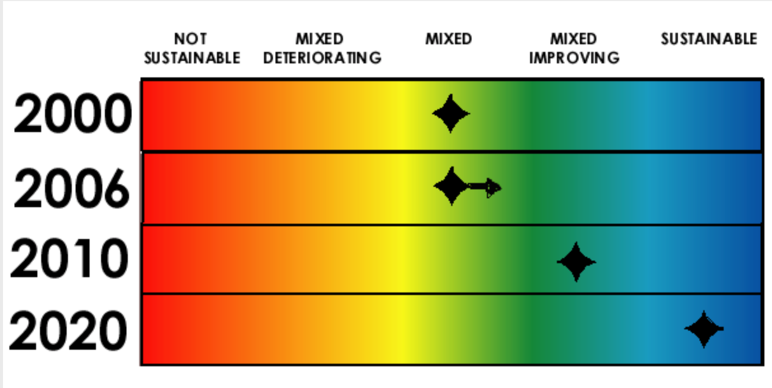
STATE OF THE LAKE

The next State of Lake Michigan Conference is planned for October 2007 in Traverse City, Michigan.

Subgoal 10
Is collaborative ecosystem management the basis for decision-making in the Lake Michigan basin?

Status

Lake Michigan Target Dates for Sustainability



The environmental problems in the Great Lakes ecosystem have become increasingly complex over the years. The myriad of jurisdictions and programs with responsibility for the lakes is similarly complex. According to the 2003 Government Accountability Office report, the government presence overseeing Great Lakes resources includes two countries, multiple tribes, and First Nations, more than 140 Federal programs, and numerous city and state programs all dealing with environmental restoration activities. While these organizations have experienced individual opportunities for successes during the last 30 years, there has been no overarching strategy to deliver coordinated restoration and protection efforts in the future.

In October 2003, the Great Lakes Governors identified nine critical environmental priorities for regional action. These were adopted by the Great Lakes mayors and the Great Lakes Commission. In May 2004, President Bush signed an Executive Order creating a Cabinet-Level Task Force to bring an unprecedented level of collaboration and coordination among, State, Federal, and local governments, Tribes, and other interests in the United States and Canada to accelerate protection and restoration of the Great Lakes. This led to the development and announcement of a series of recommendation in a final Great Lakes Regional Collaboration Report in December 2005.

Indicators (Proposed New State of the Lakes Ecosystem Indicators)

- Access to Information About the Great Lakes
- Value of Great Lakes to Basin residents

Challenges

- To develop a lake level framework for clear goals and objectives that facilitate coordinated actions among agencies and stakeholders in alignment with the Great Lakes Regional Collaboration
- To provide and facilitate opportunities for partnerships and leveraging resources

Next Steps

- Continue the development and linkage of local watersheds with basin-wide issues and activities through the watershed academy
- Coordination of LaMP and GLBTS efforts on PCBs and mercury
- LMMCC continues leadership role for collaborative monitoring in 2010
- Meet with the four Coastal Management programs to explore partnership opportunities

Major New Efforts Build on Lakewide Efforts

Since 1991, the states, tribes, and federal agencies in the Lake Michigan basin have been collaborating to restore and protect Lake Michigan through the Lakewide Management Process. New activities at Great Lakes wide scale may strengthen and enhance LaMP work.

In May 2004, President Bush signed Executive Order 13340 creating a cabinet-level Task Force to bring an unprecedented level of collaboration and coordination to accelerate protection and restoration of this national and internationally significant resource. Recognizing that effort to protect and enhance the ecosystem must go beyond the Federal government, the Executive Order also called for the convening of a Regional Collaboration of National Significance to facilitate collaboration among the federal Government, the Great Lakes states, local communities, tribes, and other interests in the region as well as Canada. The eight Strategy Teams that were formed closely followed the Lake Michigan LaMP goals adopted in 1998. They are as follows:

- Nonpoint Source Strategy Team
- Persistent Bioaccumulative Toxics (PBT) reduction Team
- Invasive Species Strategy team
- Habitat/Species team
- Areas of Concern Restoration/Sediments Strategy Team
- Indicators and Information Strategy Team
- Sustainable Development
- Coastal Health Strategy Team

This led to the development and announcement of a series of recommendation in a final Great Lakes Regional Collaboration Report in December 2005.

The Binational Executive Committee

The Binational Executive Committee (BEC) is charged with coordinating the implementation of the binational aspects of the 1987 Great Lakes Water Quality Agreement (GLWQA). The BEC is co-chaired by Environment Canada and USEPA, and includes members of the Great Lakes states, the Province of Ontario, and other federal departments and agencies in Canada and the United States and tribes. The BEC addresses binational, basinwide issues of concern and provides strategic direction to the LaMPs, RAPs, and other Great Lakes programs such as the Binational Toxics Strategy, and the State of the Lakes Ecosystem Conference.

Michigan and Indiana Cooperate in Developing the St. Joseph River Watershed Management Plan

The St. Joseph River watershed is part of two states, and multiple counties and municipalities.

Michigan and Indiana coordinated the development of a watershed management plan to ensure that planning in both states is coordinated to better protect and restore the environment.

It is a large-scale watershed plan for a bi-state watershed and included significant participation from the Indiana Department of Environmental Management (IDEM), Indiana watershed stakeholders, the Michigan Department of Environmental Quality (MDEQ), and Michigan stakeholders.

Both MDEQ and IDEM approved the watershed plan as meeting USEPA's 9 elements. It is a foundation for smaller subwatershed projects, as well as watershed-scale policy recommendations.

More information is available at: www.deq.state.mi.us/documents/deq-ess-nps-st-joe-planning.pdf and www.deq.state.mi.us/documents/deq-ess-nps-st-joe-supplemental.pdf.

Great Lakes Binational Toxics Strategy

The Great Lakes Binational Toxics Strategy (GLBTS) was signed by the United States and Canada (The Parties) in 1997 to advance the goals of Article II(a) of the Great Lakes Water Quality Agreement, to "virtually eliminate" the discharge of persistent toxic substances (PTS) to the Great Lakes environment, particularly those which bioaccumulate up through the food chain. The GLBTS sets forth seventeen (17) interim reduction goals for twelve "level 1" PTS over a ten year time-frame which ends in 2006.

In anticipation of this important milestone, in 2004, the Parties, working with many stakeholders from industry, non-governmental organizations, Provinces, States, Tribes, cities and academia, commenced an overall program review of each of the level 1 substances, to review progress made to date in reducing these substances and to explore future directions for the continued management of these substances. This report provides a concise summary of each substance review. This report also addresses two non substance specific goals in the GLBTS: 1) to assess atmospheric inputs of level 1 substances from world wide sources, and, 2) to complete or be well advanced in remediation of priority sites with contaminated bottom sediments in the Great Lakes Basin by 2006

The substance reviews include two major parts: 1) an overall environmental assessment of level 1 substances in the Great Lakes environment, including a review of current levels in Great Lakes media and biota, an evaluation of these levels against available health based/risk based criteria, historical trends and projected trends looking forward; and, 2) a source reduction assessment that looks at use and emission reductions accomplished to date under the GLBTS against the original targets, as well as an analysis of the remaining source sectors, and further opportunities for the GLBTS and others to continue to effect reductions toward our ultimate goals of virtual elimination. Finally, these reviews provide recommendations to the Parties for the future management of each level 1 substance.

General Outcomes

Overall, the environmental analyses show many of the level 1 substances remain in the Great Lakes environment at levels which exceed health based criteria, particularly mercury, PCBs, and the cancelled pesticides. These substances continue to impair the Great Lakes, and limit fish consumption, particularly among sensitive populations such as pregnant women and children, and among and indigenous fishers, such as many of the Tribes and First Nations.

With regard to source reductions, much progress has been made to date. Of seventeen reduction goals,

Great Lakes and St. Lawrence Cities Initiative

Mayors of several cities around the Great Lakes created the Great Lakes and St. Lawrence Cities Initiative in July 2003. The Initiative is a binational coalition of mayors and other local officials that works actively with federal, state, and provincial governments to advance the protection and restoration of the Great Lakes. Chaired by Chicago Mayor Richard Daley and headquartered in Chicago, is a project funded through the Northeast-Midwest Institute.

The Initiative enables mayors and other local officials to be active participants in Great Lakes issues relating to governance, economics, and science. The Initiative has been a vehicle for mayoral participation in a variety of Great Lakes efforts where mayors have not had a coordinated voice. It provides the active forum that allows mayors to coordinate their activities in meeting their stated goals in preserving the Great Lakes and enhance public and environmental health as well as the economic prosperity of all Great Lakes communities. The Mayors played an active role in the Great lakes regional Collaboration.

More information is available at: www.nemw.org/glci.

Building Collaborative Efforts in the Lake Michigan and Great Lakes Watersheds

Collaboration among a variety of stakeholders to improve the Lake Michigan ecosystem continues to increase since LaMP 2000. This chapter documents several of these collaborative activities, Some of the collaborative efforts include:

- The Great Lakes Regional Collaboration: www.glrc.us
- The Binational Executive Committee
- Great Lakes Binational Toxics Strategy: www.epa.gov/glnpo/p2/busintro.html
- The Great Lakes Human Health Network
- The Great Lakes Fishery Commission: www.glfc.gov
- Shared goals project involving USEPA Region 5 and state water quality programs, www.epa.gov/region5/watergoals.htm
- The 2002 Wingspread Accord into the Watershed Academy
- The Great and St. Lawrence Cities Initiative: ,www.nemw.org/glci
- The Great Lakes Legislative Caucus
- Council of Great Lakes Governors: www.cglg.org
- Great Lakes Commission: www.glc.org

The Lake Michigan Toolbox

NIPC Releases Framework Plan with Tools for Officials and Planners

The Northeastern Illinois Planning Commission released its “2040 Regional Framework Plan”. It provides a series of tools for local elected officials and planners to aid land-use decisions. The plan is the culmination of an extensive public-involvement process that included 200 workshops where 4,000 participants expressed their vision of how the region should address growth through the year 2040. NIPC's "Common Ground" process engaged these communities' residents, elected officials, planners, developers and other stakeholders, who expressed five top priorities for 2040 on behalf of the region:

- We want livable communities.
- We want a region that views the diversity of its people as an asset.
- We want a healthy natural environment.
- We want a regional economy that is competitive globally.
- We want governments to collaborate at the local and regional levels.

The 2040 Plan describes 17 implementation strategies that require close partnership at the regional and local levels. They include steps toward achieving a balance between jobs and housing, promoting alternative modes of travel such as walking and biking, sustaining the water supply from Lake Michigan and other sources, preserving farmland and other strategies.

Lake Michigan Watershed Academy Phase II Activities

- **Northwest Indiana Regional Planning Commission:** Hosted a September 2005 Best Management Practices Tour of the region by Bus and created a Water Conservation and Protection Toolkit with a grant from the Joyce Foundation.
- **Northeastern Illinois Planning Commission**: Developing a web site for the Lake Michigan Watershed Academy to highlight work around the basin
- **East Central Wisconsin Regional Planning Commission:** Held mini-workshops on pollutant loadings analysis along Lake Winnebago using the L-THIA land use change model and shared this information with local officials and citizens
- **Michiana Council of Governments:** Performed outreach to local and county plan commissions, zoning boards and economic development boards- collection of packet of educational tools
- **Southeastern Wisconsin Regional Planning Commission:** Held Third Annual Watershed Planning Conference- March 3, 2006 attracting 430 participants
- **The Bay-Lake Regional Planning Commission:** Held a series of mini-conferences to discuss stormwater management beyond detention ponds and using low impact development for economic gains; planning for eco-tourism and the economic benefits of the Great Lakes; and thinking of creative solutions to runoff pollution and dealing with phosphorus loading to the soil and waterways.
- **West Michigan Shoreline:** Gave presentations directed towards the local elected officials and planning commissions of the governmental units in Muskegon County, describing Smart Growth principles and providing tools on how to make sound land use decisions
- **Northwest Michigan Council of Governments:** Held two follow up workshops with local officials and municipal staff, focusing on implementation of joint planning at the watershed scale.
- **South Central Michigan regional Planning Commission:** Developing planning, zoning and site plan modules (a self-help and training manual) for use by (and for) municipalities to address the current inadequacies of regulating land use as a contributor to non-point source pollution.

See page 9-2 for more information on the Academy.

The Lake Michigan Toolbox

NIRPC Releases Water Conservation and Protection Toolkit

The Northwest Indiana Regional Planning Commission released a Water Conservation and Protection Toolkit. The toolkit consists of a series of fact sheets that provide overviews of the specific water resource protection and conservation issues. It also identifies a series of resources saved on a CD that assists people, local governments, and developers in making choices that better protect, conserve, and sustain local water resources.

Addressing water resources problems associated with a developing area requires addressing them comprehensively. This means:

- Protecting water resources from pollution and making sure that water sources are not pumped dry;
- Conserving water resources; and
- Restoring and improving water resources so that quality, quantity, flow, and timing align more closely with the natural water cycle.

Overview Issues

- What is Water Use and Availability in Lake, Porter, and LaPorte Counties in Northwest Indiana?
- The Great Lakes Charter Annex and Protecting, Conserving, Restoring, and Improving Water Resources

Fact Sheets for Local Officials

- How Can Stormwater Management Protect and Conserve Water Resources?
- How Can Sourcewater Protection Conserve and Protect Water Resources?
- How Can Land Use Planning And Zoning Protect And Conserve Water Resources?
- What Conservation Requirements Can Protect Water Resources?
- How Does Better Site Planning Protect and Conserve Water Resources?

Fact Sheets for Developers and the Public

- How Can Homeowners Protect and Conserve Water Resources?
- How Can Watershed Planning and Assessment Protect and Conserve Water Resources?

Many of the resources identified in the NIRPC toolkit, are reproduced in the Lake Michigan Toolbox resources throughout LaMP 2006. More information is available at www.nirpc.org.

ten have been met, three more will be met by 2006, and the remaining four will be well advanced toward their respective targets. Notwithstanding these accomplishments, much remains to be done to achieve the ultimate goal of virtual elimination in the Great Lakes.

Analyses suggests that significant source reduction opportunities remain for the "active substances" (i.e., substances for which we have ongoing workgroup activities), which include mercury, PCBs, dioxins and furans, HCB and B(a)P). With respect to the "inactive" (i.e., no ongoing workgroup activity) level 1 substances, cancelled pesticides, alkyl lead, and OCS, the Parties have decided to suspend GLBTS workgroup activities indefinitely, pending periodic review, and to defer to other programs, as appropriate. However, these substances will continue to be tracked and monitored in the Great Lakes. Finally, the GLBTS will continue to monitor and report on progress of sediment remediation activities in Areas of Concern in the Great Lakes basin, and will continue to study issues associated with long-range transport of toxic substances from world-wide sources, in order to better inform our priorities moving forward.

Conclusions

The GLBTS presents a unique model of how international cooperation and collaborative problem solving of issues that are beyond the reach of regulations, can lead to real results in environmental protection. There may be an important ongoing role for the GLBTS, not only with respect to the current level 1 substances, but also for newer chemicals of emerging concern. The Parties intend to focus on next steps for the GLBTS in the coming months. Protecting the chemical integrity of the Great Lakes, advancing the goals of the Great Lakes Water Quality Agreement, and virtually eliminating PTS from the Great Lakes basin are of paramount importance. The GLBTS may be one important tool to move us toward these goals.

Great Lakes Water Quality Agreement

The Canada-United States Great Lakes Water Quality Agreement (GLWQA), first signed in 1972 and renewed in 1978, expresses the commitment of each country to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem and includes a number of objectives and guidelines to achieve these goals. It reaffirms the rights and obligation of Canada and the United States under the Boundary Waters Treaty and has become a major focus of International Joint Commission (IJC) activity.

The IJC is an independent binational organization established by the Boundary Waters Treaty of 1909. Its purpose is to help prevent and resolve disputes relating to the use and quality of boundary waters and to advise Canada and the United States on related questions. It has oversight to the implementation of the GLWQA.

The 1972 Agreement set general and specific water quality objectives and called for programs to meet them. It gave priority to point-source pollution from industrial sources and sewage plants. Point-source pollution was dramatically reduced and many visible and noxious pollution problems were alleviated by regulatory programs like the Clean Water Act.

In 1978, the two governments replaced the 1972 Agreement with a new agreement. The 1978 Agreement built upon the foundation established in the earlier Agreement, as well as new information from scientists both in and out of government. It shifted the focus from conventional pollutants, such as phosphorus and bacteria, to toxic and hazardous polluting substances. Persistent toxic substances remain in the environment for very long periods, can accumulate in living organisms, and can have serious impacts on the health of wildlife and humans. Through the 1978 Agreement, the two countries adopted a policy that the discharge of any or all

Coastal America

Coastal America is a federal agency partnership to protect coastal habitat in the United States. It engages in a range of activities nationwide. It has begun to work in the Lake Michigan basin on several activities.

Corporate Wetlands Restoration Partnership

The Corporate Wetlands Restoration Partnership is a collaborative effort led by Coastal America between the federal government, state agencies and private corporations and non-profits to restore wetlands across the country. Companies contribute funds and services to match funding for aquatic habitat restoration, education and research projects. To date, over 225 corporations, 13 Federal agencies, over 125 non-governmental partners, including The Nature Conservancy, Chesapeake Bay Foundation, Atlantic Salmon Commission, Ramsar Secretariat and several foundations have partnered with the program.

Coastal America Activity in the Lake Michigan Basin

There has been preliminary activity in Illinois and Wisconsin for this program. In October of 2004 the Shedd Aquarium became the first Coastal America Ecosystem Learning Center in the Great Lakes. As part of that partnership program, Chicago's Shedd Aquarium, USFWS, IL/IN Sea Grant and Purdue sponsored a new exhibit on Great Lakes Invasive species.

The Great Lakes Charter Annex Process

The Great Lakes Sustainable Water Resources Agreement was developed by the Great Lakes Governors and Premiers as a vehicle to more effectively protect, conserve, restore, and improve the water and water dependent natural resources of the Great Lakes. The agreements are a culmination of a multi-year process that involved, eight states, two provinces, and multiple stakeholder groups, all with varying viewpoints, but all with the ultimate goal of ensuring the sustainability of the Great Lakes.

During two review processes for drafts of the then-proposed agreements, the Council of Great Lakes governors, the states, and provinces received a combined 16,000 comments.

More information is available at the Council of Great Lakes Governors website at: www.cglg.org/projects/water/index.asp.

persistent toxic substances be virtually eliminated in the Great Lakes and international section of the St. Lawrence River. Timelines were then established for municipal and industrial pollution abatement and control programs.

The Agreement was amended in 1987 and added several new programs and initiatives to restore beneficial uses in open waters of the 5 lakes and in 43 of the most contaminated local areas in the basin. Conditions have improved significantly in a number of these local Areas of Concern (AOCs) and in the open waters of the lakes.

But now, despite considerable progress to date, new challenges are emerging while some old ones persist. What does this mean for the Agreement? Should it – or how should it – address issues like alien invasive species, population growth and urbanization, new chemical pollutants, climate change and human health.

The governments of Canada and the United States asked the IJC to seek the public's views on how well the GLWQA has worked so far and how effective it has been. In response, the IJC held public meetings in 14 Great Lakes and St. Lawrence cities in Fall 2005, wrapping up its consultations with a Web Dialogue. It also received comments from individuals and organizations by hand, mail, fax, phone, e-mail and online. More than 4000 individuals and organizations took part.

For more information about the Agreement, view or download the Guide to the Great Lakes Water Quality Agreement at: www.ijc.org/glconsultations.

Great Lakes Human Health Network

A Great Lakes-wide human health network was formed by the BEC to maximize resources and efficiencies of scale. The USEPA's GLNPO provides staff resources to facilitate the exchange of information and expertise among health and environmental agencies. The human health network brings together experts and agencies from throughout the basin to share information and provide technical assistance on human health issues for inclusion in the LaMP. Currently, the Network has representative from six federal government agencies, five tribal government agencies, eleven state and provincial government agencies, and one county government agency. The Network anticipates that the membership will continue to grow as the Network becomes more widely known. Current information on the Network and its work may be found at www.epa.gov/glnpo/health.html.

The Great Lakes Fishery Commission

The Great Lakes Fishery Commission (GLFC) is a critical partner in achieving a balanced and healthy fish community in Lake Michigan, both in terms of controlling exotic species and rehabilitating native species in the lake. GLFC has adopted and implemented an integrated management of sea lamprey (IMSL) approach to control sea lamprey in the Great Lakes. The IMSL process involves using a variety of control methods instead of relying solely on chemicals. For example, GLFC is reducing the minimum lethal concentrations of chemicals used to kill larval sea lampreys in order to protect young lake sturgeon and is scheduling chemical treatments later in the summer to reduce the effects on young lake sturgeon. GLFC has reduced chemical use by 50 percent compared to the amounts used in the 1990s.

GLFC is also using sterile-male releases to impede the reproductive success of sea lampreys, conducting mark-and-recapture studies with juvenile and adult sea lampreys to measure population trends, and researching other strategies to reduce populations of sea lampreys without harming other parts of the ecosystem.

GLFC technical committees have also developed lakewide lake trout population models that estimate total allowable catches of lake trout, evaluate various fishery management strategies, and estimate damage by sea lampreys to lake trout populations.

Despite the great progress made, sea lampreys continue to kill many fish each year, threatening the restoration of lake trout to Lake Michigan. The principal challenge in controlling the sea lamprey and other exotic species in the lake lies in balancing the use of effective control measures for exotic species with preservation and restoration of native species.

Great Lakes Legislative Caucus Formed

State lawmakers from the eight states and two Canadian provinces that surround the Great Lakes have formed a caucus to coordinate legislative action on Great Lakes issues. The group, comprised of lawmakers from the 10 states and provincial Legislatures, will serve as a clearinghouse for information, policies and coordination on issues such as beach closings, water diversion, and invasive species. The caucus focused its activities around aquatic nuisance species and the Great Lakes Charter Annex.

Next Steps

Over the next 2 years, the LaMP will support the following activities to increase collaborative activities:

- Continue the development and linkage of local watersheds with basin-wide issues and activities through the watershed academy
- Coordination of LaMP and GLBTS efforts on PCBs and mercury
- LMMCC continues leadership role for collaborative monitoring in 2010
- Meet with the four Coastal Management

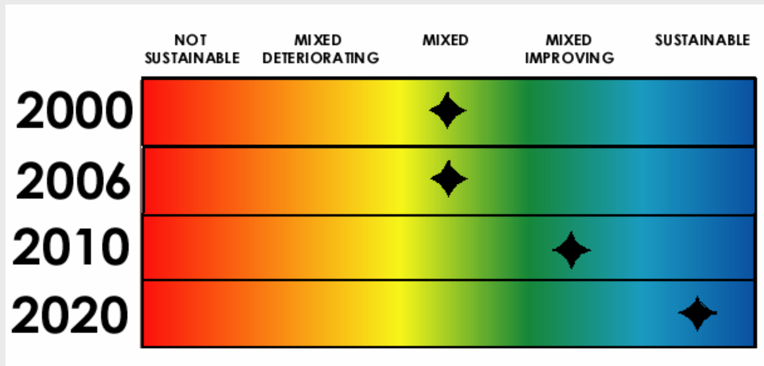
Subgoal 11

Do we have enough information, data, understanding, and indicators to inform the decision-making process?

Status

Positive movement was achieved by not only the collaborative FY 2005 intensive monitoring, but also the attention to the issue as one of the Great Lakes Regional Collaboration issues.

Lake Michigan Target Dates for Sustainability



Indicators (Proposed New State of the Lakes Ecosystem Indicators)

- Access to Information about the Great Lakes
- Research/Educational Opportunities

Challenges

- To expand Lake Michigan basin monitoring collaboration and coordination by promoting data comparability and joint planning and to deliver efficient and timely reporting on the status of the Lake Michigan ecosystem
- To leverage the 1994-95 Lake Michigan Mass Balance sampling with a 2005 Lake Michigan intensive and coordinated effort and combine with GLNPO's 2005 Aquatic Contaminant Monitoring:
  - Determine trends from comparison of 1995 Lake Michigan Mass Balance and FY 2005 Intensive year and GLNPO FY 2005 monitoring and follow up management actions and tentatively report preliminary findings in LaMP 2008 and to the State of Lake Michigan Conference in 2009
  - Sponsor cladophora monitoring and research

Next Steps

- Monitoring and research will be reviewed to identify LaMP pollutants and trends to determine if LaMP pollutants list needs to be changed
- A LMMB Study data report completed for each contaminant studied and added to the LaMP online at www.epa.gov/GLNPO/LMMB
- Progress will be made in aligning monitoring programs and indicators
- The coordinated monitoring results for the lake intensive monitoring year 2005 will be completed, analyzed, and published
- Lake Michigan models will be documented further, and additional scenarios will be simulated with results shared through the LaMP and in other ways
- Complete Lake Michigan Monitoring Coordinating Council Aquatic Nuisance Species monitoring survey results and recommendations.
- Cladophora alga research and development is being supported by the LaMP

Background

LaMP collaborators identified the need for coordinated collaboration in 1998 and sponsored a lake basin monitoring inventory and the formation of the Lake Michigan Monitoring Coordinating Council (LMMCC). The LMMCC enabled the 2005 Intensive Year of Monitoring as follow up to the 1995 Lake Michigan Mass Balance Monitoring. In 2005, the LaMP Technical Committees also conducted a review of the State of the Lakes Ecosystem Conference indicators to determine the appropriateness for Lake Michigan and to identify any gaps (see Chapter 4 and Chapter 7).
Work on these issues are in alignment with reviews at the national level conducted by the President's U.S. Commission on Ocean Policy and the Great Lakes Regional Collaboration (GLRC) Strategy Report on indicators and monitoring (www.glrc.us). Highlights and excerpts follow.

The U.S. Commission on Ocean Policy (www.oceancommission.gov) highlighted the need for "unbiased, credible and up to-date scientific information" to properly manage the human activities that effect the nation's oceans coasts and Great Lakes. The Commission, which presented its findings in 2004, found that new scientific findings demonstrate the complexity and interconnectedness of natural systems and that management approaches have not been updated to reflect this complexity with responsibilities remaining dispersed among a confusing array of agencies at the federal, state, and local levels. Managers, decision makers, and the public require timely access to reliable data and solid scientific information that have been translated into meaningful products. The Commission urged Congress to double the federal research budget over the next five years and to fund and adopt an integrated observing system on a regional basis.

The GLRC found that the volume of data collected for the Great Lakes and their tributary watersheds has expanded considerably in recent years, coinciding with an increase in the complexity of issues that need to be addressed. The current lack of accessible, integrated information management systems limits decision-making abilities and application of adaptive management principles for the protection and restoration of ecological resources. Adaptive management requires one to identify priority issues, gather information, establish metrics, evaluate options, implement actions, track progress, reevaluate actions based on observed responses, communicate results and adjust both management approaches and monitoring activities. Although such capabilities are advancing within the Great Lakes basin, they exist only in piecemeal fashion and have not been fully integrated for the comprehensive management of the Lakes. To further complicate matters, decisions made on one issue often affect other issues. Observing systems, monitoring programs, indicators, research, modeling and analysis, information management and communication must therefore be integrated into a holistic decision-making process.

- **Observing systems**, including sensors, stations, networks and field data collection are the primary means for gathering information on the chemical, biological and physical characteristics of the Great Lakes ecosystem.
- **Monitoring Programs** use these observations to take the pulse of the Great Lakes, assess natural

Great Lakes Regional Collaboration Action Items

Information and Indicators

With a resource as large and complex as the Great Lakes ecosystem, it is essential to have a **sound information base and representative indicators** to understand what is happening in the system. This information must then be communicated to the public, to decision makers, and all others involved. To improve over the current situation, the following actions are needed:

- better coordinate the collection of critical information regarding the Great Lakes ecosystem and support the U.S. Integrated Earth Observation System (IEOS) and the Integrated
- Ocean Observing System (IOOS) as key components of the Global Earth Observation System of Systems (GEOSS);
- promote the continued development of science-based indicators, including those developed through the SOLEC process;
- double funding for Great Lakes research over the next five years;
- establish a regional information management infrastructure; and
- create a Great Lakes communications workgroup to manage scientific and technical information.

The Lake Michigan Toolbox
Lake Michigan Online GIS

Lake Michigan Online Atlas

The Lake Michigan Online Atlas provides Internet access to a number of information resources related to the Lake Michigan basin. Reference maps offer an overview of the region. Computer-compatible data layers can be downloaded for use in a geographic information system (GIS). Hyperlinks and contact information improve access to regional resources. And an online mapping tool allows internet users to explore data and create custom maps using a web browser.

More information is available at http://mapserver.glc.org/website/atlas/viewer.htm.

Great Lakes Fishery Commission GIS

The Great Lakes Fishery Commission is developing an aquatic atlas in GIS format that pulls together data from the Lake Michigan Mass Balance studies, historical sediment surveys, coastal wetland data as well as dam databases to facilitate a holistic approach to managing the Great Lakes basin. These layers of aquatic habitat information will compliment the current on-line atlas work of the Great Lakes Commission.

More information is available at www.glfc.org/glgis.

Openlands and Center for Neighborhood Technology

Openlands and the Center for Neighborhood (CNT) technology are updating a website that details the green infrastructure for the greater Chicago region. In the first phase of the project, Openlands and CNT collected 170 layers of valuable data on wetlands, floodplains, rivers, protected open space, threatened and endangered species, greenways, trails and soils. The website has been utilized as a planning tool for creating linkages between existing protected lands and for identifying opportunities for natural resource protection and restoration. Phase II will improve the existing website with new and updated information and expand the project's geographic reach by adding data layers for 5 new counties. Upon completion of Phase II, the website will be interactive and allow users to create customized maps of specific geographic areas with the data layers which are most significant to them.

More information is available at: www.greenmapping.org.

variability, drive ecosystem forecasting models, and assess the progress of restorations efforts. Current challenges facing observing and monitoring include: incomplete inventories of federal, state/provincial and municipal observation and monitoring activities; insufficient spatial density of basic observations across the system; incomplete coverage over varying time scales (real-time to historic).

- **Goals or end point examples** were developed by the Great Lakes governors and adopted by the GLRC. The LaMP goals were set through a stakeholder process in 1998 and adopted by the LaMP management committee (See page i-2 for LaMP goals).
- **Indicators** provide information on the state of the Great Lakes and progress toward achieving goals. Continued efforts are needed to ensure the viability of an informative and scientifically-based set of indicators (e.g., the State of the Lakes Ecosystem Conference (SOLEC) indicator suite) that are useful for management decisions and to inform the public. The SOLEC indicator suite has been refined over the last decade to be comprehensive yet practical and actionable. In addition, indicators should be used in relation to realistic "end points" or desired results that are accepted by most stakeholders. When identifying end points, stakeholders must recognize that variability is the norm in natural systems, therefore, many targets and goals should not be expressed as discrete numbers but rather as ranges of desired, natural levels (See LaMP 2000, Chapter 3). Research has traditionally been focused on single issues. This focus must transition to an ecosystem approach with greater emphasis on predictive

forecasting and adaptive management. Research should be directed towards improving the understanding of natural fluctuations and interactions of ecosystem components. Improvements in predictive capabilities are needed, particularly regarding the impacts of chemical, biological and physical changes on ecosystem structure and function. Development of such capabilities requires a comprehensive research coordination strategy across partnering institutions.

- **Information produced by research and observations** must be made readily available to managers, decision-makers and the public. This will require information integration, management and communication. The LaMP sponsors the Lake Michigan Forum's State of the Lake Michigan Conference every two years, the LMMCC work and the LaMP document itself to inform managers and the public of current status and trends.

Various methods are used to communicate information to those that require it, but coordination needs strengthening for the sheer breadth of information collected over the region. The lack of a coordinated message can make it difficult for audience groups to interpret and understand information. The audiences that require information are also diverse, requiring that complex information needs to be sufficiently repackaged to meet their needs. Some information, such as lake conditions and beach closings, requires rapid delivery. In addition, two-way communication needs to be promoted so that user needs are conveyed back to those producing the information. A comprehensive, two-way communication strategy has not been developed to address these needs.

Lake Michigan Monitoring Coordinating Council

The Lake Michigan Monitoring Coordinating Council was established to enhance coordination, communication, and data management among agencies and other organizations that conduct or benefit from monitoring efforts in the Lake Michigan basin in the interest of supporting the Lake Michigan LaMP.

The Council has members representing federal, state, tribal, and local governments, nonprofit watershed groups, and other environmental organizations, educational entities, and the regulated community. The Council meets twice each year in locations throughout the watershed. Council meetings, biennial conferences, and feedback from constituents shape the Council's work plan and activities.

The Council framework has been developed to increase coordination between appropriate monitoring entities, allow the development of a strategic plan for monitoring, and add value to the individual efforts of the Council's member organizations. The framework takes advantage of the logical interactions between the various resource-based monitoring entities and other affected stakeholder groups.

The working groups formed under this framework will build on the efforts to coordinate monitoring within individual resources by groups such as the Lakewide Management Plan Committees, the Wisconsin Groundwater Coordinating Council, and the Great Lakes Fishery Commission. Each of these resource-based working groups will coordinate existing monitoring networks around several common considerations: monitoring objectives; spatial, temporal and parameter network design; methods comparability; quality assurance and control planning; database sharing; and data analysis approaches.

More information is available at http://wi.water.usgs.gov/lmmcc/.

GLNPO's Aquatic Contaminant Monitoring Program—FY 05 Intensive Year

GLNPO is responsible for monitoring the water quality of the Great Lakes. GLNPO has been collecting data on levels of persistent bioaccumulative toxic (PBT) substances in air and fish since 1990 and the 1970s, respectively. Many PBTs have the potential to increase the risk of cancer, birth defects, and neurological and developmental problems through long-term, low-level exposure. These pollutants can enter the Lakes in significant quantities from the air and subsequently build up in fish, which results in limits on consumption of Great Lakes fish. Data complementary to the air and fish data is needed for the water so that USEPA can accurately estimate the net amount of these pollutants that are being put into the lakes from the air and to determine how high levels are in fish relative to the levels in the water. Levels in fish can be millions of times higher than in the water itself. USEPA monitored these contaminants in the past and in 2005 again for Lake Michigan.

The following chemicals will be monitored:

- Polychlorinated biphenyls (PCBs)
- Polycyclic Aromatic Hydrocarbons (PAHs)

USGS Surface Water-Quality Network for Streams in the Lake Michigan Basin

A recent inventory and assessment of existing monitoring programs was undertaken by the Great Lakes Commission (Great Lakes Commission, 2000) as an effort to identify data sources and gaps, the adequacy of the data to support critical ecosystem indicators, and to provide recommendations for addressing major monitoring needs, particularly those considered most important for addressing lakewide management decision-making. Report findings suggest that the data inventory should be expanded to include all Lake Michigan tributaries, and emphasizes the need to coordinate monitoring efforts.

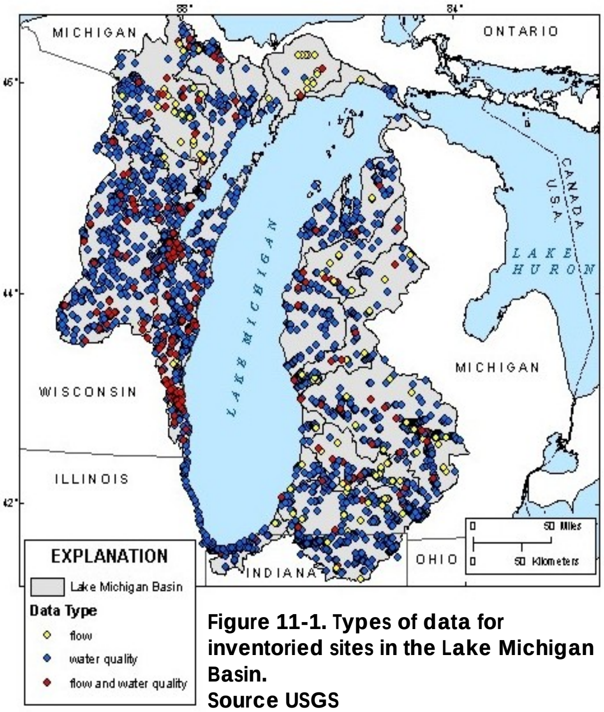


Figure 11-1. Types of data for inventoried sites in the Lake Michigan Basin.
Source USGS

To begin addressing some of these issues, the USGS retrieved surface water-quality and flow data and analyzed it from current and historic databases to identify candidate stations for inclusion in a long-term monitoring network in the Lake Michigan basin.

The inventory was compiled from the USGS National Water Quality Information System (NWIS) database, the USEPA STOrage and RETrieval (STORET) database, and the Indiana Department of Environmental Management (IDEM) database (AIMS) for the period from 1970 through 2001. These databases include water-quality data collected by numerous Federal and State agencies including the USGS, USEPA, US Forest Service (USFS), US Army Corp of Engineers (USACE), National Park Service (NPS), Wisconsin Department of Natural Resources (WDNR), Michigan Department of Environmental Quality (MDEQ), IL Environmental Protection Agency (IEPA), and IDEM.

The majority of samples included in this inventory were collected at a site during a single sample year (purple dots on Figure 11-1), however, there is a reasonably good spatial coverage of sites having from 2 to 5 years of data (yellow dots on Figure 11-2). A substantial number of sites in northern Indiana have greater than 5 years of data, as do various sites scattered throughout the Basin in Wisconsin and Michigan, however, flow data was not collected at many of these sites.

As a refinement of the inventoried data, sites with more than 5 years of water-quality data collection and including flow data are illustrated on Figure 11-2. Sites are depicted with years of sampling, numbers of samples collected, and whether or not a site is still active.

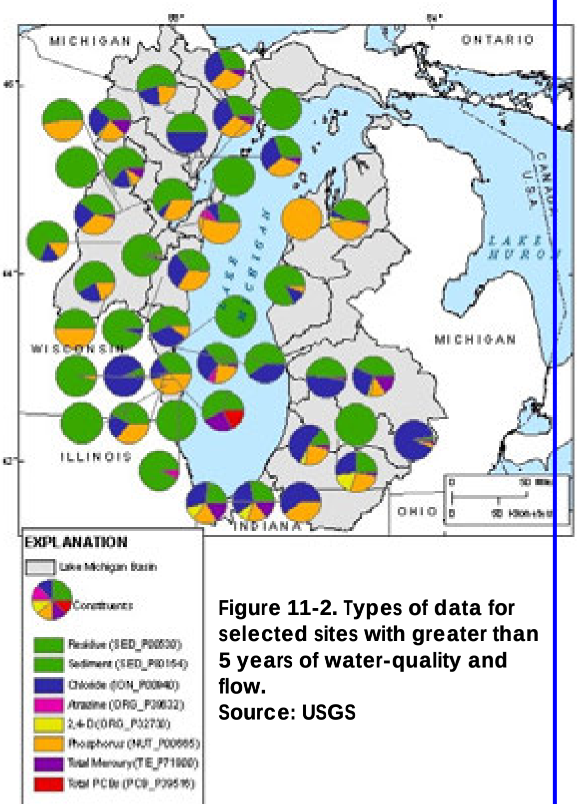


Figure 11-2. Types of data for selected sites with greater than 5 years of water-quality and flow.
Source: USGS

For additional information contact: Charlie Peters, Director, USGS Wisconsin Water Science Center, capeters@usgs.gov.

From information compiled by Dave Hall, Jana Stewart, and Krista Stensvold of USGS Wisconsin Water Science Center.

Great Lakes Coastal Wetlands Consortium

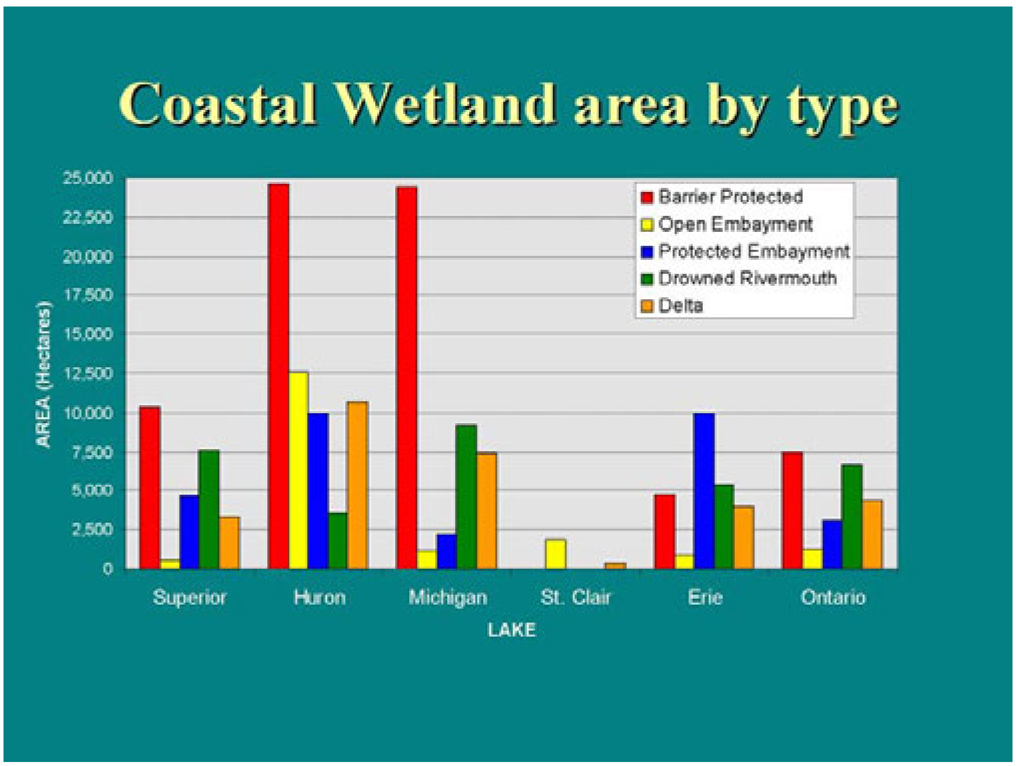
The Great Lakes Coastal Wetlands Consortium is premised on the recognized need to assess the health of Great Lakes coastal wetlands, which are an integral part of the Great Lakes basin ecosystem. Coastal wetlands have critically important ecological values and functions, yet there are currently few basinwide data available for assessing their ecological health.

The Great Lakes Commission has convened the Great Lakes Coastal Wetlands Consortium to expand the monitoring and reporting capabilities of the U.S. and Canada under the Great Lakes Water Quality Agreement.

The Great Lakes Coastal Wetlands Consortium consists of scientific and policy experts drawn from key U.S. and Canadian federal agencies, state and provincial agencies, non-governmental organizations, and other interest groups with responsibility for coastal wetlands monitoring. Approximately two dozen agencies, organizations and institutions have been brought into the Consortium as Project Management Team members. This is an unprecedented assembly of coastal wetlands expertise. In addition, other members are brought in as small project teams are formed to address discrete project elements and pilot studies. The Consortium is coordinated by staff at the Great Lakes Commission (GLC) in Ann Arbor, Michigan and has been funded by the USEPA Great Lakes National Program Office in Chicago, Illinois.

The Consortium's purpose is to design an implementable, long-term program to monitor Great Lakes coastal wetlands. This is being accomplished through the development of indicators to assess the condition of Great Lakes coastal wetlands. The selected indicators were selected through the State of the Lake Ecosystem Conference (SOLEC) process. The Consortium will provide scientific support for this monitoring program; create a database that is publicly accessible; recruit the leadership required to implement the long-term monitoring program; and develop a network of funders and agencies who will support the Great Lakes coastal wetlands monitoring program.

More information is available at: www.glc.org/wetlands/



Source: "Status of Great Lakes Coastal Wetlands" presentation, Thomas Burton, Michigan State University and Joel Ingram, Environment Canada, http://www.glc.org/wetlands/documents/Coastal-Wetlands-plenary.pdf

GLNPO Water Quality Surveys

The USEPA Great Lakes National Program Office's water quality surveys generally focus on the offshore waters of the lakes (water greater than 30 meters in depth, or greater than 3 miles from shore). To ensure that sampling activities are representative of lake conditions, samples are collected from multiple sites within each lake basin. The number and locations of the sites needed to obtain a representative sampling of each basin was statistically determined using historical data collected during intensive surveys of each lake. Each basin consists of several routine monitoring stations and a "master station". The master stations generally represent the deepest area of the basin and are often used to collect supplementary data for other (non-survey) purposes. The spring surveys are designed to collect water quality information during unstratified (isothermal) conditions of the lake, and the summer surveys are designed to monitor the Lakes during stratified conditions. As a result, the number of depths sampled during the summer is greater than the number of depths sampled during the spring surveys.

The surveys provide data to detect and evaluate trends and annual changes in chloride, nitrate nitrogen, particulate nitrogen, silica, total phosphorus, total dissolved phosphorus, particulate phosphorus, chloride, and reactive silica.

The biology program monitors phytoplankton, zooplankton, benthic invertebrates, and chlorophyll a in the water column. Zooplankton and phytoplankton samples are collected twice per year, in spring and summer. The majority of benthos samples are collected in summer, although a small number of stations are visited in spring. Some benthos-only stations are located closer to shore.

Maps of sampling stations can be found at: www.epa.gov/glnpo/monitoring/guard/sampling_stations.html

- Organochlorine pesticides including DDT and toxaphene
- Dioxins and furans
- Mercury and methylmercury
- Polybrominated diphenyl ethers (PBDEs) (flame retardants used in materials and plastics)
- Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) (from a waterproofing product now off the market)

Great Lakes National Parks Monitoring

Two national parks in the Lake Michigan basin are participating in a Great Lakes Network made up of 9 national park units from four states in the Great Lakes region. At the southern end of the Lake, work is progressing on assessing the extent of invasive plant species in interdunal wetlands of the Indiana Dunes National Lakeshore and State Parks. These special wetlands are highly vulnerable to invasives such as purple loosestrife and Phragmites. Park staffs are working with The Nature Conservancy, Save the Dunes Council, and Shirley Heinze Trust Fund to formulate a control program that will eliminate invasives and protect the native plant species.

The Sleeping Bear Dunes and the Indiana Dunes National Lakeshore are working as a unit for monitoring, fostering the exchange of information and resources between parks with similar issues, reducing per park costs through multi-park studies and providing network-based expertise that would not be affordable to the parks individually. The overall purpose is to develop broadly-based scientific data on current status and long-term trends in composition, structure, and function of the parks' ecosystems.

State of the Lakes Ecosystem Conference

Additional work has been completed on the Great Lakes indicators over the past 2 years through the State of the Lakes Ecosystem Conference (SOLEC) process. The SOLEC is hosted every two years by USEPA GLNPO and Environment Canada. The next conference will be held in Milwaukee, Wisconsin, in November 2006. The conferences are intended to provide a forum for exchange of information on the ecological condition of the Great Lakes and surrounding lands. A major goal is to bring together a large audience of government (at all levels), tribal, corporate, and not-for-profit managers to discuss problems that affect the lakes. The conferences have led to information gathering by a variety of agencies and organizations. In the year following each conference, a State of the Great Lakes Report is prepared by the governments based on the conference and public comments following the conference.

Lake Michigan Tributary Monitoring Project—FY 2005 Intensive Year

The Lake Michigan Tributary Monitoring Project, funded by the USEPA – Great Lakes National Program Office, was designed to yield updated water column contaminant concentration and loading data for a subset of the tributaries and contaminants originally included in the 1995 Lake Michigan Mass Balance (LMMB) project. It is not currently possible to revisit all Lake Michigan Mass Balance sampling sites with the same sample analyte and sample frequency schedules. In addition, funding in 2005-06 is even tighter than it was in 1994-1995. The challenge for this project was to design a less ambitious sampling plan that still yields useful information about tributary loadings throughout the Lake Michigan Basin 10 years after the 1995 LMMB. This project was coordinated and managed by the Great Lakes Commission in its role as the facilitator of the Lake Michigan Monitoring Coordinating Council.

There are four main objectives for this project:

1. Characterize present-day water column PCB, nutrient, and mercury concentrations at five of the original 11 Lake Michigan Mass Balance sampling sites.
2. Estimate mass loading for each of the five sampled Lake Michigan tributaries.
3. Estimate the uncertainty associated with each of the loading estimates.
4. Compare concentration and loading estimates with the 1994-1995 Lake Michigan Mass Balance project concentrations and loading estimates.

The original Lake Michigan Mass Balance water column sampling was designed to determine loads from each tributary with 95% confidence intervals of ± 25%. The sampling frequencies for this project were limited by budget, and can duplicate neither the sampling frequencies nor the confidence intervals associated with the load estimates that were part of the Lake Michigan Mass Balance project. Therefore, data analysis for this project will include the estimation of uncertainty in the load estimates.

Sampling on the Lower Fox River by Wisconsin U.SGS staff began in the first week of August, 2005. To date, five of 12 planned samples (plus a field duplicate and field blank) have been collected on the Lower Fox River. Wisconsin USGS staff will collect a 6th sample when ice conditions permit.

Sampling on the Indiana Ship Canal by Michigan USGS staff began in the last week of September, 2005. To date five of 12 planned samples have been collected at the Indiana Ship Canal. Michigan USGS staff collected a sixth sample plus a field replicate in early March 2006.

In addition, supplemental sampling at the St. Joseph, Grand, and Kalamazoo Rivers is complete. This supplemental sampling was designed to make intra-lab comparisons between conventional pollutant results reported by the Michigan Department of Environmental Quality and Wisconsin State Lab of Hygiene. The supplemental sampling involved obtaining split samples (for analysis at both MDEQ and WI SLOH) for nutrients and solids, for about four sample collection dates.

During 2005, a total of 92 samples were collected from 11 Lake Michigan tributaries. These tributaries (along with the number of samples from each), include the Grand (12); Kalamazoo (12) ; Muskegon (12); Escanaba (12); Pere Marquette (12); St. Joseph (12); Boardman (4); Manistee (4); Manistique (4); Menominee (4); and Sturgeon (4) Rivers.

The Lake Michigan Tributary Monitoring 10-Year Anniversary Sampling Project was a result of a cooperative effort of the USEPA, Great Lakes Commission, Michigan DEQ, and the US Geological Survey offices in Wisconsin and Michigan. Sampling began in 2005 following ice-out, when rivers become safely navigable for sampling boats and boat landings are free of ice. Sampling will continue for a period of up to one year. Field crews, consisting of teams of USGS personnel, will sample the following tributaries: the Lower Fox River in Wisconsin, the Grand Calumet River in Indiana, and the Kalamazoo, Grand, and St. Joseph Rivers in Michigan.

All water samples from all locations are being analyzed for Hg, trace metals, nutrients and conventionals. Samples from the Grand, Kalamazoo, and St. Joseph Rivers were also analyzed for PCBs. The nutrient/conventional analyses are completed, but have not yet been quality assured. Mercury, trace metal, and PCB analyses were completed in late March 2006.

Plans call for all sampling to be completed by the end of July, 2006 and will be reported in LaMP 2008.

The Lake Michigan Toolbox
Communicating Ecological Indicators

Ecological indicators need to be made more understandable to the public (including decision makers). Methods for articulating environmental values to make the connection between indicators and what the public (individuals) value about the environment should be considered.

Translating the indicators of regional ecological condition used by USEPA into common language for communication with public and decision-making audiences is critical.

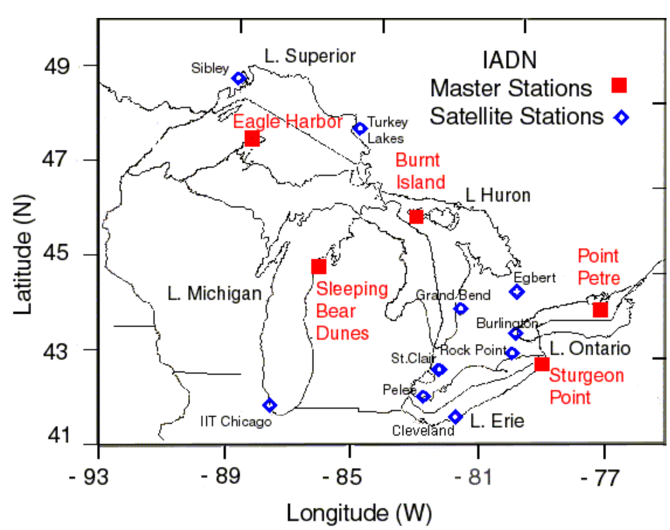
A study by researchers from Clark University, Pacific Southwest Research Station of the USDA Forest Service, University of Tennessee-Knoxville, Oak Ridge National Laboratory, USEPA, and Vanderbilt University revealed that people did not want to know what these indicators measured, or how measurements were performed. Rather, respondents wanted to know what such measurements can tell them about environmental conditions. Most positively received were descriptions of the kinds of information that various *combinations* of indicators provide about broad ecological conditions. Descriptions that respondents found most appealing contained general reference to both the set of indicators from which the information was drawn and aspects of the environment valued by society to which the information could be applied. These findings can assist with future efforts to communicate scientific information to nontechnical audiences, and to represent societal values in ecological programs by improving scientist-public communication.

More information about this issue can be found in a paper titled "Communicating Ecological Indicators to Decision Makers and the Public at: http://sunsite.wits.ac.za/eco/vol5/iss1/art19.

Integrated Atmospheric Deposition Network

The Integrated Atmospheric Deposition Network (IADN) was created under Annex 15 of the Great Lakes Water Quality Agreement in 1990 to determine the magnitude and trends of atmospheric loadings of toxic substances to the Great Lakes. IADN is operated jointly by the USEPA-GLNPO and Environment Canada. Five master stations (1 per Lake) are located in rural areas within one kilometer of the shore to represent background conditions. There are also 10 satellite stations that provide additional detail on levels of toxics in the air around the Lakes. USEPA operates 5 stations: the master stations on Lakes Superior, Michigan, and Erie, as well as two satellite stations in Cleveland and Chicago, which provide useful information about levels of persistent toxic substances in urban air and precipitation. Substances monitored by the network include polychlorinated biphenyls (PCBs), organochlorine pesticides including DDT and chlordane, and polycyclic aromatic hydrocarbons (PAHs). Trace metals such as lead, cadmium, and mercury are monitored at some Canadian sites. Dioxins, furans, and polybrominated diphenyl ethers (PBDEs) are also currently being measured at the U.S. sites.

Air (gas and particle phase) is collected every 12 days in 24-hour samples using high-volume samplers containing an adsorbent, and precipitation is collected in month-long composites. Laboratory analysis protocols generally call for solvent extraction of the organic sampling media with addition of surrogate recovery standards. Extracts are then



IADN Master and Satellite Stations

concentrated followed by column chromatographic cleanup, fractionation, nitrogen blow-down to small volume (about 1 mL) and injection (typically 1 uL) into gas chromatography instruments.

For more information on IADN, see the websites linked from the following page: www.epa.gov/glnpo/monitoring/air2/iadn_info.html.

Next Steps

- Monitoring and research will be reviewed to identify LaMP pollutants and trends to determine if LaMP pollutants list needs to be changed
- A LMMB Study data report completed for each contaminant studied and added to the LaMP online at www.epa.gov/GLNPO/LMMB
- Progress will be made in aligning monitoring programs and indicators
- The coordinated monitoring results for the lake intensive monitoring year 2005 will be completed, analyzed, and published
- Lake Michigan models will be documented further, and additional scenarios will be simulated with results shared through the LaMP and in other ways
- Complete Lake Michigan Monitoring Coordinating Council Aquatic Nuisance Species monitoring survey results and recommendations.
- *Cladophora* alga research and development is being supported by the LaMP

Great Lakes Regional Collaboration Goals and Recommendations Relevant to the Lake Michigan LaMP Subgoal 1

Information and Indicators

Recommendations

1. To provide accurate, complete and consistent information, the Great Lakes region must increase and better coordinate the collection of critical information regarding the Great Lakes ecosystem. The Great Lakes Interagency Task Force and other stakeholders need to implement the U.S. contribution to the Integrated Earth Observation System (IEOS) and the Integrated Ocean Observing System (IOOS) as part of the Global Earth Observing System of Systems (GEOSS). Monitoring must be better coordinated through the existing Great Lakes management entities, both at a lake-wide and region-wide basis.

2. To meet the information and management needs of Great Lakes restoration activities, the Great Lakes Interagency Task Force should promote the continued development and implementation of science-based indicators, including implementation of indicators developed through the SOLEC process.

3. To support Great Lakes restoration activities with appropriate scientific foresight, planning and assurance of results, the overall federal research budget to the Great Lakes should be doubled over the next five years. In addition, adequate funds should be made available to support a Great Lakes Research Office as authorized in the 1987 Clean Water Act Amendments (33 U.S.C. 1268) to coordinate these research efforts. Finally, for all new appropriations in support of Great Lake' restoration activities, at least 10 percent of these funds should be dedicated toward research to aid planning and assessment.

4. To facilitate easy and accessible information exchange among all regional partners, stakeholders and decision makers and to create a consistent and comprehensive repository of Great Lakes data, the Great Lakes Interagency Task Force and all regional partners should augment the regional information management infrastructure (i.e. establish a network of networks), adopt standardized data management protocols and commit to open data availability.

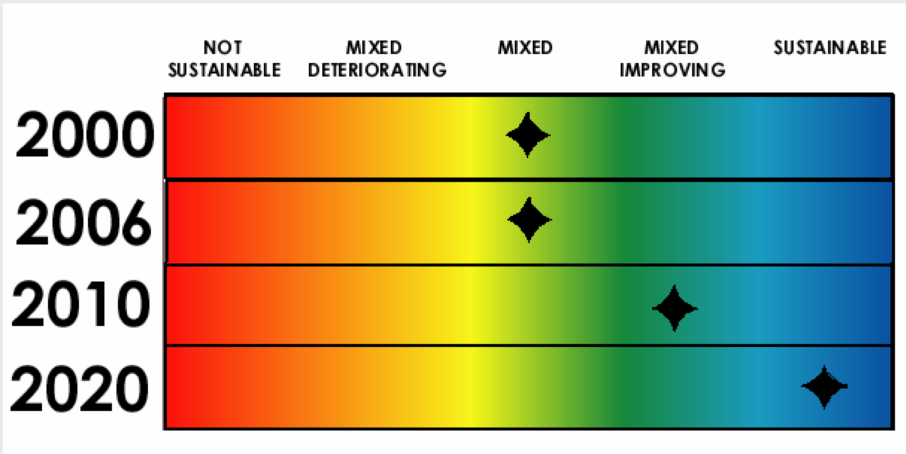
5. To coordinate and manage communication of scientific and technical information, the Great Lakes Interagency Task Force should establish a communications workgroup composed of public affairs specialists from Federal, State, and regional entities and key industries.

Subgoal 12
What is the Status of Lake Michigan Subwatersheds?

Status

While possessing globally significant biodiversity resources, all but three have some river and stream reaches listed as impaired.

Lake Michigan Target Dates for Sustainability



Indicators (State of the Lakes Ecosystem Indicators by Number)

- 7002 - Land Cover - Land Conversion
- 8163 - The Nature Conservancy Biodiversity Areas and Species Protected
- Stream Reaches Listed as Impaired
- Number of Total Maximum Daily Load Models Completed
- Number of projects supported through the 319 grants program with successful follow through

Challenges

- Watershed literacy and involvement

Next Steps

- Make watershed fact sheets available
- Utilize information to develop restoration targets for each watershed

Watershed Fact Sheets

All but three of the 33 watershed have some water reaches listed as impaired, none of the 10 Areas of Concern have been delisted, many of the globally significant biodiversity areas and high quality farmland are in peril of being lost to development.

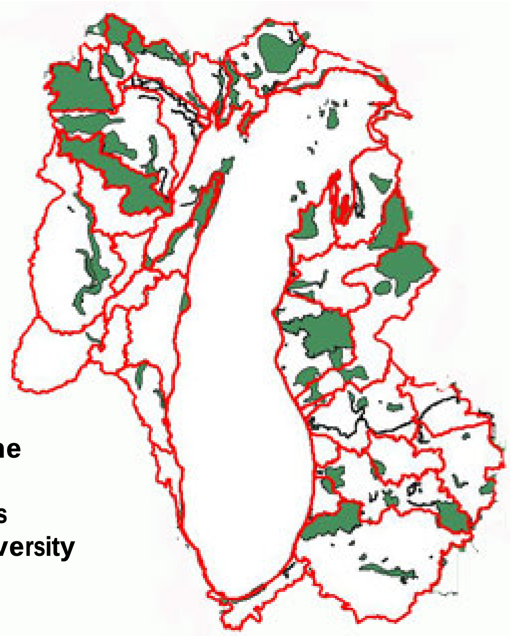
Linking LaMP Goals to Effective Implementation: The Watershed Scale

The development of the LaMP holds great promise for achieving environmental improvement in the Lake Michigan basin, but it also offers significant challenges in terms of practicing environmental restoration and protection on this scale. One of the most significant of these challenges is the need for cross-program and cross-jurisdictional coordination. This includes coordination among the U.S. and Canada, between federal agencies, and among states, provinces, and tribes, as well as coordination across a variety of statutory authorities. Because of this, EPA has taken the approach of using existing tools, as well as developing new and innovative ones, in concert with federal, tribal, state, and local partners to achieve environmental results that are relevant to a given place. To simplify the myriad of statutes, regulations, and resources affecting the management of Lake Michigan, Chapter 9 of LaMP 2006 presents a listing of the major governmental units, regulatory agencies, and other significant stakeholders that are responsible for managing the Lake Michigan ecosystem. Each watershed fact sheet in this chapter also lists groups involved in watershed management.

Lake Michigan's 33 Tributary Watersheds

The first step in advancing work watershed by watershed is to provide the available data in that format. Lake Michigan has 33 tributary watersheds at the 8-digit hydrologic unit code (HUC)* as defined by the U.S. Geological Survey (USGS). Wisconsin manages its watersheds through watershed management units that do not always correspond with USGS HUCs. In stead they follow a combination of watershed and political boundaries. Michigan's watershed management boundaries also differ and generally use smaller watersheds.

Although a decade of effort has resulted in a general awareness of the watershed approach within EPA, recent evaluations show substantial gaps in implementation. The watershed approach should not be seen as merely a special initiative targeted at just a selected set of places or involving a relatively small group of EPA or state staff. Rather, it should be the fulcrum of our restoration and protection efforts, and those of our many stakeholders, private and public. Failure to fully incorporate the watershed approach into program implementation will result in failure to achieve our environmental objectives in many of our nation's waters.



Locations of The Nature Conservancy's Areas of Biodiversity

* The Geographic Information Retrieval and Analysis System (GIRAS) was developed in the mid 1970s to put into digital form a number of data layers which were of interest to the USGS. One of these data layers was the Hydrologic Units. The map is based on the Hydrologic Unit Maps published by the USGS Office of Water Data Coordination, together with the list descriptions and name of region, subregion, accounting units, and cataloging unit. The hydrologic units are encoded with an eight- digit number that indicates the hydrologic region (first two digits), hydrologic subregion (second two digits), accounting unit (third two digits), and cataloging unit (fourth two digits).

The HUC that represents a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature

Following are overviews of the 33 Lake Michigan tributary sub-watersheds as well as an overview of the Chicago Waterways system. They provide a picture of Lake Michigan divided into watersheds, showing the special and important elements present in the watershed as well as the impairments that currently exist. Also provided is an overview of the planning underway and the groups involved. We seek comments on these fact sheets as to their content and usefulness. For additional information, see the Lake Michigan Watershed Academy description in Chapter 9, the EPA NPDES watershed permit discussions in Chapter 9, and the area of concern charts in Chapter 7.

They are intended to be updated on an as needed basis, and published with each LaMP update.

Information from The Nature Conservancy

The fact sheets also provide information from the Nature Conservancy from their just released the “Conservation Blueprint for the Great Lakes”. Jointly funded by GLNPO, the Ontario Ministry of Natural Resources, the Gund Foundation, the Charles Stewart Mott Foundation, the Richard Ivey Foundation, and the Living Legacy Trust, the blueprint was a binational, collaborative effort to identify areas of biodiversity significance throughout the Great Lakes basin.

A total of 501 places were identified, mapped, and inventoried, and an analysis of threats to each place conducted by more than 200 scientists from federal and state/provincial agencies and private organizations. The results are impressive: the basin contains 46 species found nowhere else in the world and 279 globally rare plants, animals and natural communities in a region of boreal, mixed and deciduous forests, tallgrass prairies, wetlands, sand dunes, alvars and islands. The areas are critical to the preservation of biodiversity and represent the best opportunities to preserve species, natural communities and ecological systems. For each area, the blueprint contains information about Great Lakes species, natural communities and ecological systems; maps of where conservation is underway; summaries of current projects and strategies; information on threats to biodiversity; and, detailed descriptions of plans. The blueprint also offers actions that can be taken to protect these areas.

The Nature Conservancy is making this information available to the Great Lakes Regional Collaboration for use in Great Lakes indicator and habitat protection and restoration work. The Conservation Blueprint is available online at: http://nature.org/wherewework/northamerica/greatlakes/files/conservation_blprnt_final.pdf.

Lake Michigan Overview

- Lake Michigan, the second largest Great Lake by volume with just under 1,180 cubic miles of water, is the only Great Lake entirely within the United States.
- Approximately 118 miles wide and 307 miles long, Lake Michigan has more than 1,600 miles of shoreline.
- Averaging 279 feet in depth, the lake reaches 925 feet at its deepest point.
- It has a water surface area of 22,300. The drainage basin, approximately twice as large as the 22,300 square miles of surface water, includes portions of Illinois, Indiana, Michigan and Wisconsin.
- On average, a molecule of water will spend 100 years in Lake Michigan before exiting to Lake Huron at the Straits of Mackinac.
- The lake's northern tier is in the colder, less developed upper Great Lakes region, while its more temperate southern basin contains the Milwaukee and Chicago metropolitan areas.

Additional Lake Michigan overview information on the following pages is an excerpt from the State of the Lakes Ecosystem Report. This is followed by the fact sheets on the individual subwatersheds.

3.6 Lake Michigan

Assessment: The physical integrity of the Lake Michigan ecosystem is *mixed*.

"Lake Michigan is an outstanding natural resource of global significance, under stress and in need of special attention" (Lake Michigan LaMP 2000). Since the original 2000 assessment, there has been both positive and negative change in the Lake Michigan basin. Positive work includes sediment clean ups, the purchasing of large land parcels for preservation purposes, and the rebounding of terrestrial species. Some negative changes include continued pressure from invasive species on the aquatic food web and land development in the near coastal areas.

Background Summary

Lake Michigan is one of the most complex ecosystems of the Great Lakes due to its length of 307 miles (494 km). It varies from north woods forest to southern dune and swale environments. The largest collection of fresh water sand dunes in the world is a prominent feature, as are Lake Michigan's islands which are grouped into two northern archipelagoes of 19 Grand Traverse Islands and Beaver Islands. Many of the islands have suffered a loss of natural habitat due to development and are moderately degraded. Several of the Beaver Islands are part of the Michigan Islands National Wildlife Refuge providing 235 acres (95 ha) of habitat for migratory and colonial nesting birds and federally threatened plants like dwarf iris and Pitcher's thistle. There are three islands totalling 29 acres (12 ha) in the Green Bay National Wildlife Refuge that offers similar habitats. Underwater reefs in both the nearshore and offshore are thought to play an important role in Lake Michigan spawning.

Lake Michigan is the second largest Great Lake by volume and

Figure 1. Lake Michigan drainage basin.
Source: Environment Canada

contains over 20% of the Great Lakes' coastal wetlands which are responsible for the quantity and diversity of aquatic life seen in the lake. Protection and enhancement of these areas are key to the future sustainability of the coastal ecosystem.

Lake Michigan is uniquely positioned with a direct connection to the Mississippi River System through the Chicago Diversion, and as such, has become a transfer point for many non–native species which threaten the biological integrity of all the Great Lakes and the Mississippi River.

Lake Michigan has 33 8–digit hydrologic unit code (HUC) tributary watersheds, with all but three listed as impaired and 10 estuaries designated as Areas of Concern (Figure 1). Many Michigan and Wisconsin tributaries have been dammed in the past, but recent dam removals in southeastern Wisconsin have resulted in improved fish habitat, water quality and diversity of species including the appearance of the rare greater redhorse in the Milwaukee River.

Over 10 million people are dependent on Lake Michigan for high quality drinking water and recreation. Since the passing of the U.S. Beaches Environmental Assessment and Coastal Health (BEACH) Act in 2000, the four Lake Michigan states are on track for implementing these provisions with an average of 50% more monitoring using enhanced water quality standards. The results have led to increased advisories and the need for studies to determine contamination sources and management options.

Groundwater Flow
Groundwater beneath the Great Lakes has a different and changeable divide than the Great Lakes surface/watershed divide. In the Great Lakes basin, most shallow flow discharges to local streams; the Great Lakes watershed divide (i.e. the sub–continental divide) also serves as a groundwater divide for shallow flow. Most deep flow discharges are to regional sinks with the deep aquifer divide being distant from the surface watershed divide (Figure 2).

Figure 2. Average groundwater and surface runoff components of selected watersheds in the U.S. portion of the Great Lakes basin.
Source: Holtschlag and Nicholas, 1998

Groundwater divides move in response to pumping. Studies from the western Lake Michigan groundwater basin report that the 1950 pre–development divide and the year 2000 divide for the deep bedrock aquifer, show a pattern of movement. The western basin groundwater that once flowed east toward Lake Michigan is now intercepted by pumping and diverted west under the surface–water divide.

Groundwater, once used, can be discharged to surface water bodies in a different basin. Since the late 1940s, development on the Mississippi basin side of the sub–continental divide has reversed deep flow patterns between west of the divide and the Milwaukee area. The groundwater levels are low enough that Lake Michigan can migrate into the groundwater, a reversal of the normal flow (U.S. Geological Survey 1998).

Groundwater's Role in the Health of the Lake Michigan Ecosystem
The Great Lakes are in a topographically low setting that, under natural flow conditions, causes them to function as discharge areas or "sinks" for the groundwater–flow system. Most groundwater that discharges directly into the lakes is believed to take place near the shore (Grannemann and Weaver 1999). Of all the Great Lakes, Lake Michigan has the largest amount of direct groundwater discharge (2,700 ft^3/s or 76 m^3/s) because it has more sand and gravel aquifers near the shore than any of the other Great Lakes (Grannemann and Weaver, 1999). Although this is a relatively low inflow compared to the total stream flow into the lake from land areas (41,200 ft^3/s or 1167 m^3/s) (Croley and Hunter 1994), it is nearly equal to the amount of water diverted from Lake Michigan through the Chicago Ship and Sanitary Canal (Table 1) (Oberg and Schmidt 1994).

Lake	Overlake Precipitation (percent)	Surface-Runoff (percent)	Indirect groundwater discharge (percent)
Superior	56.3	11.0	32.7
Michigan	56.2	9.3	34.5
Huron	42.2	16.3	41.5
Erie	53.5	24.3	22.2
Ontario	34.8	22.8	42.4

Table 1. Basin water supply for the Great Lakes.
Source: U.S. Geological Survey, 1998. Water Supply Paper

Groundwater Provides Refuge for Aquatic Organisms
Groundwater discharge to streams may help provide important habitat for aquatic organisms, including fish. In addition, because groundwater temperatures are nearly constant throughout the year, stream reaches with relatively large amounts of groundwater discharge can provide refuge to organisms from heat in summer and from cold in winter. For example, some stream reaches in the region remain unfrozen even though air

STATE OF THE GREAT LAKES 2005

temperatures are well below 32 degrees Fahrenheit (0 degrees Celsius). Other possible benefits to the survival of aquatic organisms related to groundwater discharge to streams include increasing concentrations of dissolved oxygen, adding small amounts of nutrients that are essential to the health of organisms, providing cold pockets of water in summer, and maintaining stream flow during dry periods.

Lake Levels
Lake Michigan's water level was measured at 2 feet (61 cm) below the long–term average in 2001, having dropped more than 40 inches (102 cm) since 1997 when it was at near record highs. Levels increased for 2002, but were still below average. The decrease in precipitation over the last five years resulted in Lake Michigan being at its lowest point since 1966. Lake levels rose between the mid–1960s and the late 1990s.

The lower lake level has caused problems for the shipping and boating industry. Cargo ships were forced to lighten their loads, and many boat ramps became inaccessible. According to the U.S. Great Lakes Shipping Association, for every inch (2.5 cm) of water that Lake Michigan loses, a cargo ship must reduce its load by 90 to 115 metric tons, leading to losses of between $22,000 and $28,000 U.S. per trip.

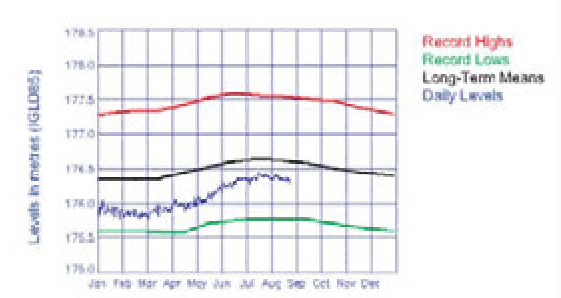


Figure 3. Lake Michigan-Huron water levels.
Source: Great Lakes Environmental Research Laboratory-National Oceanic and Atmospheric Administration

Early reports for 2004 indicated that the lake level was at an average depth due to increased rainfall early in the year. The lake measured one foot higher (30.5 cm) in the summer of 2004 than 2003 with the mean average of 579 feet or 176 metres. This fluctuation may be part of a 30–year cycle that deserves continued monitoring (Figure 3). (U.S. ACE, Detroit District)

Beaches
Lake Michigan contains the world's largest collection of fresh-water sand dunes and associated beaches, particularly along its eastern shore. Of a total of 3,100 acres (1,255 ha) along the coast, 1,200 acres (486 ha) are publicly owned and available for use, while another 1,200 acres (486 ha) are privately owned and have significant potential for public use. In addition to swimming advisories due to poor water quality, there has been a resurgence of the macro algae *Cladophora* along the coast. *Cladophora* blooms result in reduced water quality and beach use. Causes of this problem may be attributed to multiple factors, such as lower lake levels, increased water temperature, nearshore nutrients and zebra mussel activity (Great Lakes Water Institute, University of Wisconsin at Milwaukee).

Aquatic Food Web
The Lake Michigan aquatic food web is threatened due to invasive species competing for food and changing the physical environment (Figure 4). Zebra mussels have the ability to filter water allowing sunlight to penetrate to greater depths, possibly causing algae blooms. The invertebrate *Diporeia* is decreasing rapidly in Lake Michigan thus removing a foundation component of the food web (Figure 5). The yellow perch population remains low and zebra mussels, first introduced in 1989, have shown a decline in certain areas. Sea Lamprey populations have increased in abundance and are now higher than in Lakes Superior or Huron. Lake Trout are stocked and have not recovered to the point of natural reproduction in the lake.

Lake Sturgeon survive in the Great Lakes only in scattered remnants, even though large scale commercial fishing for them ended a century ago. There were remnant populations known to spawn in the waters of 8 tributaries with connections to Lake Michigan. In 2003, enhanced stocking was undertaken with the hopes that the stocked sturgeon would flourish, but not genetically impact the small remnant native population. There are currently 16 agencies and institutions involved with Lake Sturgeon monitoring and investigations are coordinated by the U.S. Fish and Wildlife Service Great Lakes Basin Ecosystem Team.

The most dramatic threat to Lake Michigan is from the Asian carp species which is working its way up the Illinois waterway system from the Mississippi River. The Asian carp was reported to have escaped from aquaculture ponds adjacent to the Mississippi River in the 1980s and the 1990s. An experimental electrical barrier is currently in place. Improvements to this barrier as well as an additional barrier are planned. This large carp species weighs up to 90 pounds (41 kg) and is considered a major threat to the Great Lakes food web.

Other Species
Land–based species are fairing better. The grey wolf is now listed as a recovered species and bald eagles have nested in the area of the Little Calumet River for the first time in 100 years.

Kirtland's warbler, piping plover, Hine's emerald dragonfly and the Karner blue butterfly all have recovery plans in place. An aggressive program to train whooping cranes to migrate and return to Wisconsin's wetlands (west of Lake Michigan) for future nesting is underway.

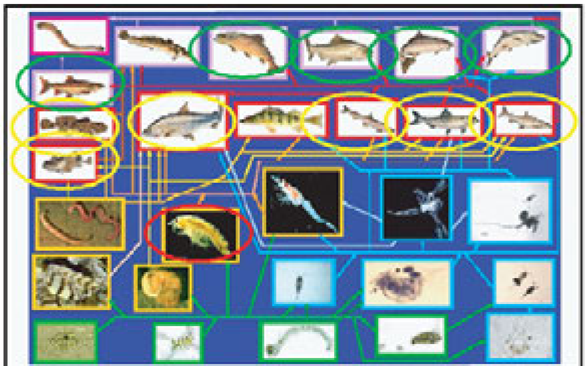


Figure 4. Lake Michigan foodweb. *Diporeia*, central in the diagram, was historically an important food for the fish on the second line of the figure (species in the red squares). *Diporeia* are the prey for the large predator fish like salmon and lake trout at the top of the chart and foodweb (species in the purple squares). Non-native species are competing with, and possibly replacing the *Diporeia* in the Lake Michigan ecosystem. The loss of *Diporeia* threatens the species that feed upon it and the whole foodweb.
Source: Mason, Krause and Ulanowicz, 2002

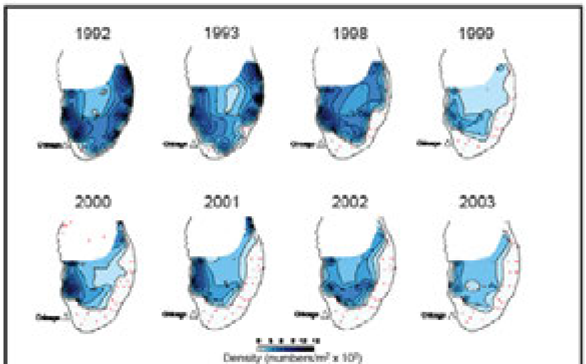


Figure 5. *Diporeia* density.
Source: Great Lakes Environmental Research Laboratory-National Oceanic and Atmospheric Administration

Natural Areas

The dune and swale systems of the eastern lakeshore are a dominant feature of Lake Michigan and provide unique habitat that foster biodiversity. While afforded some protection under law, this system faces extreme pressure as it is a sand product for industry. This area also has development pressures in the coastal communities.

Wetlands, which naturally help control runoff from urban areas by storing flood and surface water and slowly release and filter it, have been destroyed in the Lake Michigan basin states to a greater degree than elsewhere in the country. An estimated 21.9 million acres (8.9 million ha) of wetlands or 62.9% have been lost. An estimated 12.9 million acres (5.2 million ha) of wetlands remain in the four Lake Michigan states, equivalent to approximately 12.3% of the wetland area in the lower 48 states. While this percentage is for the U.S. states not just the Lake Michigan basin, it is indicative of the pressure on the wetland systems. Wetland status in the Lake Michigan basin is therefore mixed (Dahl 1990).

Forest status in the basin is good due to revisions to national forest plans (September 2003 U.S. Federal Register Notice) and the continued practice of sustainability forestry management by the Menominee Tribal Enterprises. The new forest plans address old growth management issues. The Menominee Reservation 235,000 acres (95,102 ha) of forest land represent 150 years of sustainable forest practice in the Wisconsin portion of the Lake Michigan basin.

Lakeplain system of prairies and savannas found in the southern part of the basin are two of the most imperiled ecological communities in North America. Alvars, open areas of thin soils over bedrock found in the northern basin, provide habitat for a number of rare plants and animals. Both of these systems are facing fragmentation and destruction due to land use development.

Pressures on the System

The 10 Areas of Concern in the Lake Michigan basin have contaminated sediment problems and either combined sewer overflows (CSO) and/or storm water problems. All 10 AOCs had some remedial sediment work completed with much more remediation still required. For most of the sediment sites and CSOs there are plans in place but implementation is often forecasted for the year 2020 or beyond. PCBs are the main contaminant in sediment and fish consumption advisories are in place around the lake thus keeping the assessment for fish communities in the Lake Michigan basin as mixed.

The urbanized land area in the United States has quadrupled since 1954. To compound the problem, populations in coastal areas, which contain some of the most sensitive ecosystems, have been increasing even faster than in the rest of the country. From 1982 to 1996, the population in the Chicago-Northwest Indiana area grew by 10.9% but consumed 44.2% of the land (Urban Roadway Congestion: Annual Report 1998). The

Northeastern Illinois Planning Commission's portion of the area is estimated to grow by 21% from 2000 to 2030. This growth pattern is similar to other growth areas around the lake and will further tax water infrastructure and resources.

USEPA's Office of Environmental Information states "the construction of impervious surfaces such as roads and rooftops leads to the degradation of water quality by increasing runoff volume, altering regular stream flow and watershed hydrology, reducing groundwater recharge, and increasing stream sedimentation and water acidity." A one acre (0.4 ha) parking lot produces a runoff volume 16 times as large as that produced by an undeveloped meadow. Many impervious construction materials have higher surface temperatures that may cause ambient air temperatures to rise. When combined with a decrease in natural vegetation, areas are subject to the "urban heat island" phenomenon, which may increase utility bills, cause health problems associated with heat stress, and accelerate the formation of harmful smog. Clearly the effect of urban development on our communities and environment is a cross–cutting issue.

Both the urban and agricultural uses of the land impact the lake. The Lake Michigan Mass Balance Study has modelled the pesticide atrazine in the basin and a draft report and models have determined the need for over a 50% annual reduction in loadings from agriculture lands and the air in order to keep this pesticide at a steady state in the lake. While nutrient levels are increasing in the nearshore areas due to urban runoff, these levels are not at concentrations of concern in the open lake.

Management Actions

For a lake the size and complexity of Lake Michigan, it is not surprising that there are some measures of improving conditions as well as measures of deteriorating conditions. As some issues approach resolution, other new issues are developing such as chemicals of emerging concern and new invasive species. Since the overall status of the lake involves the interactions of chemical, physical and biological changes, it is necessary to understand the interactions of how improvements in one of these categories will affect the other conditions in the lake.

There are many research and reporting needs required for Lake Michigan which include:

- determining the groundwater status, mapping and groundwater and surface water interactions;
- identifying sources of *Cladophora and E. Coli* including the interactions between physical and biological forces which affect the health of Lake Michigan beaches;
- tracking invasive species and their impact on the food web and natural areas;
- identifying protected natural areas, ground areas below flyways, unique features and wetlands and educating the public

Lake Michigan Statistics	
Elevation[a]	
feet	577
metres	176
Length	
miles	307
kilometres	494
Breadth	
miles	118
kilometres	190
Average Depth[a]	
feet	279
metres	85
Maximum Depth[a]	
feet	925
metres	282
Volume[a]	
cu.mi.	1,180
km^3	4,920
Water Area	
sq.mi.	22,300
km^2	57,800
Land Drainage Area	
sq.mi.	45,600
km^2	118,000
Total Area	
sq.mi	67,900
km^2	175,800
Shoreline Length[b]	
miles	1,638
kilometres	2,633
Retention Time	
years	99
Population: USA (2000)[c]	15,351,202
Totals	15,351,202
Outlet	Straits of Mackinac

[a] measured at low water datum
[b] including islands
[c] 2000 population census data were calculated based on the total population of each county, either completely or partially, located within the watershed.

Sources:
The Great Lakes: An Environmental Atlas and Resource Book

Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System and Censuses of Population 2001.

U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, 1990 Census of Population and Housing

about these areas and;
- modelling and GIS training for local officials to assist with land use decision making.

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Lake Michigan 8-Digit HUC Watersheds

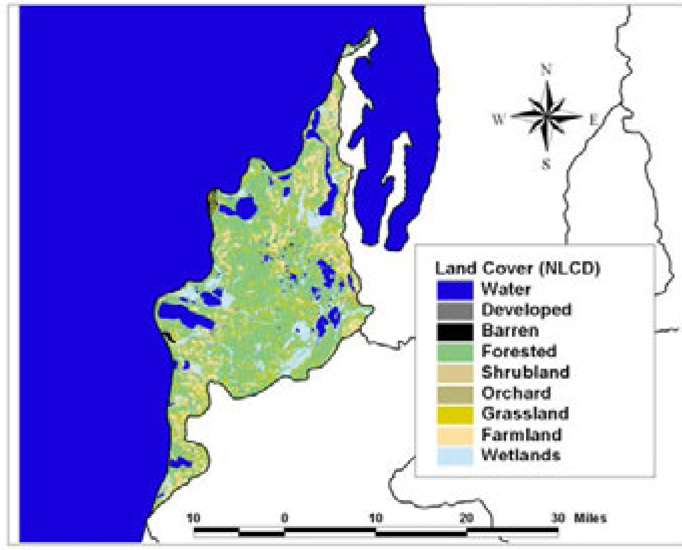
Watershed	HUC Code
Betsie-Platte	04060104
Black-Macatawa	04050002
Boardman-Charlevoix	04060105
Brevoort-Millecoquins	04060107
Brule	04030106
Cedar Ford	04030109
Chicago Area Waterway System	
Door-Kewaunee	04030102
Duck-Pensaukee	04030103
Ecsanaba	04030110
Fishdam-Sturgeon	04030112
Lower Fox (AOC)	04030204
Upper Fox	04030201
Lower Grand	04050006
Upper Grand	04050004
Kalamazoo (AOC)	04050003
Little Calumet-Galien (AOC)	04040001
Manistee	04060103
Manistique (AOC)	04060106
Manitowoc-Sheboygan (AOC)	04030101
Maple	04050005
Menominee (AOC)	04030108
Michigamme	04030107
Milwaukee (AOC)	04040003
Muskegon (AOC)	04060102
Oconto	04030104
Pere-Marquette-White (AOC)	04060101
Peshtigo	04030105
Pike-Root (Waukegan) (AOC	04040002
St. Joseph	04050001
Tacoosh-Whitefish	04030111
Thornapple	04050007
Lake Winnebago	04030203
Wolf	04030202

Scientists with the Great Lakes Environmental Indicator (GLEI) Project (http://glei.nrri.umn.edu) have developed a Condition Index that indicates the region's environmental condition by watershed. The index is based on 207 individual stressors* that fall into five dominant human-derived stresses to ecological condition: 1) type of land use, 2) amount of agricultural activity, 3) point sources of pollution, 4) atmospheric deposition, and 5) human population density. The stresses in each watershed were summarized and the resulting scores were distributed over a gradient from worst (red) to best (green) indicating the Environmental Condition of each coastal watershed, as depicted on the map of the U.S. Great Lakes basin. Using updated versions of appropriate databases and GIS techniques, managers can produce similar Condition Indexes for their area.

Source: New Index of Environmental Condition for Coastal Wetlands in the Great Lakes Basin, http://glei.nrri.umn.edu.

Betsie-Platte Watershed

Hydrologic Unit Code: 04060104



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060104 contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MDEQ/SWQ-99/135, "A Biological Survey of the Betsie and Little Betsie Rivers and Dair Creek, Benzie County, Michigan, October 1999" and report number MI/DEQ/SWQ-99/083, "A Biological Survey of the Platte River System, Benzie County, 1998".

Watershed Groups

- Conservation Resource Alliance — www.rivercare.org
- The Leelanau Conservancy — www.theconservancy.com
- Glen Lake Association — www.glenlakeassociation.com
- Grand Traverse Regional Land Conservancy — www.gtrlc.org
- Crystal Lake & Watershed Association — www.clwa.us
- Northwest Michigan Council of Governments — www.nwm.org

Watershed Management Plans

- Betsie River — Conservation Resource Alliance
- Glen Lake/Crystal River — Glen Lake Association
- Lake Leelanau — Conservation Resource Alliance
- Platte River — Benzie Conservation District

Watershed Overview / Ecology / Biodiversity

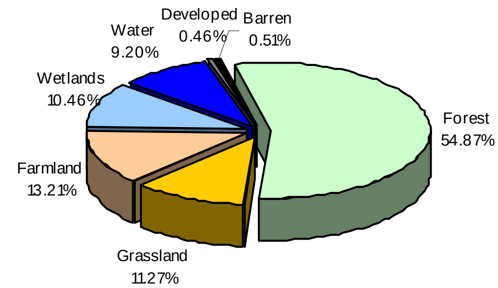
- The watershed saw significant logging activities in the late 1800s and early 1900s.
- The area is known for orchards and vineyards.
- Attempts at crop farming the cut over land proved largely unsuccessful due to meager soils. This further limited settlement expansion in the watershed.
- The watershed remained relatively undeveloped during the past century, however, deep sand deposits in the River and creeks are legacies of the impact logging and road building has had. Increasing weed growth in many lakes is further indication of the changes that have occurred since the area was first settled.
- Much of the agricultural land reverted back to State ownership and additional land was acquired in succeeding decades to create the vast State forest and Federal parklands existing today.
- Native plant species in the area range from the extremely drought tolerant species Bearberry (Arctostaphylos uvaursi) and Stiff Coreopsis (Coreopsis palmata) to the wetland species of Blue Flag Iris (Iris veriscolor) and Buttonbush (Cephalanthus occidentalis). More unusual species include the Red Milkweed or Swamp Milkweed (Asclepias incarnata), desired by the Monarch Butterfly as the favorite food source for the larvae.
- Critical habitat identified by the Nature Conservancy include: Great Lakes Hemlock - Beech - Hardwood Forest, Great Lakes Beachgrass Dune, Great Lakes Shoreline Cattail - Bulrush Marsh, Great Lakes Dune Pine Forest, Great Lakes Beachgrass Dune, Interdunal Wetland.
- Critical species identified by the Nature Conservancy and other partners include Prairie moonwort, prairie dunewort, Piping Plover, Pitcher's thistle, and Michigan monkey-flower.

Watershed Activities / Concerns / Priorities

- The Conservation Resource Alliance (CRA) was awarded grants totaling $474,309 from the State's Clean Michigan Initiative (CMI) and $104,260 from the Michigan Department of Transportation's Enhancement Program to improve water quality and control erosion in the Betsie River Watershed. The Benzie County Road Commission and Betsie River Watershed Restoration Committee is repairing up to 5 eroding road/stream crossings on the Little Betsie and Dair Creeks, and finishing streambank stabilization at 12 sites on the mainstream up to Homestead Dam.
- Identified Platte River impairments include fertilizers; human and animal waste; oils, toxic chemicals, and salt; sediment; heated runoff; altered stream; pesticides; bacteria; and channel flow.

- The Benzie County Erosion and Sedimentation Reduction Initiative has been granted $56,342 under the 2005 Great Lakes Basin Program for Soil Erosion and Sediment Control to extend work that began in 2000 to reduce soil erosion and sedimentation problems in three Lake Michigan drainage basins in Benzie County. This work is based on the watershed management plans for the Platte River Watershed, Betsie River Watershed, and Herring Lakes Watersheds.
- Under the 2004 Great Lakes Basin Program for Soil Erosion and Sediment Control, the Grand Traverse Regional Land Conservancy was granted $30,000 to conduct the Trapp Farm Wetland Rehabilitation/ Sediment Control Project, to remove manmade drainage features on former farm land to reduce excess storm water runoff. By restoring a rich conifer swamp and shrub-scrub wetlands in areas where they previously existed, it is anticipated that 80 percent of the runoff will be stored to increase residence time, clean the water and remove nutrients from the North Branch of Cold Creek and Crystal Lake.
- In 2004, The Leelanau Conservancy purchased an easement on a hillside near Glen Lake that is the birthplace of skiing in Leelanau County, Michigan. It also purchased the 80 acre Solon Swamp for potential future sale to the state of Michigan for inclusion in the Pere Marquette State Forest. The Solon Swamp area is the most extensive tract of intact wetlands in Leelanau County.
- In 2004, The Leelanau Conservancy launched a “Lake Leelanau Watershed Initiative,” an all-out effort to protect the long-term health of the Lake. The effort is a partnership between the Conservancy, the Lake Association, the Leelanau Conservation District and a committee of business owners such as Fountain Point resort and citizens concerned about the lake’s future. It will focus on protecting ecologically sensitive areas like wetlands and their associated forests as well as undeveloped shoreline.

Land Cover: Betsie-Platte



Watershed Size: 812 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and slight decreases in cultivated land and grassland.

Impaired (303d) Waters

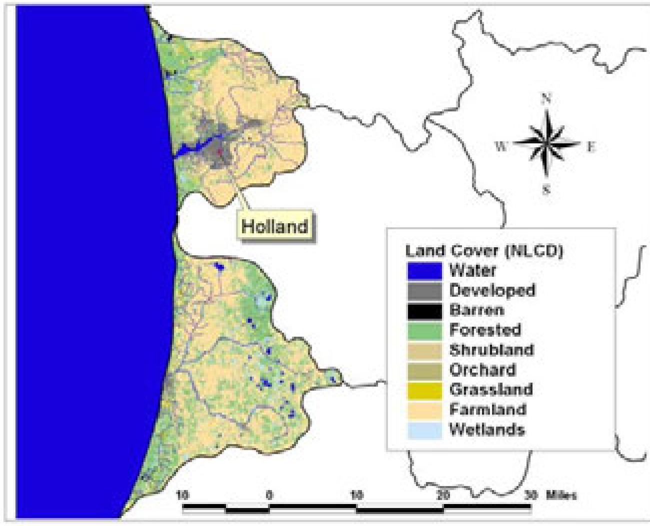
Waterbody	Impairment
Bass Lake	Mercury (Fish Tissue)
Crystal Lake	PCB Fish Consumption Advisory
Glen Lake	Chlordane Fish Consumption Advisory, Mercury (Fish Tissue), PCB Fish Consumption Advisory
Green Lake	Mercury (Fish Tissue)
Lake Ann	Mercury (Fish Tissue)
Portage Lake	PCB Fish Consumption Advisory
Unnamed Tributary to Platte Lake	Bacterial Slimes, Macroinvertebrate Community Rated Poor, Organic Enrichment

- Federal funds were appropriated for the Crystal River’s transfer into the Sleeping Bear Dunes National Lakeshore. 104 acres and 6,300 feet of river frontage--is now under the administration of the National Park Service (NPS). The majority of the land and its accompanying river frontage being protected is sensitive “dune and swale” topography. The area is recognized by the U.S. Fish and Wildlife Service as “globally rare habitat.”
- The Michigan Natural Resources Trust Fund granted $632,000 to the Leelanau Conservancy to help purchase 640 feet of Lake Michigan shoreline at the tip of the peninsula. The 42-acre property the Conservancy has dubbed “Lighthouse West” provides critical stopover habitat for migrating birds. The land is near the Grand Traverse Lighthouse and the Leelanau State Park as well as other private lands already protected by the Conservancy.
- The Nature Conservancy received funding from the Fish and Wildlife Service to remove invasive species and restore dunes in the Greater Point Betsie landscape. The project facilitates activity at the greater Pt. Betsie landscape to remove invasives and restore dunes to benefit the rare natural communities, including Pitcher's thistle, a threatened species.
- The Coastal program of the Fish and Wildlife Service partnered with The Grand Traverse Regional Land Conservancy at Green Point Dunes to (1) install a wooden stairway structure at the lowest point of the bluff to provide favorable access at Green Point and a whole-log cedar fence along the north property boundary to protect native plants and dune habitat.; (2) provide training to all workers on the project to avoid trampling or other negative effects to the sensitive plants in the locality, including Pitcher's thistle (3) provide a completion report of the activities conducted under the agreement.
- The Sleeping Bear Dunes' predator control program on North Manitou Island is focusing on control of the American crow . Crow control continued until none were observed within an identified predator-free zone or the Great Lakes Piping plover chicks had fledged. The primary goal of this project was to increase the piping plover chick fledging success on the North Manitou Island portion of the National Lakeshore by improving our management efforts and techniques.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

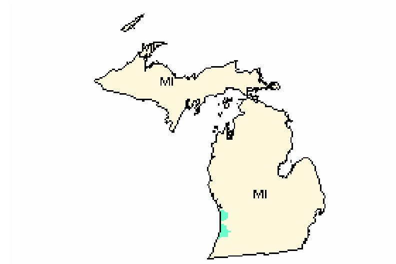
Black-Macatawa Watershed

Hydrologic Unit Code: 04050002



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050002 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SWQ-99/023, "Biological Surveys in the Black River Watershed Allegan and Van Buren Counties, August 1997" and report number MI/DNR/SWQ-95/044, "A Biological Survey of the Macatawa River, Its Tributaries and Pine Creek, a tributary to Lake Macatawa, Ottawa and Allegan Counties, Michigan, July 90".

Watershed Management Plans



- Pigeon River - Timberland RC&D Council
- Lake Macatawa Watershed Management Plan - Macatawa Area Coordinating Council

Watershed Groups

- Macatawa Greenway Partnership — www.macatawagreenway.org
- Macatawa Watershed Project — www.macatawa.org/~macc/Macatawa_Watershed/macatawa_watershed.htm
- Silver Lake Improvement Association — www.mlswa.org/slia-930

Watershed Overview / Ecology / Biodiversity

- 151 miles of the rivers and streams flow year round.
- The majority of the Black River Watershed system can be described as a low gradient system. Elevational changes between the headwaters and confluence generally do not exceed five feet per linear mile.
- Soil associations in the Black River watershed are generally fine sandy to sandy loam, poor to somewhat poorly drained glacial outwash on flat to undulating topography. Headwater portions of the watershed tend to have more permeable soil types while the middle and lower portions have poorer drainage due to finer grained soil materials.
- Most of the areas sampled in the black River basin by MDEQ shows habitat loss due to sedimentation. In some sections, channelization from historic dredging has removed channel diversity, reduced bank stability, and generally contributed to conditions that reduce the quality and quantity of stream biota.
- The Macatawa watershed is located in the Southern Michigan Northern Indiana Till Plains (SMNITP) ecoregion and has two major tributaries: the Macatawa River and Pine Creek. The lake and all its tributaries in the Macatawa watershed are protected as designated warmwater systems.
- Soil erosion and sedimentation is a major problem throughout the Macatawa River watershed due to agricultural land use and urbanization. The urbanization has modified drainage patterns, increased direct surface runoff and erosion to area streams and increased stream crossings that adversely affect stream quality.
- The Black-Macatawa watershed has eight listed impaired waters
- Holland and Benton Harbor, Michigan are the two urban areas in the watershed.
- The counties located in the watershed have a population of over 594,000.
- 96 of the 151 miles of impaired waterways (or 64%) have been assessed
- Two and a half million visitors visit Holland, Michigan each year
- Saugatuck Dunes State Park offers 14 miles of hiking and cross-country ski trails. The park's 900-acre natural area contains a coastal dune system, as well as three endangered plant species and beautiful Lake Michigan waterfront.
- Ottawa County is rated as Michigan's most diverse agricultural county. Products grown include apples, asparagus, strawberries, cherries, annuals, perennials, pumpkins, squash, among others.
- TMDLs for phosphorus caused by algal blooms and nutrients in Lake Macatawa were approved in 2000.

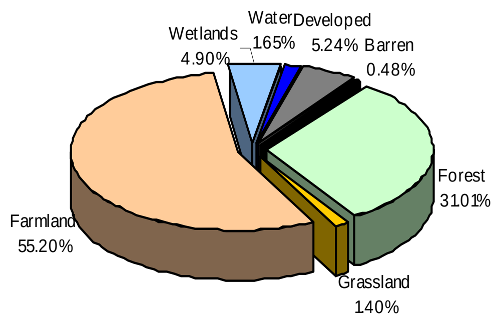
Watershed Activities / Concerns / Priorities

- The Lake Macatawa Watershed includes all the land that drains to Lake Macatawa. Laketown, Fillmore, Overisel, Holland, Park, Zeeland, Port Sheldon, Olive, and Blendon Townships. All have some land in the Macatawa Watershed, as well as the cities of Holland and Zeeland. There is excess sedimentation due to nonpoint sources, mainly agricultural, in the Macatawa watershed and its tributaries. The Noordeloos Creek Sedimentation Project is focused on a creek that is comprised largely of agricultural land. This project will reduce sedimentation by constructing a five-acre treatment wetland, a .25-acre sediment forebay and 30-foot buffer strips. The soil erosion goal is to prevent stream bank cutting by reducing stream flow, and the wetland and buffer strips will retain overflow from high water events. There will also be community outreach and education on water quality issues.
- The Macatawa Area Coordinating Council received $249,818 from the State of Michigan CMI Nonpoint Pollution Control program in 2001 to implement restoration activities to help meet phosphorus reduction goals
- The Black River Watershed Project was awarded $104,000 with $54,000 in matching funds between 2002 and 2005 to create a Watershed Management Plan to guide efforts to protect and improve water quality in the lakes and streams of the Black River Watershed. This included public education and outreach, completing a watershed inventory, identifying pollutant sources and causes, identifying critical areas, and gathering information about the watershed from preexisting sources, as well as gathering attitudes and opinions from watershed residents through surveys and one-on-one conversations.

Impaired (303d) Waters

Waterbody	State Impairment
Great Bear Lake	Phosphorus Algal Growth/Chlorophyll A
Lake Macatawa (Macatawa River Mouth)	Chlordane Fish Consumption Advisory PCB Fish Consumption Advisory
Lake Michigan (Grand Haven Beach)	Pathogens
Lake Michigan	Chlordane Fish Consumption Advisory DDT Fish Consumption Advisory Dioxin Fish Consumption Advisory PCB Fish Consumption Advisory Mercury (Fish Tissue
Pigeon River	Phosphorus Algal Growth/Chlorophyll A Fish community rated poor Macroinvertebrate community poor

Land Cover: Black-Macatawa Watershed



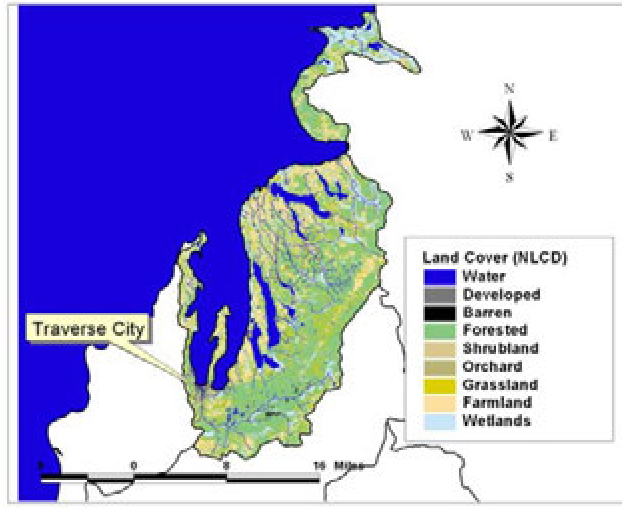
Watershed Size: 608 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and slight decreases in cultivated land, forest, and grassland.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Boardman-Charlevoix Watershed

Hydrologic Unit Code: 04060105



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060105 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SWQ-01/135, "A Biological Survey of the Upper Boardman River and Selected Tributaries to the Boardman River" and report number MI/DEQ/SWQ-02/016, "A Biological Survey of Charlevoix County Streams, Charlevoix County, Michigan, 1998".

Watershed Management Plans

- Boardman River — Grand Traverse Conservation District
- Elk River Chain of Lakes — Antrim Conservation District
- Long Lake — Grand Traverse County Drain Commission
- Mitchell Creek — Grand Traverse County Drain Commission
- Grand Traverse Bay—Watershed Center Grand Traverse Bay
- Lake Charlevoix, Charlevoix Conservation District and Tip of the Mitt Watershed Council
- Elk River Chain of Lakes Watershed — Antrim Conservation District, Tip of the Mitt Watershed Council, Conservation Resource Alliance
- Little Traverse Bay — Tip of the Mitt Watershed Council, Ann Baughman

Watershed Groups

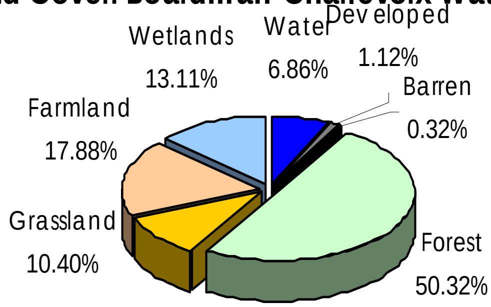
- Boardman River Project — www.boardmanriver.org
- Grand Traverse Conservation District — www.gtcd.org
- Grand Traverse County Drain Commission — www.grandtraverse.org
- Antrim Conservation District — www.antrimcd.org
- Charlevoix Conservation District — www.charlevoixcounty.org/cd.asp
- Tip of the Mitt Watershed Council — www.watershedcouncil.org
- Conservation Resource Alliance — www.rivercare.org
- Watershed Center Grand Traverse Bay — www.gtbay.org
- Northwest Michigan Council of Governments — www.nwm.org
- Grand Traverse Band of Ottawa and Chippewa Indians — www.gtb.nsn.us
- Little Traverse Bay Bands of Odawa Indians — www.ltbbodawa-nsn.gov

Watershed Overview / Ecology / Biodiversity

- The Grand Traverse Bay watershed is one of the premier tourist and outdoor recreation regions in the State of Michigan.
- The watershed has over 217 miles of Lake Michigan shoreline.
- Over 529 miles of streams and rivers flow year-round.
- The Grand Traverse Bay region is currently experiencing tremendous population growth and development pressure, with a predicted 40% increase in population by 2020.
- Sediment and excessive nutrient loading are two of the highest priority pollutants. Other pollutants that threaten the watershed's designated uses include thermal pollution, toxins, changes in hydrologic flow, invasive species, pathogens, and loss of habitat.
- Stormwater inputs are a primary concern throughout the watershed.
- Two of the three fastest growing counties in the state, Grand Traverse and Leelanau, are located within the watershed's boundaries.

- Major waterways in the basin include the Elk River, the Boardman River, Lake Charlevoix, Little Traverse Bay, and the Carp River.
- The Boardman River is the largest tributary to Grand Traverse Bay.
- The majority of the Boardman River is in the North Central Hardwood Forest ecoregion. The uppermost reach (about 7-8 miles) of the North Branch Boardman River is in the Northern Lakes and Forest ecoregion.
- The Boardman's well drained soils result in ample cold groundwater inputs to the streams and provide for the stable stream flow regimes in this watershed.
- As a trout steam, the Boardman River ranks among Michigan's top 10 streams. It contains excellent populations of brook and brown trout, particularly above Boardman Dam. The Boardman River is a high quality, "blue ribbon" trout stream and is a designated coldwater system with the exception of Boardman.
- Traditional uses of watershed resources have included agriculture, tourism and recreation. Cherries and other fruit crops dominate agricultural production in the region, and are harvested for the global market.
- The watershed is home to species of black bear, deer, great blue heron, lady slippers and trillium.
- The watershed boasts scenic bluffs, forests, nearly a hundred inland lakes, several hundred miles of stream (including 55 miles of blue ribbon trout streams), intact wetland systems and globally rare ecosystems.
- The Boardman River watershed contains Great Lakes Beachgrass Dune, Great Lakes Dune Pine Forest, Great Lakes Shallow Marsh, Great Lakes Shoreline Cattail - Bulrush Marsh, Interdunal Wetland, and White Cedar - Boreal Conifer Mesic Forest.
- The watershed has medium-sized, moderate to high groundwater streams entering Lake Charlevoix, Grand Traverse Bay/Chain of Lakes, and/or Little Traverse Bay.
- Grand Traverse Bay has pinched off bays of Great Lakes, bedrock (resistant) with bedrock (resistant) nearshore, sandy beach/dunes with sand nearshore, sandy beach/dunes with bedrock (resistant) nearshore, baymouth/barrier beaches with bedrock nearshore, and sandy beach/dunes with sand and gravel lag over clay nearshore.
- Waugoshance has baymouth/barrier beaches with bedrock nearshore, sandy beach/dunes with bedrock (resistant) nearshore, sandy beach/dunes with sand and gravel lag over clay nearshore, and sandy beach/dunes with sand/gravel nearshore.
- Waugoshance is an important Landbird stopover site, Raptor stopover site, Shorebird stopover site, and Waterfowl stopover site.
- Waugoshance is home to Bald Eagle, Black Tern, Blackburnian Warbler, Black-throated Blue Warbler, Black-throated Green Warbler, Blue-winged Warbler, Chestnut-sided Warbler, Eastern Wood-Pewee, Least Flycatcher, Mourning Warbler, Nashville Warbler, Piping Plover, Prairie Warbler, Purple Finch, Rose-breasted Grosbeak, Ruffed Grouse, Veery, Wood Duck, Wood Thrush, Dwarf lake iris, Houghton's goldenrod, and Pitcher's thistle.

Land Cover: Boardman-Charlevoix Watershed



Watershed Size: 1664 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and slight decreases in grassland, farmland and grassland.

Impaired (303d) Waters

Waterbody Name	Impairment
Arbutus Lake	Mercury (Fish Tissue)
Boyne River	PCBS Fish Consumption Advisory
Elk Lake	Mercury (Fish Tissue) PCBS Fish Consumption Advisory
Ellsworth Lake	Mercury (Fish Tissue)
Grand Traverse Bay—State Park Beach	Pathogens
Grand Traverse Bay—Milliken Beach	Pathogens
Intermediate Lake	Mercury (Fish Tissue)
Kids Creek	Macroinvertebrate Community Rated Poor
Lake Bellaire	Mercury (Fish Tissue)
Lake Charlevoix	PCBS Fish Consumption Advisory
Torch Lake	Chlordane Fish Consumption Advisory PCB Fish Consumption Advisory Dioxin Fish Consumption Advisory Mercury (Fish Tissue)

Watershed Activities / Concerns / Priorities

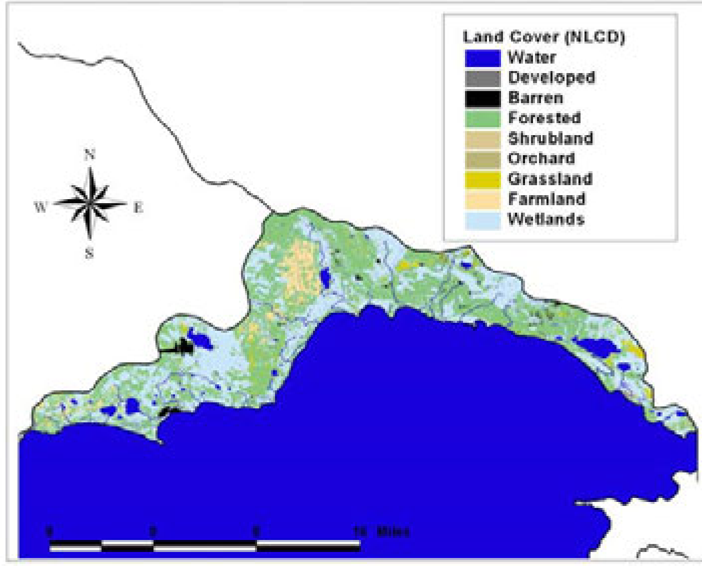
- Eroded Boardman River banks, road crossings, utility line crossings, and other sources of sediment have been stabilized through the Boardman River Project. These projects prevented over 3,000 tons of sediment annually from entering the Boardman.
- The Grand Traverse Bay Watershed Protection Plan was created with a $249,710 grant with an $87, 173 match. The plan includes a comprehensive field survey of Grand Traverse Bay shoreline, an identification of ecologically significant shoreline parcels for water quality protection in Boardman River and Leelanau County.
- The Grand Traverse Band of Ottawa and Chippewa Indians tribe has a water quality protection program for the adjacent waters to the reservation in Leelenau County.
- A grant from the Frey Foundation focuses on streambank stabilization, bridge projects and other road/stream crossing improvements, woody debris installation for fish habitat, sand traps, and wildlife corridor work for the Bear River, Boyne River, Maple River, Jordan River, Carp River, and St. Clair Lake/Six Mile Lake Watersheds.
- The Boardman River Project and the Grand Traverse Conservation District have restored 77 erosion sites using a Clean Michigan Initiative grant.
- Restoration of three road stream crossings on Ogletree Creek, a 2005 Great Lakes Basin Program Project, were undertaken in order to apply BMP construction techniques to road stream crossings. The project aims to stabilize the banks of the stream with nonwoven geotextile and field stone, plant 25 feet of linear shoreline on both sides of the banks and culverts with native deep rooted shrubs, and educate local township officials on the importance of sediment control at road stream crossings.
- The Lake Charlevoix Watershed Project was funded by 319 grants between 2001 and 2005 for $ 302,500 to implement management nonpoint plan priority recommendations. Projects focused on reducing stormwater runoff and pollution form shoreline properties; improving road/stream crossings; providing educational materials to the agricultural community; land stewardship and protection, forest management, and land use planning and management.
- A constructed wetland stormwater treatment and shore restoration demonstration project for Suttons Bay, MI addresses current runoff problems on the Inland Seas Education Association's shore and vicinity by constructing a wetland on its waterfront property in order to correct these problems and protect native shoreline and bay habitat.
- Fish passage into the Green River, a premier trout stream, is blocked less than one mile upstream from the river's confluence with the Jordan. In a partnership between the landowners, Fisheries Division, Friends of the Jordan River, Nestle Corporation and Conservation Resource Alliance, the engineering review portion of a dam removal is under way, but funding, however, is still short. Benefits of the project will ultimately involve removing a barrier from a cold water stream capable of producing additional salmonids.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Brevoort-Millecoquins Watershed

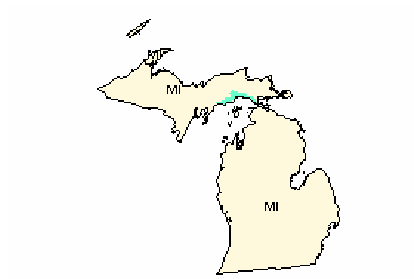
Hydrologic Unit Code: 04060107

For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060107



Watershed Overview

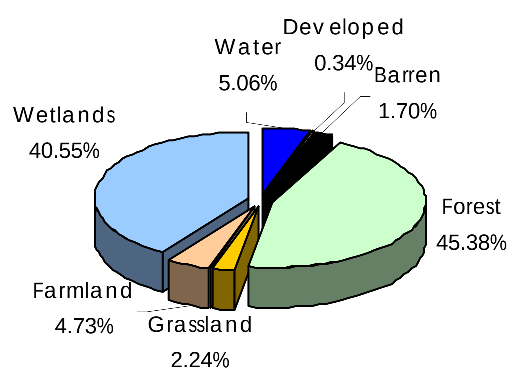
- The watershed is located at the southeastern portion of Michigan's Upper Peninsula
- The watershed covers 561.57 square miles. With 102.53 miles of Lake Michigan shoreline
- It has 19 square miles of inland lakes
- It has two listed impaired waters.
- Of the 248 river miles, 206 miles, or 83 percent have been assessed.
- The Hiawatha National Forest makes up a significant portion of the watershed.
- The watershed has many minerals and aggregates and limestone quarries.
- The Brevoort River watershed is home to Pitcher's thistle and Dwarf lake iris.



Impaired (303d) Waters

Water Body	Impairment
Millecoquins Lake	Mercury (Fish Tissue)
Guliver Lake	Mercury (Fish Tissue)
Milakokia Lake	Mercury (Fish Tissue)

Land Cover: Brevoort-Millecoquins Watershed



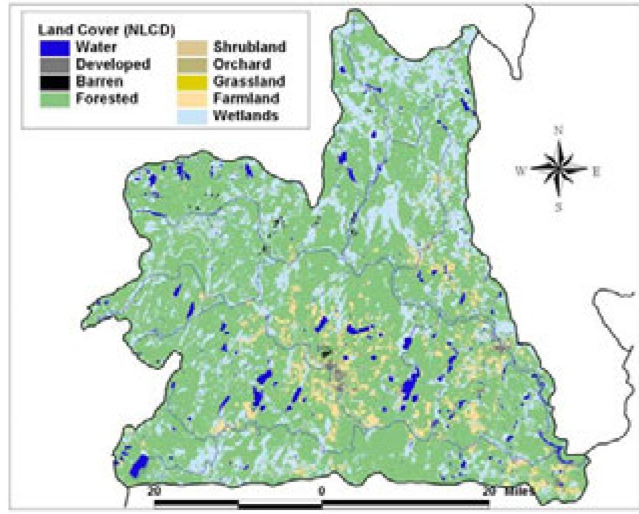
Watershed Size: 562 sq. miles

Between 1996 and 2001, there have been slight increases in grassland, cultivated land, and developed land and a slight decrease in forest.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Brule River Watershed

Hydrologic Unit Code: 04030106



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030106 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/032, "A Biological Survey of the Brule, Paint, and Michigamme River Watersheds, Iron and Marquette Counties, 2002".

Watershed Management Plans

- Iron River Watershed — Iron Conservation District

Watershed Groups

- Iron River Conservation District — www.iron.org/edc/gov-conservation.php
- Iron River Watershed Project & Council — www.ironriverwatershed.org

Watershed Overview / Ecology / Biodiversity

- Prior to the logging area, the watershed was extensively managed by Native Americans using fire to stimulate wildlife use. The name "Brule" (originally "Brulee") comes from the early French explorers means "burned woodlands."
- The predominant vegetation in the hilly uplands are sugar maple, basswood, and yellow birch while the lowland vegetation is dominated by american elm, black ash, trembling aspen, and red maple. The vegetation of drier outwash sand plains include balsam fir, white pine, red pine, and paper birch.
- Extensive logging occurred in the watershed from the late 1800s to the early 1900s. Large scale agriculture did not follow due to the soil types and colder climate.
- The federal government purchased much of the abandoned stump land and makes up the 1.7 million acre Ottawa National Forest. Much of the Brule watershed is part of this national forest.
- The watershed topography is characterized by sandy hills and elliptical ridges. These sandy deposits have high infiltration rates, can be up to 200 feet thick, and are a major source of cold groundwater to the rivers.
- The Brule River watershed covers 1057 square miles.
- It does not have any Lake Michigan shoreline and is upstream of the Menominee River watershed.
- The Brule watershed has 9 listed impaired waters.
- The Iron River in the watershed supports a naturally reproducing brook trout populations in the upper peninsula and is the source for brood stock for the Michigan Department of Natural Resources brook trout hatchery program.
- Of the approximately 40 miles of streams that constitute the Iron River watershed, 12 1/2 are classified as blue-ribbon trout water. Forty percent of Michigan's "blue ribbon" trout streams are found in the Brule, Michigamme, and paint River systems.
- Forestry, wood products, and tourism are the dominant industries. Other major activities include winter sports, fishing, hunting, camping, boating, fall color tours, and sightseeing.
- The Iron River Conservation District received $432,995 from the State of Michigan CMI Nonpoint Pollution Control program in 2001 to stabilize one road, five livestock access sites, two banks and three storm drain outlets.
- The Iron, Brule, and Paint Rivers have large, moderate groundwater small to medium-sized streams on outwash and coarse ground/end moraine, and moderate groundwater small to medium-sized streams on outwash and coarse ground/end moraine (drumlins common).

Watershed Activities / Concerns / Priorities

- The Iron County Conservation District was awarded a 319 planning grant in 1999 to develop a management plan for the Iron River Watershed. With the Watershed Council acting as a steering committee, an inventory of the watershed was conducted, an information and awareness campaign begun, and strategies to address sources of non-point pollution were developed. The initial planning grant resulted in the successful award of two subsequent grants which will fund implementation of activities through 2004.
- The Iron River Conservation District received $432,995 from the State of Michigan CMI Nonpoint Pollution Control program in 2001 to stabilize one road, five livestock access sites, two banks and three storm drain outlets.

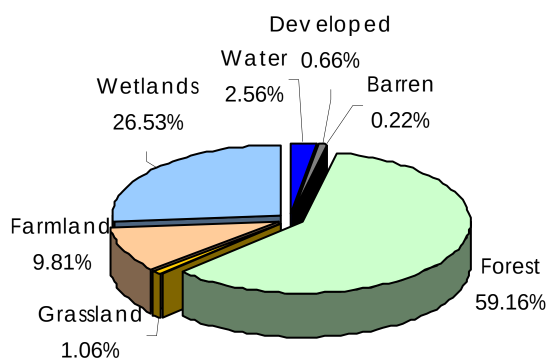
- The Iron River Watershed Project received a grant develop an information and education campaign designed to reduce nonpoint source pollution and restore or sustain habitat and water quality. This included newsletters and articles, radio and television appearances, public presentations, training workshops, road signs, interpretive signs, a website, storm drain markers, and a comprehensive brochure.
- A limited number of point source discharges exist in the area. This includes the West iron County Sewer Authority Wastewater treatment Plant and the National Steel-Dober pit site in Caspian, and Wastewater Sewage Lagoons at Crystal Falls and Alpha.
- A $318,000 fine for acid mine drainage from the Dober and Buck mineswas assessed on the Hanna Mining Co. This money was to be administered by the state, but managed by the newly formed watershed council. The award was earmarked specifically for activities to repair, enhance, or protect the Iron River, as well provide for increased public use.
- All but one of the MDEQ watershed sampling sites had an excellent habitat rating. The one that did not had a good rating.
- Macroinvertebrate community status was assessed at 6 different sites within the Brule River watershed. Two of the 6 stations received macroinvertebrate community ratings of “excellent,” while 4 stations rated acceptable.

Impaired (303d) Waters

Waterbody Name	Impairment
Cable Lake (MI)	Mercury (Fish Tissue)
Chicagon Lake (MI)	Mercury (Fish Tissue)
Fortune Lake (Second Lake) (MI)	Mercury (Fish Tissue)
Lake Emily (MI)	Mercury Mercury (Fish Tissue)
Net River (MI)	Mercury (Fish Tissue)
Ottawa Lake (MI)	Mercury (Fish Tissue)
Runkle Lake	Mercury (Fish Tissue)
Paint River (MI)	Pathogens
Kentuck Lake (WI)	Mercury Fish Consumption Advisories
Sunset Lake (MI)	Mercury (Fish Tissue)
Brule River Flowage (WI)	Mercury Fish Consumption Advisories

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Land Cover: Brule River Watershed

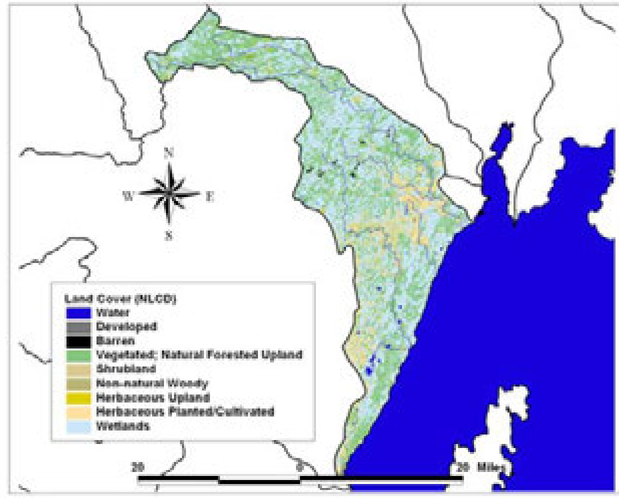


Watershed Size: 1057 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, grassland, and cultivated land and a slight decreases in forest.

Cedar Ford Watershed

Hydrologic Unit Code: 04030109



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030109 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WB-05/038, "A Biological Survey of the Big Cedar, Bark, and Ford River Watersheds Located in Delta and Menominee Counties, 2000".

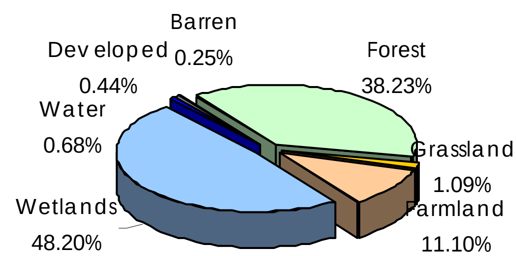
Watershed Groups

- Friends of the Cedar River
- Central Lake Superior Watershed Partnership — www.superiorwatersheds.org/shed.ford.asp
- The Bear Creek Watershed Project, Annis Water Resources Institute — www.gvsu.edu/wri/isc/bear

Watershed Overview / Ecology / Biodiversity

- The Cedar-Ford watershed covers 1029.1 square miles with almost 53 miles of Lake Michigan shoreline.
- There are just over 2 square miles of inland lakes.
- The Ford River is the longest free flowing river in Michigan.
- The watershed is an historic area for pine/hardwood logging with numerous structures still present.
- There are many large, privately held hunting camps and industrial/state forest land.
- Fishing recreation, deer and grouse hunting, snow mobile touring, and cross country skiing are some of the important basin recreational activities.
- The Bark River has medium-sized coastal streams on till and lake plain identified as identified by the nature Conservancy.
- The Ford River has ecologically important large coastal streams on till plain entering western Green Bay with extensive wetlands, and small to medium-sized till plain streams with extensive wetlands as identified by the Nature Conservancy.
- The Ford River has the important species Riverine clubtail.

Land Cover: Cedar-Ford Watershed



Watershed Size: 1029 sq. miles

Between 1996 and 2001, there has been a slight increase in grassland a slight decrease in forest.

Watershed Activities/ Concerns/ Priorities

- Cedar River Road Crossing Project (Clare Conservation District/Clean Michigan Grant)
  - Used bituminous pavement and water turnouts on approaches to the river to stabilize 5 road-stream crossings
  - Stabilized roadside ditches using erosion control fabric, riprap, and check dams.

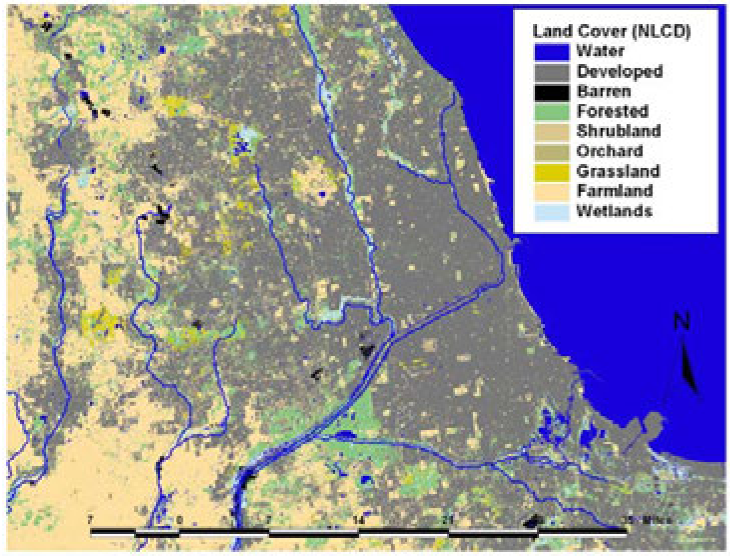
Impaired 303(d) Waters

Waterbody Name	Impairment
Green Bay	Dioxins Fish Consumption Advisory PCBs Fish Consumption Advisory Mercury (Fish Tissue)

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Chicago Area Waterway System

For more information, see the Chicago Waterways website at http://www.chicagoareawaterways.org/.



Water System Overview

- The Chicago River once flowed into Lake Michigan. To facilitate a reversal of the flow of the Chicago River to divert water from Lake Michigan to the Chicago Area Waterway System (CAWS), the Chicago Sanitary and Ship Canal, the Calumet-Sag Channel and the North Shore Channel were constructed over 100 years ago. The diversion and the artificial waterways facilitated navigation and protected the drinking water intakes in Lake Michigan from Chicago wastes. The Little Calumet River North Leg, the Chicago River, the South Branch of the Chicago River and North Branch of the Chicago River downstream from its confluence with the North Shore Channel are natural rivers that have been modified through channelization and widened and deepened.
- The CAWS includes the Calumet River and Chicago River basin water bodies that are generally classified as Secondary Contact Recreation and Indigenous Aquatic Life. The CAWS also includes Lake Calumet and a variety of tributaries designated as General Use.
- Land use within the CAWS basin is generally urban with extensive industrial development. Basin stakeholders include the City of Chicago and 31 suburban municipalities. Flow in the CAWS is dominated by treated wastewater from 5 million residents and an additional industrial load of approximately 4.5 million population equivalents.
- Chicago's wastewater system was developed with a combined sewer system that accepted both stormwater and sanitary waste. After rainstorms, the capacity of the sewer system became overwhelmed on a regular basis and combined sewer overflows (CSO) occurred. These CSOs are discharged into the CAWS and frequently from the river into Lake Michigan. To address this problem, the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) developed the Tunnel and Reservoir project (TARP), which included the construction of the Deep Tunnel project. The Deep Tunnel is a series of tunnels that lie 250 to 300 feet below the Chicago River and are located parallel to it. The first phase of the TARP project or "Deep Tunnel" project has been completed. During periods of heavy rainfall, the TARP project directs combined sanitary waste and infiltrating rainwater into massive tunnels and collection reservoirs where it can be withdrawn for treatment after the rain subsides.
- A comprehensive multi-year evaluation of current conditions in the Chicago Waterway System, and its potential for expanded uses, has been launched by the Illinois EPA. This evaluation, also called a Use Attainability Analysis (UAA), will be the first in-depth look at the system in nearly three decades. In mid-February, the Illinois Environmental Protection Agency announced plans for the project that involves the Chicago River, its two main branches (North Branch and South Branch), the Cal-Sag Channel, the Chicago Sanitary and Ship Canal, and tributaries in an area extending from the metropolitan Chicago area to the Lockport vicinity. The Chicago Waterway System makes up the surface drainage network serving the majority of the Greater Chicago metropolitan area. The system receives discharge from three of the largest municipal wastewater treatment plants in the nation as well as releases from more than 100 individual combined sewer outfalls.
- Since passage of the Clean Water Act in 1972, there have been major upgrades of treatment facilities along the Chicago Waterway. Under IEPA oversight, extensive pretreatment programs have begun, as well as treatment of industrial wastes before discharge. The first phase of the Tunnel and Reservoir (TARP) project or "Deep Tunnel" project has been completed.
- Recreational boating and other sports are on the rise within the system and improved fish populations and species diversity now support a modest recreational fishing use. These benefits indicate that the current use classification is outdated, making the planned study a timely undertaking. Jointly, these efforts have significantly improved conditions and public interest in the waterway, resulting in increased efforts to restore abandoned areas and provide public open spaces along the banks. As part of the study, a stakeholders advisory group will be created and involved through the review process and the completed review will be posted for Internet viewing.

Watershed Activities

- Chicago's shoreline habitats provide stopover sites for migratory birds and support rare plants. The dune restoration area at Loyola Beach currently supports State of Illinois endangered species. In addition the federally listed piping plover has stopped at this location. The project supports measures called for in the Service's Urban Bird Conservation Treaty by implementing dune enhancement and expansion of restoration beyond the existing dune area through invasive species control, planting native species, species inventory and education projects. The outcome of the project will be a restored dune area providing a tangible resource for rare coastal bird and plant species.

Impaired (303d) Waters

Waterbody Name	Designated Uses	Fish Consump-tion	Secondary Contact and Indigenous Aquatic Life
N. Shore Channel	Full support	Nonsupport	Full support
N. Shore Channel	Full support	Nonsupport	Full support
N. Shore Channel	Full support	Nonsupport	Full support
S. Br. Chicago	Full support	Nonsupport	Full support
N. Br. Chicago	Partial support	Nonsupport	Partial support
Chicago San. &	Partial support	Nonsupport	Full support
Chicago San. &	Full support	Nonsupport	Full support
Chicago San. &	Full support	Nonsupport	Full support
Chicago San. &	Full support	Nonsupport	Full support
Chicago San. &	Full support	Nonsupport	Full support
Cal-Sag Channel	Partial support	Nonsupport	Partial support

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Door-Kewaunee Watershed

Hydrologic Unit Code: 04030102

For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030102

The Door-Kewaunee Watershed as defined by the USGS is part of the WDNR's Lakeshore Basin Management Area. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- 1000 Friends of Wisconsin — www.1kfriends.org
- Door County Environmental Council — www.doorcountycompass.com/dcec
- Door County Land Trust — www.doorcountylandtrust.org
- River Alliance of Wisconsin — www.wisconsinrivers.org
- Clean Wisconsin — www.cleanwisconsin.org
- Lakeshore Natural Resource Partnership — www.lnrp.org.
- Charles Verhoeven, Regional Water Program Leader – Charles.Verhoeven@dnr.state.wi.us

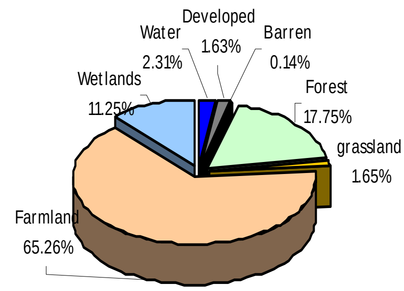
Watershed Overview / Ecology / Biodiversity

- Maple- basswood is the most common forest type, and the tree species with the greatest volume in the Lakeshore basin is ash followed by soft maple, aspen, basswood and beech.
- Recreational highlights include: hiking, birding, camping, rafting, canoeing, hunting, fishing, and boating on Lake Michigan and Green Bay.
- The diversity of islands, forests, wetlands, sand dunes, and ridge and swale topography provide habitat to an abundance of rare, threatened and endangered plants and animals.
- The Basin includes the Northern Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes In the Northern Lake Michigan Coastal area, low sand dunes and beach ridges along the shoreline support unique plant species.
- Vegetation is maple- basswood- beach forests and wetlands. In the Southeast Glacial Plains area, former savanna (now farmed) and wetlands are predominant, along with kettle lakes and the Kettle Moraine landscape feature. This area's wetlands are highly productive for plants, insects, and invertebrates.
- Surface waters are a mix of lakes and cold and warm water streams with smallmouth bass, walleye, northern pike, panfish and trout. Great Lakes fisheries provide lake trout, lake whitefish, salmon and yellow perch.
- The basin's groundwater in Door County is underlain by Niagara Dolomite, or Karst (fractured limestone), which allows pollutants such as bacteria to move quickly and which makes this resource highly susceptible to contamination.
- Wildlife include white- tailed deer, turkey, ring- necked pheasant, ruffed grouse, waterfowl, geese, beaver, mink, otter, colonial waterbirds, trumpeter swans, eagle, osprey, northern goshawk, shorebirds
- Grasslands, which support over 105 bird species, are promoted through prescribed burns and mowing.
- Cat Island in Green Bay has a critical migratory shorebird stopover site.
- Critical habitat communities on the Door Peninsula identified by the Nature Conservancy include the Great Lakes Beach, Midwest Calcareous Floating Mat, Juniper Alvar Shrubland, and Midwest Mixed Emergent Deep Marsh.
- Other important habitat include Alkaline Moist Bluff – Cliff, Beech - Maple - Northern Hardwoods Forest, Black Ash - Mixed Hardwood Swamp, Black Spruce / Labrador Tea Poor Swamp, Boreal Sedge Rich Fen, Great Lakes Alkaline Cobble/Gravel Shore, Great Lakes Alkaline Open Bluff – Cliff, Great Lakes Beach, Great Lakes Beachgrass Dune, Great Lakes Dune Pine Forest, Great Lakes Hemlock - Beech - Hardwood Forest, Great Lakes Limestone Bedrock Lakeshore, Great Lakes Shallow Marsh, Great Lakes Shoreline Cattail - Bulrush Marsh, Great Lakes White Pine - Hemlock Forest,

Interdunal Wetland, Jack Pine / Prairie Forbs Barrens, Maple-Ash-Elm Swamp Forest, Midwest Calcareous Floating Mat, Red Oak - Sugar Maple Forest, Tussock Sedge Wet Meadow, White Cedar - (Mixed Conifer) / Alder Swamp, White Cedar - Black Ash Swamp, White Cedar - Boreal Conifer Mesic Forest, White Pine - Red Oak Forest, and Wooded Dune and Swale Complex.

- Critical ecological systems on the Door Peninsula include bedrock shoreline with semi-protected and open wetlands with sand nearshore; large, spring-fed lakes; shallow dune lakes; and small coastal streams on thin till over bedrock and lacustrine sand
- Critical species on the Door Peninsula include the American Bittern, Willow Flycatcher, Hooded Merganser, Red-headed Woodpecker, American White Pelican, Forster's Tern, Common TernWarbling Vireo, Wood Duck, Ruffed Grouse, Spoon-leaf, moonwort, Whip-poor-will, Black Tern, Pitcher's thistle, Marsh Wren, Sedge Wren, Black-billed Cuckoo, Eastern Wood-Pewee, Yellow Rail, Ram's head lady's slipper, Black-throated Blue Warbler, Blackburnian Warbler, Chestnut-sided Warbler, Black-throated Green Warbler, Least Flycatcher, Bald Eagle, Wood Thrush, Baltimore Oriole, Dwarf lake iris, Black-and-white Warbler, Mourning Warbler, Rose-breasted Grosbeak, Hines emerald dragonfly, Field Sparrow, Nashville Warbler, and the Canada Warbler.
- Other important species include Crested vertigo, Deep-throat vertigo, Dwarf lake iris, Hines emerald dragonfly, Hubricht's vertigo, Iowa Pleistocene vertigo, Lake Huron locust, Multi-rib vallonia, Pleistocene catinella, Ram's head lady's slipper, Six-whorl vertigo, and Tapered vertigo.

Land Cover: Door-Kewaunee Watershed



Watershed size: 767 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, grassland, and barren land and slight decreases in farmland.

Impaired (303d) Waters

Waterbody Name	Impairment
Ahnapee River	PCB Fish Consumption Advisories
Clark Lake	PCB Fish Consumption Advisories
East Alaska Lake	Mercury Fish Consumption Advisories
Green Bay—South of Marinette and its Tribs	Mercury Fish Consumption Advisories
Kewaunee Harbor	Metals Aquatic Toxicity Fish Consumption Advisory
Kewaunee Marsh	Metals Aquatic Toxicity Wildlife
Kewaunee River	PCB Fish Consumption Advisories
MacKaysee Lake	Mercury Fish Consumption Advisories
Stony Creek	Degraded Habitat Sediment

Basin Priorities

In 2000 the Lakeshore Basin Partnership Team, which includes the Door-Kewaunee watershed, developed the following prioritized list of the most pressing issues impacting natural resources in the watershed management area.

1. Loss of riparian (stream and lakeside) buffers (streamside habitat)
2. Inadequate identification and protection of wetlands, wetland corridors, and groundwater recharge areas
3. Need for better land use Planning & improved local zoning
4. Inadequate management & protection of woodlots
5. Absence of stewardship ethic
6. Loss of small farms and/ or Conversion to large farms
7. Contamination of drinking water
8. Illegal dumping of toxins
9. Loss of biodiversity
10. Loss of shoreline habitat

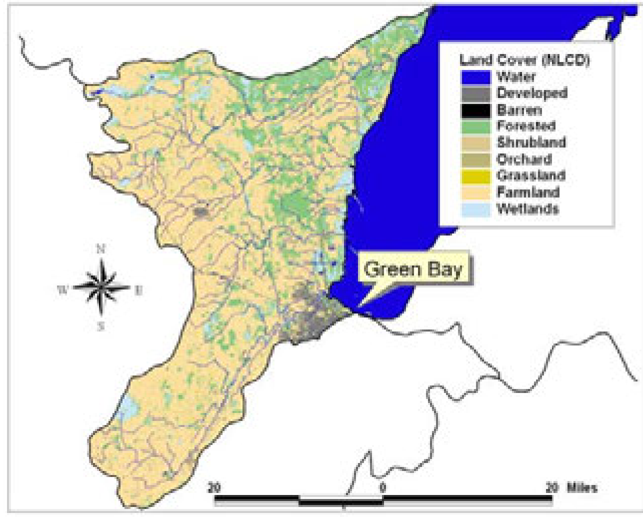
Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Basin Social Concerns

- Limit of aquatic habitat and open land to development, pollution threats to surface waters and contamination of drinking and groundwater.
- Address water quality problems from in- place pollutants, dams, urban and agricultural runoff.
- Preserve biodiversity and protect endangered and threatened species.
- Protect of large contiguous blocks of forestland, grassland and wetland that serve as habitat for mammals, birds, and amphibians, as well as providing a large self- sustaining forest ecosystem for all to enjoy.
- Exotic nuisance species, stocking issues, declining fishing opportunities, inadequate boat access.
- Monitoring of wildlife populations, water quality, and ecosystem function are needed to understand the status and trends of resources in the basin.

Duck-Pensaukee Watershed

Hydrologic Unit Code: 04030103



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030103

The Wisconsin Department of Natural Resources manages the Duck-Pensaukee watershed in two integrated management areas. The northern portion is managed as part of the Upper Green Bay Basin and the southern portion as part of a larger Lower Fox River basin. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- Duck Creek Watershed Priority Project, Outagamie County Land Conservation Department — www.co.outagamie.wi.us/landcons/DAA.html
- Wisconsin Land & Water Conservation Association, Inc. — www.wlwca.org
- Pensaukee River Priority Watershed Project — www.co.shawano.wi.us/subwebs/pnd/plan_dev/Land%20Conserv/Pensaukee/pensaukee_home.htm
- Oconto County Conservation Department — www.co.oconto.wi.us/departments.asp?d_id=2043

Watershed Overview / Ecology / Biodiversity

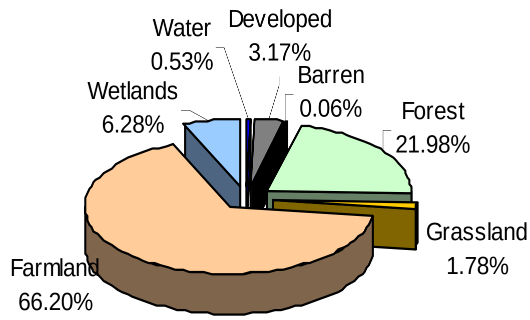
- The Duck-Pensaukee watershed covers approximately 490 square miles.
- There are approximately 35 miles of Lake Michigan shoreline.
- Green Bay is the sole urbanized area in the watershed.
- The watershed flows into the Green Bay.
- Just over 66 percent of the watershed is agricultural.
- Wildlife include black bear, white- tailed deer, turkey, ring- necked pheasant, ruffed grouse, waterfowl, geese, beaver, mink, otter, timber wolves, elk, colonial waterbirds, trumpeter swans, eagle, osprey, northern goshawk, shorebirds.
- Maple- basswood is the most common forest type and the tree species with the greatest volume in the basin is hard maple followed by aspen, white and red pine, soft maple and balsam fir.
- Coastal wetlands are an important feature of the watershed.
- Groundwater is the source of potable water for most residents within the Duck-Pensaukee watershed.
- Groundwater levels have dropped, causing suburban areas to seek direct withdrawals from Lake Michigan.

Watershed Activities / Concerns / Priorities

The following are objectives for the Upper Green Bay management Basin, which includes a significant portion of the Duck-Pensaukee watershed:

- Target the West Shore of Green Bay as a high priority for habitat protection
- Implement the DNR's 50 year Land Legacy Study, an acquisition plan for the state
- Protect shoreland habitat and water quality through water regulation and zoning
- Work with local communities in developing "smart growth" plans & promoting wise land use and zoning
- Complete a comprehensive fisheries plan for the basin, focusing on the Oconto, Menominee, and Peshtigo Rivers and Lake Michigan, including addressing invasive exotic species
- Complete the Master Plan for the Governor Tommy G. Thompson Centennial State Park
- Encourage sound forestry practices on public and private land and identify and manage terrestrial invasive exotic species
- Enhance educational activities for forestry, water quality, wildlife management, healthy ecosystem.
- The Oneida are leaders in the Duck Creek watershed, which runs through the reservation.

Land Cover: Duck-Pensaukee Watrershed



Watershed Size: 490 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and slight decreases in grassland, and forest.

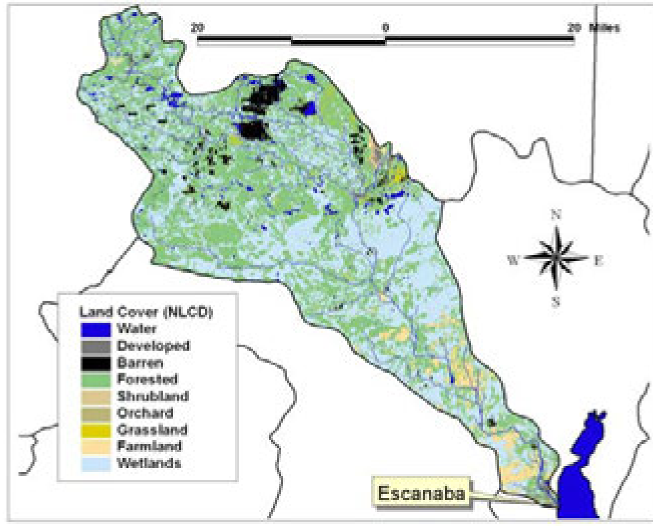
Impaired (303d) Waters

Waterbody Name	Impairment
Duck Creek * (1)	Nutrients PCB Fish Consumption Advisory Flow Alteration(s) Loss Of Instream Habitat Organic Enrichment/Low Dissolved Oxygen Sediment
Green Bay - South Of Marinette And Its Tribs Including The Menominee, Oconto, Fox & Peshtigo Rivers From Their Mouths To The First Dam	PCB Fish Consumption Advisory
GREEN BAY AOC (INNER BAY) (1)	Phosphorus Dissolved Oxygen PCB Fish Consumption Advisory
Trout Creek (2)	Nutrients PCB Fish Consumption Advisory Flow Alteration(s) Loss Of Instream Habitat Organic Enrichment/Low Dissolved Oxygen Sediment

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Escanaba River Watershed

Hydrologic Unit Code: 04030110



For more information, see the USEPA “Surf Your Watershed” website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030110 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SWQ-01/010, “A Biological Survey of the Escanaba River Watershed, Marquette, Dickinson, and Delta Counties, August 2000”.

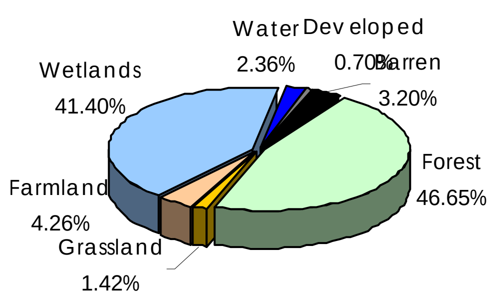
Watershed Group

- Central Lake Superior Watershed Partnership — www.superiorwatersheds.org/wsescanaba.asp

Watershed Overview / Ecology / Biodiversity

- Over 508 miles of the streams flow year-round.
- The Escanaba River Watershed is one of the Upper Peninsula’s largest watersheds.
- The Escanaba River provides ample opportunity for the outdoor enthusiast including canoeing, fishing, swimming, public campsites and hiking to name a few.
- Much of the Escanaba system in Marquette County is open for public use including a large tract on the lower East Branch owned by Marquette County.
- The Escanaba River supports brook, brown and some rainbow trout throughout along with warm water species in the impoundments.
- The upper Escanaba has three major dams on it, the Greenwood Dam, Schweitzer Dam and the Cataract Dam.
- The East Branch and the Middle Branch of the Escanaba converge in the town of Gwinn to form the Main Branch. The stretch from this convergence south to the Delta County line is mostly wide and smooth, ideal for a canoe trip. From the Delta County line, the river runs south to its discharge point at Lake Michigan, just outside of the City of Escanaba.
- The Escanaba River watershed is one of the watersheds within which the Sault Ste. Marie Tribe of Chippewa Indians live.
- The Escanaba River has critical Tufted Hairgrass Wet Alvar Grassland ecological systems as identified by the Nature Conservancy.
- The Nature Conservancy identified Little Lake’s Algae-like pondweed as an critical species in the watershed.

Land Cover: Escanaba River Watershed



Watershed size: 924 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, and grassland, and a slight decrease in forest, cultivated land, and water.

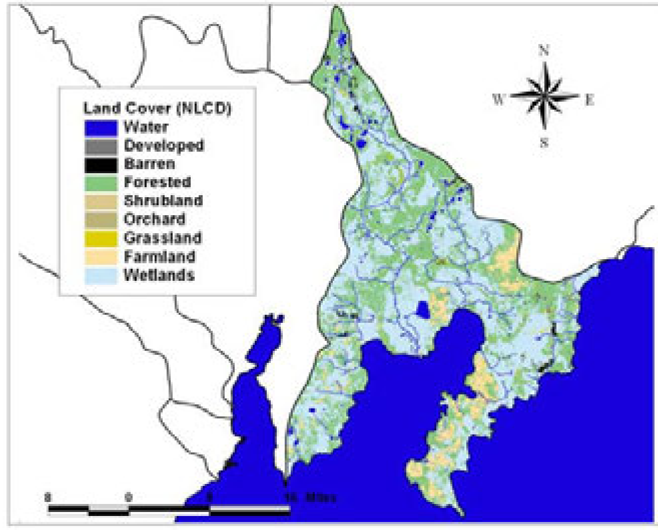
Impaired Waters

Waterbody Name	Impairment
Escanaba River	PCBS, Mercury, Mercury (Fish Tissue)
Goose Lake	Phosphorus, Algal Blooms PCBS Fish Consumption Advisory
Greenwood Reservoir	Mercury (Fish Tissue)
Round Lake	Mercury (Fish Tissue)
Schweitzer Reservoir	Mercury (Fish Tissue)
Shag Lake	Mercury (Fish Tissue)

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Fishdam-Sturgeon Watershed

Hydrologic Unit Code: 04030112



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030112 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SWQ-01/112, "A Biological Survey of the Sturgeon River Watershed and nine Other Lake Superior Coastal Watersheds in Baraga County, July 2001".

Watershed Group

- Sturgeon/Otter River Watershed Council

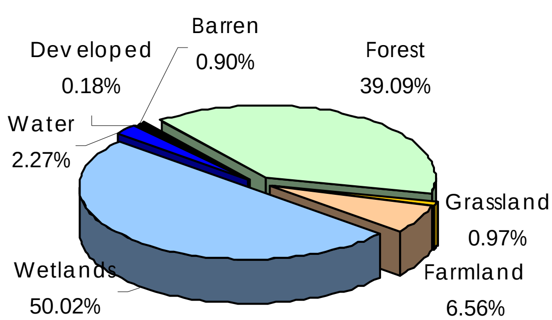
Watershed Overview / Ecology / Biodiversity

- The Fishdam-Sturgeon watershed is located in the upper peninsula of Michigan and covers approximately 559 square miles.
- The watershed has approximately 123 miles of Lake Michigan shoreline.
- Most of the wetlands in the watershed are characterized as coastal wetlands.
- The watershed has 260 miles of rivers and streams.
- The watershed now includes two identified impaired waters.
- The Nature Conservancy identified the Garden Peninsula's Spruce-Cedar Wet Alvar Woodland and Dwarf lake iris as critical species in the watershed.

Impaired (303d) Waters

Waterbody Name	Impairment
Round Lake	Mercury (Fish Tissue)
Sturgeon River	Mercury

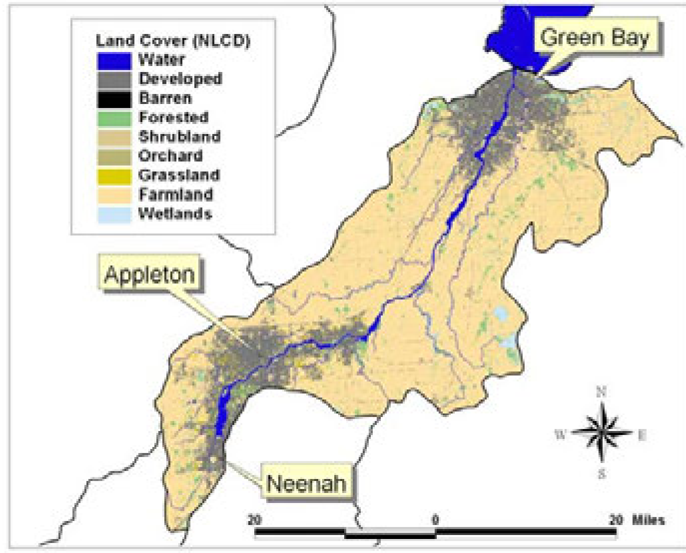
Land Cover: Fishdam-Sturgeon Watershed



Watershed Size: 559 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, grassland, bare land, and farmland, and a slight decrease in forest and wetland.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)



Lower Fox River Watershed

Hydrologic Unit Code: 04030204

More information is available at the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030204

The Wisconsin Department of Natural Resources manages the watershed as part of the Lower Fox River management area that also includes a portion of the Duck-Pensaukee watershed. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html

Watershed Groups

- Fox River Watch — www.foxriverwatch.com
- Fox-Wolf Basins, The University of Wisconsin-Extension — basineducation.uwex.edu/foxwolf
- The Lower Fox River Watershed Monitoring Program — www.uwgb.edu/watershed
- Fox Wolf Watershed Alliance — www.fwwa.org
- Lake Michigan Forum — www.lkmichiganforum.org/
- Rivers Alliance of Wisconsin — www.wisconsinrivers.org
- Bob Behrens, the Lower Fox River Water Basin Team Leader — behrer@dnr.state.wi.us

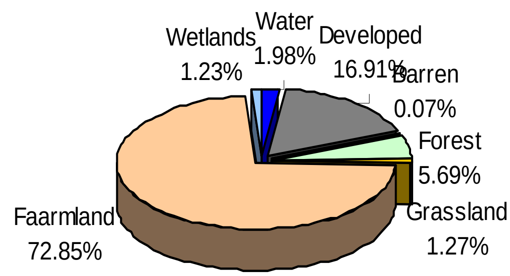
Watershed Overview / Ecology / Biodiversity

- Recreational highlights include wildlife watching, hiking, fishing, hunting, bicycling, horseback riding, snowmobiling, skiing, camping, picnicking, and water sports.
- The Lower Fox River originates at the outlet of Lake Winnebago and flows northeast for 39 miles where it empties into the bay of Green Bay. The Lower Green Bay and Fox River Area of Concern (AOC) consists of the lower 11.2 km of the Fox River below DePere Dam and a 55 km^2 area of southern Green Bay out to Point au Sable and Long Tail Point.
- The Lower Fox River has the most paper mills of any river in the world.
- Much of the drinking water in the basin is derived from groundwater. However, the City of Green Bay receives its drinking water from Lake Michigan. More communities are now building pipelines from the Lake.
- The main stem of the Fox River in the Lower Fox River Basin is fragmented by a series of 17 locks and 12 dams that were built in the mid 1800's to aid navigation or produce power.
- The Oneida Reservation, established by an 1838 Treaty, is in the basin. It is participating in the State's priority watershed program and the WTCAC.
- The Lower Fox River Basin encompasses three of the state's ecological landscapes: Northern Lake Michigan Coastal, Southeast Glacial Plains, and Northeast Plains.
- Open land consists of cropland, orchards, pastures, and meadows, and comprises the largest type of habitat within 0.5 mile of the Lower Fox River. Woodland habitat includes hardwood and conifer forest land and wooded lots with an associated understory of shrubs, grasses, legumes, and herbaceous plants.
- Wildlife diversity and populations are affected by the variability of habitats within the basin. The two main terrestrial habitats within the basin are open land and woodland. Aquatic habitats within the area are wetland, riverine, and lacustrine (lakes or lake- like).
- Numerous endangered, threatened and otherwise rare species exist in the basin, including the endangered Barn Owl and the threatened Small White Lady's Slipper.
- Wildlife include songbirds, white- tailed deer, rabbits, red fox, coyote, pheasant, Hungarian partridge, squirrel, skunk, raccoon, upland game birds, waterfowl, bats, small mammals and invertebrates, reptiles, amphibians and many others.
- The Greenleaf Escarpment has Alkaline Moist Bluff – Cliff and North-Central Maple - Basswood Forest
- The multi-rib vallonia is an important specieis in the Greenleaf Escarpment area.

Watershed Activities / Concerns / Priorities

- A Wisconsin Great Lakes Protection Fund grant enabled Brown County Land Conservation Department to secure commitments from willing landowners that cut the soil, fertilizer, manure and other pollutants carried into the stream. Participating landowners signed contracts agreeing to maintain for perpetuity a 35-foot wide strip, or "buffer," next to Baird Creek where they won't plant crops, plow or engage in any agricultural activities.
- Hydraulic dredging of PCB-contaminated sediment started in the Lower Fox River at Little Lake Butte des Morts. Over the next decade as much as 7.25 million cubic yards of contaminated sediment will be removed from a 39-mile stretch of the Lower Fox River. On the Sheboygan River, the cleanup of a 14-mile stretch of the river, as well as adjacent soil and groundwater, is expected to take seven years.
- Environmental concerns include habitat loss, deterioration and fragmentation from rapid development and conversion of rural lands; water quality problems from contaminated sediment, runoff in urban and agricultural areas, floodplain development and overuse of groundwater supplies (with groundwater quality implications); heavy recreational use of resources, such as lakes and shorelines; exotic species are a continuing emerging problem. Plant species such as reed canary grass, purple loosestrife, buckthorn, garlic mustard and Eurasian water milfoil quickly out-compete native species and affect ecosystem balance. Zebra mussels and rusty crayfish are spreading, disrupting stream and lake ecology; monitoring of wildlife populations, water quality, and ecosystem function are needed to understand the status and trends of resources.
- The main priorities identified in the integrated management plan include: Increase and protect critical habitats and habitat integrity; sustain a diverse, balanced and healthy ecosystem; Improve surface water and groundwater quality and identify water conservation opportunities; establish a self-sustaining, balanced, and diversified edible fish community; manage resources for multiple users; strengthen program support and enforcement initiatives; and Improve educational programs.

Land Cover: Lower Fox



Watershed Size: 438 sq miles.

Between 1996 and 2001, there has been a slight increase in developed land, grassland, and wetland and a slight decrease in forest, and a slightly larger decrease in farmland.

Impaired (303d) Waters

Waterbody Name	Impairment
Apple Creek *	Phosphorus, Degraded Habitats, Organic Enrichment/Low Dissolved Oxygen, Sediment, Temperature
Apple Creek *	Phosphorus, Degraded Habitats, Organic Enrichment/Low Dissolved Oxygen, Sediment, Temperature
Duck Creek	Phosphorus, Dissolved Oxygen, Sediment
Dutchman Creek	Nutrients, Ammonia
East River * *	Metals, Phosophorus, Aquatic Toxicity, Degraded Habitat, Dissolved Oxygen, Sediment
East River **	Metals, Phosophorus, Aquatic Toxicity, Degraded Habitat, Dissolved Oxygen, Sediment
Fox River (Seg. 1)	Phosphorus, Dissolved Oxygen, Fish Consumption Advisories (PCBs)
Fox River (Seg. 2 lower)	Phosphorus, Dissolved Oxygen, Fish Consumption Advisories (PCBs)
Fox River (Seg. 3 Lower)	Phosphorus, Dissolved Oxygen, Fish Consumption Advisories (PCBs)
Kankapot Creek	Loss Of Instream Habitat
Mud Creek	Loss Of Instream Habitat
Neenah Slough	Fish Consumption Advisories (PCBs), Organic Enrichment/Low Dissolved Oxygen
Plum Creek	Loss Of Instream Habitat, Temperature
Tributary to East River	PCBS, Aquatic Toxicity

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Lower Fox River/ Green Bay Area of Concern Activities

Location
- The lower 40 miles of the Fox River and Green Bay

AOC Primary Contaminants
- PCBs
- Phosphorus
- Suspended solids
- Mercury

AOC Stressors
- Urban and rural runoff
- Sediments
- Aquatic exotic species
- Wetland loss
- Habitat alteration

AOC Relevant Programs
- Clean Water Act
- Superfund
- Natural Resource Trustee's Damage Assessment

AOC Clean-up Actions
- Watershed NPS abatement
- Remedial investigation completed remedial action nearly ongoing. Dredging and PCB removal (Deposit in 7,200 cubic yards of sediment removed and Deposit 56/57: 50,000 cubic yards of sediment removed)
- Dissolved oxygen wasteload
- Deposit N, 56, 57
- Cumulative sediments remediated from 1997-2002 – 87,500 cubic yards

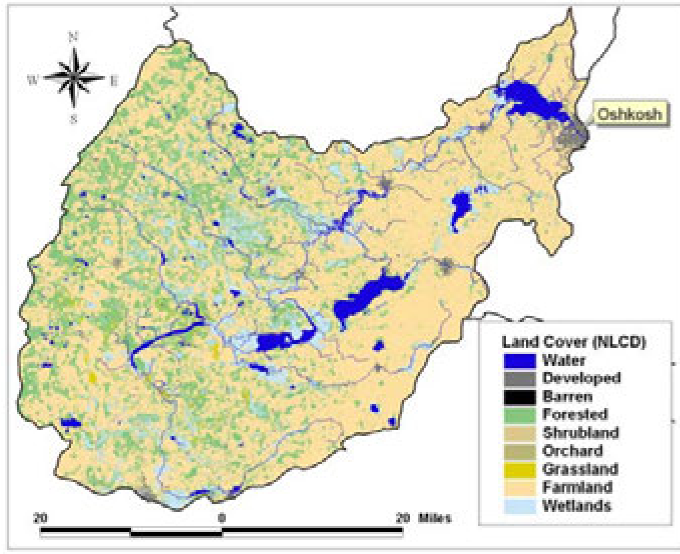
AOC Key Activities Needed
- Dredging
- Pollution Prevention
- Stream buffers
- Habitat protection and restoration

AOC Challenges
- Rapid land development
- Contaminated material disposal
- Seeing through completion of cleanup for OUs 2-5
- Coordination with RAP program for AOC delisting purposes

AOC Next Steps
- Formal agency decision (Comment period ended January 21, 2002)
- Removal of 10 million cubic yards of sediment.
- Completed dredging and implementation of cleanup plan for OU 1, expected to take 3-6 years
- OUs 2-5 final cleanup plan implementation, expected to take 15 years

Upper Fox River Watershed

Hydrologic Unit Code: 04030201

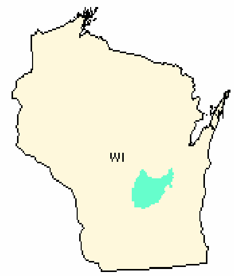


For more information, see USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030201

The Upper Fox River basin is part of the Wisconsin DNR's Upper Fox River basin management area, which also includes the Lake Winnebago watershed. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- Fox River Watch — www.foxriverwatch.com
- Fox-Wolf Basins, The University of Wisconsin-Extension basineducation.uwex.edu/foxwolf
- Fox Wolf Watershed Alliance — www.fwwa.org
- Lake Michigan Forum — www.lkmichiganforum.org/
- Rivers Alliance of Wisconsin — www.wisconsinrivers.org
- Rob McLennan, the Upper Fox River Water Basin Team Leader — Robin.McLennan@dnr.state.wi.us



Watershed Overview / Ecology / Biodiversity

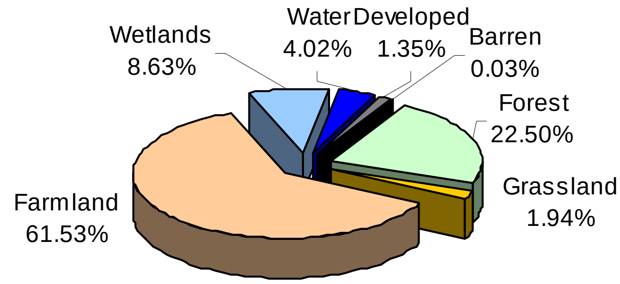
- Numerous endangered, threatened and otherwise rare species exist in the basin, including the threatened White Lady's Slipper, a species that needs fens and calcareous wet prairies, and Forster's Tern, which needs large marshes, estuaries and lake islands.
- Over 10% of the basin area is wetland greater than 40 acres in size, accounting for 145,428 acres. The total wetland area is actually much greater, as mapping identifies wetlands as small as 2 acres in size.
- There are over 55,678 acres of major public lands in the Upper Fox management basin including 51,311 acres of state wildlife, fisheries and park lands (not including the 11 state natural areas in the basin) and 4,367 acres of U.S. Fish and Wildlife Service wildlife refuge and waterfowl production acres.
- The Basin includes the Central Sand Ridges, Southeast Glacial Plains, and a small portion of the Central Sand Plains Ecological Landscapes.
- Most of the basin's cold water trout streams are located in the western portion of the basin near the Sandy Ridges ecosystem. Warm water rivers, streams and lakes support various game and non- game species including large and small mouth bass, walleye, northern pike, catfish and sturgeon.
- Common woodland wildlife include white- tailed deer, turkey, ruffed grouse; upland/ grassland wildlife includes ring-necked pheasant, non- game songbirds (vesper sparrow, bobolink (right), meadowlark); grassland nesting waterfowl include mallards and blue- winged teal. Wetland species include various waterfowl, amphibians and reptiles.
- Oak- hickory is the most common forest type and the tree species with the greatest volume in the Upper Fox Basin is white oak followed by black and pin oak, white and red pine, aspen and soft maple.
- The Nature Conservancy identified Eightmile-Waukau Creek as a critical ecological system for the Fox tributary rivers.

Watershed Activities / Concerns / Priorities

- There are a large number of dams on the Upper Fox River system. Several have been removed, including 2 on the Baraboo River. Data collected from the removal demonstrate that historical fish species have returned, and the population of exotic species declined.
- The Upper Fox watershed is home to the state's largest Wetland Reserve Restoration Program (WRP). Duffy's Marsh is a 1,732 acre wetland restoration project in Marquette County. There are over 60 WRP contracts in the larger Upper Fox River management area (which also includes the Lake Winnebago watershed).

- The Upper Fox Basin Partnership held a workshop to identify concerns and issues facing natural resources in the basin. The three priorities listed below are not ranked against each other, but rather, they rose to the top when compared to all of the other stressors affecting the natural resources of the basin and the uses of those resources by the public.
    - Wetland filling/ loss
    - Habitat loss and fragmentation
    - Nutrient loading/ Nonpoint Source Pollution
- Other environmental concerns include:
    - Water quality problems from contaminated sediments, runoff in urban and agricultural areas, floodplain development and overuse of groundwater supplies.
    - Riparian/wetland, woodland, and grassland habitat loss, deterioration, and fragmentation from rapid development and conversion of rural lands. Protection and maintenance of habitat is important for maintaining spatial and temporal ecosystem diversity critical for wildlife.
    - Grassland restoration is a major initiative, with virtually the entire historic prairie, sedge meadows and oak savannas having been converted to agriculture due to their flat topography and rich soils.
    - Exotic species are a continuing and emerging problem. Plant species such as reed canary grass, purple loosestrife, buckthorn, garlic mustard, and Eurasian water milfoil can quickly out-compete native species and wreak havoc on ecosystem balance. Zebra mussels and rusty crayfish are spreading to basin waterways, disrupting stream and lake ecology.
    - Monitoring of wildlife populations, water quality, and ecosystem function are needed to understand the status and trends of resources.
- The Oneida Tribe has a water quality protection plan for the reservation and has participated in the State priority watershed Program. It is participating in sediment and phosphorus study for assessment and modeling for the Wisconsin Lower Fox Basin. It is also participating in the Wisconsin NRCS WI Tribal Conservation Advisory Council.

Land Cover: Upper Fox River Watershed



Watershed size: 1637 sq. miles

Between 1996 and 2001, there has been an increase in developed land and grassland and a decrease in farmland and forest.

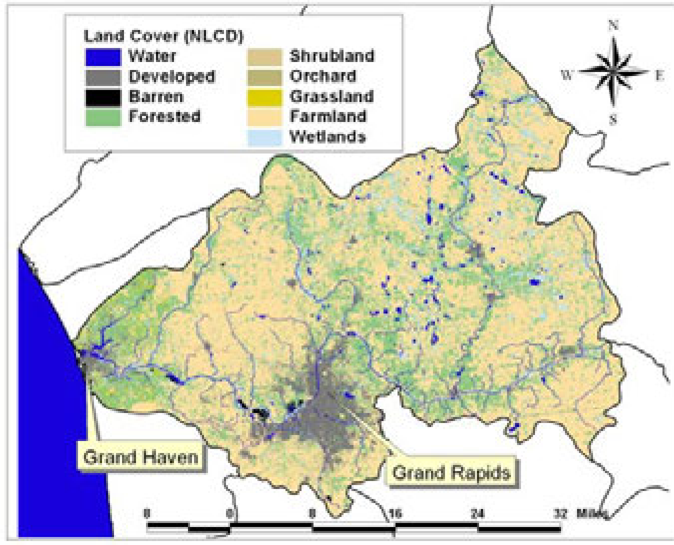
Impaired 303(d) Waters

Waterbody Name	Impairment
Big Green Lake	PCB Fish Consumption Advisory
Buffalo Lake	Mercury Fish Consumption Advisory
Butte Des Morts Lake	PCB Fish Consumption Advisory Organic Enrichment/Low Dissolved Oxygen Sediment Nutrients Mercury Fish Consumption Advisory
Fox River (From Portage North To, But Not Including Buffalo Lake)	PCB Fish Consumption Advisory
Fox River (Swan Lake Downstream to Portage)	PCB Fish Consumption Advisory
Fox River At Buffalo Lake	PCB Fish Consumption Advisory
Fox River, Oshkosh	Aquatic Toxicity
Hill Creek	Degraded Habitat Sediment
Mason Lake	Nutrients Organic Enrichment/Low Dissolved Oxygen
Peppermill Creek	Loss Of Instream Habitat Sediment Temperature
Silver Creek (2)	Contaminated Sediments Loss Of Instream Habitat Temperature
Roy Creek (All)	Degraded Habitat Sediment
Silver Lake (Big)	Aquatic Toxicity
Un. Trib To Mason Lake (T14nr7e S25	Loss Of Instream Habitat Sediment
Wurch Creek	Loss Of Instream Habitat Sediment

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Lower Grand River Watershed

Hydrologic Unit Code: 04050006



For more information, see the USEPA "Surf Your Watershed" website at: http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050006 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WB-05/097.

Watershed Management Plans

- Hager Creek — Ottawa County Parks & Recreation Commission
- Lake Macatawa — Macatawa Area Coordinating Council
- Plaster Creek — Kent County Drain Commission
- Schoolhouse Creek — Kent County Drain Commission
- Spring Lake — Spring Lake Lake Board
- Bear Creek — Cannon Township and Grand Valley State University/Annis Water resources Institute (GVSU/AWRI)
- Buck Creek — Grand Valley Metro Council
- Crockery Creek — Muskegon Conservation District
- Rogue River — Grand Valley Metro Council and GVSU/AWRI
- Sand Creek — Grand Valley Metro Council and GVSU/AWRI
- York Creek - Alpine Township and GVSU/AWRI

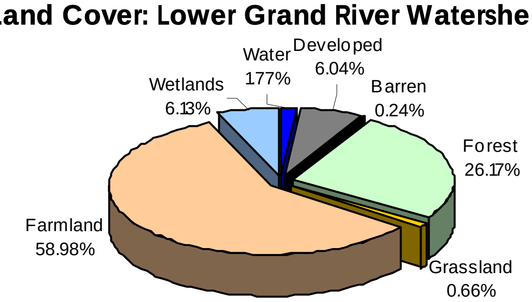
Watershed Groups

- Ottawa County Parks & Recreation Commission — www.co.ottawa.mi.us/parks
- Kent County Drain Commission — www.accesskent.com/YourGovernment/DrainCommisioner/drain_index.htm
- West Michigan Environmental Action Council — www.wmeac.org
- The Lower Grand River 319 Project, Grand Valley State University Annis Water Resources Institute — www.gvsu.edu/wri/isc/lowgrand

Watershed Overview / Ecology / Biodiversity

- Almost 60 percentof the land use is agricultural
- Grand Rapids and Grand Haven are the major urban areas in the watershed
- The Grand River Watershed is the largest watershed in the State of Michigan. The watershed has been divided into two parts, the Lower Grand River Watershed and the Upper Grand River Watershed. The Lower Grand River Watershed covers ten counties.
- The Nature Conservancy identified the following critical ecological resources in the watershed:
  - The Rogue River has White Oak - Red Oak / Early Meadow-Rue Forest
  - The Saul Lake Bog is a Leatherleaf Bog
  - Zeigenfuss Lake/Greenville has White Pine - White Oak Forest
  - The Rogue River has small to medium-sized tributary streams in end moraine and outwash

Land Cover: Lower Grand River Watershed



Watershed size: 2014 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and cultivated land and a slight decrease in forest and grassland.

Watershed Activities / Concerns / Priorities

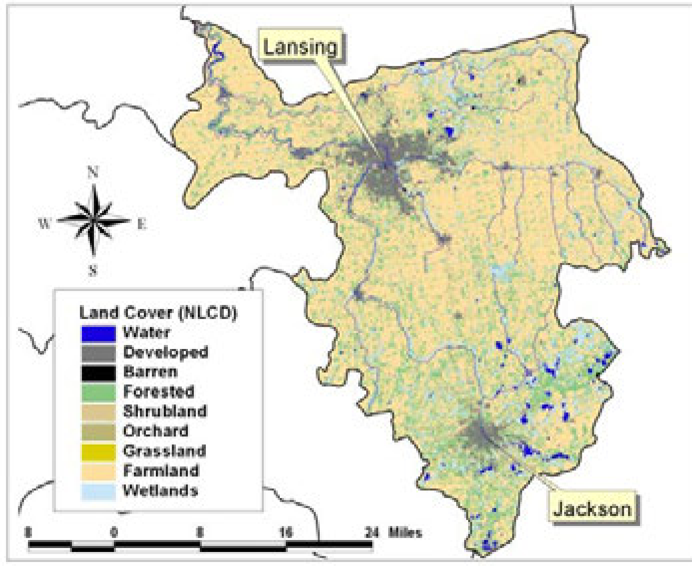
- A Section 319 Watershed Management Planning Grant was awarded by the Michigan Department of Environmental Quality (MDEQ) to facilitate the development of a watershed management plan for the Lower Grand River Watershed. The grant was awarded to the Grand Valley Metro Council. The Grand Valley Metro Council contracted with the Annis Water Resources Institute and Fishbeck, Thompson, Carr & Huber, Inc. to complete the management plan. Many communities participated in the development of this plan. Counties, cities, and townships are currently involved by matching funds or in kind services. The project has been completed.
- Ottawa County Parks is working to reduce erosion and to restore the Hager Creek area to its natural condition. To achieve this goal, the Hager Creek Watershed Management Plan was developed. This plan, which has been approved by the Michigan Department of Environmental Quality, looks at the entire length of Hager Creek as well as the surrounding land including properties west of 28th Avenue.
- Along Nash Creek, an increased magnitude and frequency of storm runoff events and altered morphology are causing excess sedimentation. Grant funds from the 2005 Great Lakes Basin Program will be used to address this problem through the development and refinement of methods for planning regional wetland detention areas along the Creek. The project will also develop and implement a model for reducing sedimentation and erosion, which will be applicable to other streams and drains with similar issues.
- The City of Grand Rapids received a $73,000 grant with a $28,000 match to investigate illicit connections to its storm sewer system. This project encompassed a visual inspection of 495 stormwater outfalls, and water quality samples collected at 250 outfalls with measurable flow. As a result of the sampling, nine sites became the focus of additional follow-up and investigation. The sources of the nine illicit sanitary sewer connections to the City's Stormwater Drainage System were identified and actions were initiated to eliminate the connection. Building on this project, three objectives were identified: continue to assess all outfalls within the City of Grand Rapids on a regular basis for any illicit discharges determined to be impacting designated uses of waters by area residents; ensure rapid remediation of the illicit connection by interacting with the responsible party or parties to eliminate the source as soon as possible; and continue routine water quality assessments to document improvements and future urban impacts.

Impaired (303d) Waters

Waterbody Name	Impairm ent
Reeds Lake	Fish Consumption Advisories PCBs Fish Tissue (Mercury)
Bass River	Pathogens Fish Community Rated Poor Macroinvertebrate Community Rated Poor
Buck Creek	Pathogens
Deer Creek (Watershed)	Nutrients Pathogens Dissolved Oxygen Fish Community Rated Poor Fish Kills Macroinvertebrate Community Rated Poor
Bills Lake	Mercury (Fish Tissue)
Grand River	PCBs Fish Consumption Advisory PCBS
Grand River Grand River	Mercury Pathogens
Plaster Creek	Pathogens Fish Community Rated Poor Macroinvertebrate Community Rated Poor
Rainbow Lake	Mercury
Rio Grande Creek	Pathogens
Sand Creek	Fish Community Rated Poor
Strawberry Creek	Fish Community Rated Poor
Unnamed Tributary To Grand River	Fish Community Rated Poor
Wabasis Lake	Mercury
York Creek	Fish Community Rated Poor

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Upper Grand River Watershed
Hydrologic Unit Code: 04050004



For more information, see the USEPA website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050004 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/049, "A Biological Survey of the Upper Grand River, Jackson, Ingham, Eaton, and Ionia Counties, Michigan, 2001".

Watershed Organizations

- Carrier Creek Stormwater Management and Restoration Project — www.carriercreek.com
- Eaton County Drain Commission — http://www.eatoncounty.org/Drain/Drain.htm
- The Upper Grand River Watershed Council — www.uppergrandriver.org

Watershed Management Plans

- Carrier Creek — Eaton County Drain Commission
- Upper Grand River — Grand Valley State University Annis Water Resources Institute

Watershed Overview / Ecology / Biodiversity

- The Upper Grand River watershed is almost 1750 square miles.
- Almost three quarters of the land is in agricultural use.
- There are three urban areas in the watershed: Lansing, East Lansing, and Jackson, Michigan.
- The watershed has 10 listed impaired waters.
- There are 958 miles of river and streams in the watershed.
- The Upper Grand watershed flows into the Lower Grand River watershed, where it then flows into Lake Michigan

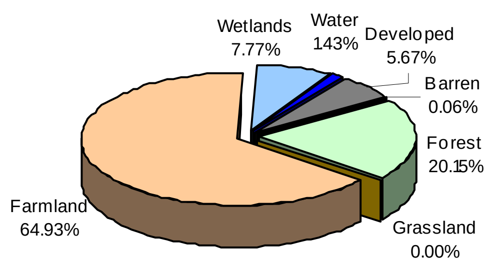
Watershed Activities / Concerns / Priorities

- A 319 grant was awarded to the Annis Water Resources Institute to develop an Upper Grand River watershed management plan.
- The Dahlem Nature Center was awarded $12,000 in grant funds to assess the benthic macroinvertebrate community, stream habitat, and water chemistry in the Upper Grand River Watershed.
- Development in Delta and Windsor townships over the last several years has significantly changed the landscape around Carrier Creek:
  - An increase in the amount of impervious surface area (i.e., rooftops and parking lots) has caused an increase in the amount of rainwater draining into Carrier Creek.
  - Water levels are flashy, fluctuating from just a few inches to nearly four feet after heavy rains.
  - Because of past dredging activities, natural floodplains have been separated from the creek and are no longer available for water storage.
- The Carrier Creek Stormwater Management and Restoration Project was developed to address these challenges. Without improvement, the increased water volume entering the creek will cause increased flooding, further erosion, and increased flashiness.
  - South of I-496 (upstream), efforts will focus on creating an effective drainage system and reducing flashy hydrology to the downstream portions of the drain.
  - North of I-496 (downstream), work will focus on creek restoration.

Impaired (303d) Waters

Waterbody Name	Impairment
Albrow Creek	Untreated sewage discharges, pathogens
Grand River	Pathogens
Grand River	Mercury
Grand River And Portage River	PCB Fish Consumption Advisory PCBS
Grand River and Red Cedar River#	Pathogens Dissolved Oxygen Fish Kills
Moorse Park Im-poundment (Grand River)	Mercury (Fish Tissue)
Portage Lake	Mercury (Fish Tissue)
Red Cedar River	Pathogens Fish Community Rated Poor Macroinvertebrate Community Rate Poor
Sycamore Creek (Wateshed)	Dissolved Oxygen
Vandercook Lake	Mercury (Fish Tissue)
Vermillion Creek	Pathogens

Land Cover: Upper Grand River Watershed



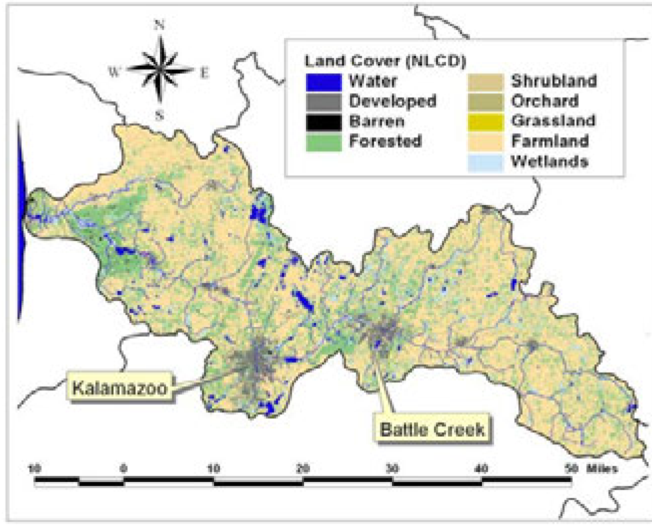
Watershed size: 1750 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, wetlands, and farmland and a slightly larger decrease in grassland.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Kalamazoo River Watershed

Hydrologic Unit Code: 04050003



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050003 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/W-05/067, "A Biological Survey of Sites in the North and South Branches of the Kalamazoo River Watershed, Calhoun, Hillsdale, and Jackson Counties, Michigan, August 2004" and report number MI/DEQ/WB-05/066, "A Biological Survey of Sites in the Upper Kalamazoo River, Calhoun and Jackson Counties, Michigan, 2004".

Watershed Management Plans

- Davis, Gourdneck and Portage Creeks — Forum for Greater Kalamazoo
- Four Townships Area — Four Townships Water Resources Council
- Greater Battle Creek Area — Calhoun Conservation District
- Little Rabbit River — Allegan Conservation District
- Portage and Arcadia Creek — Forum of Greater Kalamazoo
- Rice Creek — Calhoun Conservation District
- Upper Rabbit River — Allegan Conservation District
- Battle Creek River

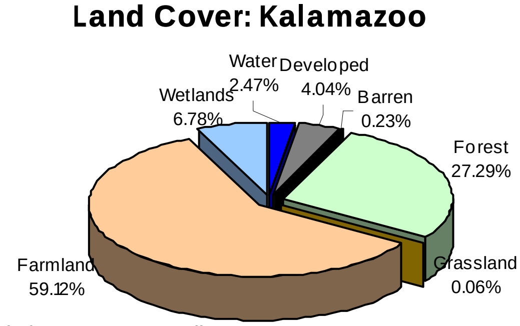
Watershed Groups

- Kalamazoo River Network — www.kalamazooriver.net
- The Forum of Greater Kalamazoo — www.theforum.org
- Four Townships Water Resources Council — www.kbs.msu.edu/ftwrc
- Calhoun Conservation District — www.calhouncd.org
- Allegan Conservation District — www.allegancd.org
- Match-e-be-nash-she-wish Band of Pottawatomi (Gun Lake Band)

Watershed Overview / Ecology / Biodiversity

- The Kalamazoo basin watershed covers 2029 square miles.
- The Kalamazoo River Watershed drains eight counties in Southwest Lower Michigan and empties into Lake Michigan at Saugatuck, Michigan.
- The Kalamazoo River is an Area of Concern due to PCB contamination. The upstream boundary is Morrow Dam, which forms Morrow Pond and extends downstream to Lake Michigan, a distance of approximately eighty miles. The Kalamazoo River has been identified as a site of environmental contamination pursuant to the Michigan Natural Resources and Environmental Protection Act 451 and is included in the Superfund National Priorities List. Kalamazoo River priorities include remediation of PCB contaminated sediments in the river and landfills in the watershed, nonpoint source pollution control (including Phosphorus control in the watershed), and habitat restoration.
- The Nature Conservancy identified the following important ecological areas, specieis, and resources in the watershed:
  - Allegan Barrens have Lakeplain Wet-Mesic Prairie, Inland Coastal Plain Marsh, Lakeplain Wet Prairie, Central Water Lily Aquatic Wetland, and Interdunal Wetland.
  - Allegan Barrens is home to Eastern Massasauga, Ottoe's skipper, Karner blue butterfly, Sprague's pygarctic, Hall's bulrush, and, Reticulated or netted nutrush.
  - Fort Custer has Blanchard's Cricket Frog, Blanding's Turtle, and Eastern Massasauga.
  - Headwaters have Leatherleaf Bog, interlobate headwater streams (Lake Michigan drainage), kettle moraine lakes, large rivers in southwest Michigan till plains (not coastal reach), and tributary streams in medium textured moraines (southern Ionia moraines).
  - Fort Custer has Central Mesic Tallgrass Prairie, Cinquefoil - Sedge Prairie Fen, Red Maple - Ash - (Elm) Swamp Forest, White Oak - Red Oak / Early Meadow-Rue Forest, Silver Maple - Elm - (Cottonwood) Forest, and White Oak - Red Oak Dry-Mesic Forest.

- Fort Custer has important large, deep, stream-connected lakes.
- The Spring Brook-Kalamazoo Nature Center has the endangered Mitchell's satyr (which is found in small numbers in locations in Michigan, Indiana, Ohio, and Maryland).
- Upper Kalamazoo tributaries have kettle moraine lakes, interlobate headwater streams (Lake Michigan drainage), and large rivers in southwest Michigan till plains (not coastal reach).



Watershed size: 2030 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, cultivated, and wetland and a slight decrease in forest and grassland.

Watershed Activities / Concerns / Priorities

- In 2002 the Four Township Water Resources Council completed a 3 year program to protect surface water quality under Section 319 of the federal Clean Water Act. The Michigan DEQ and U.S. EPA have awarded the Council a second grant of $210,000 for 2 years. The Council will provide an additional $70,000 in local contributions towards the project. The Battle Creek River Watershed Project is an effort by landowners, residents, conservation groups, and local, state, and federal agencies to protect the quality of water for drinking, agriculture, recreation, wildlife, and fisheries. A $237,000 319 grant was awarded to develop a Battle Creek River watershed management plan. The main source of sediment was found to be stream bank erosion resulting from historic dredging. Berms created from the widening, deepening, and straightening of the channel have disconnected the river from its floodplain. The Gun River watershed project is working to improve water quality and aquatic habitat. The objectives are to locate sources of pollution in the watershed, to prioritize critical areas, and to build and retain a high level of stakeholder awareness and participation. The project is designed to complement current Kalamazoo River/Lake TMDL efforts.
- Rice Creek houses a unique southern Michigan trout fishery that relies on access to critical life history spawning grounds, stable channel flow/function, and temperature and sediment controls, all of which are compromised by a mill race dam located near the City of Marshall. A project funded by the 2005 Great Lakes Basin Program restored a 0.8 mile mill race and historic channel at Ketchum Park in Marshall. The overall goal is to reduce sedimentation and enhance the inland fishery and other aquatic resources.
- The Community Foundation for Muskegon County received a $100,000 environmental grant from the Charles Stewart Mott Foundation to support a comprehensive, two-year assessment of the Mona Lake Watershed. The objectives of the Mona Lake Watershed Project are to conduct a preliminary assessment of the aquatic and terrestrial habitats and contamination sites present in the watershed and to identify areas of significant change and degradation.
- A 2004 Great Lakes Basin Program Project, the Kalamazoo River Education Initiative was awarded $29,833 to provide teachers with the knowledge, experience and tools to enable them to better instruct their students on stream ecology concepts surrounding land use, water quality issues and watershed science.

Impaired (303d) Waters

Waterbody Name	Impairment
Austin Lake	Mercury (Fish Tissue)
Battle Creek River	Fish Consumption Advisories (PCBs)
Brickyard Creek	Macroinvertebrate Community Rated Poor
Crooked Creek	Macroinvertebrate Community Rated Poor
Davis Creek	Oil
Fenner Lake	Phosphorus Fish Consumption Advisories (PCBS) Mercury (Fish Tissue) Nuisance Plant Growths
Fish Lake	Mercury (Fish Tissue)
Gull Lake	Mercury Fish Consumption Advisories (PCBS)
Gun Lake Beaches	Pathogens
Gun River	Macroinvertebrate Community Rated Poor
Kalamazoo River	Mercury
Kalamazoo River (Includes Lakes and Impoundments)	Fish Consumption Advisories (PCBs)
Wannadoga Creek	Macroinvertebrate Community Rated Poor
Pine Lake	Mercury
Rice Creek	Macroinvertebrate Community Rated Poor
Selkirk Lake	Mercury (Fish Tissue)

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

- Five acres of Battle Creek River riparian corridor were donated to the Calhoun Conservation District and 22 more acres within the watershed are in the process of being donated.
- A long-term geomorphic assessment study is being conducted on the Battle Creek River to determine stream stability, and stream bank and bed erosion.
- Two dams on the Battle Creek River have been identified for removal. The cost of these removals is approximately $150,000.
- A Watershed Management Plan was developed with a 319 grant for Portage Creek and Arcadia Creek in the south central portion of the Kalamazoo River Watershed. Nonpoint source loads rank the two project tributaries as the first (Portage Creek) and sixth (Arcadia Creek) largest contributors of phosphorus to the river. This project has improved the water quality by significantly decreasing the amounts of PCBs and phosphorus from its watershed.
- The Allegan Conservation District received a $116,400 grant with a $15,100 match to develop a watershed plan. Water quality impairments include degraded indigenous aquatic habitat and biotic diversity, reduced fish populations, excessive nutrients and high flow.
- The W.K. Kellogg Biological Station Extension Land & Water Program at Michigan State University received a $249,000 grant with an $85,100 match to support supported coordination, communication and education efforts for multi-faceted implementation activities of the Kalamazoo River/Lake Allegan phosphorus Total Maximum Daily Load (TMDL) that was approved in 2001.
- The City of Portage, Michigan was awarded a grant to implement best management practices (BMPs) in a developing area to improve Consolidated Drain Number 1, enhance a trailways area, and educate the public on water quality issues. The project resulted in annual load reductions of 40 tons of sediment, 256 pounds of phosphorous, and 680 pounds of nitrogen.

Kalamazoo River Area of Concern Activities

Location
- From Morrow Dam, which forms Morrow Pond and extends 80 miles downstream to Lake Michigan.

AOC Primary Contaminants
- PCBs
- Phosphorus
- Sediments

AOC Stressors
- Nonpoint pollution
- Sediments
- Contaminated sediment landfills

AOC Relevant Programs
- Superfund
- Clean Water Act
- Brownfields
- Natural Resource Trustee's Damage Assessment

AOC Clean-up Actions
- Superfund removal of 150,000 cubic yards of PCB-contaminated sediments from Bryant Mill Pond
- Nonpoint pollution projects Erosion control programs, and stormwater management projects
- A phosphorus TMDL for Lake Allegan and the river upstream has been established; measures are being implemented to reduce phosphorus pollution from point and nonpoint sources
- Remedial action at several Operable Units (OUs) along the river
- Watershed management projects in several sub-basins reduce pollutant inputs and develop beneficial land use measures

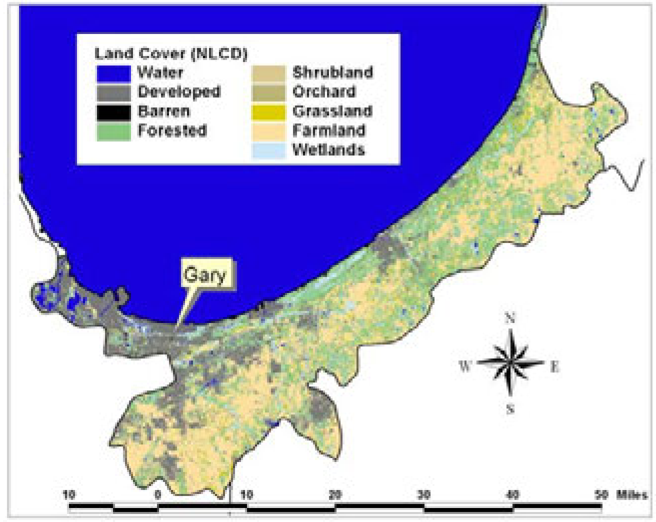
AOC Key Activities Needed
- Dredging/ Excavation
- Superfund site cleanup decision action
- Stream buffers
- Dam removal

AOC Challenges
- PRP court case
- Local funding match for federal projects
- Decisions on the remediation of this Superfund Site have effectively been on hold for the past several years

AOC Next Steps
- Continue NRDA assessment
- Finish remedial investigation/ remedial action
- Investigate strategy and determine action
- RAP to be revised in 2006
- Kalamazoo River/Lake Allegan TMDL (Total Maximum Daily Load) program pursuing water-quality data collection

Little Calumet – Galien Watershed

Hydrologic Unit Code: 04040001

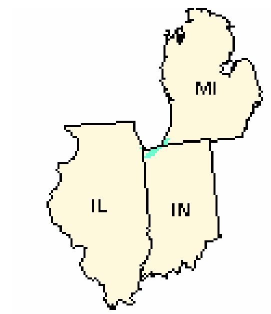


For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04040001or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/054, "A Biological Survey Sites in the Galien River Watershed, Berrien County, Michigan, July 2002".

Watershed Management Plans

- Galien River — The Conservation Fund — www.chikamingopenlands.org
- Berrien County Drain Commissioner — www.berriencounty.org

Watershed Groups



- Grand Cal Task Force
- Save the Dunes Council — www.savedunes.org
- Chicago Wilderness — www.chicagowilderness.org
- Chikaming Open Lands — www.chikamingopenlands.org
- Great Lakes Center for Environmental and Molecular Sciences (GLEAMS) — gleams.altarum.org
- Northwestern Indiana Regional Planning Commission — www.nirpc.org
- Northeastern Illinois Planning Commission — www.nipc.org/environment

Watershed Overview / Ecology / Biodiversity

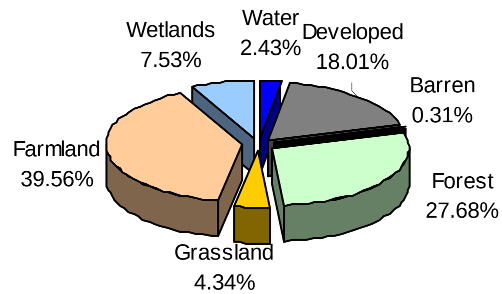
- Urban areas include Chicago, Gary, Michigan City, and Valparaiso.
- Most coastal wetlands and nearshore aquatic habitats have been eliminated or degraded. Presettlement northwest Indiana was continuous wetland. As of 1979, less than 5 percent of the original wetland cover remained. This exists primarily as narrow strips of intact habitat. Industry filled or drained the wetlands and leveled the dunes and used steel slag to fill low areas and the lakefront. The region is one of the most industrialized in the Lake Michigan basin.
- The watershed includes a Great Lakes Area of Concern. Problems in the AOC include contamination from polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs) and heavy metals, such as mercury, cadmium, chromium and lead. Additional problems include high fecal coliform bacteria levels, biochemical oxygen demand (BOD) and suspended solids, oil and grease. Nonpoint sources include contaminated sediment, industrial waste site runoff, CERCLA sites, hazardous waste sites under RCRA, underground storage tanks (USTs), atmospheric deposition, urban runoff, and contaminated groundwater. Point sources of contaminants include industrial and municipal wastewater discharges and combined sewer overflows (CSOs).
- The AOC begins 15 miles (24 km) south of downtown Chicago and includes the east branch of the river, a small segment of the west branch and the Indiana Harbor and Ship Canal. Today, 90% of the river's flow originates as municipal and industrial effluent, cooling and process water and storm water overflows. Although discharges have been reduced, a number of contaminants continue to impair the AOC.
- The Indiana Dunes National Lakeshore has more plant species (including exotics) than all but two other national parks, and at 16,000 acres is much smaller than most other national parks.
- Warren Dunes State Park provides 1,950 acres of recreational opportunities along the beautiful shore of Lake Michigan in southwestern Michigan. The rugged dune formation rises 240 feet above the lake The park has more than two miles of shoreline, six miles of hiking trails and is open year-round.
- The Indiana Dunes contains Mesic Sand Tallgrass Prairie and Black Oak / Lupine Barrens, sandy beach/dunes with sand and gravel lag over clay nearshore, sandy beach/dunes with sand/gravel nearshore, and sandy coastal dune streams. Other important communities at the Indiana Dunes include Black Oak / Lupine Barrens, Cottonwood Dune, Great Lakes Beach, Great Lakes Beachgrass Dune, Great Lakes Dune Pine Forest, Great Lakes Pine Barrens, Inland Coastal Plain Marsh, Interdunal Wetland, Lakeplain Wet Prairie, Lakeplain Wet-Mesic Prairie, Mesic Sand Tallgrass Prairie, Midwest Acid Seep, Midwest Cattail Deep Marsh, Midwest Dry Sand Prairie, Midwest Dry-Mesic Sand Prairie, Midwest Sand Barrens, Northern (Great Lakes) Flatwoods, Sand Cherry Dune Shrubland, and White Pine - Red Oak Forest.

- The Indiana Dunes is an important migratory bird stopover site and raptor stopover site. The Indiana Dunes is home to critical species including the Upland Sandpiper, American Bittern, Chuck-wills-widow, Whip-poor-will, Black Tern, Northern Harrier, Pitcher's thistle, Marsh Wren, Sedge Wren, Prairie Warbler, Chestnut-sided Warbler, Peregrine Falcon, Karner blue butterfly, Red-headed Woodpecker, Bog bluegrass, Prothonotary Warbler, Reticulated or netted nutrush, Louisiana Waterthrush, Caspian Tern, Prairie fame-flower, Golden-winged Warbler, Blue-winged Warbler, Canada Warbler, and Hooded Warbler.
- Indiana Tolleston in Lake County is home to Pale false foxglove, Karner blue butterfly, Blanding's Turtle, Byssus skipper, Great Plains ladies' tresses, Hill's thistle, and Ottoe's skipper. Important plant communities at Indiana Tolleston include Black Oak / Lupine Barrens, Bulrush - Cattail - Burreed Shallow Marsh, Central Cordgrass Wet Sand Prairie, Hardhack Shrub Prairie, Interdunal Wetland, Lakeplain Wet Prairie, Lakeplain Wet-Mesic Prairie, Mesic Sand Tallgrass Prairie, Midwest Cattail Deep Marsh, Midwest Dry Sand Prairie, Midwest Dry-Mesic Sand Prairie, Midwest Mixed Emergent Deep Marsh, Midwest Sand Barrens, Northern (Great Lakes) Flatwoods, Northern Buttonbush Swamp, Temporary Herbaceous Pond, and Tussock Sedge Wet Meadow.
- The Hoosier Prairie in Lake County, Indiana is home to the Pale false foxglove, identified by the Nature Conservancy as a critical species in the Great Lakes basin.
- Important Hoosier Prairie plant communities include Black Oak - White Oak / Blueberry Forest, Black Oak / Lupine Barrens, Central Cordgrass Wet Sand Prairie, Lakeplain Wet Prairie, Lakeplain Wet-Mesic Prairie, Mesic Sand Tallgrass Prairie, Midwest Dry Sand Prairie, Midwest Dry-Mesic Prairie, Midwest Dry-Mesic Sand Prairie, Midwest Mixed Emergent Deep Marsh, Midwest Sand Barrens, Northern (Great Lakes) Flatwoods, Northern Buttonbush Swamp, and Twigrush Wet Meadow. Important specieis at Hoosier Prairie include Blanding's Turtle, Blue-spotted Salamander, Earleaf foxglove, Henslow's Sparrow, Karner blue butterfly, Byssus skipper, Eastern Massasauga, Eastern massasauga, Hall's bulrush, Karner blue butterfly, Pitcher's thistle, Prairie fame-flower, and Reticulated or netted nutrush, and Northern Leopard Frog.
- The Nature Conservancy identified the following critical environmental resources in the watershed.
  - The Galien River has Great Lakes Shoreline Cattail Marsh
  - The Warren Dunes-Grand Mere has a land bird stopover site
  - The Warren Dunes-Grand Mere has Acadian Flycatcher, American Woodcock, Baltimore Oriole, Black-billed Cuckoo, Blue-winged Warbler, Canada Warbler, Cerulean Warbler, Chimney Swift, Eastern Wood-Pewee, Field Sparrow, Hooded Warbler, Least Flycatcher, Louisiana Waterthrush, Marsh Wren, Prairie Warbler, Prothonotary Warbler, Red-headed Woodpecker, Rose-breasted Grosbeak, Veery
  - Warbling Vireo, Willow Flycatcher, Wood Duck, Wood Thrush, Worm-eating Warbler, Yellow-billed Cuckoo, Yellow-throated Warbler, and Pitcher's thistle.

Watershed Activities / Concerns / Priorities

- The US Army Corps of Engineers (USACE) is in process of dredging the sediments from the Indiana Harbor and Ship Canal in order to continue its use as a navigable waterway.
- The Galien River Watershed Project is focused on decreasing drainage and flooding problems along the river and the streams flowing into it. The focus of a 319 grant is flood prevention and improved water quality in the system. Beneficiaries will be local farmers and those interested in fishing and other recreational activities.
- Save the Dunes Conservation Fund developing a watershed plan for the Dunes Creek watershed. Also included in the project will be a study to assess the efficacy of a pilot wetland restoration site along a section of Dunes Creek. study results will be included in the final written summary project report. Public outreach activities will include outreach brochures, news releases about the project, and quarterly newsletters, e-mail, or website articles.

Land Cover: Little Calumet – Galien



Watershed Size: 723 sq miles.

Between 1996 and 2001, there has been a slight increase in developed land, and wetland and a slight decrease in cultivated land, and grassland.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Impaired (303d) Waters

Waterbody Name	Impairment
Galien River, MI	Chlordane Fish Consumption Advisory, PCB Fish Consumption Advisory
Lake Michigan — Warren Dunes State Park Beach, MI	Pathogens
Sawyer Creek, MI	Oil
Burns Ditch, IN	E. Coli, Mercury Fish Consumption Advisory PCB Fish Consumption Advisory
Clark Ditch and Other Tribs, IN	E. Coli
Coffee Creek Basin, IN	E. Coli
Damon Run –Swanson Lamporte Ditch, IN	E. Coli
Damon Run and Trib, IN	E. Coli, Impaired Biotic Communities
Deep River, IN	E. Coli
Deep River, IN	Impaired Biotic Communities, Siltation
Deep River US30, IN	E. Coli
Main Beaver Dam Ditch Above Niles Ditch, IN	Impaired Biotic Communities
Main Beaver Dam Ditch Above Crown Point WWTP, IN	Impaired Biotic Communities
Marquette Park Lagoons (East and West), IN	PCB Fish Consumption Advisory
Munson Ditch, IN	E. Coli, Impaired Biotic Communities
Niles Ditch, IN	Impaired Biotic Communities
Potage Burns Waterway, IN	E. Coli, PCB Fish Consumption Advisory Mercury Fish Consumption Advisory
Rice Lake Tribs and Outlet, IN	E. Coli
Salt Creek, IN (Five Locations)	E. Coli, Impaired Biotic Communities
Trail Creek	E. Coli, PCB Fish Consumption Advisory, Mercury Fish Consumption Advisory
Trail Creek Trib. Basin, IN	Impaired Biotic Communities
Trail Creek—Merrillville, IN	E. Coli, Impaired Biotic Communities
Turkey Creek, IN	E. Coli, Impaired Biotic Communities
West Branch Trail Creek and other Tribs, IN	E. Coli
West Branch Trail Creek— Waterford Creek, IN	E. Coli
Wolf Lake,IN	PCB Fish Consumption Advisory
Calumet, IL	PCBS
Calumet River, IL	PCBS, Flow Alteration, Habitat Alterations
Calumet River, IL	PCBS, Organic Enrichment/Low Dissolved Oxygen, Habitat Alterations
Wolf, IL	PCBS

Grand Calumet River Area of Concern Activities

Location
- Grand Calumet River: Lagoon, East Branch and West Branch Indiana Harbor and Ship Canal, The Lake George Branch of the Canal, Wolf Lake, George Lake and Nearshore Lake Michigan.

AOC Primary Contaminants
- PCBs
- PAHs
- Mercury
- Cadmium
- Chromium
- Lead
- Pathogens
- Biochemical oxygen demand
- Suspended solids
- Oil and grease

AOC Stressors
- Contaminated Sediments
- Combined Sewer Overflows
- Contaminated groundwater
- Contaminated land sites
- Habitat Fragmentation
- Fire Suppression
- ANS

AOC Relevant Programs
- Superfund
- RCRA
- Clean Water Act
- WRDA
- Navigational Dredging
- Natural Resource Trustee's Damage Assessment

AOC Clean-up Actions
- USX dredging
- West Branch Remediation – 14,200 cubic yards of sediment remediated
- U.S. Steel Gary Works dredging of 5 river miles on the East Branch complete.
- GSD Sed. Remediation
- Navigational dredging
- LTV cleanup
- U.S. Lead - 19,000 cubic yards of sediment have been remediated
- A total of 700,000 cubic yards of sediment have been remediated
- IDEM is including additional CSO requirements in discharge permits as they are renewed in the basin pursuant to a state CSO Strategy.

AOC Key Activities Needed
- Dredging
- CSO Long Term Control Plans
- Issue NPDES Permits
- BUI Indicator Monitoring
- TMDL underway
- West Branch assessment
- Coordination with RAP program for AOC delisting purposes

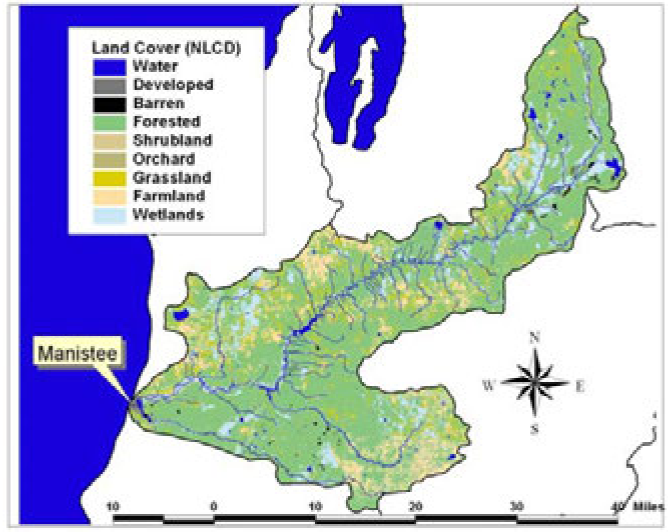
AOC Challenges
- Public concern regarding location of contaminated material disposal
- Local funding and match for federal projects
- Legal concerns
- Permitting
- Monitoring resources
- The draft Water Quality Component of Stage Two includes some provisions being implemented through indirect methods; direct resources for implementation have been limited.

AOC Next Steps
- Dredging at USX complete
- NRDA- Complete PRP negotiations.
- ACOE- WRDA Diagnostic Feasibility Study
- USX-Build Corrective Action Management Unit
- GSD-Site Characterization
- TMDL-Resolve modeling issues
- Monitor BUI Indicators
- ECI slurry wall
- The RAP process has developed and obtained funds for a Toxic Pollution Prevention (TPP) Program.

Manistee River Watershed

Hydrologic Unit Code: 04060103

For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060103



Watershed Management Plans

- Little Manistee River — Conservation Resource Alliance
- Manistee River — Conservation Resource Alliance

Watershed Organizations

- Upper Manistee River Association
- Conservation Resource Alliance — www.rivercare.org
- Little River Band of Ottawa Indians — www.itcmi.org/thehistorytribal7.html
- Huron Pines Resource Conservation & Development Council — www.huronpines.org
- Northwest Michigan Council of Governments — www.nwm.org
- Little Manistee Watershed Conservation Council - www.lmwcc.org

Watershed Overview / Ecology / Biodiversity

- The Manistee River watershed covers 1904.04 square miles, with less than half of mile of Lake Michigan shoreline.
- Its predominant land use is forest.
- The watershed has just over 15 square miles of inland lakes
- It has 833 miles of waterways, 93 percent of which have been assessed.
- Two waterways are TMDL listed waterways. One is listed for one contaminant and one is listed for three contaminants.
- The Manistee is one of the most stable, high-quality, coldwater streams in the country. It is a groundwater-driven stream.
- Excessive sediment is a primary problem in the watershed, affecting fish reproduction, alters channel morphology, and impairs aquatic invertebrates. The primary sources are erosion from degraded streambanks and poorly designed stream crossings.
- The Nature Conservancy identified the following critical ecological resources in the watershed:
- The Little Manistee River has Great Lakes Leatherleaf Intermittent Wetland.
- Critical communities of the Lower Manistee River include Great Lakes Hemlock - Beech - Hardwood Forest.
- Critical ecological systems of the Lower Manistee River include the lower reaches of Au Sable, Manistee, Muskegon Rivers, and the mainstems of Au Sable, Manistee, and Muskegon Rivers.
- Eastern Massasauga is found on the Manistee River.

Watershed Activities / Concerns / Priorities

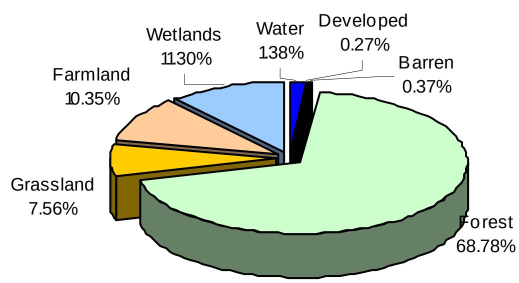
- Watershed Restoration work on the Manistee River is carried out by a diverse group of partners organized as members of the Upper Manistee River Restoration Committee. This committee is administered by Huron Pines RC&D and has actively worked on stabilizing streambanks, restoring access sites, and creating aquatic habitat.
- The river is designated as a natural river.
- The Little River Band of Ottawa Indians received a 319 grant to address four road-stream crossings that are failing, improve access to the river's edge, and reclaim a lake sturgeon spawning ground.
- The Little River Band of Ottawa Indians received one of the first 20 national watershed grants to support their efforts to restore and monitor the water quality of the Manistee River.

Impaired (303d) Waters

Waterbody	Impairment
Lake Margrethie	Mercury (Fish Tissue)
Manistee Lake	Pathogens PCBS Fish Consumption Advisory
Pine Lake	Mercury (Fish Tissue)

- The Conservation Resource Alliance (CRA) was awarded a Clean Michigan Initiative Grant for the Manistee River Watershed, including Bear Creek, for $696,691, utilizing $263,228 in local match, over a three-year period. Under this grant approximately 6 streambanks and 3 road/stream crossings within the Bear Creek Watershed will be repaired. Additionally, the CRA was awarded $80,000 in Ten Percent Funds from the U. S. Forest Service to repair 5 road/stream crossings in the watershed. CRA was also awarded a TEA 21 Grant from the Michigan Department of Transportation that includes money to address eroding road/stream crossings on Bear Creek.
- Three county Road Commissions are working cooperatively in the Pine River subwatershed to address traffic safety and water quality concerns simultaneously. With Phase 1 completed, Phase 2 has been granted $225,000 by the Michigan Department of Transportation to fix failing road/stream crossings in the Pine and Little Manistee watersheds.
- In 2002, two stream bank sites were restored by the Little Manistee River Watershed Partnership using 319 funds.
- Two stream bank sites were restored through the Pine River Watershed Restoration Project in 2002 for the Big Manistee River watershed. Design work began on three Osceola County road crossing sites to be implemented in 2003 or 2004. Site planning work on one additional streambank on the Pine is in progress, with implementation planned for 2004.
- A three year 319 project on the Manistee River was finished in 2002 by the Manistee River Watershed Partnership Project. The final project, a timber bridge over the north branch near Sharon was completed at a cost of over $320,000. The project was responsible for four large stream banks, and three large road crossings. In addition, the partnership was formed and signed by approximately 35 partners.
- In accordance with the Upper Manistee River Restoration Committee's scientific evaluation and proposed solutions, the Kalkaska Conservation District will repair eleven critical sites along Big Cannon Creek. This project was supported as a 2004 Great Lakes Basin Program Project.

Land Cover: Manistee River Watershed



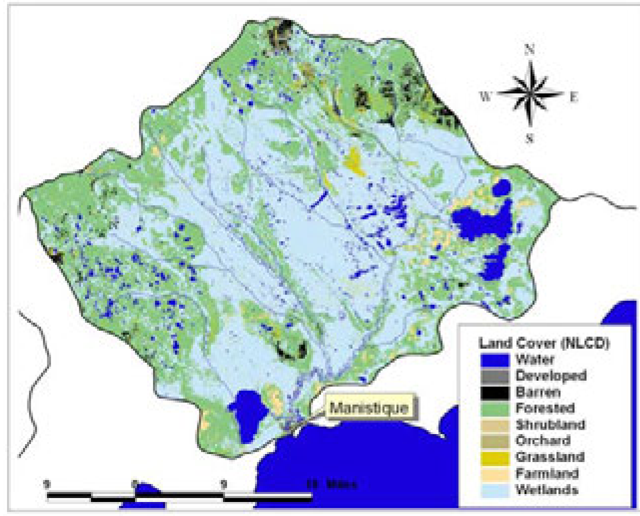
Total Acreage: 1906 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, and wetland and a slight decrease in cultivated land, grassland, and forest.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Manistique River Watershed

Hydrologic Unit Code: 04060106



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060106 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WB-05/106, "A Biological Survey of Manistique River Watershed, Luce, Mackinac, Alger, Schoolcraft, and Delta Counties, Michigan".

Watershed Groups

- Manistique River Chapter of the Michigan Statewide Public Advisory Council; Merilee Blowers, chair — www.glc.org/spac/spacmemb.html
- Manistique River Area of Concern — www.epa.gov/glnpo/aoc/manistique.html

Watershed Overview / Ecology / Biodiversity

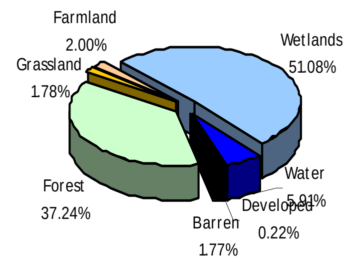
- The last 1.7 miles of the Manistique River from the dam to the mouth of the harbor at Lake Michigan is listed as an Area of Concern (AOC).
- Historical uses of Manistique River waters in the AOC include receiving wastes from sawmills, a paper mill, small industries, the municipal waste water treatment plant, plus navigation for shipping, ferrying, recreational boating and commercial fishing. Current uses include receiving the wastewater discharges from Manistique Papers, Inc. and the City of Manistique Wastewater Treatment Plant. Recreational uses are mainly boating, sightseeing, and fishing.
- Approximately 111,000 cubic yards of PCB contaminated sediments have been removed from the river and harbor from 1994-2000.
- The dredging of contaminated sediments was completed at the end of 2000. Final dredging was done by divers with hydraulic hoses to minimize resuspension of PCBs and to ensure a clean substrate when completed.
- Contractors working under EPA supervision will soon begin taking water and sediment samples in the harbor and in the river up to the first bridge. EPA will use the results of this sampling project to develop ecological and health risk assessments. These, in turn, will be used to prepare a long-term plan for monitoring the river and the harbor, and ensure the effectiveness of the harbor cleanup.
- The Seney National Wildlife Refuge is upriver of Manistique. The refuge is 95,455 acres of field and secondary growth forest. Almost two-thirds of the refuge is comprised of varying types of wetlands that provide habitat for threatened and endangered species and a variety of wildlife. The refuge is home to 26 fish species, 50 mammalian species, and 200 bird species, including eagles, loons, and trumpeter swans.
- Historically, a majority of forestland in the Manistique headwaters was logged and subsequent fires burned over the land leaving behind many white pine stump fields. Relic white pine stumps are slowly being overcome by forest again.
- The Nature Conservancy identified the following critical ecological resources in the watershed:
    - Seney Fens and East Branch Fox River have White Pine / Blueberry Dry-Mesic Forest
    - Critical ecological systems include the lower reaches of Taquamenon and Manistique Rivers and
    - Seney sand lake plain streams
    - Critical specie at the Seney Fens and East Branch Fox River - Auricled twayblade

Watershed Activities / Concerns / Priorities

- Restrictions on fish and wildlife consumption that include an advisory recommending no consumption of carp from the Manistique River bellow M-94/Old U.S. 2 and an advisory for consumptions on channel catfish (below M-94/Old U.S. 2) for women and children, and consumption restrictions on northern pike (upstream from dam at Manistique) for all persons.
- There are beach closings and restrictions on recreational access due to the presence of PCBs at the site and the combined sewer overflow (CSO) pipe located within the AOC that can discharge sewage during storms and during the spring runoff. The AOC is on the list of Michigan Sites of Environmental Contamination identified under Public Act 307. It is one of the highest ranking sites in the state.

- The Manistique River RAP found that the main problem contributing to fishery use impairment was PCBs. Aquatic nuisance species also threaten the fishery productivity. The presence of sawdust in the water and in the sediments severely degrades plant and animal habitat. The dam at the head of the old flume restricts fish passage but effectively blocks lamprey from the upper river.
- There are plans to phase out combined sewer systems by 2020.
- A study conducted in 1994 showed 115 erosion sites covering 10,821 feet of stream bank that contributes an estimated 3,000 tons of sediment each year to the Driggs River, which is a tributary to the Manistique River. The Clean Michigan Initiative and federal 319 Grant program contributed funds to support a project whose goal was to stabilize four of the most severely eroding stream banks on the Driggs River to reduce sediment loading. This project resulted in the stabilization of 1,273 linear feet of stream bank.

Land Cover: Manistique River Watershed



Watershed size: 1466 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and grassland, and a slight decrease in forest.

Impaired (303d) Waters

Waterbody Name	Impairment
Manistique River	Mercury, Mercury (Fish Tissue), Pathogens
North Manistique Lake	Mercury (Fish Tissue)
West Branch Lakes	Mercury (Fish Tissue)

Manistique River Area of Concern Activities

Location

- The last 1.7 miles of the river to the mouth of the harbor at Lake Michigan

AOC Primary Contaminants
- PCBs
- Heavy metals
- Pathogens

AOC Stressors
- Combined sewer overflow
- Sediments
- PCB-contaminated sawdust
- Wastewater discharges

AOC Relevant Programs
- Superfund

AOC Clean-up Actions
- Dredging of contaminated sediments completed in 2001 (141,000 cubic yards)
- Manistique Wastewater Treatment Plant made improvements to its system toward elimination of CSOs.

AOC Key Activities Needed
- Sampling and monitoring

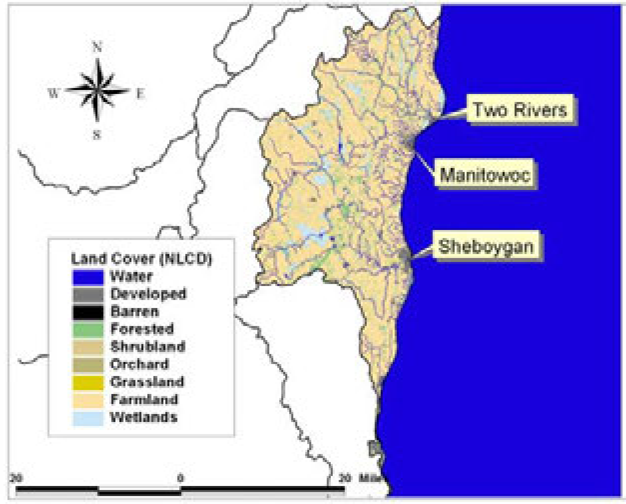
AOC Challenges
- Navigational dredging
- CSO to be closed by 2020
- Coordination with RAP program for AOC delisting purposes

AOC Next Steps
- Sampling and monitoring continuing as part of delisting process

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Manitowoc-Sheboygan Watershed

Hydrologic Unit Code: 04030101



For more information, see the USEPA website at
http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030101

- The Wisconsin DNR divides the Sheboygan-Manitowoc watershed (as defined by the USGS) between the Sheboygan basin management area and the Lakeshore basin management area. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- Sheboygan River Basin Partnership — www.sheboyganrivers.org
- Lakeshore Basin Website — basineducation.uwex.edu/lakeshore
- Lakeshore Natural Resource Partnership — www.lnrp.org
- Sheboygan River Basin DNR Team — www.dnr.state.wi.us/org/gmu/sheboygan
- Vic Pappas , Sheboygan River Basin Water Team Leader — Victor.Pappas@dnr.state.wi.us
- Deb Beyer, UW Extension Basin Educator, Lakeshore & Sheboygan Basins — deb.beyer@ces.uwex.edu

Watershed Overview

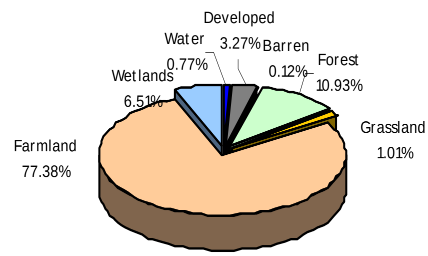
- The major tributaries of the watershed include the Branch River, the North and South branches of the Manitowoc River, the Lower Manitowoc River, Sevenmile and Silver Creeks, (all in the Manitowoc sub-watershed) Sauk and Sucker Creeks, the Black River,the Sheboygan River, the Onion River, the Mullet River, and the Pigeon River (in the Sheboygan River subwatershed).
- Predominant land uses are agricultural or rural and include pasture land, cropland and vacant fields. Natural Areas, including open water, woodlands, wetlands, parklands and undisturbed non- agricultural lands are the second most abundant land use.
- The Natural Heritage Inventory has documented 10 endangered, 20 threatened and 37 special concern plant and animal species, and 24 rare aquatic and terrestrial communities within the Sheboygan River basin.
- Runoff from specific and diffuse sources, contaminated sediment, habitat modifications (such as channelization and dams) have degraded water quality throughout the Basin.
- Recreational highlights include wildlife watching, hiking, fishing, birding, bicycling, golf, horseback riding, snowmobiling, skiing, camping, picnicking and water sports.
- State facilities such as the Kettle Moraine State Forest, Kohler- Andrae State Parks, Harrington Beach State Park, various state wildlife areas, and the Ice Age National Scenic Trail provide both satisfying and unique recreational experiences.
- The Basin includes the Southeast Glacial Plains and Northern Lake Michigan Ecological Landscapes.
- Some streams have the ability to support trout populations. Others have spring and fall runs of stocked steelhead and salmon. Fishing opportunities exist in rivers and harbors for northern pike, small mouth bass, and yellow perch.
- Wildlife include white- tailed deer, ring- necked pheasant, waterfowl, geese, gray and flying squirrels, raccoons, woodcock, a variety of hawks, songbirds, and shorebirds.
- Grasslands and barrens are promoted through prescribed burns and mowing.
- The Nature Conservancy identified critical habitats of Black Ash - Mixed Hardwood Swamp, Great Lakes Dune Pine Forest, Great Lakes Hemlock - Beech - Hardwood Forest, Great Lakes Beachgrass Dune and Great Lakes Beach as well as baymouth/barrier beaches with sand nearshore at Point Beach State Park.
- The Nature Conservancy identified Pitcher's thistle and the piping plover as critical species at Point Beach State Park.
- The Sheboygan River Area of Concern (AOC) encompasses the lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and nearshore waters of Lake Michigan . The AOC serves as a sink

for pollutants carried from three watersheds: the Sheboygan River, Mullet River and Onion River. Pollutants of concern, both conventional and toxic, have been identified as: suspended solids, fecal coliform bacteria, phosphorus, nitrogen, PCBs, PAHs and heavy metals.

Watershed Priorities

- Identified Environmental concerns for the Sheboygan River management area include:
  - Water quality problems are from in- place pollutants, runoff in urban areas, floodplain development, and agricultural practices.
  - Preservation of biodiversity and protection of endangered and threatened species, this is done by preserving their habitat.
  - A need for comprehensive approach to wetlands protection and restoration.
  - Educate people to help prevent the spread of exotic nuisance species, which can wreak havoc on ecosystem balance.
  - Monitoring of wildlife populations, water quality, and ecosystem function are needed to understand the status and trends of resources in the basin.
- Partnership priorities for the Sheboygan River Basin include:
  - Educate members and the public about the ecology of the Sheboygan River Basin and threats to its health.
  - Promote sustainable use and recreation in the Sheboygan River Basin and its watersheds.
  - Increase public awareness and membership.
  - Promote sound decision-making when issues affect the health of the basin's rivers and watersheds.
  - Support the protection and improvement of the Sheboygan River Basin and its watersheds for the benefit of the general public.
  - Develop a working relationship with local officials and collaborate with conservation organizations.
  - Promote improved health of the rivers and watersheds through conservation projects and education.
  - Purchase or promote the purchase of land or easements for conservation purposes.

Land Cover: Manitowoc-Sheboygan Watershed



Total Acreage = 1652 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, wetland, and grassland and a slight decrease in farmland and forest.

Impaired (303d) Waters

Waterbody Name	Impairment
Big Elkhart Lake	Mercury Fish Consumption Advisories
Branch River in Maitowoc Co.	PCB Fish Consumption Advisories
Bullhead Lake	Mercury Fish Consumption Advisories
Crystal Lake	Mercury Fish Consumption Advisories
East Twin River Upstream To First Dam	PCB Fish Consumption Advisories
Grandma Creek	Phosphorus, Degraded Habitat, Organic Enrichment/Low Dissolved Oxygen, Sediment
Jordan Creek	PCB Fish Consumption Advisories
Lake Michigan	Mercury Fish Consumption Advisories PCB Fish Consumption Advisories
Manitowoc River	Aquatic Toxicity, PAHS
Manitowoc River (Mouth to N. Branch)	PCB Fish Consumption Advisories
Manitowoc River (N. Branch to Chilton)	PCB Fish Consumption Advisories
Manitowoc N. Branch	Phosphorus, Degraded Habitat, Organic Enrichment/Low Dissolved Oxygen, Sediment
Otter Creek	Bacteria
Pigeon Lake	Mercury Fish Consumption Advisories
Pine Creek	PCB Fish Consumption Advisories
Pine Creek	PCB Fish Consumption Advisories
Sheboygan River	PCB Fish Consumption Advisories
Sheboygan R. Below Franklin Downstream To Sheboygan Falls	PCB Fish Consumption Advisories
Two Rivers Harbor	Aquatic Toxicity
Unnamed Trib (Osman Trib) to Meeme River	Phosphorus, Degraded Habitat, Organic Enrichment/Low Dissolved Oxygen, Sediment
Unnamed Trib to Onion River in Waldo Impoundment	Degraded Habitat, Sediment
Unnamed Trib, to S. Br. Manitowoc (T18N, R19E, Sec 24	Degraded Habitat, Sediment
West Twin River	Phosphorus, Organic Enrichment/Low Dissolved Oxygen

Restoration Activities

- The Upper River Segment, Sheboygan River Superfund Clean-up Project was remediated
- The Willow Creek Watershed Project
- The Upper Onion River Trout Restoration Project
- Otter Creek--Impaired Water Priority/Barnyard Relocation Project
- As a 2004 Great Lakes Basin Program Project, the town of Centerville will work with landowners along the Fischer and Point creeks to construct four miles of 70-foot harvestable buffersto educate landowners about the benefits of buffers using a brochure and a public harvest demonstration.
- The Manitowoc County Circuit Court ruled that Wisconsin's Department of Natural Resources did not adequately review the potential air and water pollution caused by the proposed expansion of Maple Leaf Dairy from 2800 to 9000 cows. It is believed that the expansion will aggravate existing water pollution in Fischer Creek and Point Creek and contribute to Lake Michigan beach closings in the area.
- In 2005, Pollution Risk Services (PRS) completed Phase I of the Sheboygan Superfund Site clean up of the Upper River. All PCB hot spots on the upland portion of the river bank at the former Tecumseh plant site have been remediated and a trench has been dug to intercept and test groundwater exiting the site. Phase II, including the removal, dewatering, and disposal of 35,000 cubic yards of soft sediment and armored materials from the Upper River, is planned for 2006.
- The Sheboygan River Basin Partnership (SRBP) has embarked with WDNR on an information and education effort for Willow Creek, a small tributary to the Sheboygan River that has its confluence in the AOC. The creek receives annual runs of trout and salmon from Lake Michigan, and recent fish surveys discovered the presence of young brook trout and salmon, which seemed to indicate at least some amount of natural reproduction. It appears that stream improvements are possible in some of the degraded sections and SRBP has been meeting with landowners and local municipal officials to discuss projects in the watershed. In addition, the SRBP is seeking grant funds to conduct additional stream studies.
- Numerous actions have been completed or are underway to restore the headwaters of the Onion River, a tributary to the Sheboygan River, which is a trout stream. The improvements are part of an overall strategic plan spearheaded by the Lakeshore Chapter of Trout Unlimited and numerous other partners. Some of the improvements include public land acquisition, removal of ponds and small dams, installation of lunker structures and farm runoff management practices. Recent trout surveys indicate that a newly instituted fishing regulation change on the river has protected many fish from harvest. The hope is that more adult trout will be available to boost natural reproduction of trout in the system.
- In 2005, WDNR and the Sheboygan County Land and Water Conservation Department worked with a local farmer to relocate a barnyard and grazing area along the banks of Otter Creek. Otter Creek is a tributary to the Sheboygan River and is listed as a 303d impaired waterway primarily due to bacteria contamination. Grant dollars for the state portion came from Wisconsin's Environmental Damages Compensation Fund. The county and the landowner also shared in the cost of the project.

Sheboygan River Area of Concern Activities

Location
- The lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and nearshore waters

AOC Primary Contaminants
- Suspended Solids
- PCBs
- PAHs
- Heavy Metals
- Pathogens
- Phosphorus

AOC Stressors
- Industrial & agricultural runoff
- Habitat restoration on streambanks and wetland areas

AOC Relevant Programs

- Superfund
- Clean Water Act #319

AOC Clean-up Actions

- Partial removal of PCB-contaminated sediments
- Agency decision (2001)
- 2004 Municipal stormwater permits for the Village of Kohler, Town of Sheboygan and Town of Wilson.

AOC Key Activities Needed

- Completion of PCB remediation
- Completion of PAH remediation at Camp Marina coal gasification site
- Control buffers
- Habitat protection
- NPS controls for urban and rural pollution

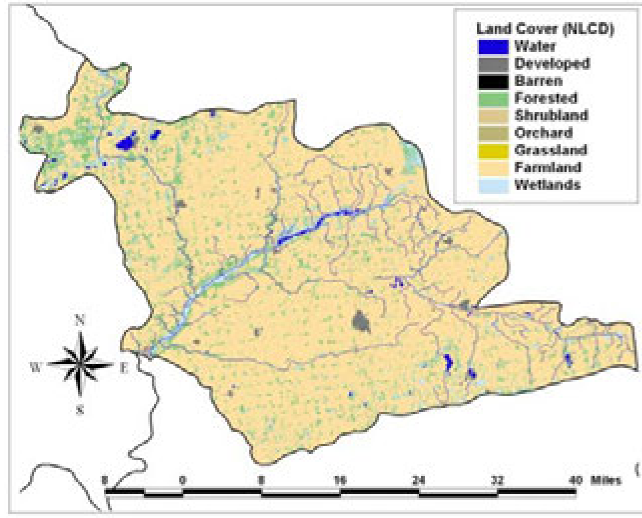
AOC Next Steps

- Complete dredging started in 2004
- Complete site clean-up and removal of preferential pathways
- Groundwater monitoring

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html); Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Maple River Watershed

Hydrologic Unit Code: 04050005

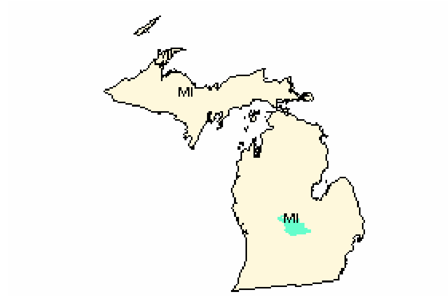


For more information see the USEPA website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050005 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/017, "A Biological Survey of the Maple River Watershed and Selected Tributaries, Shiawasse, Clinton, Montcalm, Gratiot, and Ionia Counties, Michigan, August 2002".

Watershed Groups

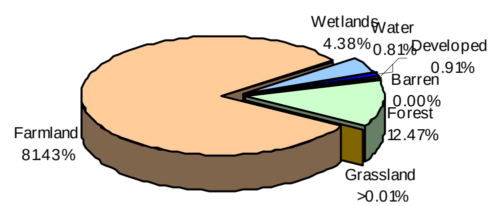
- Maple River Improvement Project, Conservation Resource Alliance — www.rivercare.org/aboutcra/projects/projects.php

Watershed Overview / Ecology / Biodiversity



- The Maple River watershed covers over 937 square miles.
- The watershed has 404 miles of waterways that flow year round.
- The watershed is over 81 percent agricultural.
- The Maple River watershed feeds into the Lower Grand River.
- According to the *"Hungerford's Crawling Water Beetle Draft Recovery Plan,"* U.S. Fish and Wildlife Service, August 2004, excessive erosion and sedimentation at degraded road crossings is a potential threat to the beetle's habitat in the Maple River. The West Branch of the Maple is known to support the best trout fishery and coldest water within the watershed. The current crossing is a system of 5 culverts which are critically failing to the extent that they are blocking fish passage. The undersized and failing culverts are causing flooding and consequent warming of upstream waters. The project involves replacing the existing culverts with a free-span structure which will accommodate the natural flow of the river. In addition, the embankments will be stabilized, and road runoff managed to reduce or eliminate sedimentation at the crossing.
- The Nature Conservancy identified the Maple River as a network of important medium-sized, lowland river with extensive riparian wetlands.

Land Cover: Maple River Watershed



Total Acreage: 937 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, forest and wetland, and a slight decrease in grassland.

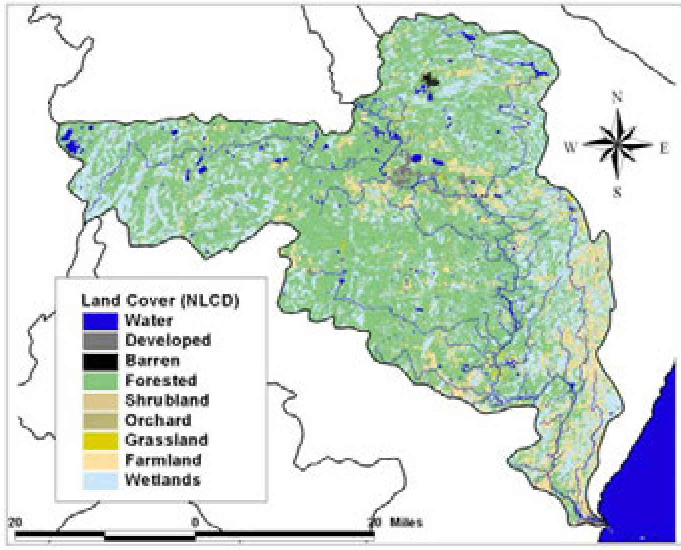
Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Impaired (303d) Waters

Waterbody Name	Impairment
Alder Creek	Phosphorus, Nuisance Plant Growths
Lost Creek	Phosphorus, Algal Growths, Bacterial Slimes Fish Community Rated Poor, Macroinvertebrate Community Rated Poor
Maple River	Phosphorus, Nuisance Plant Growths
Peet Creek	Phosphorus, Nuisance Plant Growths

Menominee River Watershed

Hydrologic Unit Code: 04030108



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030108 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/039, "A Biological Survey of selected Streams in the Menominee River Watershed, Dickinson County, 2002".

Watershed Management Plans

- Fumee Creek — Dickinson Conservation District — www.dickinsoncd.org
- Hamilton Creek — Dickinson Conservation District
- Pine Creek (Dickinson Co) — Dickinson Conservation District

Watershed Groups

- Dickinson Conservation District — www.dickinsoncd.org
- Hamilton, Fumee, and Pine Creek Watershed Projects — www.dickinsoncd.org/hamiltoncreek;
- www.dickinsoncd.org/fumeecreek; www.dickinsoncd.org/pinecreek
- Menominee River Area of Concern — www.epa.gov/glnpo/aoc/menominee.html
- Menominee River RAP, Great Lakes Commission — www.glc.org/spac/rapdocs.html

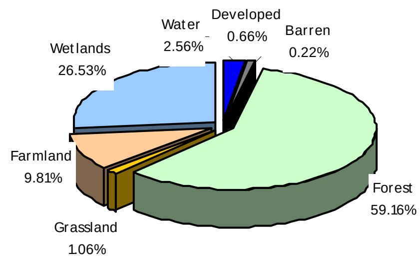
Watershed Overview / Ecology / Biodiversity

- The Menominee River forms the boundary between Wisconsin and the Upper Peninsula of Michigan in Marinette, Florence, Forest, Vilias, Menominee, Dickinson, and Iron counties before draining its contents into Lake Michigan.
- Historic iron mining in Menominee was a catalyst for growth in the watershed.
- Piers Gorge whitewater area is located in the watershed. It is often done as a big-water, carry-up park-and-play whitewater rafting area.
- The Menominee system is comprised of a number of large and small tributaries, the major tributaries being the Michigamme, Brule, Pine, Paint, Iron and Sturgeon Rivers. The Menominee originates at the confluence of the Michigamme and Brule Rivers and flows approximately 115 miles to the east towards the waters of Green Bay.
- The total basin covers approximately 4,070 square miles with 2,618 square miles located in Michigan and 1,452 square miles located in Wisconsin.
- The topography in the Menominee River basin was formed and heavily altered by periodic glaciation, the most recent of which was the Wisconsin period- 10,000-20,000 years ago.
- The region is characterized by lakes, glacial plains, end moraines, and poorly integrated east to west drainage. Bedrock outcrops and moraine deposits in the northern river basin create a more rugged terrain with a maximum elevation of 1300 feet, giving the basin a gradient of approximately five feet per mile. The Menominee basin consists mostly of sand and gravel called outwash which is underlain by dolomite.
- The Menominee River Area of Concern (AOC) includes the lower 4.8 km of the river from the Upper Scott Paper Company (Wisconsin) Dam to the river's mouth and approximately 5 km north and south of the mouth along the adjacent shoreline of Green Bay. The AOC also includes the cities of Marinette and Menominee, as well as the adjacent nearshore area of Green Bay, Wisconsin, extending three miles north and south of the river mouth.
- Active natural resource exploitation and land use changes occurred throughout the watershed in the mid-1800's. Iron ore deposits were discovered in the 1850's on the western edge of the Menominee Iron Range and numerous mines opened shortly thereafter particularly in the Iron Mountain, Michigan area.
- The logging era impacted water quality and physical habitat conditions in the . The rivers and streams were used extensively for log drives during the 1880's and 1890's.
- Some of the developed areas are constructed on man-made soils that were deposited during the lumbering boom around the turn of the century. These man-made soils are composed of sawdust and waste wood that was discarded and

then overlain with sand or topsoil as the building surface. These unstable soils have subjected many structures with excessive settling and alignment shifting.

- Two large impoundments are located on the Sturgeon River including Genes Pond and the Hardwood Reservoir. These impoundments modify river temperatures and influence downstream fish and macroinvertebrate communities. Warmwater fish species such as walleye, black crappie, and yellow perch are now common in the Sturgeon River downstream of these impoundments.
- Consistent with the Wilderness Shores Settlement (WSS), the Wisconsin Electric Power Company is required to remove a 65-foot dam located on the Sturgeon River near Loretto, Michigan. This dam removal project is scheduled to be complete by 2007.
- The major economic activities are logging, paper making, tourism, and potato farming.
- The Menominee is a sturgeon spawning area.
- The Nature Conservancy identified the Pine-Popple River as having a critical large, moderate groundwater small to medium-sized streams on outwash and coarse ground/end moraine.
- The Nature Conservancy identified the Lower Menominee River as a critical ecological system with riverine coastal marsh, Lake sturgeon, and Skillet clubtail.

Land Cover: Menominee River Watershed



Watershed size = 2285 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and farmland and a slight decrease in grassland, and wetland.

Watershed Activities / Concerns / Priorities

- The Wisconsin portion of the watershed is part of the Wisconsin DNR's Upper Green Bay basin management area.
- The Pine Creek Watershed Project is an ongoing effort to address non-point source pollution throughout the 48,000 acre watershed in south central Dickinson County, Michigan. The watershed received a Clean Michigan Initiative Grant targeting sediment and nutrient pollution caused by road crossings, forest harvest practices, agriculture, cropland erosion, ORV trail crossing, and eroding streambanks. The watershed has also received funding from an EPA Section 319 grant to promote education about Best Management Practices and non-point source pollution control.
- The Fumee Creek Watershed Project was awarded a two 319 grant and officially began the planning phase of the watershed project in October 2000. The goal of the Project is to protect and restore the creek and the lakes and streams within the watershed from further degradation due to non-point sources of pollution.
- The Hamilton Creek Watershed plan was funded by a 319 grant to reduce runoff in the watershed, reducing sediment, nutrients and heavy metals associated with this process; reduce erosion in the watershed, reducing sediment, nutrients and heavy metals associated with these processes; improve natural habitat for fish and wildlife within the watershed; and to promote stewardship activities in the watershed. The project is

Impaired (303d) Waters

Waterbody Name	State Impairment
Chalk Hills Impoundment (Menominee River), MI	Mercury (Fish Tissue)
Fumee Lake, MI	Mercury (Fish Tissue)
Hamilton Lake, MI	Mercury (Fish Tissue)
Menominee River, MI	Fish consumption advisory (PCBS) Mercury (Fish Tissue)
Unnamed Tributary to Porterfield Creek, MI	Phosphorus Algal Growth
Emily Lake, WI	Fish consumption advisory (Mercury)
Lower Menominee AOC, MI	Arsenic Fish Consumption Advisory (Mercury), PAHs
Menominee River (Pier's Gorge to Lower Scott Flowage, MI	Fish consumption advisory (Mercury) Fish consumption advisory (PCBs)
Menominee River in Marinette County, WI	Fish consumption advisory (Mercury) Fish consumption advisory (PCBs)
Sand Lake T38 R18E S21, WI	Fish consumption advisory (Mercury)
Sea Lion Lake, WI	Fish consumption advisory (Mercury)
Van Zile Lake, WI	Fish consumption advisory (Mercury)

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

planting native plants surrounding Lake Mary, surveying frog population, monitoring water quality, and mapping aquatic plants.

- Hannahville Indian Community has a water quality protection program for its reservation.

Menominee River Area of Concern Activities

Location

- Lower 4.8 km of river to the mouth and 5 km north and south of the mouth along the bay shore

AOC Primary Contaminants

- Arsenic
- Mercury
- PCBs
- Oil and grease
- Pathogens

AOC Stressors

- Sediments
- Coastal wetlands habitat loss
- Nonpoint pollution
- Historic shoreline developments to support harbor activities

- **AOC Relevant Programs**
- RCRA Corrective Action
- Superfund

AOC Clean-up Actions

- Arsenic remediation (33,000 cubic yards)
- Combined sewer overflow project

AOC Key Activities Needed

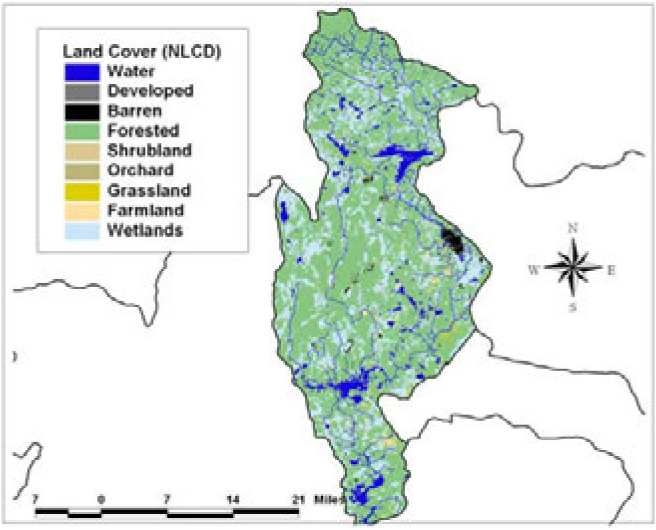
- Dredging
- Protect riparian and coastal habitat
- Pollution prevention

AOC Challenges

- Woody debris is present at the WPSC Marinette MGP Site, which may have hindered accurate determination of the sediment thickness
- Coordination with RAP program for AOC delisting purposes; bi-state coordination issues

AOC Next Steps

- Arsenic dredging completed
- Paint sludge deposit cleanup above river mouth



Michigamme River Watershed

Hydrologic Unit Code: 04030107

For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030107 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WD-03/032, "A Biological Survey of the Brule, Paint, and Michigamme River Watersheds, Iron and Marquette Counties, 2002".

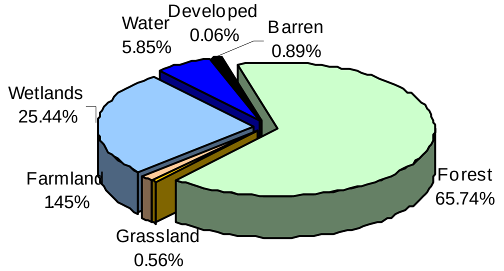
Watershed Groups

- Michigamme Highlands Project, The Upper Peninsula Conservation Program of The Nature Conservancy — www.nature.org
- Central Lake Superior Land Conservancy — www.clslc.org/projects.htm

Watershed Overview / Ecology / Biodiversity

- The Michigamme River watershed covers approximately 727 square miles.
- There are 465 miles of rivers and streams in the watershed.
- The Michigamme River system flows into the Menominee River watershed.
- Approximately 82 percent of the watershed is forested. The predominant vegetation in the hilly uplands are sugar maple, basswood, and yellow birch while the lowland vegetation is dominated by american elm, black ash, trembling aspen, and red maple. The vegetation of drier outwash sand plains include balsam fir, white pine, red pine, and paper birch.
- Forty percent of Michigan's "blue ribbon" trout streams are found in the Brule, Michigamme, and paint River systems.
- Most of the forested lands in the Michigamme watershed is owned by private forest product companies.
- Forestry, wood products, and tourism are the dominanat industries. Other major activities include winter sports, fishing, hunting, camping, boating, fall color tours, and sightseeing
- The watershed topography is characterized by sandy hills and elliptical ridges. These sandy deposits have high infiltration rates, can be up to 200 feet thick, and are a major source of cold groundwater to the rivers.
- The lower Michigamme River watershed has a large area of pitted and flat glacial outwash plains. Most of the streams originate in sedge and forested wetlands or sallow kettle lakes, which causes the water to appear strained from the presence of decaying plant material.
- Bedrock outcrops are common.
- Many abandoned mines can be found in the watershed.
- Most waters are heavily stained with tannins from wetland drainages.
- There are five listed impaired waters.
- Macroinvertebrate community status was assessed at 10 different sites within the Michigamme River watershed. Half received macroinvertebrate community ratings of "excellent," while the other half rated acceptable.

Land Cover: Michigamme River Watershed



Watershed Size: 727 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and forest and a slight decrease in farmland and forest.

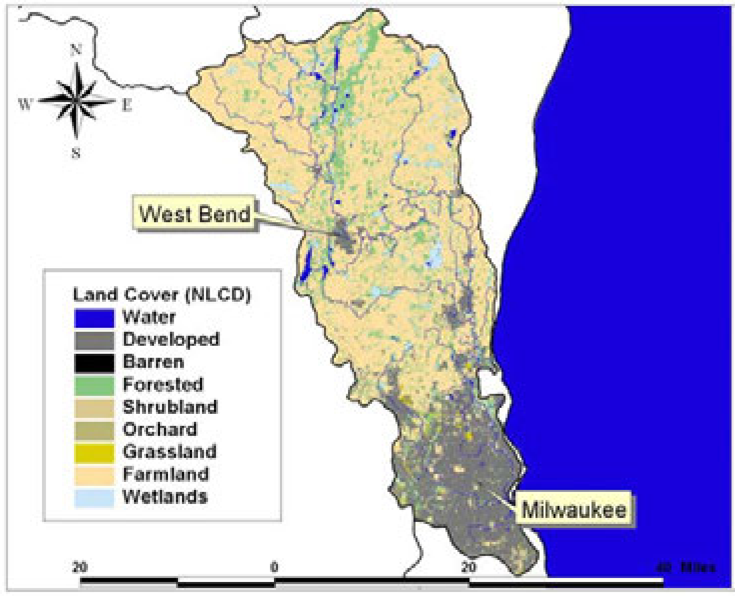
Impaired (303d) Waters

Waterbody Name	Impairment	Anticipated TMDL Submittal
Beaufort Lake	Mercury (Fish Tissue)	2011
Craig Lake	Mercury (Fish Tissue)	2011
Lake Michigamme (Michigamme River)	Mercury (Fish Tissue)	2011
Michigamm Reservoir (Michigamme River Imp.	Mercury (Fish Tissue)	2011
Michigamme River	Mercury (Fish Tissue)	2011
Peavy Pond	Mercury (Fish Tissue)	2011
Perch Lake	Mercury (Fish Tissue)	2011
Runkle Lake	Mercury (Fish Tissue)	2011
Unnamed Lake	Mercury (Fish Tissue)	2011

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Milwaukee River Watershed

Hydrologic Unit Code: 04040003



the USEPA “Surf Your Watershed” website at
http://cfpub.epa.gov/surf/huc.cfm?huc_code=04040003

The Milwaukee River basin is part of the Wisconsin DNR’s Milwaukee River basin management area. For more information, see the Wisconsin Department of Natural Resources’ “Wisconsin's Basins” website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- Friends of Milwaukee’s Rivers — www.mkeriverkeeper.org
- Milwaukee Metropolitan Sewerage District — www.mmsd.com
- Milwaukee River Basin Partnership — basineducation.uwex.edu/milwaukee
- River Revitalization Foundation — www.riverrevitalizationfoundation.org

Watershed Overview / Ecology / Biodiversity

- The Milwaukee River Basin encompasses almost 900 square miles of land in portions of Dodge, Fond du Lac, Milwaukee, Ozaukee, Sheboygan, Washington, and Waukesha counties.
- The southern quarter of the basin is the most densely populated area in the state, holding 90% of the basin’s population, which is approximately 1.3 million people.
- The Basin includes 6 watersheds, 3 of the watersheds (Milwaukee River North, Milwaukee River East- West, Milwaukee River South) contain the Milwaukee River from start to finish. The other three watersheds (Cedar Creek, Menomonee River and Kinnickinnic River) are named after the major rivers they contain.
- Collectively the six watersheds contain about 500 miles of perennial streams, over 400 miles of intermittent streams, 35 miles of Lake Michigan shoreline, 57 named lakes and many small lakes and ponds.
- The Natural Heritage Inventory has documented 16 endangered, 26 threatened and 65 special concern plant and animal species, and 30 rare aquatic and terrestrial communities within the Basin.
- The Milwaukee Estuary Area of Concern (AOC) includes: the lower 5 km of the Milwaukee River downstream of North Avenue Dam; the lower 4.8 km of the Menomonee River downstream of 35th Street; the lower 4 km of the Kinnickinnic River downstream of Chase Avenue; the inner and outer Harbor and the nearshore waters of Lake Michigan, bounded by a line extending north from Sheridan Park to the city of Milwaukee's Linnwood water intake.
- The AOC encompasses 57.5 km^2 or 2.6 % of the entire basin, including lands that drain directly to the AOC via storm sewers and combined sewer systems. This relatively small drainage area contributes disproportionately large amounts of pollutants associated with urban runoff.
- Runoff from specific and diffuse sources, contaminated sediment, habitat modifications (such as channelization and dams) have degraded water quality throughout the Basin.
- Recreational highlights include wildlife watching, hiking, fishing, hunting, bicycling, horseback riding, snowmobiling, skiing, camping, picnicking, and water sports.
- The Basin includes the Southeast Glacial Plains, Southeast Lake Michigan Coastal and Northern Lake Michigan Ecological Landscapes.
- Some streams have the ability to support some trout populations. Others have spring and fall runs of stocked trout and salmon. Fishing opportunities also exist in the rivers and harbors for northern pike, small mouth bass, and walleye.
- Wildlife include white- tailed deer, ring- necked pheasant, waterfowl, geese, gray and flying squirrels, raccoons, woodchucks, great horned owls, a variety of hawks, songbirds, and shorebirds.
- Grasslands are promoted through prescribed burns & mowing.
- Maple- basswood is the most common forest type and the tree species with the greatest volume in the Basin is ash followed by hard maple, basswood, soft maple and red oak.
- The Nature Conservancy identified the East Branch of the Milwaukee River and the Kettle Moraine Lakes as having have important groundwater/wetland fed headwater streams in ice contact and end moraine and critical kettle moraine lakes.

- The Milwaukee River Mainstem has critical moderate groundwater mainstems on till/lake plain; headwaters in ice contact/end moraine as identified by the Nature Conservancy.

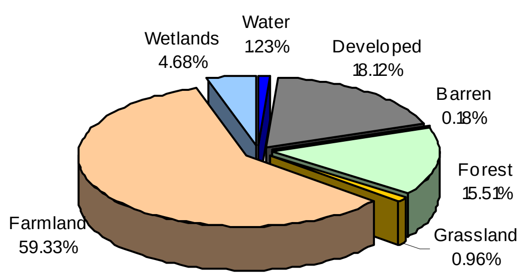
Watershed Activities

- Water quality problems are from in- place pollutants, runoff in urban areas, floodplain development, and agricultural practices. As people move to the more rural areas of the basin, groundwater quantity and quality issues will become very important.
- Preservation of biodiversity and protection of endangered and threatened species, this is done by preserving their habitat.
- A comprehensive approach to the protection and restoration of wetlands is needed.
- Educate people to help prevent the spread of exotic nuisance species, which can wreak havoc on ecosystem balance.
- Monitoring of wildlife populations, water quality, and ecosystem function are needed to understand the status and trends of resources.
- Milwaukee County Parks plans to stabilize and reconstruct approximately 0.25 miles of trail and vernal streambank; remove invasive exotic plant species; install erosion control geotextile; plant trees and shrubs and herbaceous plugs; and hold two single-day volunteer events per year to educate residents on the issues of erosion, invasive species and native plantings.
- The Milwaukee Metropolitan Sewerage District is leading a number of watershed-based prjects to reduce the number and frequency of combined sewer overflows

Impaired (303d) Waters

Waterbody Name	Impairment
Adell Tributary	Degraded Habitat, Sediment
Beaver Creek	Aquatic Toxicity
Cedar Creek	PCB Fish Consumption Advisories
Evergreen Creek(T11n R19e Sec 36 Sw Se)	Degraded Habitat, Sediment
Forest Lake	Mercury Fish Consumption Advisory
Indian Creek	Metals, Phosphorus, Aquatic Toxicity, Degraded Habitat, Organic Enrichment/Low Dissolved Oxygen, Sediment, Temperature
Jackson Park Pond	PCB Fish Consumption Advisory
Lehner Creek	Degraded Habitat, Sediment, Temperature
Lincoln Creek	Metals, Phosphorus, Aquatic Toxicity, Degraded Habitat, Organic Enrichment/Low Dissolved Oxygen, PAHS, Sediment, Temperature
Little Menomonee R.	Aquatic Toxicity, Creosote
Long Lake	Mercury Fish Consumption Advisory
Mauthe Lake	Mercury Fish Consumption Advisory
Milwaukee R. Estuary AOC (Outer Harbor to LM)	Metals, Aquatic Toxicity, Bacteria, PCB Fish Consumption Advisory
Milwaukee R. Estuary AOC (Menomonee River)	Metals, Phosphorus, Aquatic Toxicity, Bacteria Organic Enrichment/Low Dissolved Oxygen, PCB Fish Consumption Advisory
Milwaukee R. Estuary AOC (Kinnickinnic River)	Metals, Phosphorus, Aquatic Toxicity, Bacteria, Organic Enrichment/Low Dissolved Oxygen, PCB Fish Consumption Advisory
Milwaukee R. Estuary AOC (Milwaukee River)	Metals, Phosphorus, Aquatic Toxicity, Bacteria, Organic Enrichment/Low Dissolved Oxygen, PCB Fish Consumption Advisory
Milwaukee River	Bacteria PCBFish Consumption Advisory
Milwaukee River — Lime Kiln Dam Upstream	PCB Fish Consumption Advisory
Natural Channel Reaches	Degraded Habitat Sediment
Unnamed Trib to Cedar Cr.	Degraded Habitat Sediment
Zeunert Pond	Mercury Fish Consumption Advisory

Land Cover: Milwaukee River Watershed



Watershed size: 865 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, forest, and bare land and a slight decrease in grassland and wetland.

Data Sources. Land cover map and percentages: National Land Cover data-base, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Milwaukee Estuary Area of Concern Activities

Location

The lower 5 km of the Milwaukee River ; the lower 4.8 km of the Menominee River; the lower 4 km of the Kinnickinnic River; the inner and outer Harbor and the nearshore waters

AOC Primary Contaminants

- Phosphorus
- Pathogens
- PCBs
- Metals
- PAHs

AOC Stressors

- Urban and rural runoff
- Wastewater discharges
- Sediments
- Habitat loss
- Dams

AOC Relevant Programs

- Clean Water Act
- Clean Air Act
- Superfund
- Brownfields
- Navigational dredging

AOC Clean-up Actions

- Water pollution abatement
- Pollution prevention education begun
- Dam removal
- 7,000 cubic yards remediated

AOC Key Activities Needed

- Dredging
- Nonpoint source pollution control
- Stream buffers
- Pathogen source research

AOC Challenges

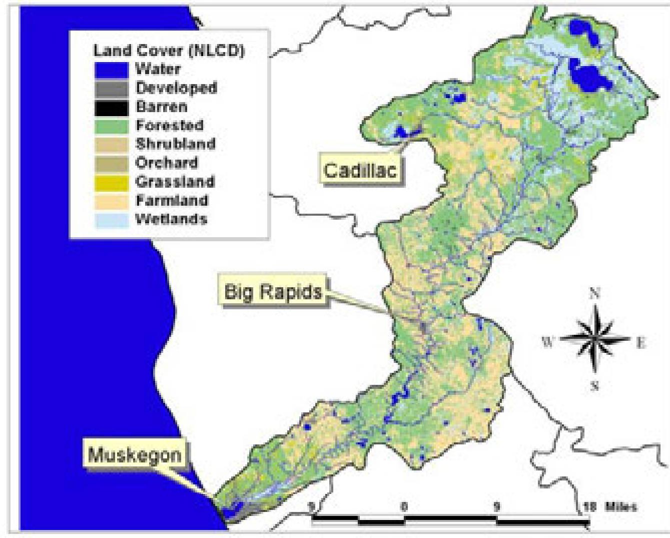
- High urban density and rapid development
- Historic developed sites which could be restored to improve floodplain functions and wetland function

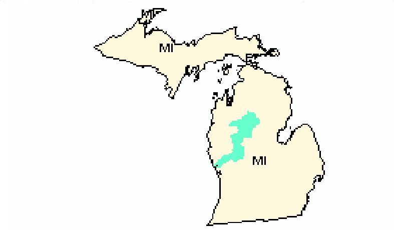
AOC Next Steps

- Complete assessment for Kinnickinnic River
- Estabrook Impoundment remediation needed
- Research into pathogen sources
- Watershed analysis to assess water quality impacts and options for restoration

Muskegon River Watershed

Hydrologic Unit Code: 04060102





For more information see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060102 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/WB-05/070, "A Biological Survey of the Middle Muskegon River Watershed , Clare, Mecosta, Newaygo, and Osceola Counties, Michigan, 2001" and report number MI/DEQ/WB-05/071, "A Biological Survey of the Upper Muskegon River Watershed, Clare, Missaukee, Osceola, and Roscommon Counties, Michigan, 2001".

Watershed Management Plans

- Higgins Lake — Huron Pines RC&D Council
- Muskegon River — Grand Valley State University Annis Water Resources Institute
- Upper Clam River — City of Cadillac
- Bear Creek
- Bear Lake

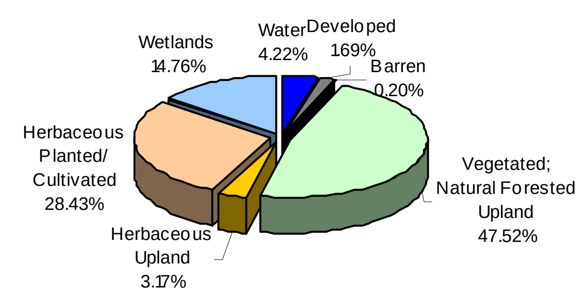
Watershed Groups

- Muskegon River Watershed Assembly — www.mrwa.org
- Huron Pines RC&D Council — www.huronpines.org
- Muskegon River Watershed Project, Annis Water Resources Institute — www.gvsu.edu/wri/isc/muskegon
- Muskegon River Watershed River Initiative Assessment — www.muskegonriver.org
- Muskegon Watershed Research Partnership — www.mwrp.net
- City of Cadillac — www.cadillac-mi.net/

Watershed Overview / Ecology / Biodiversity

- The Muskegon River Watershed drains approximately 2,723 square miles of land and is located in north-central Michigan.
- The River is approximately 219 miles long from its start at Houghton and Higgins Lakes down to its mouth at Muskegon Lake and, eventually, Lake Michigan.
- The Muskegon River Watershed is one of the of the largest watersheds in the State of Michigan and spans across the better part of nine counties: Wexford, Missaukee, Roscommon, Osceola, Clare, Mecosta, Montcalm, Newaygo, and Muskegon.
- Muskegon Lake, a 4,149 acre inland coastal lake located in Muskegon County along the east shoreline of Lake Michigan is an Area of Concern (AOC). The AOC includes the entire lake with the lake being separated from Lake Michigan by sand dunes. The Muskegon River flows through the lake before emptying into Lake Michigan. The immediate inland area is primarily residential and industrial, with chemical and petrochemical companies, foundries, a pulp and paper mill, and other industries located on the lake or within its immediate watershed.
- The Muskegon River and many of its streams and creeks are considered cool water fisheries. They can support both cold-water fish, such as trout and salmon, and warm water fish, such as northern pike and smallmouth bass.
- The sportfishery is worth an estimated $5 million per year.
- Impairments are excessive nutrient loading, sedimentation, hydrologic flow, invasive species and toxic substances.
- The river faces significant thermal pollution, which raises water temperature, from dams hydroelectric facilities, stormwater runoff, and a lack of streamside canopy. When temperature rises, available oxygen decreases, making it difficult for aquatic life to survive.

Land Cover: Muskegon River Watershed



Watershed size: 2738 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, grassland, and wetland and a slight decrease in farmland, and forest.

Watershed Activities

- The Annis Water Resources Institute (AWRI) from Grand Valley State University received a Section 319 grant to support the development of the since approved watershed management plan. The project currently has funds to do several structural practices in the watershed along with public education.
- The Great Lakes Fishery Trust (GLFT) selected the Muskegon River watershed as the focus of their "River Initiative," involving multi-million dollar, annual funding support for the next three to five years.
- The Hersey River Restoration Project is working to clean up contaminated sediments and development of an agreeable plan between the village of Hersey and the MDNR for the removal of dilapidated dam structures on the Hersey River.
- The Marion Millpond/Middle Branch River project will remove the Marion Dam, retain the millpond by constructing a bermed dike between it and the River, and construct a covered bridge.
- The Village of Marion, in Osceola County, together with the MDNR Fisheries Division have agreed on a plan to restore both the Middle Branch River and the Marion Millpond including the removal of the Marion Dam.
- The Muskegon Lake & Estuary Emergent Vegetation Restoration Demonstration Project is working to re-establish native wild rice stands, soft stem bulrush and other aquatic vegetation for fish and wildlife habitat in the Muskegon Lake Area of Concern (AOC) and the lower river (estuary) located at the river mouth and within the Muskegon State Game Area.
- Using funds from the Michigan Department of Environmental Quality and the Wege Foundation, the Muskegon River Watershed Assembly (MRWA) and Grand Valley State University's Annis Water Resources Institute (GVSU-AWRI) are implementing projects that: updates the existing Muskegon River Watershed Management Plan to meet EPA's newest criteria.
- Funded by the Great Lakes Fisheries Trust as part of the Muskegon River Initiative, the Mega Model project will build upon existing models, data, and management tools, the project will produce a system-wide model that will be used to perform risk assessment in the Muskegon River Watershed.
- Through funds from the Wege Foundation and the Fremont Area Foundation, the Sustainable Futures for the Muskegon River Watershed project developed a geographical information system (GIS) outreach tool, which will is disseminated to the public through an integrated information and education program.
- The Annis Water Resources Institute (AWRI) is conducted an environmental analysis of well water in Mecosta County with funding from the Ice Mountain Stewardship Fund of the Fremont Area Community Foundation. The study provided critical information on health hazards in the County and groundwater supplies.
- AWRI has established a research fund for long-term monitoring of Muskegon Lake.
- The Muskegon Lake AOC Urban Sediment Project, a 2004 Great Lakes Basin Program Project, aims to correct the effects of urban runoff, soil erosion and sedimentation at three highly visible sites within AOC. The project will implement corrective measures and transfer information on three distinct BMP systems sites.
- The Nature conservancy identified the following critical ecological resources in the watershed:
  - The Muskegon Dunes holds Hemlock - Yellow Birch Wet-Mesic Forest, Great Lakes Beachgrass Dune, and Interdunal Wetlands.
  - The Muskegon and White Rivers include Great Lakes Hemlock - Beech - Hardwood Forest, Inland Coastal Plain Marsh, Mesic Sand Tallgrass Prairie, and White Pine - White Oak Barrens
  - Houghton Lake, Higgins Lake, and the Upper Muskegon River include very large, deep, inland lakes, very large, wetland-connected inland lakes, and wetland-connected headwater streams on outwash plain, ice contact and end moraine
  - The White and Muskegon Rivers have cold,

Impaired (303d) Waters

Waterbody Name	Impairment
Bear Lake	Phosphorus Algal Blooms, PCBS Fish Consumption Advisories
Croton Pond	Mercury (Fish Tissue)
Hess Lake	PCBS Fish Consumption Advisories
Higgins Lake	Chlordane Fish Consumption Advisories PCBs Fish Consumption Advisories Mercury (Fish Tissue)
Houghton Lake	PCBs Fish Consumption Advisories
Lake Mitchell	Mercury (Fish Tissue)
Lily Lake	Mercury (Fish Tissue)
Muskegon Lake And Muskegon River#	Mercury PCBs Fish Consumption Advisories Mercury (Fish Tissue), PCBS
Ruddiman Creek	Pathogens, Fish Community Rated Poor, Macroinvertebrate Community Rated Poor
Ruddiman Creek (Wetlands)	PCBs Fish Consumption Advisories
Ryerson Creek	Fish Community Rated Poor Macroinvertebrate Community Rated Poor
Todd Lake	Mercury (Fish Tissue)

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

groundwater-fed stream on sandy lake plain
- The White and Muskegon Rivers are Waterfowl and Shorebird stopover sites
- Houghton Lake, Higgins Lake, and the Upper Muskegon River are home to the Eastern Massasauga, Secretive locust, and Hill's thistle
- The White and Muskegon Rivers are home to the Black Tern, Kirtland's Snake, Hill-prairie spittlebug, Karner blue butterfly, Sprague's pygarctic, and the Hill's thistle.

Muskegon Lake Area of Concern Activities

Location
- The entire 4149 acre lake and several tributaries.

AOC Primary Contaminants
- PCBs
- Mercury

AOC Stressors
- Sediments
- Nonpoint pollution

AOC Relevant Programs
- Brownfields
- Navigational dredging
- Great Lakes Legacy Act

AOC Clean-up Actions
- Wastewater treatment upgraded
- Some tributary remedial actions underway
- Removal of about 80,000 cubic yards of contaminated sediment in Ruddiman Creek

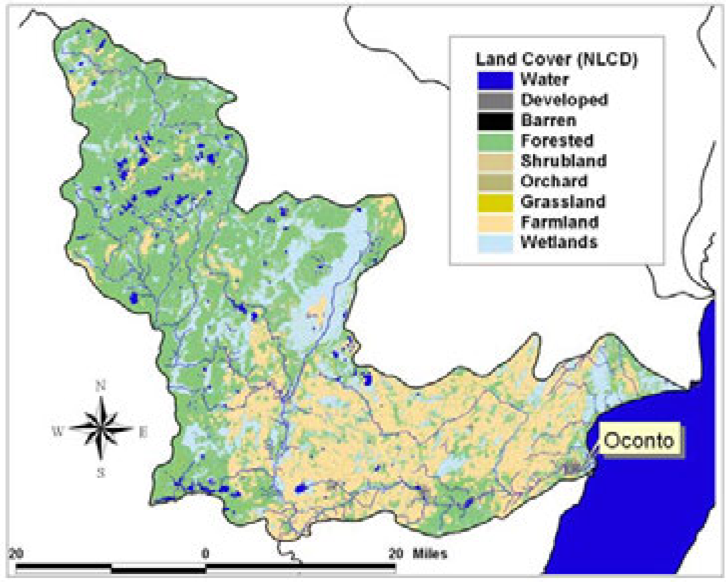
AOC Key Activities Needed
- Dredging
- Stream buffers
- More assessment

AOC Challenges
- PCB disposal
- Local funding match for federal projects

AOC Next Steps
- Remediation of brownfields and sediments
- Complete assessment of contaminated sediment in Ryerson Creek and in Muskegon Lake at the Division Street Outfall.

Oconto River Watershed

Hydrologic Unit Code: 04030104



For more information, see the USEPA "Surf Your Watershed website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030104

The Oconto River Watershed is part of WDNR's Upper Green Bay management Basin. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html

Watershed Groups

- River Alliance of Wisconsin — www.wisconsinrivers.org
- Upper Green Bay Basin DNR Management Area — www.dnr.state.wi.us/org/gmu/upgb
- Upper Green Bay Basin Partnership — basineducation.uwex.edu/uppergb
- Great Lakes Basin Program for Soil Erosion and Sediment Control — www.glc.org/basin

Watershed Overview / Ecology / Biodiversity

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- The Oconto watershed covers over 1035 square miles and has over 560 miles of streams.
- The major waterways include the Oconto River, the Lower Oconto River, the Little River, the Lower North Branch Oconto River, and the South Branch of the Oconto River.
- Most of the watershed is part of the Upper Green Bay basin management area as identified by Wisconsin DNR.
- Wildlife include black bear, white- tailed deer, turkey, ring- necked pheasant, ruffed grouse, waterfowl, geese, beaver, mink, otter, timber wolves, elk, colonial waterbirds, trumpeter swans, eagle, osprey, northern goshawk, shorebirds.
- Maple- basswood is the most common forest type and the tree species with the greatest volume in the basin is hard maple followed by aspen, white and red pine, soft maple and balsam fir.
- Coastal wetlands are an important feature of the watershed.
- Groundwater is plentiful and clean and is used for drinking water
- Oconto is the primary urbanized area in the watershed.

Watershed Activities / Concerns / Priorities

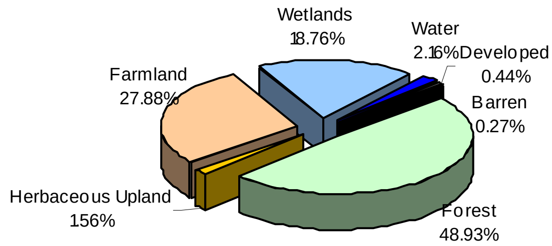
The following are objectives for the Upper Green Bay management Basin, which includes the Oconto River watershed:

- Target the West Shore of Green Bay as a high priority for habitat protection
- Implement the DNR's 50 year Land Legacy Study, an acquisition plan for the state
- Protect shoreland habitat and water quality through water regulation and zoning
- Work with local communities in developing "smart growth" plans & promoting wise land use and zoning
- Complete a comprehensive fisheries plan for the basin, focusing on the Oconto, Menominee, and Peshtigo Rivers and Lake Michigan, including addressing invasive exotic species
- Encourage sound forestry practices on public and private land and identify and manage terrestrial invasive exotic species
- Enhance educational activities for forestry, water quality, wildlife management, healthy ecosystem

Impaired (303d) Waters

Waterbody Name	Impairment	TMDL Submittal
Green Bay – S. of Marinette & Tribs to the first dam	PCB Fish Consumption Advisory	NA
Maiden Lake	Mercury Fish Consumption Advisory	NA
Oconto River Machinckanee	Mercury Fish Consumption Advisory	New
Reservoir Pond	Mercury Fish Consumption Advisory	NA

Land Cover: Oconto River Watershed



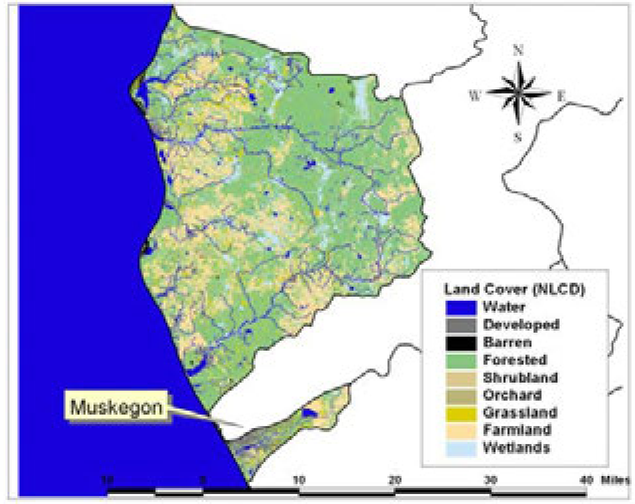
Watershed size: 1035 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and forest and a slight decrease in grassland and wetlands.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Pere Marquette-White Watershed

Hydrologic Unit Code: 04060101



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04060101

Watershed Groups

- White River Watershed Partnership — www.wrwp.org
- Oceana Conservation District — www.oceanaconservation.org
- Conservation Resource Alliance — www.rivercare.org
- Pere Marquette Watershed Council — www.peremarquette.org
- The Mona Lake Watershed Council — www.monashores.net/monalakewatershed/Design1/home.htm

Watershed Management Plans

- Pere Marquette — Conservation Resource Alliance
- South Branch, Pentwater River — Oceana Conservation District
- Hamlin Lake/Big Sable — Conservation Resource Alliance

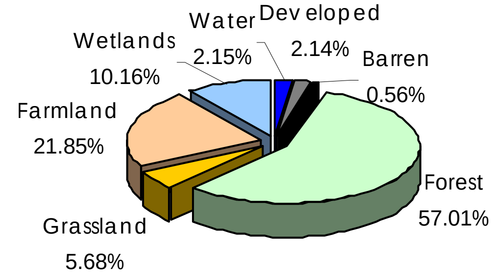
Watershed Overview / Ecology / Biodiversity

- The Pere Marquette watershed covers over 2100 square miles.
- The watershed has over 90 miles of Lake Michigan shoreline.
- The watershed is primarily forested and is near Muskegon, Michigan.
- Recreational uses include fishing, wildlife viewing, boating, canoeing, kayaking, camping, and hiking.
- The White River is a State designated natural river.

Watershed Activities / Concerns / Priorities

- The White River Watershed partnership, formed in 2003, has a mission to protect the unique characteristics and the natural resources of the White River watershed by promoting education, conservation, restoration, and preservation activities.
- The primary goals of the Pentwater River Watershed Program are to protect and enhance the high quality waters of the South Branch of the Pentwater River by implementing Best Management Practices (BMPs) within the watershed. BMPs are defined as any structural, vegetative, or managerial practice to treat, prevent, or reduce water pollution.
- The Pere Marquette River Restoration Committee is building on the original 10-year, $1.5 million restoration project with a 319 Nonpoint Source Pollution grant for $373,646. A Pere Marquette Watershed Management Plan has been completed with this grant and 9 road/stream crossing sites have been formally selected for repair with four County Road Commissions. CRA has also applied for a $720,000 grant to complete streambank stabilization, road/stream crossing improvements, and livestock and agricultural projects throughout the watershed.
- Three County Road Commissions have been working together and with CRA to complete reconstruction at 23 road stream crossings over a 7-year period. Phase 1 funding was for $102,800, Phase 2 funding for $109,287 and Phase 3 for $103,450 with project partners providing one-to-one match. CRA is responsible for public education of the project and site plan reviews for Best Management Practices to preserve water quality.
- Using funding from the Orvis Company Foundation and other supporters and landowers, the Conservation Resource Alliance worked with Kanouse Outdoor Restoration to repair erosion at five steep, sandy eroding streambanks along the Baldwin River. In addition, a combination of woody debris and fish habitat platform structures were placed at all of the sites to provide hiding and resting cover for fish, aquatic insects and a variety of wildlife. The Mason County Road Commission, using a grant from the Great Lakes Commission, recently completed improvements at the Stephens Road bridge crossing of the Big Sable River in Free Soil Township to decrease excessive sedimentation in the river.
- In 2003, the Lake Michigan Forum conducted an assessment of environmental stewardship in Michigan's Mona Lake watershed. The assessment process was aimed at identifying opportunities for creating a permanent ethic of environmental stewardship among leaders and the general public in the local watershed. The Forum gathered existing environmental information and interviewed individuals living and working in the Mona Lake watershed. Using the resulting information, the Forum characterized existing stewardship activities in the watershed and compared these against a set of elements that, if in place, would represent a "best-case stewardship scenario" for any watershed.

- The Mona Lake Watershed Council is working on projects to support the health of the watershed. First, the Council has partnered with the Lake Michigan Federation to educate residents about health concerns from contaminated sediment in Little Black Creek. The Council is also working with other partners to explore clean-up options for the creek. In addition, the Watershed Council received a grant from the Michigan Department of Environmental Quality to develop a Watershed Management Plan. The Council is also working with the Muskegon County Stormwater Committee to promote stormwater pollution prevention programs.



Watershed size: 2105 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and forest and a slight decrease in grassland and wetlands.

- The Pere Marquette Headwaters Erosion Control Project, a 2005 Great Lakes Basin Program Project, plans to install appropriate BMPs including a combination of fieldstone, log terracing, seedling planting and brush/mulching at six severely eroded streambanks on the Baldwin River. This project aims to stabilize the banks and upper slopes, reducing the amount of sedimentation in the River.
- The Big Sable Watershed Restoration Phase I was funded by a $142,000 grant from the Clean Michigan Initiative with a $48,000 match. The Big Sable River includes 24 miles of mainstream and a number of tributaries that flow through Lake and Mason counties and empty into Hamlin Lake. The river's headwaters and upstream are recognized for both brook and brown trout, while downstream to Hamlin Lake is noted mostly for brown trout. Hamlin Lake is recognized as one of west Michigan's best fishing spots. The goal of this project was to reduce several of the larger contributors of sediment into Hamlin Lake.
- The White Lake AOC includes White Lake and a one-quarter mile wide zone around the lake. Most of the land around the AOC is wooded or grassy, with some sand dunes located along Lake Michigan. Land use in the AOC is primarily recreational and agricultural, and to a lesser extent residential and industrial. White Lake priorities include contaminated sediment remediation, eutrophication control, remediation of groundwater and former industrial site contamination, and habitat restoration.
- The Nature Conservancy identified the following critical ecological resources in the watershed:
  - Big Sable Point and Hamlin Lake include Great Lakes Dune Pine Forest, Great Lakes Beachgrass Dune, and Interdunal Wetland
  - The Pentwater Marsh includes Great Lakes Shoreline Cattail - Bulrush Marsh
  - The Pere Marquette watershed includes Central Cordgrass Wet Prairie and Central Cordgrass Wet Sand Prairie
  - Flower Creek and Dunes include Great Lakes Shoreline Cattail - Bulrush Marsh
  - Newaygo Prairies include Inland Coastal Plain Marsh, Midwest Dry Sand Prairie, and White Pine - White Oak Forest
  - Hoffmaster-Kitchel Dunes contains Great Lakes Beachgrass Dune
  - Stony Creek-Camp Miniwanca contains Great Lakes Shoreline Cattail - Bulrush Marsh
  - Pere Marquette River Watershed contains drowned river mouth lakes
  - Big Sable Point-Hamlin Lake is home to Pitcher's thistle
  - Pere Marquette River Watershed is home to Karner blue butterfly, and Hill's thistle
  - Flower Creek and Dunes is home to Pitcher's thistle
  - Newaygo Prairies is home to Hill-prairie spittlebug, Karner blue butterfly, and Hill's thistle
  - Hoffmaster-Kitchel Dunes is home to pitcher's thistle

Impaired (303d) Waters

Waterbody	Impairment
Big Blue Lake	Mercury (Fish Tissue)
Black Creek	PCBS Fish Consumption Advisory
Hamlin Lake	Mercury (Fish Tissue)
Lake Michigan—South of Franfort	Chlordane Fish Consumption Advisory DDT Fish Consumption Advisory Dioxin Fish Consumption Advisory PCBS Fish Consumption Advisory Mercury (Fish Tissue)
Mona Lake	PCBS Fish Consumption Advisory
Pere Marquette River	Mercury PCBS Fish Consumption Advisory PCBS
White Lake	Chlordane Fish Consumption Advisory PCBS Fish Consumption Advisory

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

White Lake Area of Concern Activities

Location

- Includes White Lake and a one-quarter mile wide zone around the lake.

AOC Primary Contaminants

- Heavy metals
- Stormwater nonpoint pollution
- Arsenic
- Chromium

AOC Stressors

- Sediments
- Industrial contamination
- Groundwater contamination

AOC Relevant Programs

- Superfund
- RCRA

AOC Clean-up Actions

- Dredging in ATannery Bay@ (2002) – 73,000 cubic yards of waste (hides, chromium, arsenic
- Cleanup of Occidental Chemical site in 2002
- Potential sources of groundwater contamination to White Lake and its tributaries have been identified and remediation efforts are underway
- Some eutrophication has been alleviated by improvements to the sewage collection and treatment systems
- Contaminated groundwater venting to the lake is being intercepted by purge wells and treated prior to discharge

AOC Key Activities Needed

- Assessment and further study of contaminated sites
- Stream buffers
- Coordination with RAP program for AOC delisting purposes

AOC Challenges

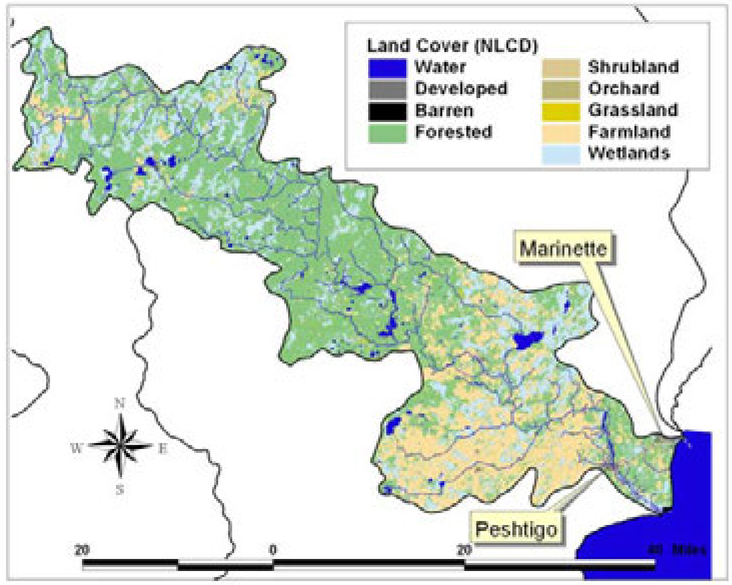
- Funding to pinpoint locations having greatest impact to eutrophication

AOC Next Steps

- Further study of the extent of contamination from the Whitehall Leather Company is needed, in addition to possible remediation funds.
- Assessment is needed of sediments at discharge points for other contaminated sites

Peshtigo River Watershed

Hydrologic Unit Code: 04030105



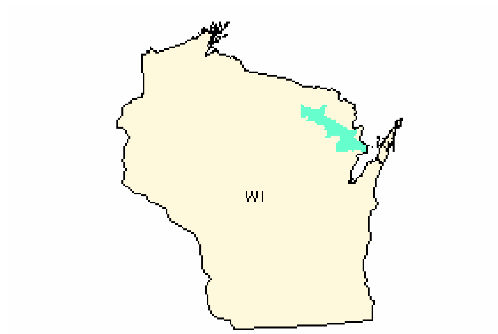
For more information, see the USEPA "Surf Your Watershed" website at:
http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030105

The Peshtigo River Watershed is part of the WDNR Upper Green Bay Management Area. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at
http://dnr.wi.gov/org/gmu/gmu.html

Watershed Groups

- Marinette County Land & Water Conservation — www.marinettecounty.com/lw_home.htm

Watershed Overview

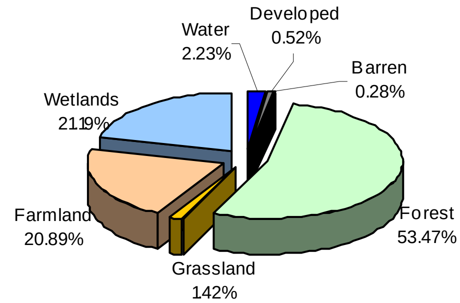


- The watershed flows into Green Bay in Wisconsin.
- The major waterways in the watershed include the Lower Peshtigo River, the Little Peshtigo River, The Middle Peshtigo and Thunder River, and the Upper Peshtigo River.
- The watershed has three listed impaired waters
- Marinette is the only urbanized area in the watershed.
- Wildlife include black bear, white- tailed deer, turkey, ring- necked pheasant, ruffed grouse, waterfowl, geese, beaver, mink, otter, timber wolves, elk, trumpeter swans, eagle, osprey, northern goshawk, shorebirds.
- Maple-basswood is the most common forest type and the tree species with the greatest volume in the basin is hard maple followed by aspen, white and red pine, soft maple and balsam fir.
- The Nature Conservancy identified the following critical habitats and ecosystems in the Peshtigo River: Great Lakes Shoreline Cattail - Bulrush Marsh; Silver Maple - Elm - (Cottonwood) Forest; White Pine - Red Oak Forest; Central Wet-Mesic Tallgrass Prairie; lake plain wetland lakes; large rivers on till plain and lake plain; cool/cold headwaters; large, cool/coldwater rivers in outwash, end moraine, and ice contact; large, headwater lakes in ground moraine, outwash, and ice contact; low gradient tributary streams on west Green Bay till plain; riverine coastal marsh; and spring-fed headwater lakes.
- The Nature Conservancy has identified the following critical species in the Peshtigo River watershed: Wood Duck; Le Conte's Sparrow; Ruffed Grouse; American Bittern; Whip-poor-will; Veery; Black Tern; Northern Harrier; Marsh Wren; Sedge Wren; Black-billed Cuckoo; Northern Bobwhite; Eastern Wood-Pewee; Yellow Rail; Cerulean Warbler; Blackburnian Warbler; hestnut-sided Warbler; Black-throated Green Warbler; Least Flycatcher; Willow Flycatcher; Bald Eagle; Wood Thrush; Baltimore Oriole; Hooded Merganser; Wild Turkey; Black-and-white Warbler; Mourning Warbler; Rose-breasted Grosbeak; American Woodcock; Clay-colored Sparrow; Field Sparrow; Forster's Tern; Golden-winged Warbler; Blue-winged Warbler; Nashville Warbler; Warbling Vireo; and Canada Warbler.

Watershed Activities / Concerns / Priorities

- The following are objectives for the Upper Green Bay management Basin, which includes the Peshtigo River watershed:
- Target the West Shore of Green Bay as a high priority for habitat protection
- Protect shoreland habitat and water quality through water regulation & zoning
- Work with local communities in developing "smart growth" plans & promoting wise land use and zoning
- Complete a comprehensive fisheries plan for the basin, focusing on the Oconto, Menominee, and Peshtigo Rivers and Lake Michigan, including addressing invasive exotic species
- Encourage sound forestry practices on public and private land and identify and manage terrestrial invasive exotic species
- Enhance educational activities for forestry, water quality, wildlife management, healthy ecosystem

Land Cover: Peshtigo River Watershed



Total Acreage = 1165 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and forest and a slight decrease in grassland and wetlands.

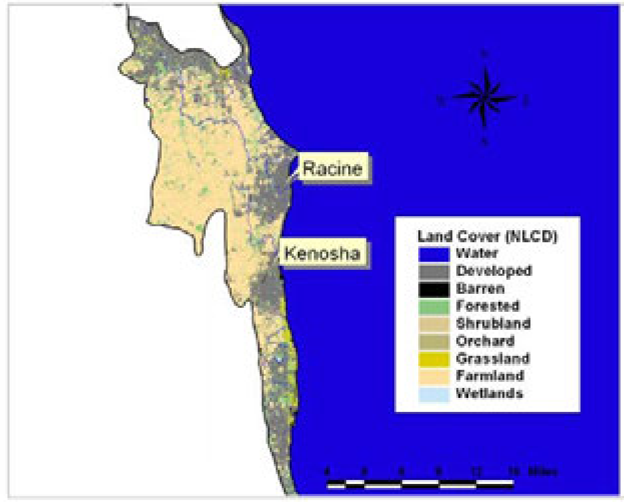
Impaired (303d) Waters

Waterbody Name	Impairment
Bass Lake	Organic Enrichment/Low Dissolved Oxygen Winter Kills Nutrients
Gilas Lake	Mercury Fish Consumption Advisory
Noquebay Lake	Mercury Fish Consumption Advisory
Peshtigo River at Caldron Falls Flowage	Mercury Fish Consumption Advisory
Peshtigo River at High Falls Flowage	Mercury Fish Consumption Advisory
Peshtigo River at Peshtigo Flowage	Mercury Fish Consumption Advisory
Green Bay—South of Marinette and its tribs	Mercury Fish Consumption Advisory

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Pike-Root (Waukegan) Watershed

Hydrologic Unit Code: 04040002



For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html and the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04040002

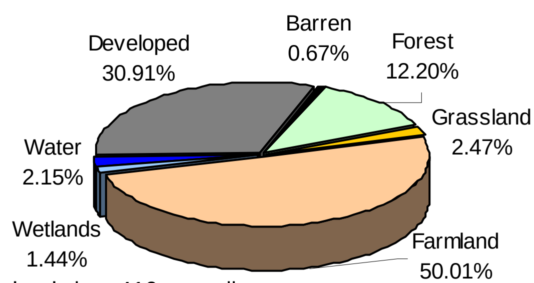
Watershed Groups

- Root-Pike Watershed Initiative Network — www.rootpikewin.org
- 1000 Friends of Wisconsin — www.1kfriends.org
- Midwest Center for Environmental Science and Public Policy — www.mcespp.org
- Sustainable Racine — www.sustainable-racine.com
- The Waukegan Harbor Citizens Advisory Group — wkkhome.northstarnet.org/iepa/page2.html
- Mike Luba, Root-Pike River Basin Water Leader — Michael.Luba@dnr.state.wi.us

Watershed Overview / Ecology / Biodiversity

- The Pike-Root watershed covers over 410 square miles and includes major subwatersheds as the Pike River, the Root River, Oak Creek, Racine Harbor, the Waukegan River, and Waxdale Creek. The watershed has over 113 miles of shoreline on the west side of Lake Michigan.
- The watershed stretches from south of Milwaukee to north of Chicago. It includes the cities of Racine and Kenosha, Wisconsin, and Waukegan, Illinois.
- The Waukegan Harbor is an Area of Concern. Waukegan Harbor consists of approximately 1.2 km^2 of industrial, commercial, municipal and open/vacant lands. The watershed of the expanded study area contains the Waukegan River drainage basin, the North Ditch drainage basin and other nearshore areas which drain to Lake Michigan.
- While over 50 percent of the watershed is used for agricultural purposes, 30 percent is urbanized.
- Groundwater below the surface basin has seen significant overpumping. There are several cones of depression.
- The Waukegan River, which is part of the basin, is the only river in Illinois that flows into Lake Michigan.
- The National Heritage Inventory has documented 16 endangered, 20 threatened, and 52 special concern plant and animal species and 17 rare aquatic and terrestrial species in the watershed.
- The combined effects of the draining of the majority of wetlands and stream modifications like channel manipulation have led to degraded water and habitat quality throughout the Pike- Root Basin.
- The Nature Conservancy identified critical Lakeplain Wet-Mesic Prairie, Mesic Sand Tallgrass Prairie, Interdunal Wetland, Black Oak / Lupine Barrens and Midwest Dry-Mesic Sand Prairie at the Chiwaukee Prairie-Illinois Beach.
- Chiwaukee Prairie-Illinois Beach is an important landbird stopover site and a raptor stopover site.
- Critical species identified by the nature Conservancy at the Chiwaukee Prairie-Illinois Beach include the pale false foxglove and the prairie white-fringed orchid. Other important species identified by the Nature Conservancy include Central Cordgrass Wet Prairie, Central Cordgrass Wet Sand Prairie, Central Mesic Tallgrass Prairie, Central Water Lily Aquatic Wetland, Cinquefoil - Sedge Prairie Fen, Great Lakes Beach, Great Lakes Beachgrass Dune, Lakeplain Wet Prairie, Midwest Dry Sand Prairie, Midwest Mixed Emergent Deep Marsh, Skunk Cabbage Seepage Meadow, Tussock Sedge Wet Meadow, Blazing star stem borer moth, Forked aster, Henslow's Sparrow, Henslow's sparrow, Karner blue butterfly, Kirtland's Snake, Kirtland's snake, Pale false foxglove, Prairie white-fringed orchid, and Silphium borer moth.

Land Cover: Pike-Root Watershed



Watershed size: 410 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and wetlands, a slight decrease in forest, and a slightly larger decrease in grassland.

Watershed Activities / Concerns / Priorities

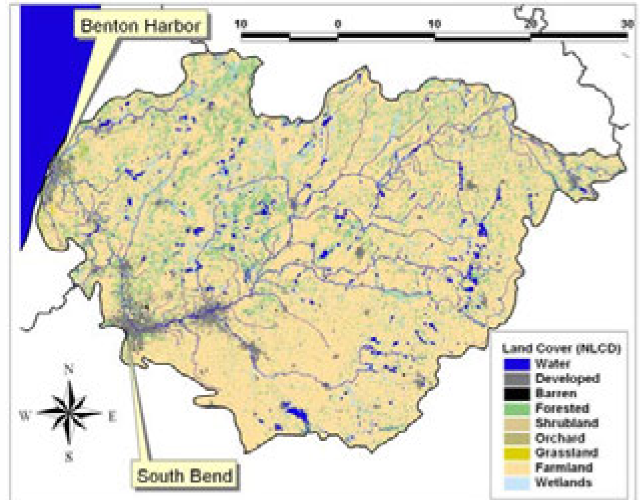
- Recommendations for improving the Pike and Root River watersheds are:
  - Implement of urban nonpoint source best management practices.
  - Implement of agricultural nonpoint source best management practices, including buffer strip development.
  - Conduct baseline surveys on streams within the watershed.
  - Assess sediment delivery, sediment transport, and streambank erosion.
  - Conduct aquatic habitat and sediment assessments above and below dams on the Pike and Root Rivers.
  - Implement aquatic habitat restoration and water quality improvement practices.
  - Implement wetland restoration projects where practicable.
  - Evaluate dams for removal
- The Root-Pike Watershed Initiative Network awarded $21,886 to seven area watershed projects to improve rivers and lakefronts within the Root River and Pike River watersheds in the Racine area.
- About 1 million pounds of PCBs have been dredged from Waukegan River.
- Friends of Fort Sheridan received 2005 Great Lakes Basin Program Project funding to restore the Scott Loop ravine which has eroded to build out. Restoration plans include repairing and stabilizing the down-cut ravine channel and stabilizing the ravine slopes.
- Great Lakes Basin Program Project funds were awarded to Northeastern Illinois University in 2005 to study and quantify methods of ravine restoration. Previously-installed BMPs in Illinois ravines flowing into Lake Michigan will be compared with an unimproved site to study their effectiveness.
- 2005 Great Lakes Basin Program funds support the Waukegan River Ravine Erosion Control project to implement measures to stop channel down-cutting, widening and bank erosion along the Waukegan River's North Fork .
- Using funds from the 2004 Great Lakes Basin Program, the Waukegan Harbor Citizens' Advisory Group and the Waukegan Park District sponsored five workshops to inform Waukegan River property owners about erosion control, including a demonstration of erosion control techniques. They will also create a digitally formatted laminated photographic aerial display, and design and produce four posters, two demonstrating simple erosion control methods and two more illustrating before-and-after conditions.

Impaired (303d) Waters

Waterbody Name	Impairment
Lake Michigan, WI	Mercury and PCB Fish Consumption Advisories
N. Branch Pike R., WI	Aquatic Toxicity, Fish Fills
Oak Creek, WI	Aquatic Toxicity
Racine Harbor, WI	Aquatic Toxicity, Metals
Root River, WI	Phosphorus, Organic Enrichment/Low Dissolved Oxygen, Sediment
Root River Canal, WI	Phosphorus, Organic Enrichment/Low Dissolved Oxygen, Sediment
Root River Canal W. Branch, WI	Phosphorus, Organic Enrichment/Low Dissolved Oxygen, Sediment
Root R. From Its Mouth Upstream To The Horlick Dam In Racine, WI	PCB Fish Consumption Advisory
Waxdale Creek, WI	Fish Kills, Aquatic Toxicity
Lincoln Pk North Pnd, IL	Nutrients, Phosphorus, Suspended Solids, Algal Growth, Noxious Aquatic Plants, Siltation
Pettibone Creek, IL	Priority Organics, PCBS, Metals, Arsenic, Copper Lead, Mercury, Zinc, Habitat Alterations
Pettibone Creek (S. Br.), IL	Priority Organics PCBS
Washington Park Lagoon, IL	Metals, Nutrients, Organic Enrichment/Low Dis-solved Oxygen, Suspended Solids, Aquatic Weeds, Siltation
Waukegan River (Two Locations), IL	Priority Organics, PCBS, Salinity/TDS/Chlorides, Habitat Alterations
Waukegan River (South Branch), IL	Priority Organics, Nutrients, Salinity/TDS/Chlorides, Total Ammonia

St. Joseph River Watershed

Hydrologic Unit Code: 04050001

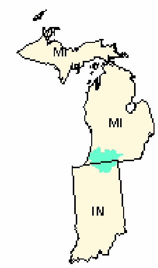


For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050001or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SQW-02/080, "A Biological Survey of the Lower St. Joseph River Watershed, Berrien and Cass Counties, 2001".

Watershed Management Plans

- Dowagiac River — Cass Conservation District — casscd.org
- Nottawa Creek — Calhoun Conservation District — www.calhouncd.org

Watershed Groups



- Friends of the St. Joseph River — www.fotsjr.org
- St. Joseph River Basin Commission — www.sjrbc.com
- St. Joseph River Watershed Management Planning Project — www.stjoeriver.net
- Baugo Creek Watershed Management Plan — www.macog.com/PDFs/SJRBC/d10plnfnl.pdf
- MEANDRS — www.meandrs.org
- Pokagon Band of Potawatomi tribe—Dowagiac River watershed.

Watershed Overview / Ecology / Biodiversity

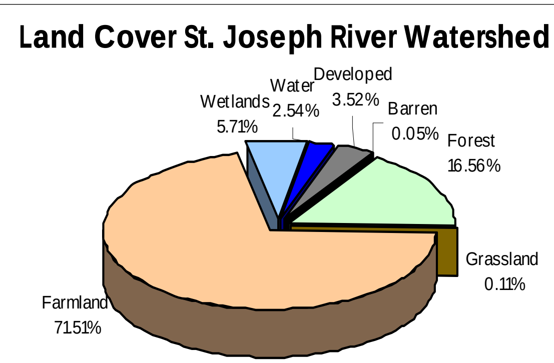
- The St. Joseph River Watershed is located in the southwest portion of the Lower Peninsula of Michigan and northwestern portion of Indiana. It spans the Michigan-Indiana border and empties into Lake Michigan at St. Joseph, Michigan.
- The watershed drains 4,685 square miles from 15 counties (Berrien, Branch, Calhoun, Cass, Hillsdale, Kalamazoo, St. Joseph and Van Buren in Michigan and De Kalb, Elkhart, Kosciusko, Lagrange, Noble, St. Joseph and Steuben in Indiana).
- The watershed includes 3,742 river miles and flows through and near the Kalamazoo-Portage, the Elkhart-Goshen, the South Bend and the St. Joseph/Benton Harbor metropolitan areas.

Watershed Activities / Concerns / Priorities

- The Friends of the St. Joe River was awarded a $230,000 grant with a $71,000 match in 2002 to develop a Watershed Management Plan for the entire St. Joseph River Watershed. This plan unites stakeholders in both Michigan and Indiana in a concerted effort to address water quality issues and natural resource protection across jurisdictional boundaries. All data compiled and reports generated as part of the planning project are available on the project website, www.stjoeriver.net. Products included: an informational brochure of the planning project; a Project WET workshop for 4-9 grade teachers in Paw Paw River Watershed; a rain garden workshop in partnership with Elkhart Environmental Center; a road/stream crossing workshop that helped stakeholders quantify sediment loads; volunteer stream monitoring training session for high school teachers and students; non point source modeling report; SWAT & urban storm water BMP effectiveness reports; and a report analyzing the mitigation needs and preservation potential of subwatersheds. A supplemental grant allowed the Friends of the St. Joe River to ensure that the watershed plan meets the nine minimum elements of watershed plans as required by USEPA.
- The St. Joseph watershed project has generated maps of subwatersheds, cities, USGS water resources stations, digital elevations, wetlands, river valley segments, land use, average annual precipitation, 1950-1999, designated trout streams, geological features, and soils.
- Under the Dowagiac River watershed management plan, nine municipalities in the Dowagiac River watershed have or will receive technical and/or financial assistance to work on master plans and zoning ordinances to protect farmland,

open space, rural character, wetlands, floodplains and water quality.

- Using Indiana's 2001 Incremental Funds from the federal 319 grant program, the Five Lakes Conservation Association, Inc. is developing a comprehensive management plan for the Little Elkhart Creek-Messick-Oliver Lake, Little Elkhart Creek-Dallas Lake, and Little Elkhart Creek-Tamarack-Cree Lakes watersheds that make up the headwaters of the Elkhart River. The Association plans to support a Watershed Planning Team, made up of experts and representatives from each watershed; conduct community outreach activities; hold at least eight public meetings; and conduct water quality and macroinvertebrate monitoring.
- Using Indiana's 2003 Incremental Funds from the federal 319 grant program, the Steuben County Commissioners is developing a watershed management plan for the Pigeon Creek watershed within Steuben County. The Commissioners plan to create a Planning Committee consisting of local officials, landowners, interested parties, experts, and representatives from cities and towns; develop a series of GIS maps and GPS information; develop a watershed map; hold at least three additional public meetings; and disseminate at least eight news releases to educate the public and encourage participation in the process.
- Using Indiana's 2001 Base Funds from the federal 319 program, Elkhart County Commissioners will be conducting water quality monitoring and engineering and geospatial analyses on 14-digit hydrologic unit code (HUC) watersheds in Elkhart County to prioritize watersheds according to levels of E. coli contamination. The Commissioners will educate the public on water quality issues in the three highest priority watersheds. They will also develop a watershed management plan (using stakeholder input and support) for the watershed most affected by E. coli contamination.
- Using 319 grant funds, the St. Joseph River Watershed Initiative will determine source of fecal contamination in the St. Joseph-Lake Erie watershed and northeastern Indiana; continue a trend water quality monitoring program; and develop a watershed management plan for the Cedar Creek subwatershed. The Initiative will also hold stakeholder meetings and conduct public outreach and education programs.
- The St. Joseph River Watershed Initiative is working to implement the St. Joseph River Watershed Management Plan by providing cost-share assistance to farmers for modification of their planting, tillage, and/or harvesting equipment to allow them to effectively implement conservation tillage and/or nutrient and pest management. Farmers will maintain accurate records where the conservation tillage equipment was used in comparison to a conventional tillage system. This information, when compiled, will provide an opportunity to evaluate the agronomic and economic performance of the conservation tillage system.
- Using Indiana's 2001 Incremental Funds, the Crooked Lake Association plans to reduce sediment and nutrient inputs into Crooked Lake by constructing approximately five sediment and nutrient retention basins/wetlands in the Crooked Lake watershed. The Association will conduct water quality monitoring before and after the construction of the retention basins/wetlands to determine their effectiveness. They will also conduct visual monitoring of sediment plumes following rain events and provide photographic documentation of the monitoring effort.
- The Crooked Lake Association will undertake a project to install 10 water bars and 750 lineal feet of drainage swale across and adjacent to existing gravel roads within the Steuben County 4-H Park, a known source of excessive sedimentation, loss of plant beds, and a decline in water clarity in the Crooked Lake. Rain gardens will also be installed to store and retain stormwater within the park. An education outreach program will be developed. This project is funded through the 2005 Great Lakes Basin Program.
- The most significant water quality problem in Lake George is excess sediment, much of it from severely eroding shorelines. The Lake George Sediment Control project, organized by the City of Hobart, will: 1) stabilize the eroding banks of Lake George with bioengineering methodology; 2) increase the habitat value of the riparian zone by establishing vegetation; 3) decrease the loss of shoreline oak trees; and 4) increase public awareness of erosion issues and environmentally friendly erosion control techniques. It is funded under the 2005 Great Lakes Basin Program.
- The St. Joseph River Erosion Reduction Project, using funds from the 2004 Great Lakes Basin Program, will work with partner conservation districts for farmer-to-farmer outreach efforts in six counties to sell conservation programs, thereby increasing buffers/filter strips in the watershed. It will also create digitized records, including an electronic database and GIS mapping, of conservation practices on the land within the watershed, in order to more



Watershed size: 4694 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land and a slight decrease in farmland, grassland, forest, and wetlands.

accurately and efficiently pinpoint critical areas in need of conservation and target efforts for reducing erosion and pollution.

- The High Drive Park/Christiana Creek Bank Restoration will stabilize Christiana Creek by installing biologs along with native plant material. The proposed plant material has the ability to filter out contaminants at a much higher rate than non-native plant material, thus improving the water quality and increasing its value to the overall health of the environment.
- The City of Watervliet, with support from the 2004 Great Lakes Basin Program, will incorporate porous pavement, rain gardens, and interpretive signs to increase awareness of "green" development techniques within the city. The project will incorporate one of the community's greatest natural resources, the Paw Paw River, to attract users to the site.

Basin Prioritization of Concerns

- The Watershed Concerns have been prioritized by the Steering Committee, according to the importance of each concern and the ease of implementing BMP's to correct those concerns, in the following manner:

  1. Sediments (tie)
  1. Nutrients (tie)
  3. Habitat Loss
  4. Wetlands (tie)
  4. Animal Waste (tie)
  6. Pesticides (tie)
  6. Urbanization & Land Use (tie)
  8. Biota
  9. CSO's
  10. Pathogens (tie)
  10. Hydrologic Modification (tie)
  10. Litter (tie)

Surface Water Designated Use Targets

- Warm and cold water fisheries
- Other indigenous aquatic life/wildlife
- Partial body contact, recreation
- Full body contact, recreation (May - October)
- Navigation
- Public Water Supply: Surface Intake Point
- Industrial Water Supply
- Agriculture
- Certain water bodies are also protected as a coldwater fishery

Additional Basin Designated Use Targets

- Groundwater
- Habitat preservation
- Increased public access (to the river/streams)
- Archeological preservation
- Preserve agricultural uses and access
- Preserve open space
- Greenways
- Public water trails
- Watershed linkages
- Manage invasive species

Impaired (303d) Waters

Waterbody Name	Impairment
Austin Lake, MI	Mercury (Fish Tissue)
Barton Lake, MI	Mercury (Fish Tissue) PCBs Fish Consumption Advisory
Coldwater Lake, MI	Mercury (Fish Tissue)
Dowagiac River, MI	PCBs Fish Consumption Advisory
Crawford Ditch, IN	Copper, Oil And Grease
Elkhart, River, IN	E. Coli, Mercury Fish Consumption Advisory, PCBs Fish Consumption
Eau Claire Extension Drain, MI	Macroinvertebrate Community Rated Poor
Farmers Creek, MI	Pathogens, Nuisance Plant Growth, Untreated Sewage Discharges, Pathogens
Fawn River, MI	PCBs Fish Consumption Advisory
Lake Chapin (St. Joseph River), MI	PCBs Fish Consumption Advisory
Mckinzie Creek, MI	Fish Community Rated Poor
Ox Creek, MI	Macroinvertebrate Community Rated Poor, Fish Consumption Advisories (PCBs)
Palmer Lake, MI	Mercury (Fish Tissue)
Randall Lake (North Lake and Cemetery Lake Chain), MI	PCBs Fish Consumption Advisory Mercury (Fish Tissue)
St. Joseph River, MI	PCBs Fish Consumption Advisory PCBS
St. Joseph River, MI	Mercury
Union Lake, MI	PCBs Fish Consumption Advisory

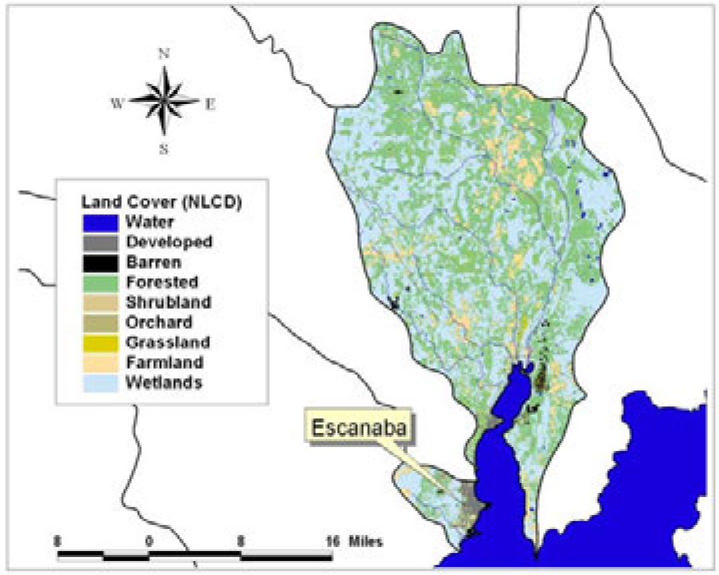
Waterbody Name	Impairment
Jimmerson Lake, IN	Mercury Fish Consumption Advisory
Juday Creek, IN	PCBs Fish Consumption Advisory
Lake James, IN	Mercury Fish Consumption Advisory
Lake Shipshewana, IN	PCBs Fish Consumption Advisory
Lake Wabee, IN	Mercury Fish Consumption Advisory
Lake Wawasee, IN	Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory
Long Lake, IN	Mercury Fish Consumption Advisory
Marsh Lake, IN	Mercury Fish Consumption Advisory
Mather's Ditch, IN	Dissolved Oxygen, Endrin
Mud Creek, IN	Ammonia Dissolved Oxygen
Olin Lake, IN	Mercury Fish Consumption Advisory
Oliver Lake, IN	Mercury Fish Consumption Advisory
Orland Tributary, IN	Dissolved Oxygen
Pigeon Creek, IN	Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory
Snow Lake, IN	Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory
St. Joseph River, IN	E. Coli , Mercury Fish Consumption Advisory, PCBs Fish Consumption Advisory
Tippecanoe Lake, IN	Mercury Fish Consumption Advisory

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Tacoosh-Whitefish Watershed

Hydrologic Unit Code: 04030111

For more information, see the USEPA "Surf Your Watershed" website at:
http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030111



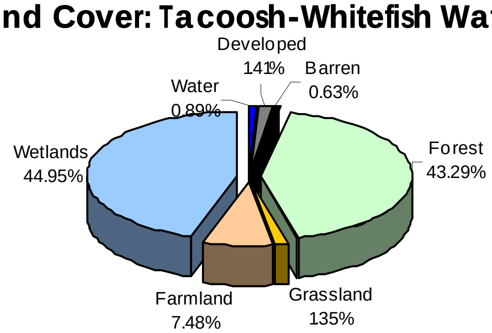
Watershed Overview / Ecology / Biodiversity

- The Tacoosh-Whitefish watershed is located in the upper peninsula of Michigan and covers approximately 633 square miles.
- The watershed has almost 53 miles of Lake Michigan shoreline.
- Escanaba, Michigan is the lone large urbanized area in the watershed.
- The watershed is mostly forest and wetland.
- The watershed includes parts of the Hiawatha National Forest.
- The watershed supports a world-class Walleye fishery and is an important spawning stream.

Impaired (303d) Waters

Waterbody Name	Impairment
Little Bay De Noc (Lake Michigan)	PCBS Fish Consumption Advisory Mercury (Fish Tissue)

Land Cover: Tacoosh-Whitefish Watershed



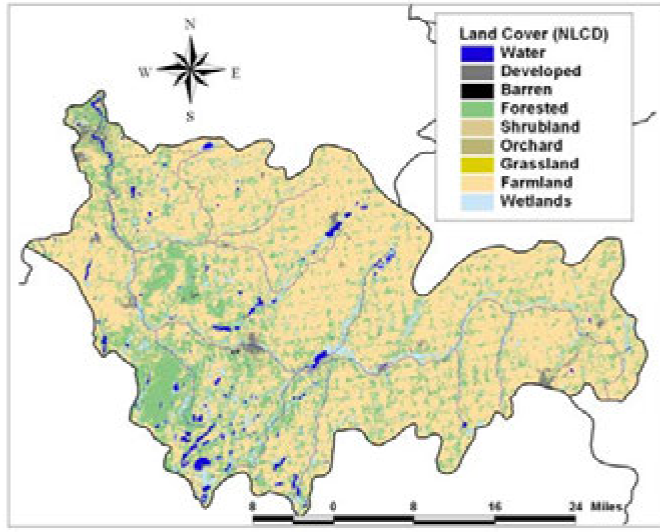
Watershed Size: 633 sq. miles

Between 1996 and 2001, there has been a slight increase in grassland, developed land, and farmland and a slight decrease in forest and wetlands.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Thornapple River Watershed

Hydrologic Unit Code: 04050007



For more information, see the USEPA website at: http://cfpub.epa.gov/surf/huc.cfm?huc_code=04050007 or contact the Michigan Department of Environmental Quality at 517-335-6969 to request a copy of report number MI/DEQ/SWQ-02/001, "A Biological Survey of the Thornapple River and Selected Tributaries, 1998".

Watershed Management Plans

- Coldwater River — Coldwater River Watershed Council

Watershed Organizations

- Coldwater River Watershed Council — www.coldwaterriver.org
- Thornapple River Watershed Council — www.thornappleriver.org
- Thornapple River Environmental Issues — www.thornappleriver.com
- Western Michigan Environmental Action Committee — www.wmeac.org
- Coldwater River Watershed Project — www.gvsu.edu/wri/isc/

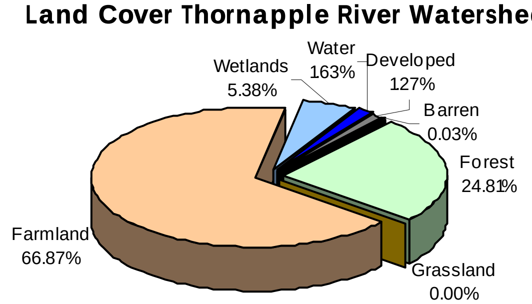
Watershed Overview / Ecology / Biodiversity

- The Thornapple River watershed flows into the Lower Grand River watershed.
- The watershed covers over 855 square miles.
- Over 83 percent of the watershed is in agricultural use.
- 324 miles of the watershed's streams and rivers flow year-round.

Impaired (303d) Waters

Waterbody Name	Impairment
Bear Creek (Tyler Creek)	Pathogens
Coldwater River	Pathogens
Jordan Lake	Mercury (Fish Tissue)

Land Cover Thornapple River Watershed

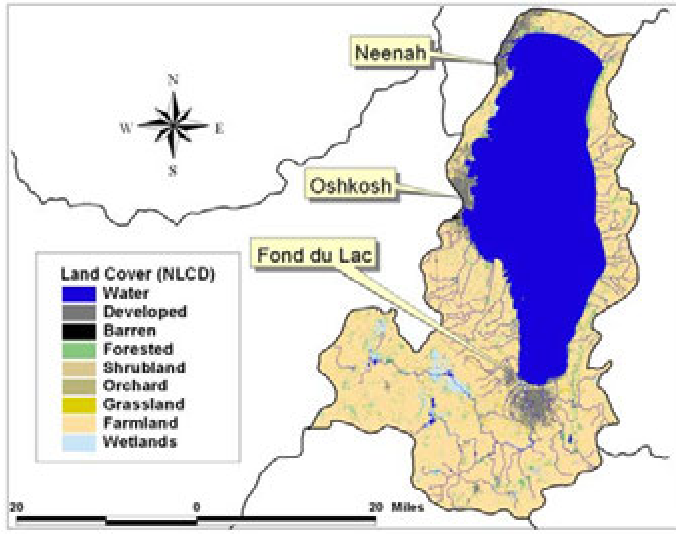


Watershed size: 857 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, forest, and wetland and a slight decrease in grassland.

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Lake Winnebago Watershed
Hydrologic Unit Code: 04030203



For more information, see the USEPA "Surf Your Watershed" website at http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030203

The Wisconsin DNR manages the Lake Winnebago watershed as part of the Upper Fox River basin management area. For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html

Watershed Contacts

- The University of Wisconsin-Extension — basineducation.uwex.edu/foxwolf
- Fox Wolf Watershed Alliance — www.fwwa.org
- Lake Michigan Forum — www.lkmichiganforum.org
- Fond du Lac County Land & Water Conservation Department — www.co.fond-du-lac.wi.us/dept/landcon/landcon.html
- Fond du Lac River Priority Watershed Project — www.wclwcd.org/fdl.htm
- Winnebago County Land & Water Conservation Department — www.wclwcd.org
- Rob McLennan, the Upper Fox River Water Basin Team Leader — Robin.McLennan@dnr.state.wi.us

Watershed Overview / Ecology / Biodiversity

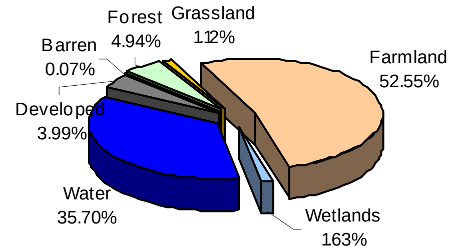
- The Lake Winnebago watershed covers over 581 square miles.
- Over 200 square miles of the watershed are lakes, the largest being Lake Winnebago.
- The watershed is located between the Upper and Lower Fox Rivers in Wisconsin.
- The watershed is primarily glacial plain.
- The watershed is above a sandstone aquifer.
- The Niagra Escarpment, a bedrock ridge, forms the eastern boundary of the Lake Winnebago watershed.
- Menasha, Oshkosh, and Fond du Lac, Wisconsin are the primary urbanized areas located in the watershed.
- High Cliff State Park is a 1,145 acre state park located in Calumet County.
- A Glacial Habitat Restoration Area (GHRA) is located in the watershed in Winnebago and Fond du Lac counties. The GHRA is an area where the state is restoring a patchwork of grasslands and wetlands over a large rural landscape so that wildlife can thrive side-by-side with agriculture.
- The basin hosts resident and migratory neo-tropical songbirds in its open grassland/ agricultural habitat.

Watershed Activities / Concerns / Priorities

- Numerous urban stormwater outfalls discharge to Lake Winnebago from portions of the Cities of Oshkosh, Neenah, and Menasha. Storm event runoff from commercial, industrial, and residential construction sites and from plat developments in rapidly developing sections of Oshkosh, Neenah, and Menasha are also nonpoint source pollution problems.
- Water quality modeling done by Northeast Wisconsin Waters of Tomorrow (NEWWT) have indicated this watershed to be a major contributor of phosphorus and suspended solids to Lake Winnebago.
- Critical animal waste and soil erosion problems are intensified by the steep slopes along the Niagara escarpment.
- Average soil loss in all of Calumet County is estimated to be 2.7 tons per acre. These factors accelerate nutrient and sediment delivery to Lake Winnebago. Both the Winnebago Comprehensive Management Plan and the Lower Green Bay Remedial Action Plan identified this watershed as a high priority for the control of nonpoint sources of pollution.
- The eastern portion of the watershed was selected as a nonpoint source priority watershed project in 1989. The primary goals of this watershed project are to reduce Phosphorus and sediment loading to Lake Winnebago and decrease the loading of heavy metals from urban nonpoint sources.

- The Winnebago County Land & Water Conservation Department in Wisconsin, through the 2004 Great Lakes Basin Program, will sponsor a pair of one-day workshops aimed at examining compliance with existing Erosion Control & Storm Water Management Ordinance in Winnebago County and other storm water management issues targeted to elected officials, designers and developers. The LWCD will also prepare a full-color, four-fold informational brochure covering erosion control practices, installation, operation and maintenance.
- Lake Winnebago specific fisheries priorities include:
  - Continue the Lake Winnebago Fisheries Community Assessment through trawling, seining, shocking, and netting to characterize the Lake Winnebago fish community and assess year-class strength.
  - Continue lake sturgeon management in the Winnebago-Fox-Wolf System. Conduct population and harvest assessments; continue public involvement and education; work closely with the Winnebago Citizens Sturgeon Advisory Committee; pursue Upper Fox River long term sturgeon spawning stock rehabilitation, spawning, and nursery habitat protection and enhancement; cooperate with other regional, statewide, national, and international sturgeon management and research programs; and prepare the annual Winnebago System Sturgeon Management report, direct sturgeon registration, and determine harvest cap for the annual sturgeon spearing season.

Land Cover: Lake Winnebago Watershed



Watershed size: 581 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, grassland, and wetlands and a slight decrease in farmland and forest.

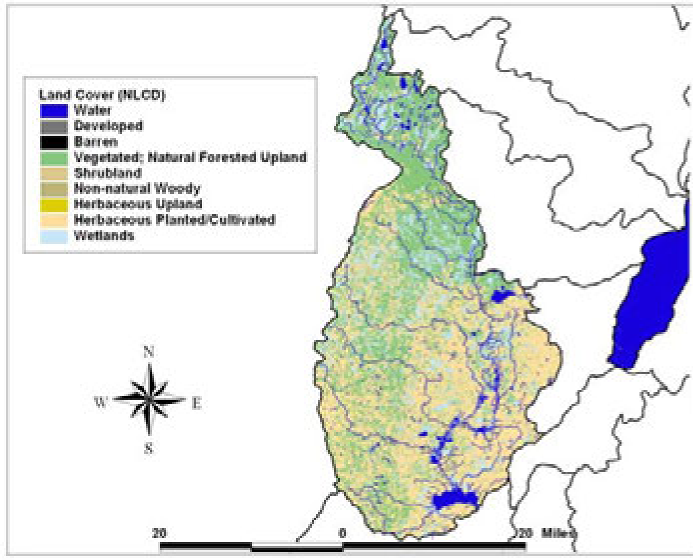
Impaired 303(d) Waters

Waterbody Name	Impairment
Deneveu Creek	Degraded Habitat Sediment
Fond Du Lac River	Metals Fish Consumption Advisories (Mercury) Fish Consumption Advisories (PCBs) TOC
Lake Winnebago	Nutrients Phosphorus Dissolved Oxygen Eutrophication Fish Consumption Advisories (Mercury) Fish Consumption Advisories (PCBs) Sediment
Fox River, Oshkosh	Aquatic Toxicity
Fox River, Lower Seg 1 (1)	Phosphorus Dissolved Oxygen Fish Consumption Advisories (PCBs)
Mosher Creek	Degraded Habitat Sediment
Parsons Creek	Degraded Habitat Sediment

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Wolf River Watershed

Hydrologic Unit Code: 04030202



For more information, see the USEPA "Surf Your Watershed website at
http://cfpub.epa.gov/surf/huc.cfm?huc_code=04030202

For more information, see the Wisconsin Department of Natural Resources' "Wisconsin's Basins" website at http://dnr.wi.gov/org/gmu/gmu.html.

Watershed Groups

- The University of Wisconsin-Extension – basineducation.uwex.edu/foxwolf
- Fox Wolf Watershed Alliance — www.fwwa.org
- Lake Michigan Forum — www.lkmichiganforum.org
- Wolf River Basin — www.dnr.wi.gov/org/gmu/wolf
- Dan Helf, Wolf River Basin Water Team Leader — Daniel.Helf@dnr.state.wi.us

Watershed Overview / Ecology / Biodiversity

- The Wolf Basin's general topography can be characterized by rolling hills, plain meadows, lush and forested wetlands, numerous lakes and small tributaries. Vegetation consists primarily of hardwood forests mixed with large amounts of hemlock, northern white-cedar swamp, and hardwood-conifer swamp.
- The Wolf River originates with a discharge from Pine Lake located in Forest County. The river flows south for about 203 miles until it reaches Lake Poygan. At that point it becomes part of the Winnebago Lake system. Waters from the Winnebago system then flow into the Lower Fox River where they eventually reach the Bay of Green Bay.
- Development within the basin is predominately along the Wolf River or its major tributaries. Communities like Shawano, Clintonville, New London, Waupaca, Weyauwega and more were developed primarily because of being located on waterways that were used by the logging industry
- The Basin includes the Northern Hills and Northeast Plains Ecological Landscapes with small portions in the Central Sand Hills, Southeast Glacial Plains and North Central Forest.
- Surface waters are a mix of cold and warm water streams with smallmouth bass, walleye, northern pike, panfish, trout and salmon. Groundwater is generally abundant, clean and used for drinking water in many of the basin's communities.
- Over 143 rare animal species live in the Wolf River Basin, including northern goshawk, red- headed woodpecker, great gray owl, barn owl, red- shouldered hawk, bad eagle, osprey and various butterflies, beetles, dragonflies, fish, grasshoppers, mayflies, mussels, mammals, snails, snakes and turtles.
- The basin supports 57 rare plant (known accounts), including 8 state endangered, 11 state threatened, 38 special concern and two federally listed plants species. The majority of these plants are associated with wetlands.
- Menominee, Stockbridege-Munsee Band of Mohicans, Forest County Potawatomi Community, Sokaogon Chippewa, and Mole Lake-- participate in the Wisconsin NRCS Tribal Conservation Advisory Council
- The Nature Conservancy identified the Wolf Lake Chain, the Lower Wolf River, oxbow lakes, and rapids reach of the mainstem Wolf River as critical ecological systems.
- Important plant communities in the Wolf River watershed include Midwest Mixed Emergent Deep Marsh, Silver Maple - Elm - (Cottonwood) Forest, and Tussock Sedge Wet Meadow.
- The Nature Conservancy identified the Wolf River as a critical migratory waterfowl stopover site.
- The Nature Conservancy identified the following critical species in the Wolf River watershed: Lake sturgeon; American Bittern; Black Tern; Sedge Wren; Cerulean Warbler; Snuffbox; Wood Thrush; Red-headed Woodpecker; Black-and-white Warbler; Round pigtoe; Prothonotary Warbler; Golden-winged Warbler; and Blue-winged Warbler.
- The Lower Embarrass River's large tributaries to the lower Wolf River and cool headwaters are critical ecological systems identified by the Nature Conservancy.
- Critical species in the Lower Embarrass River include the Lake Sturgeon, Snuffbox, Round Pigtoe, Pygmy snaketail, Salamander mussel, and Western sand darter.

Watershed Activities / Concerns / Priorities

Environmental Concerns

- Loss of aquatic habitat and open land to development; pollution threats to surface and groundwater. Simplification of diverse habitat and loss of special places that support rare species.
- Water quality problems from in- place pollutants, dams, urban and agricultural runoff.
- Preserve of biodiversity and protect endangered and threatened species.
- Protection of large contiguous blocks of forests, grassland and wetland that serve as habitat for mammals, birds, and amphibians and provide a large self-sustaining ecosystem for all to enjoy.
- Invasive exotic nuisance species: purple loosestrife, gypsy moths, zebra mussels, Eurasian water milfoil, garlic mustard (uplands), and others.
- Monitoring wildlife populations, water quality, and ecosystem function is needed to the status and trends of resources in the basin.

Basin Priorities

Wolf Basin Partners identified the following areas as highest basin priorities:

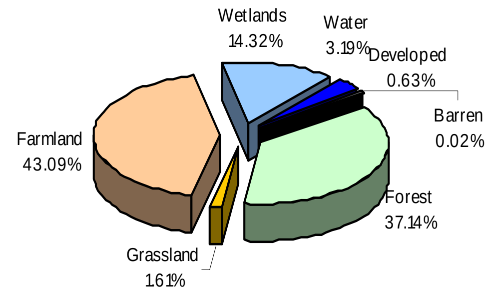
- Water Pollution
- Loss of Shoreline Habitat
- Hunting/ Fishing/ Trapping and Recreational Uses
- Inventory of Resources

Wisconsin DNR's Wolf Team has also identified priorities to guide work:

- Preservation and protection of wetlands
- The presence and spread of exotic species
- Pressures on Natural Resources from development
- Promoting sound land use and "smart growth" or comprehensive planning

Data Sources. Land cover map and percentages: National Land Cover database, 1992 (http://edc.usgs.gov/products/landcover/nlcd.html; Land use change: NOAA Coastal Change Analysis Program, 1996 and 2001 (http://www.csc.noaa.gov/crs/lca/ccap.html); Total Maximum Daily Load (TMDL) Impaired Waters: Surf Your Watershed (www.epa.gov/surf)

Land Cover: Wolf River Watershed



Watershed size: 3727 sq. miles

Between 1996 and 2001, there has been a slight increase in developed land, farmland, and forest and a slight decrease in grassland and wetlands.

Impaired (303d) Waters

Waterbody Name	Impairment
Arbutus Lake	Mercury Fish Consumption Advisory
Bear Creek	Degraded Habitat Sediment
Big Hills Lake	Mercury Fish Consumption Advisory
Carpenter Creek	Degraded Habitat Sediment
Cloverleaf Chain of Lakes	Mercury Fish Consumption Advisory
Collins Lake	Mercury Fish Consumption Advisory
Columbia Lake	Mercury Fish Consumption Advisory
Deep Hole Lake	Mercury Fish Consumption Advisory
Kusel Lake	Mercury Fish Consumption Advisory
Little Sand Lake	Mercury Fish Consumption Advisory
Mayflower Lake	Mercury Fish Consumption Advisory
Poygen Lake	Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory Organic Enrichment/Low Dissolved Oxygen Sediment
Rat River *	Organic Enrichment/Low Dissolved Oxygen Phosphorus
Rat River *	Organic Enrichment/Low Dissolved Oxygen Phosphorus
Roberts Lake	Mercury Fish Consumption Advisory
Shawano Lake	Mercury Fish Consumption Advisory
Winneconne Lake	Phosphorus Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory Organic Enrichment/Low Dissolved Oxygen Eutrophication Sediment
Wolf River Below Shawano Dam Down To State Hwy 156	Mercury Fish Consumption Advisory PCBs Fish Consumption Advisory
Wolf River from Shawano Dam to Lake Poygan	PCBs Fish Consumption Advisory

Appendix A
Lake Michigan LaMP 2006 Pollutant Identification and Classification

I. Background

The Lake Michigan LaMP in 2000[1] announced its management approach to the Lake Michigan ecosystem would be adaptive. How does one identify Lake Michigan pollutants in an adaptive manner? The Lake Michigan LaMP in 2002 proposed an ongoing biennial review process in its Appendix A[2]. The pollutant identification process for the LaMP was developed in consideration of federal and state regulatory programs, Lake Michigan Lakewide Management Plans drafted before 2000, Great Lakes strategies, and Annex 2 of the *Great Lakes Water Quality Agreement of 1978 As Amended by Protocol Signed November 18, 1987* (GLWQA).

A summary of these influences and previous pollutant identification work provides context for the rest of this LaMP 2006 Appendix.

> Annex 2 of the GLWQA (1987) defines "critical pollutants" as substances that persist at levels that, singly or in synergistic or additive combination, are causing, or are likely to cause, impairment of beneficial uses[3] despite past application of regulatory controls due to their: presence in open lake waters; ability to cause or contribute to a failure to meet Agreement objectives through their recognized threat to human health and aquatic life; or ability to bioaccumulate. The GLWQA, as incorporated into the Great Lakes Critical Programs Act of 1990[4] requires the parties to prepare a Lakewide Management Plan to evaluate existing information on concentration, sources, and pathways of critical pollutants, including loading information and estimates, to develop load reduction targets, to track implementation of remedial measures, and to identify a process to recognize the absence of a critical pollutant in open lake waters.
>
> In 1992 and 1993, a list of pollutants was developed by the Federal and State Agencies participating in the Lake Michigan lakewide management planning process. The pollutants were categorized into three groups: critical pollutants, pollutants of concern, and emerging pollutants. This list was incorporated into the chemical stressors section of Chapter 5 in Lake Michigan LaMP 2000[5]. Listed in descending order with regard to the potential level of impairment or importance to the lake, the three categories of LaMP pollutants were: critical pollutants, to be addressed through LaMP reduction targets; pollutants of concern, to be addressed by local actions facilitated by the LaMP, and a Pollutant Watch List to be addressed by monitoring and research encouraged by the LaMP.
>
> In order to adaptively prepare the pollutant list, ambient environmental data is essential. Great Lakes National Program Office grantees have sometimes sampled the open waters of Lake Michigan for pollutants while collecting monitoring samples for its Limnology Program[6]. The Lake Michigan Mass Balance provided a wealth of chemical data for the 1994-1995 period. For a ten year comparison to the Lake Michigan Mass Balance data, states are collecting additional tributary samples in 2005 and 2006. Federal and state agencies monitor fish for public health fish consumption advisories and to assess the condition of water resources.[7] Finally, the Great Lakes National Program Office also supports a fish monitoring program.[8]
>
> Section 303(d) of the Clean Water Act requires states to prepare lists of waters within the state's boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters. Section 305(b) of the Clean Water Act requires each State to report, to U.S. EPA, the water quality of all navigable waters biennially. The four

Lake Michigan states satisfied these federal requirements in a variety of formats, complicating comparison. After states followed federal guidance including the 2002 Integrated Water Quality Monitoring and Assessment Report, the Consolidated Assessment and Listing Methodology, Guidance[s] for [the] 2004 [& 2006] Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act, the finding, understanding and integration of state water quality information became easier. As state lists of impaired waters change, the LaMP pollutant identification process will reflect those changes. One change consistent with the federal guidance documents and adopted by three Lake Michigan states was the incorporation of hydrologic unit codes, a national system for identifying water bodies and stream segments. This code is reported by Michigan as the NHD code and by Indiana as the 14-digit HUC.

There are multiple Great Lakes-wide strategies. The *Great Lakes Strategy 2002: A Plan for the New Millennium*[9] is a strategic plan for the Great Lakes Ecosystem developed by the United States Policy Committee for the Great Lakes. It reiterates the goals of the Clean Water Act and the GLWQA, and summarizes water[10], air[11] and international[12] programs in the context of Great Lakes goals and objectives. In December 2004, consistent with President Bush's May 18, 2004 Executive Order, a Great Lakes Regional Collaboration formed[13]. In December 2005, a Great Lakes Regional Collaboration Strategy was released. It devoted a chapter to toxic pollutants, one of eight issues addressed.

The State-of-the-Lakes Ecosystem Conference (SOLEC) is another activity established through the 1987 GLWQA. SOLEC focuses on an ecosystem setting (e.g., near shore in 1996) or subject (e.g., chemical integrity in 2006) in its binational conferences in even-numbered calendar years. The desire to use indicators developed by SOLEC is important to the Lake Michigan LaMP pollutant identification process.

The pollutant identification challenge facing the Lake Michigan Lakewide Management plan stakeholders is to be consistent with established policy and promulgated rules. Also, as resources are finite, it is advantageous to rely on existing programs. In that vein, Illinois' draft 303(d) list for 2006 references Superfund sites and Resource Conservation and Recovery Act facilities.[14] The Lake Michigan LaMP 2004 Appendix A had asked whether such sites should be considered during pollutant identification.

II. Lake Michigan LaMP Pollutants Looking Back

1. Criteria to Define Pollutants

The primary goal for pollutant categorization is to identify, at the appropriate geographic scale, problem-causing chemicals that must be addressed regardless of the type of action to be taken. The pollutant categories are heavily dependent on public health fish consumption advisories and state water quality standards because data are available for these programs. In addition, the pollutant watch list includes chemicals without final national water quality criteria, state water quality standards, or fish consumption advisories. Candidates for the watch list therefore include conventional pollutants like nitrogen or ammonia as well as "emerging" pollutants without regulatory thresholds or action levels.

The working definitions of critical pollutant, pollutant of concern, and watch list are the same as in Appendix A of LaMP 2004[15]. Any one of these four criteria may be relied upon to define the Lake Michigan LaMP 'critical pollutants':

- Pollutants identified on Illinois, Indiana, Michigan, or Wisconsin Clean Water Act Section 303(d) lists or in Section 305(b) reports as sources of impairment to the open waters of the lake;
- Pollutants that have been found to exceed Great Lakes Water Quality Initiative (GLI) water quality criteria in the open waters of the lake;

- Pollutants that exceed or trigger a relevant Action Level, such as a fish consumption advisory (FCA) or a maximum contaminant level (MCL), in the open waters of the lake; or,
- Pollutants associated with other lakewide designated use impairments (e.g., impairment to aquatic life).

Any one of the following three criteria may be relied upon to define Lake Michigan LaMP 'pollutants of concern':

- Pollutants on State 303(d) lists identified as causing impairments in nearshore waters and Lake Michigan tributary mouths;
- Pollutants exceeding an Agency action level in nearshore waters or tributary mouths, including pollutants identified as a source of impairment in a Great Lakes Area of Concern; or
- Pollutants associated with regional use impairments (e.g., impairment of local fish communities or populations).

The three criteria proposed in 2002 for Lake Michigan LaMP 'watch list' pollutant identification are:

- potential to impact the Lake Michigan ecosystem;
- presence in the Lake Michigan watershed; and,
- bioaccumulation potential, persistence in water or sediment, or toxicity singly or through synergistic effects.

2. Pollutants Proposed in 2004, Finalized in 2006

In Lake Michigan LaMP 2006 Appendix A, we are continuing the adaptive management process of reviewing information not incorporated when the Lake Michigan LaMP 2004 Appendix A was prepared. The new information is used to propose a 2006 pollutant list for finalization in 2008. The pollutant list proposed in 2004 is finalized in 2006 'as is,' unless adverse comments were received or preparatory mistakes were made. In the latter case, corrections are made. The terms "proposed" and "final" are relative and are terms of convenience. There won't be a truly final list of Lake Michigan LaMP pollutants until the LaMP adaptive management process changes or pollutant-caused impairments are remediated. See Table A-1 on the following page for the revised list of LaMP 2006 pollutants (proposed in LaMP 2004). Several corrections were made to the Lake Michigan LaMP 2004 Tables A-6 and A-7:

- including pathogens on the critical pollutant row;
- deleting general category names for pollutants like Salinity/TDS/chlorides;
- deleting "impaired biotic communities (i.e., the possibility of a pollutant causing the impairment has not been eliminated)";
- combining the two tables.
- adding a reference for PFOS; and,
- many of the watch list pollutants proposed in 2004 are not finalized below because peer-reviewed literature or data produced pursuant to a quality assurance plan and satisfying all three watch list criteria were not included in LaMP 2004 or subsequently identified.

The Great Lakes Initiative definition of open waters was used to identify critical pollutants and pollutants of concern in 2004. That approach is rejected later in this document; see scenario 1 in the Lake Michigan LaMP Pollutants 2006 Review, Pollutant Classification into Categories Using Scenarios 1 through 4.

Table A-1. Lake Michigan Pollutants Proposed in 2004 and Revised in LaMP 2006.

Pollutant Classification	Final LaMP 2006 Pollutants Revision of 2004 Proposed Pollutants
Critical Pollutants	PCBs, mercury, DDT and metabolites, chlordane, dioxin, and pathogens (E. coli, Cryptosporidium, Giardia, Salmonella).
Pollutants of Concern	Siltation, sediments, organic enrichment/low dissolved oxygen (DO), nutrients, phosphorus, metals, arsenic, cadmium, copper, chromium, lead, zinc, nitrogen, total (nitrates + total Kjehldal nitrogen), and TDS (conductivity).
Watch List	PBDEs, PCNs, PFOS[17], asbestos, PAHs, selenium, radioactive material, toxaphene, sulfur, atrazine & degradation products , metolachlor & degradation products, acetochlor & degradation products, glyphosate & degradation products, 1,4-dichlorobenzene

Between 2004 and 2006, the proposed 2004 LaMP pollutants were compared to National Recommended Water Quality Criteria[18] and three states' water quality standards to determine whether any of the 2004 proposed watch list pollutants have any regulatory thresholds. Watch list pollutants with final federal water quality criteria in 2006 include anthracene, acenaphthene, bis(2-ethylhexyl) phthalate, butylbenzyl phalate, 1,4-dichlorobenzene, di-n-butyl phalate, di-n-octyl phthalate, diethyl phthalate, fluoranthene, fluorene, nonylphenol, phenanthrene, pyrene, selenium, thallium and toxaphene. Water quality criteria for aquatic life remain draft for atrazine[19], nonylphenol[20], and selenium[21]. At least one Lake Michigan state has water quality standards for radioactive material (as strontium 90, gross beta, and radium 226), atrazine, butylated hydroxyl toluene, and 4-methyl phenol, in addition to the watch list pollutants identified as having federal water quality criteria.

Please note that water quality criteria are provided in the context of a designated use, like human consumption of organisms and water, human consumption of organisms, and acute (criteria maximum concentration) aquatic life or chronic (criteria continuous concentration) aquatic life. Federal water quality criteria may have been finalized for one designated use and not others. In other words, additional criteria may be proposed for pollutants identified above as having federal water quality criteria.

III. Lake Michigan LaMP Pollutants 2006 Review

1. Pollutant Categorization Scenarios

Given the Great Lakes Water Quality Agreement, federal water quality criteria, state water quality standards, requirements to calculate Total Maximum Daily Loads, and LaMP critical pollutants, how do we go about restoring the contaminant-impaired uses of Lake Michigan? As in LaMP 2004, we rely on data prepared by state and federal programs to identify pollutants, look for monitoring available to help us assess the ambient conditions, and review scientific literature. Once pollutants are identified, the appropriate scale for action should be determined. If one pollutant was primarily in open waters and not in nearshore waters, an open water TMDL could be appropriate. If one pollutant was primarily in nearshore waters and not in open water then, for example, the shoreline approach taken by Indiana for its *E. coli* TMDL might be appropriate for other contaminants. Between LaMP 2004 and LaMP 2006, we intended to examine the metadata from State and Federal monitoring programs in four scenarios with the intention of fine-tuning the criteria used to define the LaMP pollutant categories. Ideally, the categories would suggest the appropriate scale for TMDL development among other purposes.

In the first scenario, we proposed to rely on the Water Quality Guidance for the Great Lakes System (GLI)[22] definition of open waters of the Great Lakes and evaluate impairments as Lake Michigan or not Lake Michigan. In this scenario, load reduction targets and total maximum daily loads (TMDLs) would be calculated for the entire Lake. We subsequently learned that when Michigan moved toward a probabilistic assessment of state waters in order to prepare its 305(b) report, it stopped collecting fish in the open waters of the lake.

However, Michigan collection of 'open water fish' continues when the fish are spawning in rivers, and Michigan's Lake Michigan fish consumption advisory applies to the open waters. Similarly, Wisconsin reports fish consumption advisories for Lake Michigan in its 303(d) list. Indiana's draft 2006 303(d) list associates the fish consumption advisory with the waterbody segment name 'Lake Michigan shoreline.'

In the second scenario, we proposed to apply the State of the Lakes Ecosystem Conference 1996 definition of near shore waters (approximated by a depth less than 90 feet), consistent with dividing Lake Michigan into zones for calculating a total maximum daily load. Open waters are deeper than 27 meters. Nearshore waters are from the beach lakeward to a depth of 27 meters. Inland waters are up to the first dam or other state-designated river segment. Pollutant monitoring data specific to open waters and distinct from nearshore waters is not readily available for the lake. The Illinois Lake Michigan monitoring plan identifies stations where lake depths are greater than 90 feet. Pollutant transport from the atmosphere and tributaries to the GLWQA-defined open waters of the Lake was addressed through the Lake Michigan Mass Balance (LMMB) study in 1994-1995, but the sampling points have not been categorized with respect to a depth of 90 feet, and most of the pollutant data collected has not been modeled with a Lake Michigan Mass Balance Level 3 model, the only model level that can distinguish the SOLEC-defined near shore from the SOLEC-defined open waters.
In the third scenario, we proposed to categorize fish consumption advisories by "open water" and "near shore water" fish species, possibly resulting in division of Lake Michigan into zones for TMDL preparation. As in the first scenario, the indicator crosses the geographic boundary. This scenario is further evaluated in this document and is somewhat weakened by inconsistencies in preparation of state advisories and inconsistent knowledge of analytes detected. In other words, a very detailed review of the fish pollutant analyte list for each state has not been completed, and it isn't clear whether a pollutant is only in one state's waters or whether the pollutant was not analyzed by all states.

Finally, we proposed a fourth scenario, to consist of identifying "open water" and "nearshore water" impairments by pollutant. For example, E. coli exceedances have been addressed by Indiana through a TMDL for a geographically discrete nearshore zone. For other pollutants, the presumption that a pollutant moves along the shoreline without affecting the open waters and without significant air deposition is known to be incorrect. Mercury, PCBs, chlordane, and atrazine are known to be air-deposited to Lake Michigan as well as water-transported[23]. The International Air Deposition Network (IADN) includes two stations on Lake Michigan, at the Illinois Institute of Technology in Chicago at the south end of the Lake and at Sleeping Bear Dunes National Lakeshore in Michigan, slightly south of the 45th Parallel of Latitude. Gas-phase, particle, and precipitation samples are collected at both stations. Of the final LaMP 2006 pollutants, the IADN chemical list[24] includes PCBs, chlordane (trans- and cis-), and DDT (p,p'- , p,p'-DDD, and p,p'-DDE). IADN trace metals are not monitored at the Lake Michigan stations. In addition to Lake Michigan Mass Balance air deposition findings (for mercury, PCBs, chlordane, and atrazine), IADN demonstrates the importance of atmospheric deposition of toxic chemicals like chlordane and DDT to Lake Michigan. IADN Dioxin monitoring was initiated in the summer of 2004 and will continue indefinitely depending on funding availability.

The Lake Michigan states' 303(d) lists were reviewed to identify impaired Lake Michigan waters. In previous LaMPs, only EPA-approved final 303(d) lists were cited. The 303(d) lists due on April 1, 2006 were available as draft Clean Water Act Section 305(b) consolidated reports from three of four Lake Michigan states at the time of document preparation. The draft lists, where available, are referenced in this LaMP because the consolidated reports contained the hydrologic unit code and could be electronically sorted. This significantly expedited preparation of this document.

2. Pollutants from Clean Water Act Section 303(d) Lists of Category 5 Waters for which a TMDL is required

a. Illinois

Illinois' draft 2006 303(d) list groups assessment information as follows: Lake Michigan, Lake Michigan Beaches, and Lake Michigan Bays and Harbors, and Great Lakes/Calumet River Watershed. Based on the Illinois 303(d) list, the fish consumption use of Lake Michigan is impaired by PCBs. Lake Michigan beaches are polluted by E. Coli and PCBs. Lake Michigan bays and harbors are polluted by Arsenic, Cadmium, Chromium (total), Copper, Lead, PCBs, Zinc, Nitrogen (total), and Phosphorus (total). Listed stream segments adjacent to and discharging to Lake Michigan are polluted by Alpha BHC, Arsenic, Copper, Dieldrin, DDT, Endrin, Lead, Manganese, Mercury, Nickel, PCBs, Silver, Total Dissolved Solids (TDS), and Zinc. Finally, listed Lake Michigan watershed stream segments upstream of the tributary mouth are polluted by Alpha BHC, Aldrin, chromium (total), DDT, Endrin, Heptachlor, Hexachlorobenzene, Nickel, PCBs, Silver, and Nitrogen (total).

b. Indiana

Based on Indiana's draft 2006 303(d) list, deep Lake Michigan open waters are either not impaired or not assessed. The Lake Michigan shoreline is impaired due to PCBs, mercury, and E. coli. Assessed stream segments discharging to Lake Michigan are impaired due to PCBs, mercury, and E. coli. Listed Lake Michigan watershed stream segments upstream of the tributary mouth are polluted by nutrients, PCBs, mercury, E. coli, ammonia, chlorides, cyanide, oil and grease, siltation, and total dissolved solids in Indiana.

c. Michigan

Based on Michigan's draft 2006 303(d) list, Lake Michigan is impaired due to PCBs, mercury, TCDD (dioxins), chlordane, and DDT. The listed Lake Michigan beaches (including beaches on bays) are impaired by pathogens. Listed Lake Michigan bays are impaired due to PCBs, chlordane, TCDD (dioxins), mercury, pathogens, and nuisance oil product pollution. Listed Lake Michigan tributary mouths are polluted by PCBs, mercury, chlordane, nuisance oil product pollution, and pathogens. Listed Lake Michigan watershed stream segments upstream of the tributary mouth are polluted in Michigan by phosphorus, pathogens, mercury, PCBs, TCDD, chlordane, dissolved oxygen, organic enrichment, and bacterial slimes.

d. Wisconsin

Based on Wisconsin's final 2004 303(d) list and a review of counties on Lake Michigan and Green Bay, the Lake Michigan open waters are impaired due to polychlorobiphenyls and mercury. The Lake Michigan beaches are impaired due to E. coli. Bays are impaired due to mercury, polychlorobiphenyls, and phosphorus. Tributary mouths are impaired due to mercury and polychlorobiphenyls. Assuming that stream miles are counted beginning with zero at the mouth, then the stream segments assessed next to Lake Michigan are polluted by sedimentation, creosote, polychorobiphenyls, polycyclic aromatic hydrocarbon, phosphorus, TBD, nitrate, mercury, metals, and bacteria, so these are pollutants of concern. Listed Lake Michigan watershed stream segments upstream of the tributary mouth in Wisconsin are polluted by phosphorus, sediment, polychorobiphenyl, metals, mercury, and bacteria.

3. Pollutants Exceeding GLI Criteria

Pollutants have not been found to exceed Great Lakes Water Quality Initiative water quality criteria in the deep open waters of Lake Michigan. Unlike the other Great Lakes, Lake Michigan open waters are not monitored by Canada for chemical pollutants. Lake Michigan open water has been analyzed by researchers and found to be of good quality with respect to PCBs and mercury. Also, atrazine concentrations measured in 1994-1995 did not exceed current federal water quality criteria.

4. Pollutants from Fish Consumption Advisories

State fish consumption advisories are prepared when pollutant concentrations in fish tissue are greater than the action level or regulatory threshold. For LaMP 2004, we listed fish species included in State of Michigan consumption advisories for Lake Michigan and then categorized the species location: normally found in open waters, normally found in nearshore waters, and/or normally found in inland waters up to the first dam. See LaMP 2004 Table A-1[25]. Between 2004 and 2006, we reviewed fish consumption advisories or guides for all four states and added species to the 2004 Table A-1. It is Table A-2 below. We then replaced the x's in the columns above with the contaminant causing the fish consumption advisory. Collapsing the rows by state, we summarized fish contaminants by open waters, nearshore waters, and inland waters in Table A-3.

Table A-2 Fish species in the table are included in the consumption guides or advisories prepared by Illinois, Indiana, Michigan, or Wisconsin. Professional judgment and references available on the Internet were used to categorize the fishes' habitat.

Fish Habitat → Fish Species↓	Normally found in Open Waters	Normally found in Near-shore Waters	Normally found in Inland Waters
Black Redhorse			X
Bloater	X		
Bluegill		X	X
Brook Trout			
Brown Trout	X	X	X
Burbot	X		
Carp		X	X
Catfish		X	X
Channel Catfish		X	X
Chinook Salmon	X	X	
Chub	X		
Coho Salmon	X		
Crappie		X	X
Flathead Catfish		X	X
Freshwater Drum		X	X
Golden Redhorse			X
Lake Trout	X		
Largemouth Bass		X	X
Longnose Sucker	X	X	
Muskellunge		X	X
Northern Hogsucker			X
Northern Pike		X	X
Pink Salmon		X	
Quillback		X	X
Rainbow Trout			X
Redhorse Sucker	X	X	X
Rock Bass		X	X
Round Goby		X	
Sheepshead		X	X
Shorthead Redhorse	X	X	X
Silver Redhorse			X
Smallmouth Bass		X	X
Smelt	X	X	
Splake		X	X
Steelhead	X	X	
Sturgeon	X	X	X
Suckers		X	X
Sunfish		X	X
Walleye	X	X	X
Whitefish	X		
White Perch		X	
White Sucker		X	X
Yellow Bullhead		X	X
Yellow Perch		X	X

Table A-3 Contaminants causing fish consumption advisories in Lake Michigan. Illinois has a state-wide advisory (SWA) for predator fish for women of childbearing age and children. Indiana has a do not eat advisory for fish from the Grand Calumet River/Indiana Harbor Canal. †Michigan has a mercury advisory for all inland lakes, reservoirs, and impoundments. *Wisconsin's safe eating guidelines (SEG) do not specify the contaminant causing the advisory.

Fish habitat→ CONTAMINANT causing advisory↓	Lake Michigan OPEN WATERS	Lake Michigan NEARSHORE WATERS	Lake Michigan INLAND WATERS
PCBs, number of fish species by state	Illinois 4 Indiana 8 Michigan 11 Wisconsin 9 Total 31	Illinois 5 Indiana 13 Michigan 16 Wisconsin 21 Total 50	Illinois 6 Indiana 16 Michigan 7 Wisconsin 17 Total 40
Mercury, number of fish species by state	Illinois SWA Indiana 1 Michigan 0 Wisconsin * Total 1	Illinois SWA Indiana 3 Michigan 2 Wisconsin * Total 5	Illinois SWA Indiana 4 Michigan 2† Wisconsin 1 and * Total 7
Chlordane, number of fish species by state	Illinois 0 Indiana 0 Michigan 3 Wisconsin * Total 3	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1
DDT, number of fish species by state	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1
Dioxin, number of fish species by state	Illinois 0 Indiana 0 Michigan 3 Wisconsin * Total 3	Illinois 0 Indiana 0 Michigan 2 Wisconsin * Total 2	Illinois 0 Indiana 0 Michigan 1 Wisconsin * Total 1
Safe Eating Guidelines	Wisconsin 3	Wisconsin 16	Wisconsin 20

5. Pollutant Classification into Categories Using Scenarios 1 through 4

Based on a review of pollutants identified from the draft 2006 303(d) lists for Illinois, Indiana, and Michigan, the 2004 final 303(d) list for Wisconsin, and fish consumption advice, the LaMP 2006 critical pollutants and pollutants of concern can be classified using the scenarios described earlier in this document.

Scenario 1. GLI Definition of Open Waters used to categorize pollutants

In this scenario, open waters are all waters lakeward from a line drawn across the mouth of tributaries to the Lake. In this scenario, critical pollutants are found in all depths of the lake, harbors, bays, and beaches. Pollutants causing impairments are taken from 303(d) lists, fish consumption advice, and monitoring data.

Applying the GLI definition of open waters doesn't help the LaMP distinguish between pollutants requiring lakewide action and pollutants to be remediated through regional or local actions. The GLI definition of open waters lumps together AOC and LaMP pollutants. Therefore, the LaMP will not rely on the GLI definition of open waters in order to categorize pollutants.

Table A-4. Proposed LaMP 2006 Pollutants for Finalization in 2008 Using GLI Definition of "Open Water"

Pollutant Classification	Proposed LaMP 2006 Pollutants for Finalization in 2008 Using GLI Definition of "Open Water"
Critical Pollutants (connotation of lakewide TMDL and LaMP action)	**Illinois** PCBs, E. Coli, arsenic, cadmium, chromium, copper, lead, zinc, nitrogen (total), phosphorous (total) **Indiana** PCBs, mercury, E. coli **Michigan** PCBs, mercury, TCDD (dioxins), chlordane, DDT, pathogens, nuisance oil product pollution **Wisconsin** polychlorobiphenyls, mercury, E. coli, and phosphorus
Pollutants of Concern (connoting AOC action)	**Illinois** Alpha BHC, Arsenic, Copper, Dieldrin, DDT, Endrin, Lead, Manganese, Mercury, Nickel, PCBs, Silver, Total Dissolved Solids (TDS), and Zinc **Indiana** PCBs, mercury, and E. coli **Michigan** PCBs, mercury, chlordane, nuisance oil product pollution, and pathogens **Wisconsin** mercury and polychlorobiphenyls sedimentation, creosote, polycyclic aromatic hydrocarbon, phosphorus, TBD, nitrate, metals, and bacteria
Watch List (prevent from reaching the Lake)	**Illinois** Alpha BHC, Aldrin, chromium (total), DDT, Endrin, Heptachlor, Hexachlorobenzene, Nickel, PCBs, Silver, and Nitrogen (total) **Indiana** nutrients, PCBs, mercury, E. coli, ammonia, chlorides, cyanide, oil and grease, siltation, and total dissolved solids **Michigan** phosphorus, pathogens, mercury, PCBs, TCDD, chlordane, dissolved oxygen, organic enrichment, and bacterial slimes. **Wisconsin** phosphorus, sediment, polychorobiphenyl, metals, mercury, and bacteria

Scenario 2. Use SOLEC definition of open water to categorize pollutants.

Once again, pollutant monitoring data specific to open waters and distinct from nearshore waters is not readily available for Lake Michigan. The Illinois Lake Michigan monitoring plan identifies stations with lake depths greater than 27 meters or 90 feet. Pollutant transport from the atmosphere and tributaries to the deep open waters of the Lake was addressed through the Lake Michigan Mass Balance (LMMB) study in 1994-1995, but the sampling points have not been reviewed with respect to a depth of 27 meters for this document. Most of the LMMB pollutant data collected has not been modeled with a Lake Michigan Mass Balance Level 3 model, the only LMMB model level that can distinguish the SOLEC-defined near shore from the SOLEC-defined open waters. IADN sampling stations qualify as near shore in SOLEC terminology, but there are not air criteria or regulatory thresholds with which to compare ambient analytical results for LaMP pollutants. Therefore, the SOLEC definition of open water is not suitable for LaMP pollutant categorization because there isn't enough data from ambient monitoring programs lakeward of the shoreline, harbors, and bays. The SOLEC definition of open water may be suitable for LaMP pollutant categorization when LMMB level 3 model simulations are available or when EEGLE[26] simulations include lake depth information.

Scenario 3. Deduce pollutant categories from fish contaminant advisories.

Table A-3 shows that species-specific consumption advisories with species categorized by habitat (open waters, nearshore waters, and inland waters) can, in some instances, be used to prioritize areas needing contaminant-specific action. For example, more inland species of fish are contaminated with mercury compared to the number of species inhabiting deeper open waters contaminated with mercury. Chlordane impairs more species of open water fish than inland fish in Lake Michigan waters. Some fish consumption advisories are relatively local, and concentration of contaminants would probably be more useful than knowing only the species contaminated and the existence of an advisory. A more robust analysis would include mapping fish contaminant data and evaluation for spatial trends. Higher fish contaminant concentrations could be associated with sources to be controlled (i.e., distinguish air from water pathways), but this may not shed new light as a source inventory already exists. In conclusion, the summary of fish contaminants causing advisories, lumped by species and tallied by state, do not make the appropriate scale for TMDL development self-evident. The appropriate definition of open water isn't easily derived from fish consumption advisories.

Scenario 4. Use general knowledge of pollutant properties to categorize pollutants.

In chapter 5 of LaMP 2000[27], the LaMP pollutants were discussed as chemical, physical, and biological stressors. The loads of these stressors were discussed by source of data, such as monitoring, research, and regulatory programs, and measured or estimated loads to the lake were reported. When information gathered between 2000 and 2006 is added to the LaMP 2000 information, pollutant categorization can be done subjectively (i.e., using professional judgment) as follows.

Table A-5 (Part 1). Scenario 4 Table

Pollutant	Critical Pollutant	Pollutant of Concern	Watch List	Reason – typically the pollutant is associated with a category 5 water body on a state's clean water act Section 303 (D) list. Categorization considers long range air transport and known pollutant sources and pathways.
PCBs	X	X	X	PCBs are critical pollutants, pollutants of concern, and on the watch list because of fish consumption advisories in all four states from Lake Michigan to headwaters. Wisconsin reports polychlorobiphenyls.[28]
Dioxins/furans	X	X		Dioxins/furans are critical pollutants because Michigan has fish consumption advisories for Lake Michigan and it is on Michigan's list for Lake Michigan, including bays and a near shore inland lake. No impairments due to dioxin are reported by Illinois, Indiana, and Wisconsin.
Mercury	X	X	X	Mercury is a critical pollutant because of fish consumption advisories reported on the Indiana, Michigan, and Wisconsin lists, and air deposition research. Mercury is a pollutant of concern reported in bays, harbors, and tributary mouths on all four states' lists. Stream segments and water bodies throughout the watershed are listed for mercury fish consumption advisories.
DDT and metabolites	X	X	X	DDT and metabolites are a critical pollutant because Michigan has Lake Michigan fish consumption advisories. No impairments due to organic pesticides are reported in Indiana's and Wisconsin's 303(d) lists. DDT was reported on 303 (d) lists for assessed stream segments near to and far from Lake Michigan.
Chlordane	X	X	X	Chlordane is a critical pollutant because Michigan has Lake Michigan fish consumption advisories. No impairments due to organic pesticides are reported on Indiana's and Wisconsin's 303(d) lists. In Michigan, White Lake, Torch Lake, Roscommon, Glen Lake, Galien River, and Lake Macatawa are listed for chlordane.
E. coli		X	X	E. coli impairs Lake Michigan in Illinois (66 beaches). In Indiana, 58 stream segments or water bodies, including 4 segments of shoreline are impaired. E. coli is not monitored offshore, but may be transported with sediment.

Table A-5 (continued)

Pollutant	Critical Pollutant	Pollutant of Concern	Watch List	Reason – typically the pollutant is associated with a category 5 water body on a state's clean water act Section 303(D) list. Categorization considers long range air transport and known pollutant sources and pathways.
bacteria		X	X	Bacteria impairs 11 Lake Michigan beaches in Wisconsin. In addition, bacteria are reported on Wisconsin's 2004 303(d) list for more than 7 stream segments or water bodies in the counties bordering Lake Michigan. Bacteria are not monitored offshore, but may be carried with sediment[29]. Municipal water intakes are at depths considered near shore.
pathogens		X	X	Pathogens impair Lake Michigan beaches in Michigan. Pathogens are reported on Michigan's list as a problem for 27 stream segments or water bodies. See the endnote for bacteria.
Bacterial slimes			X	Michigan listed Lost Creek and Unnamed Tributary to Platte Lake segments.
Alpha BHC		X	X	Illinois listed the segment closest to the Lake and an upstream portion of Pettibone Creek for Alpha BHC.
Dieldrin		X	X	Illinois listed the tributary segment and an upstream portion of Pettibone Creek for Dieldrin.
Endrin		X	X	Illinois listed the tributary segment and an upstream portion of Pettibone Creek for Endrin.
Nitrogen		X	X	Illinois listed Waukegan harbor and an upstream portion of Waukegan River.
Nitrate			X	Wisconsin listed at least Dutchman Creek.
Cyanide			X	Indiana listed upstream segments of the Grand Calumet and Little Calumet Rivers
Ammonia			X	Indiana listed two upstream segments.
Phosphorus		X	X	Illinois listed Waukegan Harbor. Michigan listed twelve upstream segments or water bodies. Wisconsin listed more than 22 stream segments or water bodies including Green Bay AOC (inner bay).
Nutrients			X	Indiana listed Wisler Ditch and tribs.
Organic enrichment			X	Michigan listed a segment of Unnamed Tributary to Platte Lake.
Dissolved Oxygen			X	Michigan listed Deer Creek and Sycamore Creek segments.
Polycyclic Aromatic Hydrocarbon		X	X	Wisconsin listed at least Lincoln Creek, Lower Menominee AOC, and Manitowoc River.

Table A-5 (continued)

Pollutant	Critical Pollutant	Pollutant of Concern	Watch List	Reason – typically the pollutant is associated with a category 5 water body on a state's clean water act Section 303(D) list. Categorization considers long range air transport and known pollutant sources and pathways.
Creosote			X	Wisconsin listed at least Little Menomonee River segment.
Nuisance oil product pollution		X		Michigan listed Sawyer Creek.
Oil & grease			X	Indiana listed upstream portions of the Indiana Harbor Canal and Grand Calumet River.
Siltation			X	Indiana listed one upstream segment of Deep River tributary.
Sedimentation		X	X	Wisconsin listed at least 20 stream segments including Mud Creek, Root River, and Two Rivers Harbor.
TDS			X	Indiana listed one upstream segment, Mud Creek.
Chlorides			X	Indiana listed one upstream segment, Mud Creek.
metals		X	X	Wisconsin listed at least Racine Harbor, Milwaukee River estuary AOC, Milwaukee River Estuary AOC - Kinnickinnic River, Milwaukee River Estuary AOC – Menomonee River, Milwaukee River Estuary AOC, Kewaunee Marsh, Kewaunee Harbor, and East River
Arsenic		X		Illinois listed Waukegan Harbor and Pettibone Creek.
Cadmium		X		Illinois listed Waukegan Harbor
Chromium		X	X	Illinois listed Waukegan Harbor and an upstream segment of S. Br. Waukegan River
Copper		X		Illinois listed Waukegan Harbor and Pettibone Creek.
Lead		X		Illinois listed Waukegan Harbor and Pettibone Creek.
Manganese		X		Illinois listed Pettibone Creek.
Nickel		X	X	Illinois listed Pettibone Creek and S. Br. Waukegan River.
Silver		X	X	Illinois listed Pettibone Creek and S. Br. Waukegan River.
Zinc		X		Illinois listed Waukegan Harbor and Pettibone Creek.

The 'apply professional judgment' scenario allows classification of E. coli, pathogens (viruses, protozoa, bacteria), and bacteria as pollutants of concern because they have not been demonstrated to cause an impairment in the deep waters of Lake Michigan. At the same time, when biological pollutants impact all states, a classification of E. coli, pathogens, and bacteria as critical pollutants could be appropriate to boost visibility and attract needed resources. Consistent with IADN and LMMB findings, air deposited toxics like PCBs, dioxins/furans, mercury, and organochlorine pesticides have an open water impact and are critical pollutants. Providing the names of the Category 5 waters when only a few are impaired gives some sense of the impairment magnitude. Likewise, providing a number of assessed waters when many are impaired can suggest how widespread the impairment is. Comparison of state lists suggests a discrepancy in number and type of pollutants analyzed. The pollutant specific method and professional judgment also apply to Watch List pollutants identified through literature review.

Table A-6. LaMP Pollutants for Discussion in 2006-2008

Pollutant Classification	LaMP Pollutants for Discussion in 2006-2008
Critical Pollutants	PCBs, mercury, DDT and metabolites, chlordane, and dioxin/furan.
Pollutants of Concern	PCBs, mercury, DDT and metabolites, Chlordane, dioxin/furan, E. coli, bacteria, pathogens, Alpha BHC, Dieldrin, Endrin, Nitrogen, Phosphorus, polycyclic aromatic hydrocarbons, nuisance oil product pollution, sedimentation, metals, arsenic, cadmium, chromium, copper, lead, manganese, nickel, silver, and zinc.
Watch List	Bacterial slimes, Nitrate, cyanide, ammonia, nutrients, organic enrichment, dissolved oxygen, polycyclic aromatic hydrocarbons, creosote, oil and grease, siltation, sedimentation, TDS, chlorides, metals, chromium, manganese, PBDEs, PCNs, PFOS, asbestos, PAHs (acenaphthylene, acenaphthene, fluorene, 1 methyl-fluorene, phenanthrene, anthracene, 2-methylphenanthrene, fluoranthene, pyrene, retene, benzo(a)fluorene, benzo(b)fluorene, benz(a)anthracene, chrysene, benzo(b +k) fluoranthene, benzo(e)pyrene, benzo(a)pyrene, perylene, indeno(c,d)pyrene, diben(ah) anthracene, benzo(ghi)perylene, antanthrene, and coronene), thallium, selenium, phthalates, radioactive material, synthetic musks: six polycyclic musks (AHTN, HHCB, ATII, ADBI, AHMI, & DPMI) and two nitro musks (musk xylene and musk ketone), toxaphene, sulfur, atrazine & degradation products , metolachlor & degradation products, acetochlor & degradation products, glyphosate & degradation products, 1,4-dichlorobenzene, 2,6-di-*tert*-butylphenol, 2,6-di-*tert*-p-benzoquinone, butylated hydroxy toluene, tri (2-chloroethyl) phosphate, tri (2-chloroethyl) phosphate, 4-methyl phenol, cimetidine, trimethoprim, lincomycin, cholesterol, coprostanol, 1-naphthol, 2-naphthol

IV. Lake Michigan LaMP 2006 Pollutants to be Reviewed in 2008

Scenarios 3 and 4 are most helpful when reviewing the critical pollutants and pollutants of concern. The same watch list pollutants proposed in 2004 are proposed again here. Resources to perform a comprehensive literature review were not available.

All actions to virtually eliminate PCBs, dioxin/furan, mercury, DDT, and Chlordane from use and potential release to the environment should be taken in all four Lake Michigan states. Efforts have been underway through a variety of mechanisms, like Hospitals for a Healthy Environment (H2E), Federal Electronics Challenge, PCB Phase Down, and pesticide re-registration and reviews. The Toxic Pollutants chapter of the Great Lakes Regional Collaboration Strategy included the following recommendations.

1) Reduce and virtually eliminate the principal sources of mercury, PCBs, dioxins and furans, pesticides and other toxic substances that threaten the health of the Great Lakes basin ecosystem, through coordinated intergovernmental strategies.
2) Prevent new toxic chemicals from entering the Great Lakes basin: Target production, use and sound disposal of toxic chemicals across the Great Lakes basin through strategic deployment of pollution prevention and waste minimization programs.
3) Institute a comprehensive Great Lakes research, surveillance and forecasting capability to help identify, manage, and regulate45 chemical threats to the Great Lakes basin ecosystem. A Great Lakes basin-wide coordinated program that incorporates and augments current efforts should be created to better characterize links between PTS sources and exposure. The multiparty program should preferably be housed within an existing program or organization and call upon the combined resources of federal agencies, states, academia, the private sector, and our Canadian neighbors.
4) Support efforts to reduce continental and global sources of PTS to the Great Lakes basin.

These recommendations apply to pesticide pollutants of concern, too. The above recommendations are consistent with the Great Lakes Binational Toxics Strategy and other strategy documents.

With respect to the biological pollutants and other pollutants of concern, the Coastal Health, AOC/ Sediments, and Nonpoint Source chapters in the Great Lakes Regional Collaboration Strategy identified relevant goals. Chapters 2 and 3 of this LaMP address biological pollutants, too.

V. Concluding Remarks/Next Steps

Additional pollutants, such as those transported by air attached to particles like soot, may be unrecognized pollutants of concern in nearshore urban areas. There is consensus by the Task Force on Hemispheric Transport of Air Pollution that ozone and its precursors, fine particles, acidifying substances, mercury, and persistent organic pollutants have potential for long range air transport. It's not clear that all of these are sampled and analyzed in order to prepare the 303(d) lists or fish consumption advisories. Nonattainment areas could be targeted for investigation after reviewing maps of nonattainment counties for Clean Air Act particulate matter standards. Comparing target analyte lists for fish monitoring and water quality assessment programs was beyond the scope of this document, but would help in evaluating whether dioxin, for example, is below fish consumption advisory risk thresholds or not analyzed in Wisconsin and Indiana. (Dioxin is not part of Illinois' Lake Michigan monitoring.)

This document concluded that looking at fish consumption advisories by species and applying professional judgement to pollutants identified on Clean Water Act Section 303(d) lists are reasonable approaches to defining critical pollutants and pollutants of concern. However, the definitions of critical pollutant, pollutant of concern, and watch list are still open to revision. Questions for reviewers to consider follow. Should pollutants appear only in the lakewide category (critical pollutant) if the pollutant causes impairments throughout the watershed or should the same pollutant also be a pollutant of concern and on the watch list? Do we need rigorous definitions of "open water" and "nearshore water" if the scenario 4 approach is selected? Is there data available to distinguish pollutants in nearshore waters from open waters in other Great Lakes? These questions and more will be the focus of the 2006 SOLEC Lake Michigan workshop on November 2, 2006 in Milwaukee, Wisconsin.

Endnotes

[1] Lake Michigan LaMP 2000 is online at www.epa.gov/grtlakes/lakemich/index.html.

[2] Appendix A comprises pages 89 – 95 of the Lake Michigan LaMP 2002, available online at www.epa.gov/grtlakes/lakemich/lm02/index.html.

[3] The GLWQA (1987) identifies fourteen changes in the chemical, physical or biological integrity of the Great Lakes System sufficient to impair beneficial uses. For lakewide adaptive management, these fourteen changes were rephrased as six endpoint goals such as "We can all eat any fish."

[4] Lake Michigan Lakewide Management Plan requirements of the Great Lakes Critical Programs Act of 1990 were incorporated in Section 118 of the Federal Water Pollution Control Act (33 U.S.C. §1268(c)(4)).

[5] Chapter 5 may be accessed online at www.epa.gov/grtlakes/lakemich/lmlamp2000/LM%20chapter%205.pdf.

[6] A distinction is made between samples taken for a research project of limited duration and samples routinely taken using an established protocol over many years. The latter type of sampling is called 'monitoring' in this Appendix. GLNPO's Limnology Program is described online at www.epa.gov/glnpo/monitoring/limnology/index.htm.

[7] See, for example, Status and Trends of Prey Fish Populations in Lake Michigan, 2005 and Status of Pelagic Prey Fishes in Lake Michigan, 1992-2005

[8] See GLNPO's Fish Indicators web page at www.epa.gov/glnpo/glindicators/fish.html.

[9] Available online at www.epa.gov/grtlakes/gls/gls2002.pdf .

[10] Great Lakes Water Quality Initiative Guidance, National Pollutant Discharge Elimination System Permits, Total Maximum Daily Load, Great Lakes Binational Toxics Strategy.

[11] International Atmospheric Deposition Network, Maximum Achievable Control Technology, Great Lakes Regional Air Toxics Emissions Inventory and Regional Air Pollutant Inventory Development System

[12] Persistent Organic Pollutants and Heavy Metals Protocols under the United Nations' Economic Commission for Europe's Convention (UNECE) on Long Range Transboundary Air Pollution (LRTAP), the Stockholm Convention on Persistent Organic Pollutants, and the North American Commission for Environmental Cooperation (CEC) Sound Management of Chemicals Program which has developed North American Regional Action Plans (NARAPs) for a number of chemicals.

[13] For more information about the Great Lakes Regional Collaboration, see www.epa.gov/greatlakes/collaboration/strategy.html and www.glrc.us/.

[14] The draft Illinois 303(d) list was found at www.epa.state.il.us/water/tmdl/303d-list.html at the time of document preparation.

[15] See LaMP 2004 Appendix A online at www.epa.gov/grtlakes/lakemich/2004update/lmlamp04_3a.pdf , pages A-4 through A-6.

[16] Tables A-6 and A-7 are on pages A-14 and A-15 of LaMP 2004 online at www.epa.gov/grtlakes/lakemich/2004update/lmlamp04_3a.pdf.

[17] Kannan, K., Tao, L., Sinclair, E., Pastva, S., Jude, D., and Giesy, J. "Perfluorinated Compounds in Aquatic Organisms at Various Trophic Levels in a Great Lakes Food Chain." Arch. Environ. Contam. Toxicol. 48, 559-566 (2005).

[18] *National Recommended Water Quality Criteria*, EPA publication number EPA/OW/OST 4304T, 2006 is available online at www.epa.gov/waterscience/criteria/nrwqc-2006.pdf.

[19] For more information, see www.epa.gov/waterscience/criteria/atrazine/index.htm.

[20] For more information, see www.epa.gov/waterscience/criteria/nonylphenol/.

[21] For more information, see www.epa.gov/waterscience/criteria/selenium/index.htm.

[22] Title 40 of the Code of Federal Regulations section 132.2: Open waters of the Great Lakes (OWGLs) means all of the waters within Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Ontario, and Lake Superior lakeward from a line drawn across the mouth of tributaries to the Lakes, including all waters enclosed by constructed breakwaters, but not including the connecting channels. States have adopted this definition.

[23] Lake Michigan Mass Balance results have been reported in this Lake Michigan LaMP, previous LaMPs, and on the Great Lakes National Program Office webpage. See, for example, the LMMB PCB Data Report at www.epa.gov/grtlakes/lmmb/results/pcb/index.html or the LMMB Mercury Data Report at www.epa.gov/grtlakes/lmmb/results/mercury/index.html.

[24] From Atmospheric Deposition of Toxic Substances to the Great Lakes: IADN Results through 2000, available on-line at www.epa.gov/glnpo/monitoring/air/iadn/reports/IADN_1999_2000.pdf . See pages 2 and 3.

[25] LaMP 2004 Table A-1 is on page A-3, online at www.epa.gov/grtlakes/lakemich/2004update/lmlamp04_3a.pdf.

[26] The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory investigated an annually recurrent winter-spring sediment plume visible on satellite imagery of Lake Michigan, resulting in many Episodic Events: Great Lakes Experiment (EEGLE) publications. Sediment plumes have also been documented in fall. See www.glerl.noaa.gov/eegle/.

[27] Chapter 5 of the Lake Michigan LaMP 2000 is online at www.epa.gov/grtlakes/lakemich/lmlamp2000/LM%20chapter%205.pdf.

[28] According to www.chemfinder.com, the term polychlorobiphenyls corresponds to Arochlor 1262. Arochlor 1262 is a mixture of PCB congeners containing 62% chlorine by weight.

[29] See previous endnote and description of increased bacteria growth with increased P in the plume at www.glerl.noaa.gov/eegle/projects/p09/results.9.2000.html.

[30] See Table A-5 in Lake Michigan LaMP 2004 on pages A-10 through A-13, online at www.epa.gov/grtlakes/lakemich/2004update/lmlamp04_3a.pdf.

Appendix B
State of the Lakes Ecosystem Conference (SOLEC) Indicators

Indicators: Background

The State of the Lakes Ecosystem Conference (SOLEC) was established by the US and Canada in 1992 to hold biannual conferences to meet the reporting requirements of the Great Lakes Water Quality Agreement (GLWQA). SOLEC has led the effort to collect, develop and refine a set of science-based, not programmatic, indicators and taken an adaptive management approach to continually improve the effort.

In LaMP 2000, Chapter Three presented a cross walk of the SOLEC indicators and the Lake Michigan Lakewide Management Plan goals. In preparation for LaMP 2006, the LaMP Technical Coordinating Committee conducted a review of current SOLEC indicators in association with the Lake Michigan LaMP Goals. An extremely strong alignment was found to still be in place.

The Lake Michigan LaMP has also adopted the SOLEC sustainability target gauge to help provide a quick, summary visual of a measurement of where we are in achievement of the goal. For LaMP 2006, the titles at each end of the gauge have changed from good and poor to sustainable and unsustainable. It is hoped this action will help underscore the need to take action. In addition, following the" Status of the Goal" at the beginning of each chapter a list of indicator titles are included to inform the reader as to the data used to inform the status conclusion.

SOLEC Great Lakes Revised Indicator Framework

SOLEC has also been reviewing the indicators and has under gone a peer review process. A strong message that emerged from both internal and external Peer Review sessions was the need to reduce the overall number of indicators by identifying and eliminating those indicators that may be unnecessary or redundant. An additional and related comment was that in order to accomplish this reduction, categorical groupings of indicators by topic, issue or theme could be developed. Based on these recommendations, SOLEC organizers grouped related indicators into the following categories and sub-categories (or “bundles” and “sub-bundles”) for ease in and presentation of related information and understanding of the larger issue:

1. Contamination
   a. Nutrients
   b. Toxics in Biota
   c. Toxics in Media
   d. Sources and Loadings

2. Biotic Communities
   a. Fish
   b. Birds
   c. Mammals
   d. Amphibians
   e. Invertebrates
   f. Plants
   g. General

3. Invasive Species
   a. Aquatic
   b. Terrestrial

4. Coastal Zones
   a. Nearshore Aquatic
   b. Coastal Wetlands
   c. Terrestrial

5. Aquatic Habitats
   a. Open Lake
   b. Groundwater

6. Human Health

7. Land Use - Land Cover
   a. General
   b. Forest Lands
   c. Agricultural Lands
   d. Urban/Suburban Lands
   e. Protected Areas

8. Resource Utilization

9. Climate Change

In this approach, many indicators are relevant to more than one category. For example, “Contaminants in Sport Fish” is included in both “Contamination: Toxics in Biota” and “Human Health.” All of the indicators within a category, however, contribute to a more complete evaluation of environmental conditions pertaining to that category.

Other categories are possible, and they may of greater usefulness in the future. Likewise, the “old” categories previously used for reporting Great Lakes indicators may still be relevant for some users. As originally conceived, the Great Lakes suite of indicators was developed around the topics of open and nearshore waters, coastal wetlands, nearshore terrestrial, land use, human health, societal, and unbounded. Each indicator was associated with one primary category, but all the indicators were also evaluated for relevancy to other SOLEC categories and to other major environmental groupings (e.g., land, water, air, biota), issues (e.g., contaminants, invasive species, urban sprawl), or indicator systems (e.g., IJC Desired Outcomes, Great Lakes Water Quality Agreement Impaired Beneficial Uses).

The categories currently listed are incomplete, and others may be incorporated in the future. For example, under “Aquatic Habitats,” indicators have yet to be identified and developed for inland surface waters, including tributaries, inland lakes, and inland wetlands. The category “Resource Utilization” is also very incomplete and will require quite extensive consideration of socio-economic indicators relevant to the assessment of Great Lakes ecosystem components. Likewise, “Human Health” could be expanded to “Human Health and Well Being” and include indicators to assess social values of residents in the Great Lakes basin.

Changes to the Indicator Assessment Process

In response to suggestions from the peer reviews that the SOLEC process for the assessment of indicators was not sufficiently transparent or standardized, some changes were made to make assessments more credible and internally consistent. Previously, the available assessment options were restricted to Good, Mixed Improving, Mixed, Mixed Deteriorating, and Poor. These were not always sufficient or helpful. For SOLEC 2004, a system is being used to better express the relative condition and trend for all indicators. Authors have provided a qualitative assessment for their adopted as they have done in the past, but the assessment categories are now less ambiguous. Specifically, authors have provided a "condition" of the ecosystem related to their indicator by selecting a "good, fair, poor or mixed" status and then assigning a "direction" of "improving, unchanged, deteriorating or undetermined" to each indicator.

Four broad ranking categories were used to characterize the assessments:

- Good. The state of the ecosystem component(s) is/are presently meeting ecosystem objectives or otherwise is in acceptable condition.
- Fair. The ecosystem component(s) is/are currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria, or other characteristics of fully acceptable conditions.
- Poor. The ecosystem component(s) is/are severely negatively impacted and it does not display even minimally acceptable conditions.
- Mixed. The ecosystem component(s) displays both good and degraded features.

In addition, four ecosystem trajectories (or trends over time) were recognized:

- Improving. Information provided by the report shows the ecosystem component(s) to be changing toward more acceptable conditions.
- Unchanging. Information provided by the report shows the ecosystem component(s) is/are neither getting better nor worse.
- Deteriorating. Information provided by the report shows the ecosystem component(s) to be changing away from acceptable conditions.
- Undetermined. Data are not available to assess the ecosystem component(s) over time, so no trend can be identified.

For Lake Michigan: Sustainability would be beyond meeting ecosystem objectives and would include a system to maintain that status which might include monitoring, a watershed plan and local or state programs or regulations to prevent regression and the ability to address new issues should they occur.

Indicator Number	Bundle	Status
	CONTAMINATION	
	Nutrients	
111	Phosphorus Concentrations and Loadings	No change
4860	Phosphorus and Nitrogen Levels (Coastal Wetlands)	No change
7061	Nutrient Management Plans	Proposed at 2002
	Toxics in Biota	
114	Contaminants in Young-of-the-Year Spottail Shiners	No change
115	Contaminants in Colonial Nesting Waterbirds	No change
121	Contaminants in Whole Fish	Proposed at 2002. Revised description
124	External Anomaly Prevalence Index for Nearshore Fish	Proposed at 2002. Replaces 101
4177	Biologic Markers of Human Exposure to Persistent Chemicals	New title. Revised description
4201	Contaminants in Sport Fish	New indicator. Replaces 113 & 4083. New description
4506	Contaminants in Snapping Turtle Eggs	Revised description
8135	Contaminants Affecting Productivity of Bald Eagles	Revised description needed
8147	Contaminants Affecting the American Otter	Revised description needed
	Toxics in Media	
117	Atmospheric Deposition of Toxic Chemicals	No change
118	Toxic Chemical Concentrations in Offshore Waters	No change
119	Concentrations of Contaminants in Sediment Cores	No change
4175	Drinking Water Quality	Revised description
4202	Air Quality	New indicator. Replaces 4176. New description
9000	Acid Rain	No change
	Sources and Loadings	
117	Atmospheric Deposition of Toxic Chemicals	No change
4202	Air Quality	New indicator. Replaces 4176. New description
9000	Acid Rain	No change

Indicator Number	Bundle	Status
	BIOTIC COMMUNITIES	
	Fish	
8	Salmon and Trout	No change
9	Walleye	No change
17	Preyfish Populations and Communities	New title
93	Lake Trout	Revised description
125	Status of Lake Sturgeon in the Great Lakes	Proposed at 2002
4502	Coastal Wetland Fish Community Health	Revised description
	Birds	
115	Contaminants in Colonial Nesting Waterbirds	No change
4507	Wetland Dependent Bird Diversity and Abundance	New title. Revised description
8135	Contaminants Affecting Productivity of Bald Eagles	Revised description needed
8150	Breeding Bird Diversity and Abundance	No change
	Mammals	
8147	Contaminants Affecting the American Otter	Revised description needed
	Amphibians	
4504	Coastal Wetland Amphibian Diversity and Abundance	New title. Revised description
7103	Groundwater Dependent Animal and Plant Communities	Proposed at 2002. Revised description
	Invertebrates	
68	Native Freshwater Mussels	No change
104	Benthos Diversity and Abundance	No change
116	Zooplankton Populations	Revised description needed
122	Hexagenia	No change
123	Benthic Amphipod (Diporeia spp.)	No change
4501	Coastal Wetland Invertebrate Community Health	Revised description
	Plants	
109	Phytoplankton Populations	Revised description needed.
4862	Coastal Wetland Plant Community Health	New indicator. Replaces #4513. New description
8162	Health of Terrestrial Plant Communities	Proposed at 2002.
8500	Forest Lands - Conservation of Biological Diversity	New indicator. Description available
	General	
8114	Habitat Fragmentation	No change
8137	Nearshore Species Diversity and Stability	No action taken
8161	Threatened Species	No change
8163	Status and Protection of Special Places and Species	Proposed at 2002. No action
	INVASIVE SPECIES	
	Aquatic	
18	Sea Lamprey	No change
9002	Non-Native Species (Aquatic)	New indicator. Need description
	Terrestrial	
9002	Non-Native Species (Terrestrial)	New indicator. Need description

Indicator Number	Bundle	Status
	COASTAL ZONES	
	Nearshore Aquatic	
6	Fish Habitat	No action taken
4860	Phosphorus and Nitrogen Levels (Coastal Wetlands)	No change
4861	Effect of Water Levels Fluctuations	No change
4864	Human Impact Measures (Coastal Wetlands)	New indicator. New description
8131	Extent of Hardened Shoreline	No change
8142	Sediment Available for Coastal Nourishment	No action taken
8146	Artificial Coastal Structures	No change
	Coastal Wetlands	
4501	Coastal Wetland Invertebrate Community Health	Revised description
4502	Coastal Wetland Fish Community Health	Revised description
4504	Coastal Wetland Amphibian Diversity and Abundance	Revised description
4506	Contaminants in Snapping Turtle Eggs	Revised description
4507	Wetland Dependent Bird Diversity and Abundance	New title. Revised description
4510	Coastal Wetland Area by Type	Revised description
4511	Coastal Wetland Restored Area by Type	Revised description
4516	Sediment Flowing into Coastal Wetlands	No action taken
4860	Phosphorus and Nitrogen Levels	No change
4861	Effect of Water Levels Fluctuations	No change
4862	Coastal Wetland Plant Community Health	New indicator. Replaces #4513. New description
4863	Land Cover Adjacent to Wetlands (Coastal Wetlands)	New indicator. New description
4864	Human Impact Measures	New indicator. New description
	Terrestrial	
4861	Effect of Water Levels Fluctuations	No change
4864	Human Impact Measures	New indicator. New description
8129	Area, Quality, and Protection of Special Lakeshore Communities - Alvars	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Islands	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Cobble Beaches	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Sand Dunes	Revised description needed
8131	Extent of Hardened Shoreline	No change
8132	Nearshore Land Use	No action taken
8136	Extent and Quality of Nearshore Natural Land Cover	No action taken
8137	Nearshore Species Diversity and Stability	No action taken
8142	Sediment Available for Coastal Nourishment	No action taken
8149	Protected Nearshore Areas	No action taken

Indicator Number	Bundle	Status
	AQUATIC HABITATS	
	Open Lake	
6	Fish Habitat	No action taken
111	Phosphorus Concentration and Loadings	No change
118	Toxic Chemical Concentrations in Offshore Waters	No change
119	Concentrations of Contaminants in Sediment Cores	No change
8131	Extent of Hardened Shoreline	No change
8142	Sediment Available for Coastal Nourishment	No action taken
8146	Artificial Coastal Structures	No change
	Groundwater	
7100	Natural Groundwater Quality and Human-Induced Changes	Proposed at 2002. Revised description
7101	Groundwater and Land: Use and Intensity	Proposed at 2002. Revised description
7102	Base Flow due to Groundwater Discharge	Proposed at 2002. Revised description
7103	Groundwater Dependent Plant and Animal Communities	Proposed at 2002. Revised description
	HUMAN HEALTH	
4175	Drinking Water Quality	Revised description
4177	Biologic Markers of Human Exposure to Persistent Chemicals	New title. Revised description
4179	Geographic Patterns and Trends in Disease Incidence	No change
4200	Beach Advisories, Posting and Closures	New indicator. Replaces 4081. New description
4201	Contaminants in Sport Fish	New indicator. Replaces 113 & 4083. New description
4202	Air Quality	New indicator. Replaces 4176. New description
	RESOURCE UTILIZATION	
3514	Commercial / Industrial Eco-Efficiency	Proposed at 2002
3516	Household Stormwater Recycling	Proposed at 2002
7043	Economic Prosperity	Revised description needed
7056	Water Withdrawal	No change
7057	Energy Consumption	No change
7060	Solid Waste Generation	Revised description needed
7064	Vehicle Use	Proposed at 2002. Replaces 7012. No action taken
	CLIMATE CHANGE	
4858	Climate Change: Ice Duration on the Great Lakes	No change
9003	Climate Change: Effect on Crop Heat Units	Proposed at 2002

Indicator Number	Bundle	Status
	LAND USE- LAND COVER	
	General	
4863	Land Use Adjacent to Wetlands (Coastal Wetlands)	New indicator. New description
7002	Land Cover - Land Conversion	Revised description needed
7101	Groundwater and Land: Use and Intensity	Proposed at 2002. Revised description
8114	Habitat Fragmentation	No change
8132	Nearshore Land Use	No action taken
8136	Extent and Quality of Nearshore Natural Land Cover	No action taken
	Forest Lands	
8500	Forest Lands- Conservation of Biological Diversity	New indicator. New description
8501	Maintenance and Productive Capacity of Forest Ecosystems	New indicator. Description needed
8502	Maintenance and Forest Ecosystem Health and Vitality	New indicator. Description needed
8503	Forest Lands- Conservation and Maintenance of Soil and Water Resources	New indicator. Description needed
	Agricultural Lands	
7028	Sustainable Agriculture Practices	No action taken
7061	Nutrient Management Plans	Proposed at 2002
7062	Integrated Pest Management	Proposed at 2002
	Urban/Suburban Lands	
7000	Urban Density	Revised description needed
7006	Brownfield Redevelopment	Revised description needed
7054	Ground Surface Hardening	Revised description needed
	Protected Areas	
8129	Area, Quality, and Protection of Special Lakeshore Communities - Alvars	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Cobble Beaches	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Islands	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Sand Dunes	Revised description needed
8149	Protected Nearshore Areas	No action taken
8163	Status and Protection of Special Places and Species	Proposed at 2002. No action taken

Proposed Indicators with Descriptions and Sample Reports

SOLEC is a continually evolving process and proposals for new indicators are accepted throughout the SOLEC cycle for presentation, critique and potential acceptance into the full suite of Great Lakes indicators. For SOLEC 2004, sample descriptions and/or sample reports for the proposed indicators in the table below were submitted to SOLEC organizers. The descriptions and reports themselves are included here. Please provide any comments to SOLEC organizers.

Proposed Indicators	Status
Wastewater Treatment	sample description and report; proposed to replace #7059 & #7063
The following indicators are grouped under the new proposed *Well Being* Indicator Suite:	
Value of the Great Lakes to Basin Residents	sample description
Sense of Place: Indian Tribes Around the Great Lakes Basin	sample description and report
National Park Visitation	sample description and report
Capacity of Federal Program for Great Lakes Priorities	sample description
Public Recreational Access to the Great Lakes	sample description
Access to Information about the Great Lakes	sample description
Research/Educational Opportunities	sample description
Population and Income Distribution	sample description

Glossary

Aquatic Nuisance Species (ANS)
Water-borne plants or animals that pose a threat to humans, agriculture, fisheries, and/or wildlife resources.

Area of Concern (AOC)
Areas of the Great Lakes identified by the International Joint Commission as having serious water pollution problems requiring remedial action and the development of a Remedial Action Plan. AOCs are defined in the Great Lakes Water Quality Agreement as: "a geographic area that fails to meet the general or specific objectives of the Great Lakes Water Quality Agreement, or where such failure has caused or is likely to cause impairment of beneficial use or of the area's ability to support aquatic life." Initially, there were 43 AOCs in the Great Lakes Basin.

Area of Stewardship
An Area of Stewardship watershed focus is an area, most often a watershed, for which a level of ecosystem integrity has been established as a goal and where an integrated, multi-organizational initiative or partnership is actively working to achieve that goal. The Lake Michigan Watershed Academy is being established to promote the concept of stewardship. Examples of such areas include the Chicago Wilderness, the Kalamazoo Multi-Jurisdictional Watershed Agreement, and the work in Grand Traverse Bay, Michigan and Door County, Wisconsin.

Basin
The land area that drains into a lake or river. This area is defined and bounded by topographic high points around the waterbody.

Beneficial Use
The role that the government decides a waterbody will fulfill. Examples of these uses include healthy fish and wildlife populations, fish consumption, aesthetic value, safe drinking water sources, and healthy phytoplankton and zooplankton communities. Restoring beneficial uses is the primary goal of the Remedial Action Plans for the Areas of Concern and of the Great Lakes Water Quality Agreement.

Beneficial Use Impairment
A negative change in the health of a waterbody making it unusable for a beneficial use that has been assigned to it. Examples of the 14 use impairments designated in the Great Lakes Water Quality Agreement include: restrictions on fish and wildlife consumption, beach closings, degradation to aesthetics, loss of fish and wildlife habitat, and restrictions on drinking water consumption. Local use impairments occur in Areas of Concern or other areas affecting the lake. Regional use impairments occur in an Area of Concern cluster or multi-jurisdictional watershed. Open water or lakewide impairment is a condition of pervasive impairment.

Binational Executive Committee (BEC)
The Binational Executive Committee (BEC) is a high-level forum composed of senior-level representatives of the USPC and Canadian counterpart agencies who are accountable for delivering major programs and activities to fulfill the terms of the GLWQA. The BEC derives its mandate from the provisions of the GLWQA which relate broadly to notification, consultation, coordination, and joint activity. In particular, Article X specifies the commitments of the Parties to consultation and review: "The Parties (U.S. and Canada), in cooperation with State and Provincial Governments, shall meet twice a year to coordinate their respective work plans with regard to the implementation of this Agreement and to evaluate progress made."

Biological Integrity
The ability of an ecosystem to support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to the best natural habitats within a region.

Boundary Waters Treaty
The international treaty between the United States and Great Britain signed on January 11, 1909, regarding the waters joining the United States and Canada and relating to questions arising between the two nations. It gave rise to the International

Joint Commission and the Great Lakes Water Quality Agreement.

Buffer Strips
Vegetated buffer strips along waterways act as filters for sediment, nutrients and pesticides that are washing off the land heading for the nearest stream. They are often wetlands that can also mitigate flood water movement and serve as habitat for wildlife.

Cladophora
A natural occurring macroalgae found predominantly along the coast. Large blooms lead to unsightly and foul-smelling beaches and have negative health and economic consequences. The blooms can result in reduced drinking and swimming water quality. Possible causes include increased nutrient inputs, increased water clarity and /or temperature and changing lake levels.

Conservation Easement
A conservation easement is a deed restriction placed on a piece of property to protect resources associated with that parcel, sometimes irrevocable. It can cover a whole parcel or be for a stream bank or lake shore. The easement is often held by government entities while land owners receive tax reductions or other payments

Criteria Pollutants
A group of air and water pollutants regulated by the EPA under the Clean Air Act and Clean Water Act on the basis of criteria that includes information on health and environmental effects. Criteria pollutants include particulates, some metals, organic compounds, and other substances attributable to discharges.

Critical Pollutant
Chemicals that persist at levels that are causing or could cause impairment of beneficial uses lakewide. The Lake Michigan LaMP has identified six critical pollutants: PCBs, dieldrin, chlordane, DDT and its metabolites, mercury, and dioxins/furans. *See also* Great Lakes Critical Pollutants. Related program: Lakewide Management Program.

Designated Uses
The role that a waterbody is slated to fulfill, such as a drinking water source. Uses are specified in water quality standards for each waterbody or segment, whether or not the current water quality is high enough to allow the designated use. Other typical uses of a waterbody include propagation of fish and wildlife, recreation, agriculture, industry, and navigation.

Ecosystem
A biological community and its environment working together as a functional system, including transferring and circulating energy and matter. It is an interconnected community of living things including humans, and the physical environment with which they interact.

Ecosystem Indicator
An organism or community of organisms that is used to assess the health of an ecosystem as a whole. When tracked over time, an ecosystem indicator provides information on trends in important characteristics of the system. Also known as an environmental indicator.

Ecosystem Integrity
A measure of the capacity of ecosystems to renew themselves and continually supply resources and essential services. Ecosystem integrity is the degree to which all ecosystem elements-species, habitats, and natural processes-are intact and functioning in ways that ensure sustainability and long-term adaptation to changing environmental conditions and human uses.

Ecosystem Management
The process of sustaining ecosystem integrity through partnerships and interdisciplinary teamwork. Ecosystem-based management focuses on three interacting dimensions: the economy, the social community, and the environment. Ecosystem-based management seeks to sustain ecological health while meeting economic needs and human uses.

Emerging Pollutant
The Lake Michigan Lakewide Management Plan addresses emerging pollutants, which include those toxic substances that, while not presently known to contribute to use impairments or to show increasing loadings or concentrations, have characteristics that indicate a potential to impact

the physical or biological integrity of Lake Michigan. These characteristics include presence in the watershed, ability to bioaccumulate, persistence (greater than 8 weeks), and toxicity. Emerging pollutants include atrazine, selenium, and PCB substitute compounds.

End Point Subgoal
End point subgoals describe the desired levels of ecosystem integrity and ecological services required to restore beneficial uses and provide for healthy human natural communities in the basin.

Fish Consumption Advisory (FCA)
An advisory issued by a government agency recommending that the public limit their consumption of fish. Advisories are issued to limit exposure to toxic substances in the fish that have the potential to impact human health. A fish consumption advisory is prepared annually by each state. Fish caught from selected lakes and streams are tested for toxic substances.

Great Lakes Water Quality Agreement (GLWQA)
An international agreement signed by the United States and Canada in 1972 and updated in 1978 and 1987. The Agreement seeks to restore and maintain full beneficial uses of the Great Lakes system. Language committing the two nations to virtually eliminate the input of persistent toxic substances in order to protect human health and living aquatic resources was included when the Agreement was updated in 1978. The philosophy adopted by the two governments is zero discharge of such substances.

Habitat
That space that is or can be successfully occupied (inhabited) by a species or biotic community or some broader (taxonomic or phylogenetic) entity. Habitat is simply the place where an organism or group of closely related organisms live.

Lake Michigan
Lake Michigan is the only one of the five Great Lakes wholly within the U.S. border. It is bounded by the states of Michigan, Indiana, Illinois, and Wisconsin. It is connected with and flows into Lake Huron through the Straits of Mackinac.

Lake Michigan Basin
Used to describe Lake Michigan and the surrounding watersheds emptying into the lake.

Lake Michigan Lakewide Management Plan (LaMP)
This document is both a reference document and a proposal for a process that will guide remediation of past errors and the achievement of sustainable integrity of the basin ecosystem. It contains clear, comprehensive goals, specific objectives, a strategic plan, and a system of indicators and monitoring for use in judging environmental status and effectiveness of current actions.

Lake Michigan Management Committee (LMMC)
The LMMC guides the overall development and implementation of the Lake Michigan LaMP. The current membership includes: EPA (Lake Michigan Team, Great Lakes National Program Office, and Office of Research and Development), U.S. Fish and Wildlife Service, Army Corps of Engineers, U.S. Geological Survey, U.S. Department of Agriculture (Natural Resources Conservation Service), Illinois Environmental Protection Agency, Indiana Department of Environmental Management, Michigan Department of Environmental Quality, Wisconsin Department of Natural Resources, Great Lakes Fishery Commission, Chippewa/Ottawa Treaty of Fishery Management Authority, and the Grand Traverse Band of Ottawa and Chippewa Indians, Michigan.

Lake Michigan Mass Balance Study (LMMB)
This mass balance research project begun in 1994 is part of the Lake Michigan Lakewide Management Plan and is designed to develop a sound, scientific base of information that will guide future toxic pollutant load reduction and prevention activities.

Lake Michigan Monitoring Coordinating Council (LMMCC)
The Council provides a forum for identifying gaps and establishing monitoring priorities, exchanging information, and forming partnerships. It responds to the need for enhanced coordination, communication, and data management among the many agencies and organizations that conduct or benefit from environmental monitoring efforts in the basin.

LaMP Technical Coordinating Committee (TCC)
The TCC develops documents and programs, and

recommends strategies, goals, and objectives. The current membership includes the same agencies/entities as the Management Committee, plus the Oneida Tribe of Wisconsin. There is a steering committee and six subcommittees under the TCC.

Methyl Mercury
Any of several extremely toxic compounds formed from metallic mercury by the action of microorganisms and capable of entering the food chain. Methyl mercury is an organic form of mercury created when inorganic mercury is released into the environment where it volatilizes back to the atmosphere as a gas or as adherents to particulaltes. Methylmercury biomagnifies up the food chain as it is passed from a over food chain level to a higher food chain level through consumption of prey organisms or predators.

Nutrients
Elements or compounds essential as raw materials for organism growth and development, such as carbon, nitrogen and phosphorus. If out of balance can cause impairment of waterways

Pressure-State-Response Approach
The pressure-state-response approach involves linking environmental indicators to stressors that impact the environment and to program activities. The use of this approach should promote consistency in the development and application of environmental indicators. It is an organizing framework used by U.S. EPA Region 5 in its "Guide for Developing Environmental Goals, Milestones and Indicators," found in LaMP Appendix H.

Remedial Action Plan (RAP)
These are federally-mandated local plans designed to restore environmental quality to Areas of Concern on the Great Lakes (there are 10 in Lake Michigan and there were initially 43 throughout the Great Lakes). The Areas of Concern were identified for their persistent pollution problems. Remedial Action Plans were called for by a protocol added to the Great Lakes Water Quality Agreement in 1987.

Sediments
soil particles that are or were at one time suspended in and carried by water as a result of eroison and /or suspension. The particles are deposited in areas where the water flow is slowed such as in harbors, wetlands and lakes.

Stressor
Any chemical, physical, or biological entity that can induce adverse effects on individuals, populations, communities, or ecosystems and be a cause of beneficial use impairments. Examples of stressors include: pathogens; fragmentation and destruction of terrestrial and aquatic habitats; exotic nuisance species; nutrients; and uncontrolled runoff and erosion.

Sustainable Development
Sustainable development is the process of economic development to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Total Maximum Daily Load (TMDL)
TMDLs are set by regulators to allocate the maximum amount of a pollutant that may be introduced into a waterbody and still assure attainment and maintenance of water quality standards.

U.S. Policy Committee

The U.S. Policy Committee is a forum of senior-level representatives from the Federal, State, and Tribal governmental agencies that share responsibility for environmental protection and natural resources management of the Great Lakes – to advance the restoration and protection of the Great Lakes Basin Ecosystem. U.S. Policy Committee Partners include the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Coast Guard, U.S. Department of Agriculture, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, U. S. Geological Survey, Agency for Toxic Substances and Disease Registry, U.S. Forest Service, Great Lakes Fishery Commission, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, Great Lakes Tribal Governments.

Water Table
The upper surface of the groundwater or that level below which the soil is saturated with water

Selected Beach Health References

Information

Web links listed below provide reference material for information cited in LaMP updates on beaches and safe swimming. In addition, a collection of useful resources (journal articles, publications, published abstracts, and technical reports) has been compiled for future use.

Lake Michigan States' Beach Program WEB Pages

State of Illinois

Illinois Beach Monitoring Home page
www.idph.state.il.us/envhealth/beachhome.htm

Chicago Park District's Swim Report
www.chicagoparkdistrict.com/index.cfm/fuseaction/swim_report.home.cfm

Northern Illinois Lake Michigan beach notification Web site (Lake County Health Department, Wilmette Park District, Winnetka beaches and the City of Evanston)
www.earth911.org/waterquality/default.asp?cluster=17

State of Indiana

Indiana Department of Environmental Management Beach Home page
www.in.gov/idem/beaches

IDEM beach water quality notification Web site, www.earth911.org/waterquality

State of Michigan

Michigan Beach Monitoring home page
www.michigan.gov/deq/1,1607,7-135-3313_3686_3730---C1,00.html

Michigan Department of Environmental Quality – Great Lakes
www.michigan.gov/deq/1,1607,7-135-3313_3677---,00.html

Michigan Sea Grant
www.miseagrant.umich.edu/

State of Wisconsin

Wisconsin Beach Health Web site
www.wibeaches.us

Wisconsin Sea Grant
www.seagrant.wisc.edu/

The Door County Beach Contamination Source Identification Interim Report http://map.co.door.wi.us/swcd/BeachInterimReport.pdf#search='door%20county%20beach%20contamination

Milwaukee Metropolitan Sewerage District. 2003. Deep Tunnel Fact Sheet.
www.mmsd.com/tunnelfactsheet.html

U.S. EPA

Assessing and Monitoring Floatable Debris.
www.epa.gov/owow/oceans/debris/floatingdebris/

BEACH Watch home page including links to the BEACH Act, the *National Beach Guidance and Required Performance Criteria for Grants,* EPA's national beach water quality database, and technical and reference documents.
www.epa.gov/waterscience/beaches/

BEACON – Beach Advisory and Closing On-line Notification
www.epa.gov/waterscience/beacon/

Great Lakes National Program Office
www.epa.gov/glnpo/

Great Lakes Monitoring – The Swimmability Index
www.epa.gov/glnpo/glindicators/water/beachb.html

Great Lakes Strategy 2002 – A Plan for the New Millennium.
www.epa.gov/grtlakes/gls/gls04.html

National Beach Guidance and Required Performance Criteria for Grants www.epa.gov/waterscience/beaches/grants/guidance/index.html

National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Study: Water Quality
www.epa.gov/nheerl/neear/index.html

National Pollutant Discharge Elimination System (NPDES)
http://cfpub1.epa.gov/npdes/home.cfm?program_id=5

U.S. EPA *Report to Congress on Impacts and Control of CSOs and SSOs* http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm

U.S. EPA *Report to Congress on Implementation and Enforcement of the CSO Control Policy*
http://cfpub.epa.gov/npdes/cso/cpolicy_report.cfm?program_id=5

Other Web Sites

Alliance for the Great Lakes
www.lakemichigan.org

Beaches in the Great Lakes Region
www.great-lakes.net/tourism/rec/beach.html#new

Centers for Disease Control - Healthy Swimming
www.cdc.gov/healthyswimming/

Council of Great Lakes Research Managers – Great Lakes-St. Lawrence Research Inventory
http://ri.ijc.org

Great Lakes Beach Association
www.great-lakes.net/glba/

Great Lakes Beach Association Annual Proceedings, Green Bay, WI, November, 2005.
www.great-lakes.net/glba/2005conference.html

Great Lakes BeachCast – Great Lakes Beach Information (many links from this site)
www.great-lakes.net/beachcast/nr_moreinfo.html

Great Lakes Commission
www.glc.org/

Great Lakes Information Network (GLIN)
www.great-lakes.net/

Great Lakes Protection Fund
www.glpf.org/

Great Lakes Research Consortium
www.esf.edu/glrc/

Great Lakes Sea Grant Network
www.greatlakesseagrant.org/

Great Lakes Water Institute – Bacterial Genetics Research Lab
www.uwm.edu/Dept/GLWI/ecoli/

International Association for Great Lakes Research
www.iaglr.org/

NOAA Great Lakes Environmental Research Laboratory (GLERL)
Center of Excellence for Great Lakes and Human Health
www.glerl.noaa.gov/res/Centers/HumanHealth/

USGS Great Lakes Science Center
www.glsc.usgs.gov/

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HOME PAGES:

Lake Michigan Mass Balance Study
http://www.epa.gov/glnpo/lmmb/index.html

U.S. EPA Great Lakes National Program Office
http://www.epa.gov/glnpo

U.S. EPA Large Lakes and Rivers Forecasting Research Branch
http://www.epa.gov/med/grosseile_site/index.html

Lake Michigan Lakewide Management Plan
http://www.epa.gov/glnpo/michigan.html

LAKE MICHIGAN MASS BALANCE STUDY REPORTS AND PUBLICATIONS

Lake Michigan Mass Balance Study Project Reports:

The Lake Michigan Mass Balance Project: Quality Assurance Plan for Mathematical Modeling, 1999 (March 2004)
http://www.epa.gov/med/grosseile_site/qa_lmmbp.pdf

Results of the Lake Michigan Mass Balance Study: Polychlorinated Biphenyls and trans-Nonachlor Data Report. April 2004
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Lake Michigan Mass Balance Methods Compendium
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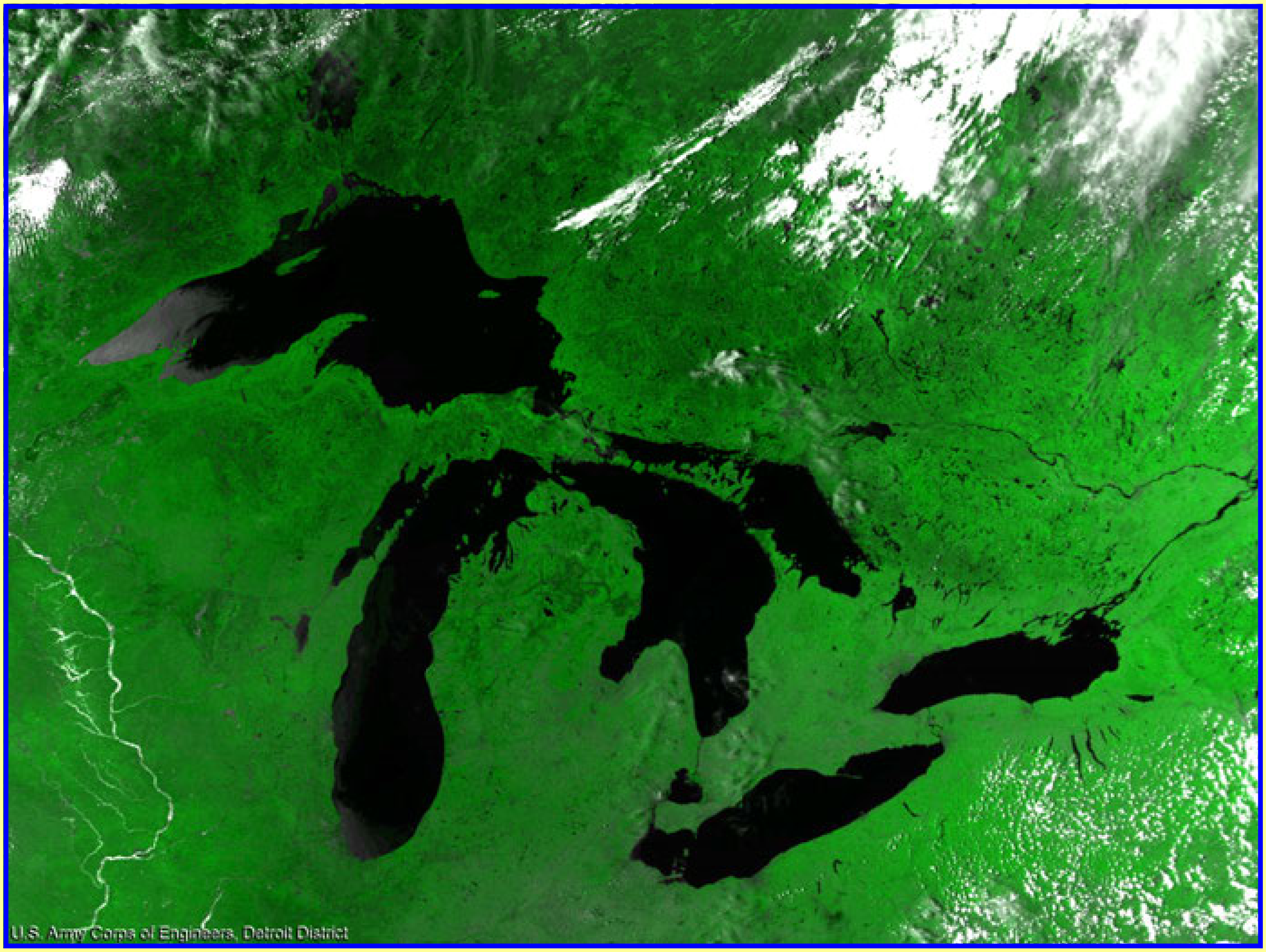
Links to other peer-reviewed journal publications (citations and abstracts) that resulted from the Lake Michigan Mass Balance Study:
http://www.epa.gov/glnpo/lmmb/results/pubs.html



ACKNOWLEDGEMENTS

The Lake Michigan Management Plan 2006 was developed by the Lake Michigan Technical Committee with assistance from the Lake Michigan Forum and various other agencies and organizations. The LaMP benefited from the publicly and privately funded research of many institutions, results of pilot projects and generous critiques throughout the process. Our goal is to restore and protect the integrity of the Lake Michigan ecosystem through collaborative, place-based partnerships. The following is a list of some of the major contributors to the LaMP.

Agency for Toxic Substances and Disease Registry

Chippewa-Ottawa Resource Authority

Grand Traverse Band of Ottawa and Chippewa Indians

Illinois Environmental Protection Agency

Indiana Department of Environmental Management

Lake Michigan Forum

Michigan Department of Environmental Quality

Oneida Tribe, Wisconsin

U.S Army Corps of Engineers

Great Lakes Fishery Commission

U.S. Department of Agriculture, Natural Resources Conservation Service

U.S. Environmental Protection Agency (Region 5, Great Lakes National Program Office, Office of Research and Development)

U.S. Fish and Wildlife Service

U.S. Geological Survey

Wisconsin Department of Natural Resources

The Nature Conservancy

The Lake Michigan LaMP 2000, 2002, 2004, and 2006 are available at:
http://www.epa.gov/glnpo/michigan.html