Wisconsin Water Quality Report to Congress - Year 2012

Prepared by the Wisconsin Department of Natural Resources
Water Division

Wisconsin's Water Quality Report

The Federal Clean Water Act requires all states to prepare a Water Quality Report to Congress every two years. This "Integrated Report" combines the Clean Water Act sections 305(b) and 303(d). The report contains an overall summary of water quality conditions in the State and an updated Impaired Waters List. Wisconsin data is also provided electronically to the United States Environmental Protection Agency (US EPA) as part of the Integrated Reporting Process.

Wisconsin's 2012 Wisconsin Water Quality Report to Congress summarizes assessment progress and activities related to water quality protection during the past two years. This document is an online publication only that can be accessed at the Wisconsin Department of Natural Resources (WDNR) website: http://dnr.wi.gov/org/water/condition/2012_IR/.

Lower Wisconsin River, Boscobel, Wisconsin
Photo by L. Helmuth 2012

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Previous reports were published in 2010, 2008 (data submittal only), 2006, 2004, 2002, 2000, 1996, 1994, 1992, 1990, 1988, 1987, and earlier. WDNR's earlier documents are available for review at the GEF II building, 101 S. Webster Street, Madison. Later versions are available electronically.

Foreword

The year 2012 celebrates the 40th anniversary of the Federal Clean Water Act. Since the Clean Water Act became law in 1972, Wisconsin has made great strides in evaluating, restoring and enhancing water quality through Water Division programs within the Wisconsin Department of Natural Resources.

One of Wisconsin's most common pollutants is phosphorus. Phosphorus has long been recognized as the controlling factor in plant and algae growth in Wisconsin lakes and streams. Small increases in phosphorus to our surface waters can fuel substantial increases in aquatic plant growth, algae blooms (that can contain toxins), and nuisance algae (*Cladophora*). The resulting increased plant growth causes decreased levels of oxygen, which is needed to support a healthy fishery and aquatic ecosystem. All of these impairments to our surface waters can reduce recreational use, property values, and public health.

Important steps WDNR has taken to curb phosphorus loading to our surface waters include:

- Promulgating water quality criteria for phosphorus. In 2010, Wisconsin was one of the first states in the Nation to adopt rules requiring numeric water quality criteria for phosphorus for streams and rivers.
- Continually improving surface water quality through Wisconsin's Permit Discharge and Elimination System (WPDES) Program. The WPDES Program has protected and restored water quality by issuing timely and enforceable discharge permits. Wisconsin's program has resulted in state-of-the-art wastewater treatment facilities operated by a well-trained workforce statewide.
- Creating one of the strongest Nonpoint Source Programs in the Nation to control phosphorus runoff from agricultural fields, barnyards and urban stormwater. Over the past few decades, Wisconsin has spent millions of dollars implementing management practices in 86 priority watershed projects covering urban and rural areas. Nonpoint administrative rules aid in enforcement and compliance, when needed. Through permitting of over 230 Concentrated Animal Feeding Operations (CAFOs) in the State of Wisconsin, WDNR has nutrient management plans for more than 441,000 acres of cropland.
- Supporting innovative efforts to create more cost effective solutions to clean up phosphorus in our waterways including: Total Maximum Daily Loads (TMDLs), Adaptive Management, and Water Quality Trading.

WDNR's Water Division staff work hard to efficiently use resources available to ensure focused efforts on meeting water quality goals and protecting recreational uses for generations to come. WDNR continually strives to make decisions based on science, track and document progress, and educate the public about water quality issues. The quality of life benefits from protecting our water resources are vital to the State's economy. Wisconsin's responsibility to assess, manage, protect, and enhance our water resources for the citizens of Wisconsin is reflected in this 2012 Integrated Water Quality Report to Congress.

Ken Johnson, Water Division Administrator

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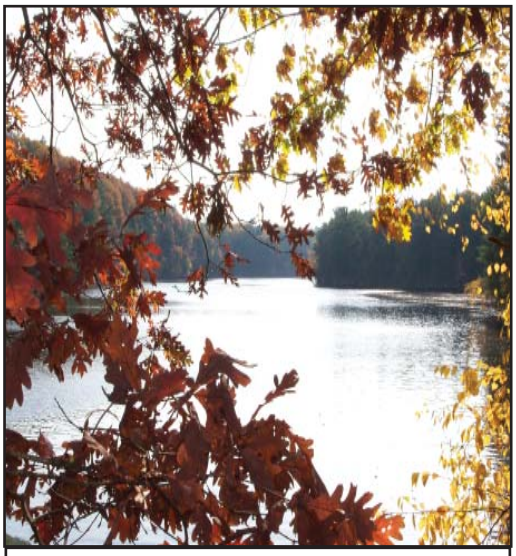
A. Introduction



Wisconsin River, Upham Woods
Photo by Lisa Helmuth

Wisconsin is a state bountiful with natural resources, including many and varied lakes, streams, wetlands, aquifers, and springs. Every other year, the Wisconsin Department of Natural Resources (WDNR) provides reports on the quality of the State's water resources to the United States Environmental Protection Agency (US EPA), which in turn, shares this information with the United States Congress. The information provided may be considered as a tool for rule making, budget appropriations, and program evaluation by federal legislators.

Improving Water Assessment Methods

This 2012 report is Wisconsin's second "Integrated Report." The Integrated Report combines the Clean Water Act Sections 305(b) and 303(d), which require states to report on the general condition of waters and those not meeting water quality standards (also known as the Impaired Waters List). This submittal process allows EPA and the public to find comprehensive information on the status of Wisconsin's waters summarized in one report on a biennial basis.

For the 2012 assessment cycle, Wisconsin has improved assessment approaches to determine if waterbodies are meeting their Designated Uses for Fish and Aquatic Life, recreation, and public health. The methods for assessment are summarized in Wisconsin's Consolidated Listing and Assessment Methodology (WisCALM, Attachment C). Key highlights for this year include:

- New phosphorus assessment methods for lakes, rivers and streams
- An improved way to evaluate Wisconsin's Great Lakes and inland beaches
- A new reporting category for waters when impairments are suspected to be caused by nautral or uncontrollable sources (5C)
- A new reporting category for waters that exceed the phosphorus water quality criteria thresholds outlined in WisCALM (5P)
- Methods for decision making are developed by WDNR staff and reflect sound science advocated by national experts and regional liaisons. Consistency and transparency in decision making for the health of Wisconsin waters are two main goals for WDNR.

Healthy Waters Key to a Healthy Economy and Quality of Life

A high priority for WDNR is the preservation and management of waters and shorelines throughout the State. Thousands of people each year visit the State's treasures. Water recreation is a major theme in Wisconsin, providing an important component of the tax base, as well as an incentive for citizens to engage in protecting the water resources they enjoy. Even as the Nation continues to contend with economic uncertainty, Wisconsin's $12.3 billion tourism industry remains strong[1]. Tourism posted a 1.8% gain in 2010, and generated over 291,000 full-time job equivalents. Hunting and fishing remain stable in Wisconsin, compared to declines in other regions of the United States (Hemken and Ivers[2], 2005). Detailed projections of recreational uses, including water related outdoor activities outlined in the 2011-2016 Wisconsin Statewide Comprehensive Outdoor Recreation Plans (SCORP)[3] indicate that water is becoming increasingly valued for a wider variety of activities by a broader base of individuals. This trend is clearly emerging at the same time that water and land resources preserved in a natural state are becoming more scarce.

1 Wisconsin Dept. of Tourism. The Economic Impact of Expenditures By Travelers On Wisconsin, Calendar Year 2010.

2 Hemken, Doug, and Elizabeth Ivers. 2005. From Hunting to Rock Climbing: Adult Participation in Selected Outdoor Activities, Wisconsin Recreation Statistics, 1992-2002. Wisconsin Dept. of Natural Resources, Research Management Findings, Issue 54.

3 Wisconsin Dept. of Natural Resources, 2012. The 2011-2016 Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP). WNR Pub PR-026-2012.

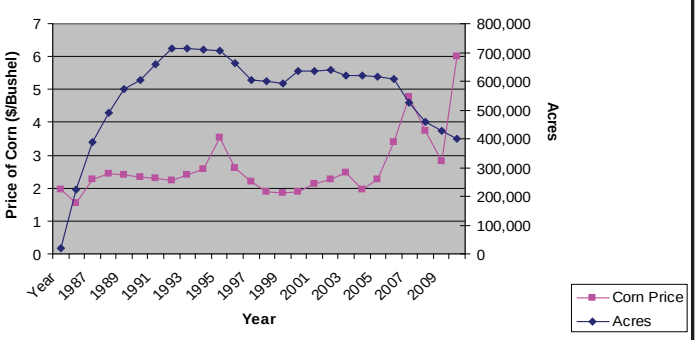


Figure 1. The effect of corn prices on land acreage participating in the USDA's Land Conservation Reserve Program (CRP) in Wisconsin.

One example of this trend can be seen with the United States Department of Agriculture (USDA) Land Conservation Reserve Program (CRP). As corn prices have increased over the past decade[4], more land has been taken out of CRP as shown in Figure 1. Just as placing land in the CRP has the potential to increase water quality, removing land from CRP, to put into agricultural uses, has the potential to degrade water quality.

A 2008 Wisconsin Department of Administration (DOA) Report (Wisconsin Population 2035, A Report on Projected State and County Populations and Households for the Period 2000-2035, and Municipal Populations 2000-2030[5]) projects Wisconsin's population to grow from 5.36 million in 2000 to 6.65 million in 2035, a projected increase of nearly 1.3 million people or 24.1 percent.

The DOA report projected the county level growth rates (Figure 2), showing population pressure in the northeast, northwest, and south and southeast corridor of the State. The growth rates predicted match those that occurred between the 2000 and 2010 censuses. Wisconsin leaders recognize the connection between population growth and pressures on our natural resources, and have passed Smart Growth legislation to address the need for considering impacts of urban growth.

Wisconsin is redoubling efforts to strategically manage water because of these trends. The Water Division has identified four critical objectives, goals, performance measures, and a forum for describing "Success Stories," to provide an evaluation of Wisconsin's progress over time. This 2012 Water Quality Report describes the current condition of the State's water resources along with future trends and strategies for protecting and preserving this irreplaceable resource.

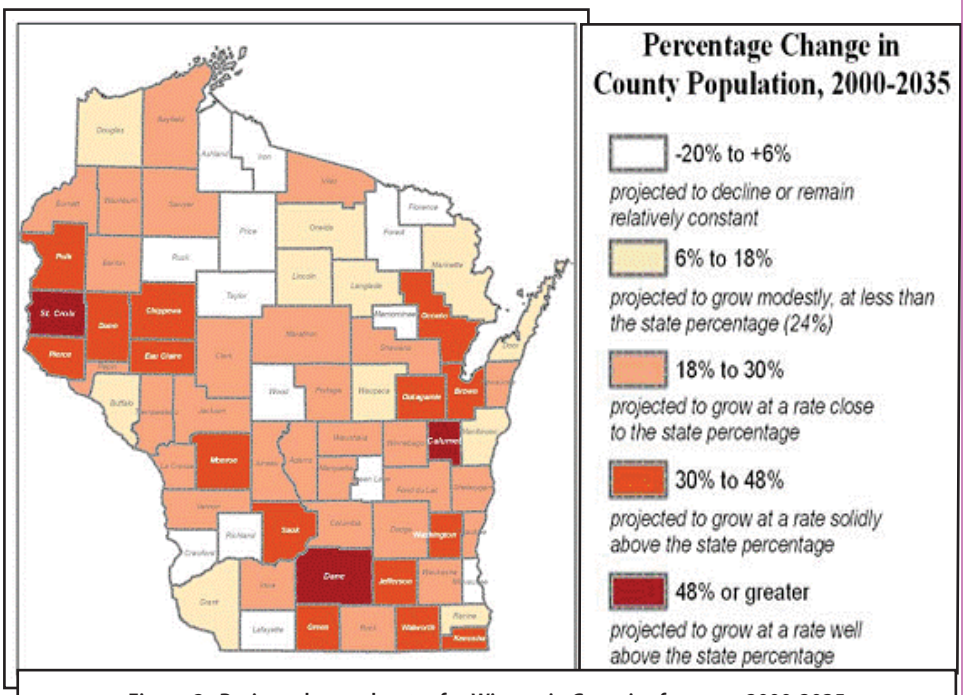


Figure 2. Projected growth rates for Wisconsin Counties for years 2000-2035

4 Charts can be created at this link for various agricultural crops and their historical market prices: http://www.farmdoc.illinois.edu/manage/uspricehistory/USPrice.asp.

5 Egan-Robertson, David, Don Harrier, and Phil Wells. 2008. Wisconsin Population 2035, A Report on Projected State and County Populations and Households for the Period 2000-2035, and Municipal Populations 2000-2030. Wisconsin Dept. of Administration.

B. Total Waters and Watershed Planning

Wisconsin has approximately 88,000 miles of streams, half of those miles perennial, and the remainder intermittent (based on 1:24,000 scale United States Geological Survey (USGS) Topographic Quandrangle Maps and GIS interpretation). The State's abundant resources also include: nearly 15,000 inland lakes, 1,000 miles of Great Lakes shoreline, and 5 million acres of wetlands. Wisconsin springs provide baseflow for streams to provide habitat for fish and aquatic life and source water for drinking (Figure 3). Despite the abundace of water resources in Wisconsin, many are threatened by human-induced stressors.

Wisconsin's Water Resources At a Glance

Lakes	
Number of Lakes	15,000
Lake Acres	1.2 million
Stream Miles	
Perennial	40,000
Intermittent	40,000
Great Lakes	
Shoreline Miles	1,000
Coastal Beaches	192
Wetland Acres	5 million
Groundwater Gallons	1.2 quadrillion

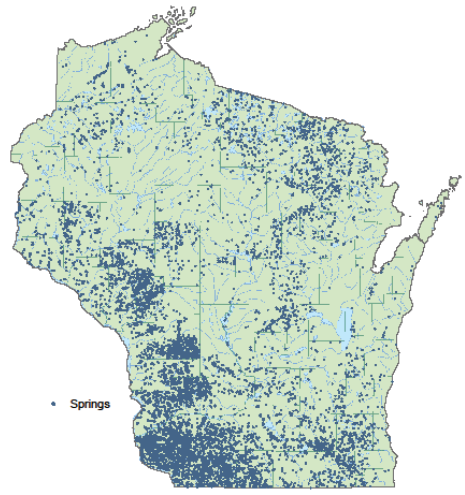


Figure 3. Statewide Map of Historical Springs in Wisconsin

WDNR's Water Management Approach

WDNR's Water Division manages resources using the watershed approach. Watersheds and basins are interconnected areas of land draining from surrounding ridge tops to a common point, such as a lake or stream confluence. Picture a raindrop making its way from the very top of a hill, through and over the land, through streams and rivers to a lake. All lands and waterways can be found within a watershed. Managing our waters on a watershed scale allows WDNR to study the interconnectedness between the overall ecosystem and the presence, movement, and interaction of water in the landscape. Water quality management plans are developed for watersheds and basins to holistically protect our water resources.

Wisconsin divides watershed management among hydrologic drainage areas, including three major basins, 24 basins, and 334 watersheds (watersheds roughly equivalent to the 10-digit hydrologic unit code (HUC)). To interactively view surface water resources online, see the State's Surface Water Data Viewer.

Hydrologic drainage areas, known as Hydrologic Unit Codes or "HUCs" have been delineated by federal agencies. To the extent possible, Wisconsin has tried to create maps consistent with the HUC delineations. For various management purposes, some differences in the hydrologic boundaries may exist. Provided below is a list of hydrologic drainage areas the WDNR maintains, along with how WDNR uses each type of area, a map depicting their definitions, and a description of how they are similar and/or different from the HUCs.

Major Basins

In Wisconsin, there are 3 major basins: the Lake Superior Basin, Mississippi River Basin and the Lake Michigan Basin. Figure 4 shows the Wisconsin Major Basins. Wisconsin's major basins closely resemble the "HUC Regions:" Level 1, 2-digit Hydrologic Unit Hierachy HUCs (exit DNR).

Basins

Basins are subdivisions of the 3 major basins of the State. Wisconsin has 24 basins which provide the framework for Wisconsin's Basin Plans (formerly known as Water Quality Management Plans). Figure 5 shows Wisconsin's 24 Basins, which are approximately equivalent to "HUC Regions:" Level 4, 8-digit Hydrologic Unit Hierarchy HUCs (exit DNR).

Watersheds

Watersheds are a further hydrologic subdivision of the basins. Within each basin, watersheds are assessed on a rotating basis. Currently water management efforts are shifting toward a watershed scale approach for Total Maximum Daily Loads (TMDLs), and implementing both nonpoint and point sources controls. Figure 6 shows Wisconsin's 334 Watersheds, which are approximately equivalent to "HUC Watersheds:" Level 5, 10-digit Hydrologic Unit Hierarchy HUCs (exit DNR).

Figure 4. Wisconsin's Major Basins

Figure 5. Wisconsin's 24 Basins

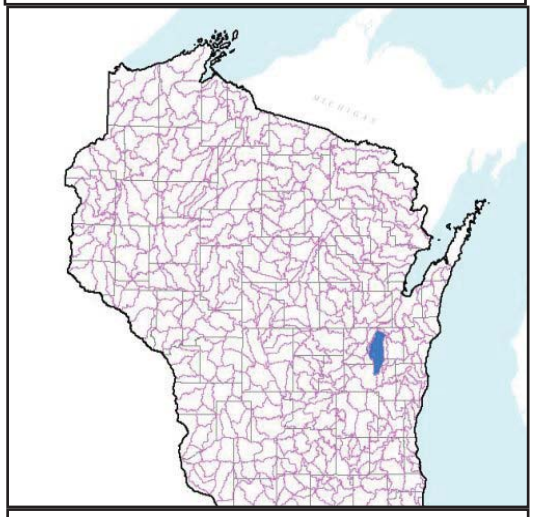


Figure 6. Wisconsin's 334 Watersheds

Water Quality Management Plans: Watershed Planning

Since the 1970s, under Section 208 of the Clean Water Act, Wisconsin has been evaluating and planning for the restoration and protection of water resources throughout the State through a systematic evaluation of resource condition in its Water Quality Management Planning Program (Watershed Planning).

In 2008, the WDNR revamped its paper-based planning program and created an online presence to update and display water quality assessment information. Using the State's Wisconsin Consolidated Assessment and Listing Methodology (WisCALM), as well as new information technology tools, the Water Quality Program now updates approximately 24 watersheds per basin per year. This scheduled assessment process is a critical part of the State's Water Quality Management Planning Program. The planning effort is largely aimed at the 12-digit HUC level.

Water Quality Management Planning is a federal and state requirement which provides watershed, or "local," information about the condition of Wisconsin's resources for multiple purposes: wastewater, water quality standards attainment assessments, broad-scale watershed stressor evaluation, impact analyses, evaluations of partnership efforts and activities, and their alignment with ecosystem based opportunites derived from ecological landscape level analyses (http://dnr.wi.gov/topic/landscapes/), and related variables. The activity of watershed planning within the context of the WDNR Clean Water Act Implementation framework is a critical function that provides both time and work planned focus for biologists, hydrologists, wastewater specialists, and other resource professionals to evaluate resource condition, and identify management opportunities to maintain or improve aquatic health - a fundamental element of WDNR's delegated authority from US EPA.

The Ecological Landscapes Program, a WDNR cross-division program, identifies ecological restoration potential throughout Wisconsin, helps drive planning efforts in the Water Quality Bureau (Figure 7). The first step in watershed planning determines the overall water quality condition, impairments, and sources of pollutants in the watershed. Impacts on the waterbody may include upstream land use, watershed impervious surface areas, pending land use changes, and related activities. Modeling efforts to streamline watershed-based analyses can improve planning efforts.

The watershed planning process also defines management objectives, develops implementation plans, implements actions, and adapts as necessary. The watershed approach provides a flexible management framework for water resource protection and implementation, ideally on a 12 - digit HUC scale. More intense efforts can be conducted at smaller scales as needed. Stakeholder involvement is critical, and management activities supported by sound science and appropriate technology are key to restoring water quality.

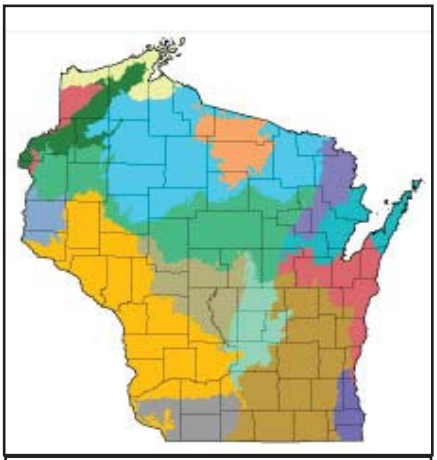


Figure 7. Wisconsin's Ecological Landscapes

Watershed plans (Figure 8) can include the following:

- Watershed characteristics (such as land use data and information for runoff and impervious surface area analyses)
- Elements of point and nonpoint sources
- Water assessment information based on biological, chemical, and habitat/physical data
- Ongoing management activities in the watershed
- Recommended analyses and actions
- Key stakeholder involvement opportunities
- Opportunities for landscape-scale ecosystem based restoration activities
- Identification of fiscal and capital resources related to developing and implementing the prioritized goals and priorities articulated in the watershed plan

Watershed Plans are formal updates to the Wisconsin's Areawide Water Quality Management Plan, under ch. NR 121, Wisconsin Administrative Code, and Section 208 of the Federal Clean Water Act.

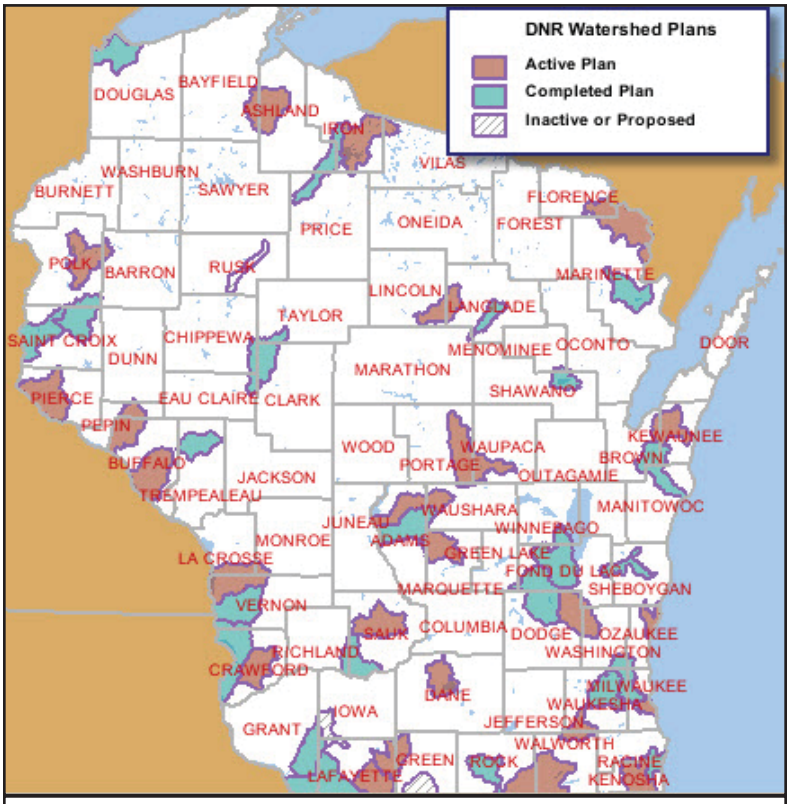


Figure 8. Watershed Plan Status

C. Surface Water Monitoring

C1. Wisconsin's Three-Tiered Approach

Wisconsin's water quality monitoring program is a Division level effort shared among the three Water Bureaus: Drinking Water and Groundwater, Fisheries, and Watershed Management. In November 2008, WDNR released an update to its comprehensive Water Division Monitoring Strategy, which is available at: http://dnr.wi.gov/org/water/monitoring/strategy.htm. Sampling protocols within the Monitoring Strategy are developed by Monitoring Technical Teams, comprised of staff with a high level of technical knowledge and applied field sampling experience.

The WDNR's Water Division Monitoring Strategy is organized into a three-tiered approach:

Tier 1: Statewide Baseline Monitoring
Tier 2: Targeted Evaluation Monitoring
Tier 3: Management Effectiveness & Compliance Monitoring

The three tiers differ primarily in sampling intensity and location. Tier 1 monitoring is completed on a statewide or broad geographic scale to determine trends and to assess the overall health of surface waters. Tier 2 and 3 monitoring is conducted at targeted sites and involves a more rigorous sampling design.

Tier 1: Statewide Baseline Monitoring

Tier 1 monitoring collects baseline physical, chemical, and biological information necessary to satisfy Water Division information needs at a broad spatial scale. This level of monitoring determines water quality and fisheries status and trends in each waterbody type based on ecologically based indicators, and identifies potential problem areas. Waterbody types evaluated under this Tier include lakes, rivers, streams, wetlands, Great Lakes, the Mississippi River, and groundwater. For resources that are too numerous to individually evaluate, such as streams, a probabilistic, randomly-selected sampling effort allows information from sampled waters to be used, through statistical analysis and inference, to provide technically rigorous and credible information on all of the State's waters. Figure 9 shows random long term trend (LTT) sampling sites for Tier 1 locations throughout the State. The random stratified sample design allows managers to group waterbody types of similar condition, land use characteristics and, ecoregions (ie., streams that naturally behave similarly), to make assumptions about their condition based on the similarity of these fundamental characteristics. Where environmental problems are discovered through Tier 1 monitoring or other credible sources of information, problem areas are identified and prioritized for further study under Tier 2.

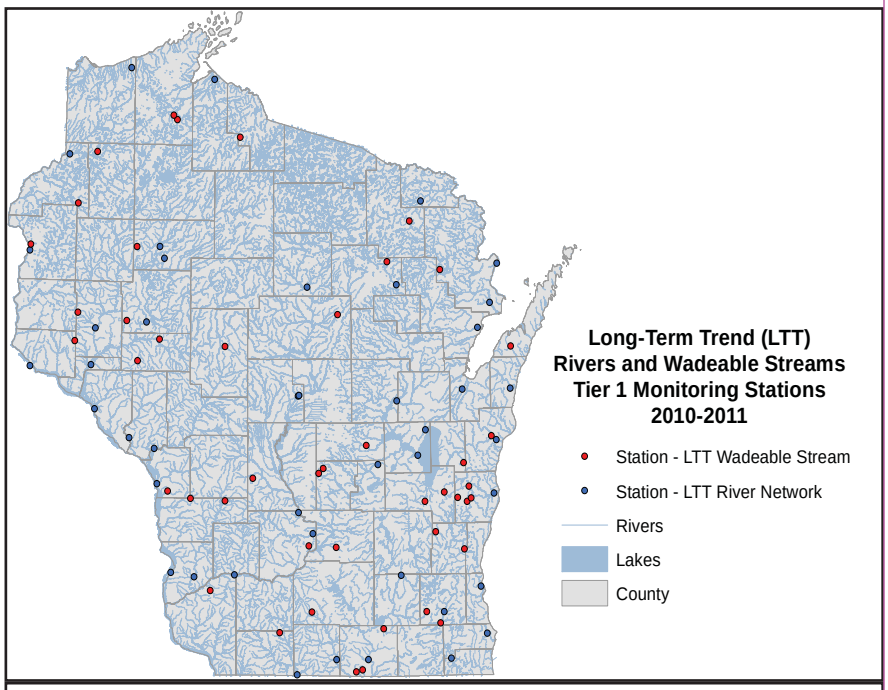


Figure 9. Long-Term Trend (LTT) Tier 1 stations located throughout the state of Wisconsin.

Tier 2: Targeted Evaluation Monitoring
Tier 2 monitoring involves a targeted approach and comprehensive evaluation of individual water segments, or watersheds. One common application of Tier 2 monitoring includes monitoring waters that were flagged as "poor" or "fair" under Tier 1, to confirm impairment for Wisconsin's 303(d) Impaired Waters List. Confirmation of the problem may be made, along with documentation of potential sources or causes. Tier 2 monitoring also includes more rigorous water quality sampling to collect data for Total Maximum Daily Load (TMDL) development.

Tier 3: Management Effectiveness & Compliance Monitoring
Tier 3 monitoring provides follow-up analysis of management plans that have been implemented for problem waterbodies, and evaluates permit compliance and the effectiveness of permit conditions. Monitoring under this tier evaluates the responses of waterbodies to management actions. Effectiveness of waterbody-specific management actions is determined using core indicators from the more intensive sampling designs under Tier 2 that are specific to the problem being addressed. The chosen indicators are compared before and after management actions are implemented.

Regulatory monitoring of permitted entities is included in this category. Effluent monitoring helps WDNR determine whether permitted entities are meeting their permit conditions and state regulations. Monitoring of receiving waters assesses what the effect of an effluent is on the water quality in the receiving waterbody. This monitoring helps determine whether current effluent limits are appropriate or should be altered. Monitoring of public drinking water wells is carried out to ensure that surface and groundwater meet federal public health standards for contaminants in drinking water.

C2. Wisconsin's Beach Monitoring

Great Lakes Beaches

The federal Beaches Environmental Assessment and Coastal Health (BEACH)Act, was passed in October 2000. The BEACH Act requires States that border the Great Lakes or other coastal areas to develop beach monitoring programs, and a process for notifying the public about beach conditions. Wisconsin receives an annual allotment from US EPA to continue developing and implementing Wisconsin's Beach Monitoring and Notification Program.

North Beach, Racine County
Photo Courtesy of Julie Kinzelman

Wisconsin has approximately 55 miles of public beach and a total of 192 coastal beaches along the shores of Lake Michigan and Superior. The definition of "beach" for the purpose of Wisconsin BEACH Act implementation is: *A publicly owned shoreline or land area, not contained in a man-made structure, located on the shore of Lake Michigan or Lake Superior, that is used for swimming, recreational bathing or other water contact recreational activity.*

Wisconsin's Beach Monitoring and Notification Program was developed to reduce the risk of exposure of beach users to disease-causing microorganisms in water. Wisconsin was one of the first states to develop their program in 2003 and has been a model program for other states. Selected beaches along the Great Lakes are monitored for *E. coli* bacteria in accordance with BEACH Act requirements. Since 2003, WDNR has worked closely with approximately 16 local health departments, university researchers, the State Lab of Hygiene, and the United States Geological Survey (USGS) to monitor approximately 123 sites along the shorelines of Lake Michigan and Lake Superior.

The amount of sampling that occurs at each beach varies depending on the beach's assigned priority. Beaches are ranked and

classified as "high," "medium" or "low" priority dependent on: beach usage, the potential for impacts from stormwater runoff, the number of bathers and waterfowl present, and the location of discharges and farms. High priority beaches are sampled four times per week, medium priority beaches twice a week, and low priority beaches once a week. Prompt notification is provided to the public whenever bacterial levels exceed EPA's established standards: an advisory is posted if *E. coli* values exceed 235 colony forming units (CFU)/100mL, and a closure occurs if *E. coli* levels exceed 1000 CFU/100mL. Advisories and closures may also follow rainfall events or stormwater and/or sewage overflows, which may increase the *E. coli* concentration in water. Other factors that may influence *E. coli* concentrations include: the presence of *Cladophora* (a green alga that accumulates on the shoreline in large mats causing nuisance conditions for beach users), wind direction, wave height, water temperature, and beach grooming.

The program has evolved over the last several years. Citizens can be notified of current beach conditions through a variety of methods: signs posted at every monitored beach, the Beach Health Website (http://www.wibeaches.us), and daily emails to citizens about their favorite beach. An informational brochure is also available entitled "Before You Go to the Beach." A video was created in partnership with the State Lab of Hygiene in 2006 to show Wisconsin health officials how and where to properly take beach samples. In addition, in 2009 a Sanitary Survey video was created by researchers from the University of Wisconsin-Oshkosh, with additional funding from US EPA. Since 2008, sanitary surveys have been conducted by various health departments to monitor certain parameters at beaches. This monitoring identifies potential sources of pollution to enable mitigation and implementation to improve beach health.

Inland Lake Beaches

Monitoring for *E. coli* also occurs at several inland beaches in Wisconsin. The Inland Beach Program is modeled after Wisconsin's Great Lakes Beach Monitoring and Notification Program. The same protocols and indicator species, *E. coli*, are used for monitoring and notification purposes. A pilot program began in 2003 on ten inland State Park Beaches. The Department of Health Services currently provides grants for monitoring pathogens on inland waters. Since the start of this pilot program, other local health departments have chosen to monitor inland beaches. Health departments have sought grants or used their own funding to conduct inland beach monitoring at popular swimming beaches in their counties. Signs are often posted notifying swimmers of conditions and some of these inland beaches are also entered into the Beach Health database. Notification of conditions at these inland beaches can be found at: http://www.wibeaches.us.

C3. Monitoring for Fish Consumption

Fish Tissue Monitoring Program

Each year the WDNR collects and analyzes samples of fish tissue from Wisconsin's inland waters and the Great Lakes, including their tributary streams. The objectives of the fish contaminant program include protection of fish consumers by determining the levels of bioaccumulatory contaminants in the edible portions of fish and comparing these levels to health guidelines, as determined by the Wisconsin Division of Health. Samples are collected and/or analyzed by WDNR as a part of normal fish contaminant monitoring by cooperators like the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), the US EPA, or as a part of special projects and research.

Samples from the Great Lakes are analyzed for polychlorinated biphenyls (PCBs), pesticides, and mercury, while samples from river systems are primarily analyzed for PCBs and mercury. Fish samples from inland lakes are analyzed almost exclusively for mercury. Fish consumption advisories are issued for certain species and sizes of fish from given areas where the concentrations of chemicals in the fish flesh exceed the health advisory levels. Fish contaminant data are also used to make natural resource and environmental management decisions.

Statewide General Fish Consumption Advisories

Wisconsin issues general advice that applies to most inland waters where mercury concentrations or other pollutants do not require more stringent advice. The general advisory issued in 2002 is based on US EPA's reference doses for mercury and typical levels of mercury found in Wisconsin fish, based on the mercury concentration data that Wisconsin amassed over the last 30 years. Fish Consumption Advice can be found at: http://dnr.wi.gov/fish/consumption/moreinformation.html.

Specific Fish Consumption Advisories

In addition to the general advisory that applies to most inland waters, more stringent, "specific" consumption advice applies to specific waters in which fish have been found containing higher concentrations of mercury, or PCBs and other pollutants. These are waters for which testing indicated the presence of PCBs, dioxin/furans, and perflourochemicals. Additionally, more stringent advice applies to some species in specific surface waters due to higher concentrations of mercury. The number of sites with fish consumption advice has changed over the years, in part due to monitoring, banning and limiting chemical usages, and modification of the protocols used to determine appropriate advice. More information on collecting fish tissue samples and analylsis can be found in Attachment C (WisCALM).

C4. Citizen Based Monitoring

The DNR is committed to engaging citizens in helping meet its water monitoring needs. This interest in building information resources through citizen volunteers is shared by DNR's nonprofit partners, local units of government, community-based water management organizations, and citizens across the State.

Volunteer Monitor collecting macroinvertebrate samples on the Brunsweiler River, Photo Courtesy of Bad River Water Association

Citizen Stream Monitoring Network (Water Action Volunteer Monitoring)

A three level Citizen-Based Water Monitoring Network for streams was developed to accommodate the varied interests and time availability of citizens.

Level 1 – Introductory (Educational)
The introductory level of monitoring is designed to introduce citizens to the basics of monitoring and educate them about the waterbody type they are monitoring and the connection between land use and the resulting effects on water quality. Data generated at this level may be used for generalized screening purposes but will not necessarily be used for making management decisions. The three existing programs that provide introductory monitoring opportunities are the Water Action Volunteers (exit DNR in new window) program for streams, the Citizen Lake Monitoring Network, and the Clean Boats, Clean Waters (exit DNR in new window) program, for addressing invasive species transport and introduction concerns.

Level 2 – Status (one year) and Trends (three or more years)
Status and trends level monitoring offers citizens a more intensive monitoring experience. Citizens are asked to follow a specific monitoring schedule, including specific times and locations for monitoring. To participate in this level, citizens should have completed one year of monitoring at Level 1. An orientation session and a formal training session are provided to citizens who

have chosen to commit to this Level. If citizens follow defined methodology and quality assurance procedures, their data are stored in a Department database and used in the same manner as any Department-collected data for status and trends monitoring defined in the Monitoring Strategy. Due to the DNR's limited monitoring budget, a limited number of citizen organizations can participate. Both lake and stream monitoring opportunities are available at this level.

Level 3 – Special Projects/Sport Fisheries Assessments
Special projects are those that do not fit into generalized status and trends monitoring. They offer a unique opportunity to address a specific water quality issue or concern. These projects are defined annually and involve a wide range of complexity, expense, and time commitment. Citizens participating at this level often work with WDNR biologists, with whom a trusted relationship has been built through their participation in Levels 1 and 2. Examples of projects can be found at: http://watermonitoring.uwex.edu/level3. To ensure a full commitment participating at this level, citizens should have monitored at Level 1 or 2 previously.

Funding, training, or ongoing local support for these efforts is not guaranteed due to lack of staff time to support every citizen effort statewide. However, local groups can seek funding to support this level of monitoring on their own. Funding opportunities available to local groups are routinely announced on program distribution lists and at this website: http://watermonitoring.uwex.edu/level2/funding.html.

Citizen Lake Monitoring Network

Wisconsin's Lake Partnership nurtures public involvement. High quality monitoring data support sound management. WDNR relies on the public to gather data for lakes. More than 75% of the lake monitoring stations are now reporting data online into WDNR's SWIMS database by volunteers. The remaining volunteers submitted data through a touchtone telephone line, or on paper. The eventual goal is to work towards reporting 100% of data online. This shift will decrease mailing costs and staff time, which will allow the Citizen Lake Monitoring Network to grow.

Volunteer clarity and chemistry data are used by loon research, climate change, and USGS staff. Data are used for lake restoration projects and may be used to aid in management decisions, such as identifying impaired waterbodies for the State's 303(d) Impaired Waters List. All data are quality assured and checked for completeness. Annual reports are produced and available here: http://dnr.wi.gov/lakes/clmn/). Data collected by volunteers form the backbone of Wisconsin's lake assessment efforts.

D. Water Quality Standards and Assessments

Water Quality Standards

The purpose of water quality standards is to maintain and improve the quality of Wisconsin's waters, and to uphold the requirements of the Clean Water Act, by:

- Determining the types of activities the water should support, also commonly referred to as a waterbody's "Designated Uses"
- Developing water quality criteria to protect these Designated Uses from excess pollution
- Establishing an antidegradation policy to maintain and protect existing uses and high quality waters
- Identifying general policies to implement these protection levels in point source discharge permits

Water quality standards for surface waters are outlined in chs. NR 102, 104, and 105 of the Wisconsin Administrative Code. Water quality standards serve as the benchmark in determining the health of the waterbody, helping to identify a range of conditions from the highest quality waters (Oustanding and Exceptional Resources Waters) to the impaired waters of the State.

Designated Uses

As part of water quality standards, each waterbody is assigned a Designated Use. Classifying waters into each Designated Use category involves science that reflects an evaluation of the resource and its natural characteristics. Wisconsin's Designated Uses are:

Fish and Aquatic Life: All surface waters are considered appropriate for the protection of fish and other aquatic life. Surface waters vary naturally with respect to factors like temperature, flow, habitat, and water chemistry. This variation allows different types of Fish and Aquatic Life communities to be supported. Five subcategories for fish and aquatic life uses are outlined in s. NR 102.04, Wis. Adm. Code.

Recreational Use: All surface waters are considered appropriate for recreational use unless a sanitary survey has been completed to show that humans are unlikely to participate in activities requiring full body immersion.

Public Health and Welfare: All surface waters are considered appropriate to protect for incidental contact and ingestion by humans. All waters of the Great Lakes as well as a small number of inland waterbodies are also identified as public water supplies and have associated water quality criteria to account for human consumption[6]. Fish Consumption Use also falls under this category.

Wildlife: All surface waters are considered appropriate for the protection of wildlife that relies directly on the water to exist, or relies on it to provide food for existence.

Triennial Water Quality Standards Review

Every three years, the WDNR reviews Wisconsin's surface water quality standards and selects specific standards or related guidance for development or revision. This comprehensive evaluation, called the Triennial Standards Review (TSR), is required by the federal Clean Water Act and is an essential process to keep Wisconsin's waters swimmable, fishable, drinkable, and suitable for use by industry, agriculture and the citizens of the State. This review helps focus WDNR efforts to integrate the latest science and technology, and federal requirements into how the State regulates surface water quality. In addition, this process assists the Department in its work planning process and in identifying needed actions for moving projects forward.

The public has an opportunity to participate in assigning priorities under the TSR, as well as to provide comments on specific rulemaking that result from TSR priorities. Based on internal and external feedback, WDNR has set priorities for the 2011-2014

6 Distinct water quality criteria are specified for public water supply and non-public water supply waters. Wisconsin does not currently have a formal "Drinking Water" use designation in its standards. Establishment of a "Drinking Water" use designation may be considered as part of a future standards change. If so, specific drinking water use assessment procedures will be included in future updates to the WisCALM document.

TSR, and is actively engaged in rulemaking and/or guidance development for these priority topics: antidegradation, phosphorus standards implementation, pollutant trading guidance, and site-specific criteria for phosphorus. The WDNR will inform the public of the progress made on these priorities in a status report to be completed by 2013. For more information about the TSR process and for the final 2011-2014 TSR Priorities report visit the TSR website.

D1. 2012 Assessment Methodology

Chapter NR 102, Wisconsin Administrative Code, establishes water quality standards for surface waters of the State, and describes the Designated Use categories and the water quality criteria necessary to support these uses. The State is responsible for assigning Designated Uses, and conducting periodic assessments of these uses on individual waterbodies. Implementation of our surface water quality standards is described in various guidance documents, including guidance on assessment of surface water Designated Use attainment using chemical, physical and biological data collected.

WDNR's water quality assessment goal is to use clearly defined, publicly accessible methods for collection and analysis of data, to ensure defensible assessment decisions. *Wisconsin's Consolidated Assessment and Listing Methodology* (WisCALM) was updated in 2012 to conduct assessments for determining the attainment of Designated Uses. In the creation of the WisCALM document, WDNR relied heavily upon the US EPA *Consolidated Assessment and Listing Methodology (CALM)* (2002), as well as guidance documents prepared by other states including: Michigan, Minnesota, North Carolina, Ohio, Oklahoma, Pennsylvania, and Washington. See Attachment C, or WDNR's website for the complete WisCALM guidance: http://dnr.wi.gov/org/water/condition/wiscalm.htm.

For 2012, the following components of WisCALM were revised:

- The structure of the document was organized by waterbody type (lakes vs. streams) and Designated Use classifications.
- The recreational use assessment methodology for beaches was revised from using a rolling geometric mean to a monthly aggregate geometric mean when comparing to applicable *E. coli* criteria.
- Specific assessment methodologies were revised for assessing the Fish and Aquatic Life (FAL) and recreational uses of lakes when using pathogen (*E. coli*), total phosphorus, or chlorophyll.
- Specific assessment methodologies were revised for assessing FAL use of streams/rivers when using the total phosphorus indicator.
- Public Health and Welfare Uses was revised to provide clarification on the waters listed due to general and specific fish consumption advisories.
- Section 7.1 was expanded to discuss, in more detail, issues related to EPA's policy of Independent Applicability, and describes options for resolving data conflicts.
- The Threatened Waters Section (7.3) lists US EPA's definition of "threatened waters," and describes Wisconsin's use of the US EPA's definition of the threatened waters classification. The Watch Waters Section (7.4) defines the "watch water" classification as those waterbodies that have insufficient or conflicting data such that an impairment decision cannot be made, and, therefore, are identified for further monitoring.
- Integrated Report Listing Categories were revised to include two new categories of 303(d) Impaired Waters – Category 5C, which was established for waters where available information indicates that non-attainment of water quality standards may be caused by naturally occurring or irreversible human-induced conditions, and Category 5P for waters that exceed phosphorus criteria only.
- The prioritization or ranking of assessment units for TMDL development was revised to define high priority waters as those for which a TMDL is currently in development, medium priority waters are those waters for which information is currently being gathered for future TMDL development (all category 5b waters, which are those waters impaired due to atmospheric deposition of mercury, will be ranked as medium priority waters), and low priority waters are those for which TMDLs will be developed in the future.

Data Used for Assessment

Data submitted by the public and data collected through WDNR's tiered monitoring program is used for assessments. Assessment data for the State's Integrated Report are stored in the State's Water Assessment, Tracking and Electronic Report System (WATERS). The monitoring data used to make assessment decisions is stored in the Surface Water Integrated Monitoring System (SWIMS) and the Fisheries Database (Fish DB). The public can view spatial information about each waterbody using the WDNR's interactive mapping tool, the Surface Water Data Viewer (SWDV) as well as using online searchable webpages (http://dnr.wi.gov/water/watersearch.aspx). WDNR staff ensure all data used for assessments meet quality assurance requirements and data are representative of current conditions. If WDNR chooses to exclude data, these decisions are documented within the WDNR's WATERS database.

D2. Statewide Water Condition Results

General assessments are conducted to determine whether a waterbody is in Excellent, Good, Fair, or Poor condition. Waters described as Excellent are fully supporting their Designated Uses; those that are Good clearly support the corresponding Designated Use, but may also have room for improvement; waters described as Fair are supporting their Designated Uses, but may be in a state that warrants additional monitoring in the future to assure water conditions are not declining. Waters described as Poor may be considered impaired (not supporting), and may warrant placement on Wisconsin's Impaired Waters List in accordance with Section 303(d) of the federal Clean Water Act.

As discussed in the monitoring section of this report, the vast number of water resources in the State preclude monitoring and assessing all waters in any specific timeframe. The State has over 88,000 miles of streams, and only 35,000 miles (approximately 40%) are entered into the assessment database. WDNR generally prioritizes the collection and entry of water information for waters within watershed planning areas, or waters within areas that are showing degradation or impairment. As resources allow, additional waters will be monitored and updated in the assessment database to ensure the documentation of the State's water conditions are as comprehensive as possible.

Table 1 through Table 10 summarize the status of Wisconsin's waters entered in DNR's WATERS assessment database. The tables show how many miles or acres of the resource were assessed or not assessed, and of those assessed, how many are Fully Supporting, Supporting, or Not Supporting each of the four Designated Uses. For US EPA summarization purposes, the condition levels of Fully Supporting and Supporting should be considered "fully supporting".

Results of Statewide Condition Assessments

Lakes - Table 1 below shows that Fish and Aquatic Life uses for lakes have been more thoroughly assessed than other Designated Uses. This is due to the 2012 Assessment Methodology work which enabled the WDNR to assess over 4,200 lakes for Fish and Aquatic Life uses using a combination of in-lake samples and data gathered from satellite imagery. The State's Citizen Lake Monitoring Network contributed greatly to the high-quality work represented below, with over 1,200 volunteers sampling approximately 800 monitoring stations for Fish and Aquatic Life use support each year.

Table 1. Summary of Designated Use Support for Lakes - Acres

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption	951.06	17,658.49	239,189.36	647,127.25	904,926.16
Fish and Aquatic Life	222,832.34	308,486.7	221,183.65	152,423.47	904,926.16
Public Health and Welfare			224.35	904,701.81	904,926.16
Recreation	100,516.63	17,705.14	169,610.85	617,093.54	904,926.16

Impoundments - Unfortunately, 50 percent of assessed impoundments are impaired for Fish and Aquatic Life uses (Table 2). This is frequently due to the build up of contaminants behind riverine structures such as dams. As sediment collects behind a dam, contaminants that attach to sediment such as nutrients and metals tend to collect in these deposits as well.
Eighty-three thousand acres of assessed impoundments are not supporting fish consumption uses.

Table 2. Summary of Designated Use Support for Impoundments - Acres

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		3,997	83,509.41	3,4911.21	122,417.62
Fish and Aquatic Life	19,834.27	29,560.78	63,773.53	9,249.04	122,417.62
Public Health and Welfare				122,417.62	122,417.62
Recreation	16,629.5	1,579.6	13,768.35	90,440.17	122,417.62

Bays/Harbors - The number of bays and harbors in the State is not clearly depicted in Table 3. More bays and harbors exist, but are not adequately documented in the WATERS database. As the table indicates, most of the assessed bay acres are considered impaired in one or more use designations and few (364 acres) are considered fully supporting.

Table 3. Summary of Designated Use Support for Bays and Harbors - Acres

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption			19,971.73	6,085.9	26,057.63
Fish and Aquatic Life	363.74	2.61	20,827.36	4,859.37	26,053.08
Public Health and Welfare			6,042.93	20,014.7	26,057.63
Recreation			301.77	25,755.86	26,057.63

Rivers/Streams, and Riverine Backwaters - Table 4 indicates that 35,000 river and stream miles are documented in WATERS, but in actuality the State has over 88,000 river/stream miles from 54,000 discrete rivers and streams. The percentage of rivers/streams that are indicated as assessed represents a small fraction of river/stream miles in the State (about 18% of the river miles). Of those miles assessed (35,000 miles), about 12% of river miles are not supporting Fish and Aquatic Life uses. A very small fraction of river miles have been assessed for Fish Consumption or Recreational Uses, as these assessments are often conducted in response to a known problem or specific program need, such as a county health department monitoring program for swimming uses.

Table 4. Summary of Designated Use Support for Rivers and Streams - Miles

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption**	3.2	111.17	1,139.88	34,347.53	35,601.78
Fish and Aquatic Life	6,576.48	4,386.46	4,598.24	20,028.22	35,589.40
General*			230.7	35,371.08	35,601.78
Public Health and Welfare				35,601.78	35,601.78
Recreation	4.24	9.33	139.63	35,448.58	35,601.78

* General Use is used in this instance for ambient water quality criteria exceedances in the Mississippi River.
** River miles indicated as fully or supporting are those that were once covered under a specific fish consumption advisory but which now longer warrant such an advisory.

Riverine backwater is a water type that WDNR has identified to distinguish those water areas that are open water features of a larger riverine system but not actually part of the specific river mainstem. The few acres identified in Table 5 are part of Slaughterhouse Creek, a contaminated site in Oneida County. US EPA does not have a backwater category, therefore these acres will be grouped with open water in the data submittal to US EPA.

Table 5. Summary of Designated Use Support for Riverine Backwaters - Acres

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption				2,911.87	2,911.87
Fish and Aquatic Life		157.29	1.28	2,753.3	2,911.87
Public Health and Welfare				2,911.87	2,911.87
Recreation				2,911.87	2,911.87

Great Lakes Shoreline - Wisconsin has over 1,000 miles of Great Lakes Shoreline, with only a fraction of those shoreline miles considered assessed for Fish and Aquatic Life uses (Table 6). Many of these waters are impaired due to sediment contamination from historic discharges or "legacy" pollutants. As resources allow, a more comprehensive assessment of Great Lakes Shorelines will be conducted in future years.

Table 6. Summary of Designated Use Support for Great Lakes Shoreline - Miles

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption			112.32	856.01	968.33
Fish and Aquatic Life			268.33	700	968.33
Public Health and Welfare				968.33	968.33
Recreation				968.33	968.33

Great Lakes Beaches- As with the other resources, Great Lakes Beaches are represented in Table 7 where monitoring data are available to provide assessment information. Wisconsin has approximately 55 miles of public beach and a total of 192 coastal beaches along the shores of Lake Michigan and Superior. Of these, 14 miles are considered impaired for Recreational Uses.

Table 7. Summary of Designated Use Support for Great Lakes Beaches - Miles

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption				42.91	42.91
Fish and Aquatic Life				42.91	42.91
Public Health and Welfare				42.91	42.91
Recreation		28.43	14.34	0.14	42.91

Inland Beaches - As with Great Lakes Beaches, inland beaches are under-represented in the State's assessment database as these areas are added when an impairment is found to exist. In the future a more comprehensive list of beaches will be available in the database. Many inland lakes provide fantastic recreational opportunities through high quality beaches. However, these inland beaches have not been inventoried or entered into the State's assessment database. WDNR enters beaches based on specific information or monitoring data as resources allow, and only these beaches are represented in Table 8. Plans for future data management work include conducting a comprehensive inventory of inland beaches and entering that inventory and assessment data into the assessment database.

Table 8. Summary of Designated Use Support for Inland Beaches - Miles					
Use Category	**Fully Supporting**	**Supporting**	**Not Supporting**	**Not Assessed**	**Total Size**
Fish Consumption			0.26	7.28	7.54
Fish and Aquatic Life	0.14	0.02	0.09	6.34	7.54
Public Health and Welfare				7.54	7.54
Recreation		3.44	2.26	1.84	7.54

Springs - The State has many known or suspected springs, few of which are documented in the WATERS database. Some inventories of springs do exist, however, these springs have not been entered into the WATERS database and are therefore not reflected in Table 9. Future work may incorporate springs data into WATERS for management purposes. For the purpose of assessment, many of these springs are classified as "small lakes' or "shallow headwaters" and thus are assessed using the TSI general assessment protocols.

Table 9. Summary of Designated Use Support for Springs **					
Use Category	**Fully Supporting**	**Supporting**	**Not Supporting**	**Not Assessed**	**Total Size**
Fish Consumption				1,500.79	1,500.79
Fish and Aquatic Life	446.07	338.09		716.38	1,500.79
Public Health and Welfare				1,500.79	1,500.79
Recreation				1,500.79	1,500.79

Wetlands - It is difficult to determine exactly how many acres of wetlands were in Wisconsin prior to European settlement. In the early 1800s, state surveys estimated approximately five million wetland acres in Wisconsin. More recently, soil scientists estimate that Wisconsin once contained 10 million acres of wetlands. This figure is based on more accurate data from classifying wet soils (somewhat poorly, poorly, and very poorly drained soils) as wetlands. The State's work in assessing wetlands is largely based on interpretation of satellite imagery depicting the presence and dominance of reed canary grass infestations. This initial assessment work will be followed in future years by the application of more complex assessment tools including the evolving floristic quality index and the presence of aggressive invasive aquatic plants that simplify and degrade wetland resources. The wetlands assessment numbers in Table 10 will likely change once more sophisticated tools are implemented.

Table 10. Summary of Designated Use Support for Wetlands					
Use Category	**Fully Supporting**	**Supporting**	**Not Supporting**	**Not Assessed**	**Total Size**
Fish Consumption				5011408.09	5011408.09
Fish and Aquatic Life		5009989	1000	419.09	5011408.09
Public Health and Welfare				5011408.09	5011408.09
Recreation				5011408.09	5011408.09

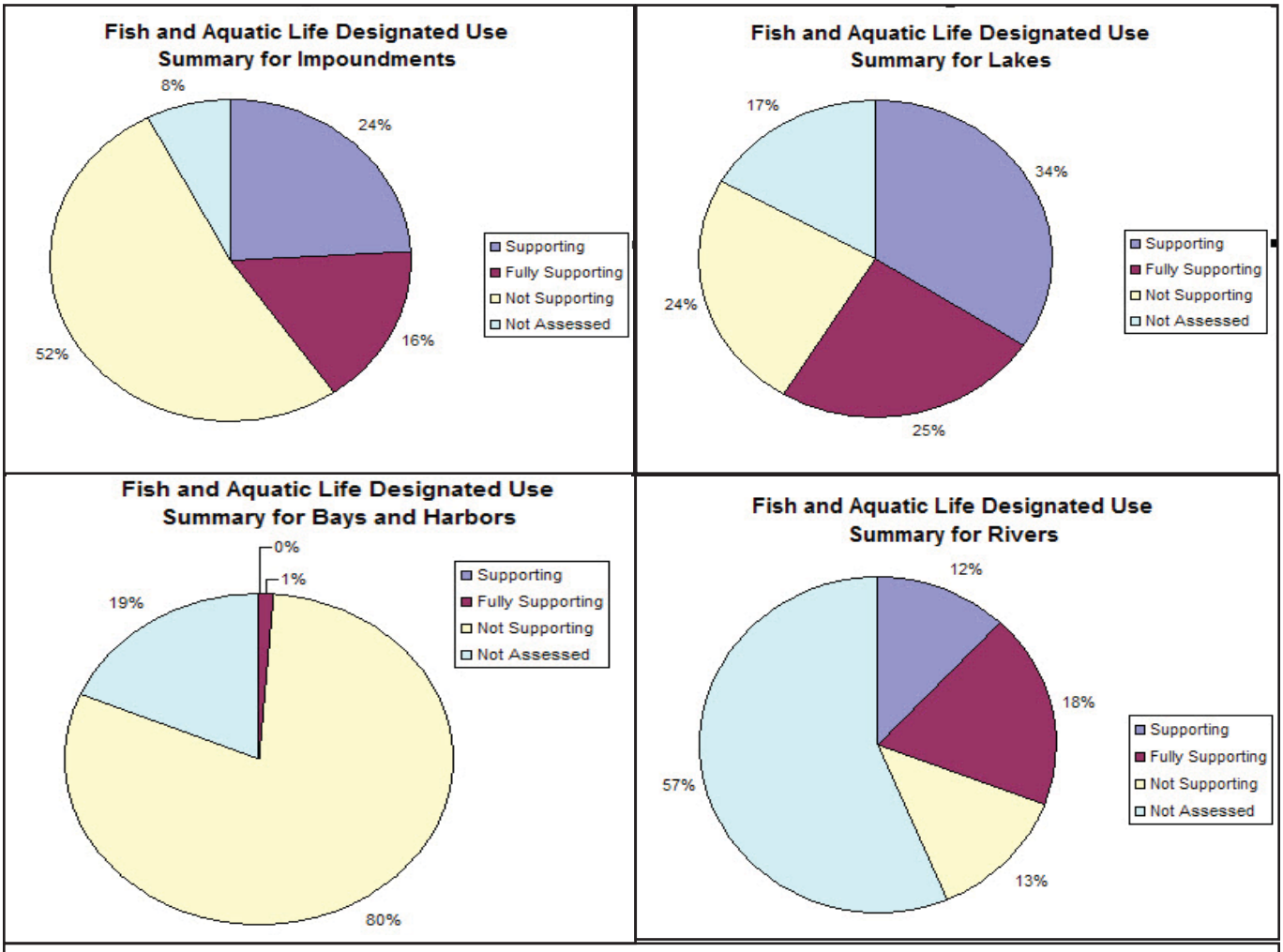


Figure 10. Summary of Designated Use Support Percentages for Lake and Impoundment acres, River/Stream miles, and Bay and Harbor acres in WATERS (as found in Tables 1 through 4 above).

For fish and aquatic life uses, the pie charts in Figure 10 show how many water bodies are fully supporting, supporting, or not supporting their Designated Uses. The pie charts also indicate the percent of waters not assessed for fish and aquatic life uses.

Lake Trophic Status and Trends in Water Quality

General Condition Assessments for Wisconsin lakes are expressed as a Trophic Status Index (TSI), and determined for each lake based on available chlorophyll a, satellite, or secchi data. The analysis of satellite data using consistent methodology represents a major breakthrough in WDNR's assessment processes. Because satellite data are available for the majority of lakes in the State, this allows a much more comprehensive assessment of Wisconsin's lakes. The satellite image data are converted to Secchi depth values, which measure water clarity, and by inference, a lake's trophic state. To determine how the coloration in satellite data should correctly be interpreted, citizen volunteers measured actual Secchi depths on lakes around the State and researchers used those findings to calibrate the equation used in the model. Once the satellite images are converted to Secchi depth values, these values were used to calculate lakes' Trophic Status Index (TSI) scores. The TSI scores are used in the General Assessment framework to determine if each lake is in Excellent, Good, Fair, or Poor condition at the time the images are taken.

As shown in Table 11, 88% of the lakes were assessed using satellite data. Chlorophyll a data, the most accurate but also most time-consuming assessment tool, were available for only 7% of lakes. Secchi data, collected primarily by citizen lake monitoring volunteers, were available for 5%. Using a combination of these tools, 82% of Wisconsin's total number of lake acres had a General Condition Assessment conducted.

Table 11. Lakes for which Trophic Status was assessed using various TSI analysis tools, 2011

TSI Analysis Tool	# Lakes Assessed using TSI Methodology	% of TSI Assessed Lakes (# Lakes)	% of all Lakes (# Lakes)	# Acres Assessed using TSI Methodology	% of TSI Lakes (Lake Acres)	% of all Lakes (Lake Acres)
Chlorophyll	311	7%	2%	169,969	20%	16%
Satellite	4130	88%	24%	435,099	51%	42%
Secchi	252	5%	1%	246,065	29%	24%
Total TSI Assessed Lakes*	**4,693**	**100%**	**28%**	**851,113**	**100%**	**82%**

**Conservatively estimated, the total number of lakes in the State is ~15,000.*

Results of the General Condition Assessment in Table 12 show that 14% of assessed lakes are considered to be in Excellent condition, 37% Good, 17% Fair and only 4% Poor. Of those that were considered Poor, some but not all are designated as Impaired if there are enough data to warrant listing under the WisCALM criteria.

Table 12. Summary of General Condition of TSI Assessed Lakes, 2011

All Lakes Assessed by 2010 TSI Methodology	Number Lakes	Percent (# Lakes)	Lake Acres	Percent (# Acres)
Excellent	661	14%	126,498	15%
Good	1731	37%	415,538	48%
Fair	804	17%	124,954	15%
Poor	166	4%	75,261	9%
No Condition Rating*	1331	28%	108,862	12%
Total TSI Assessed Lakes	**4693**	**100%**	**851,113**	**100%**

**Either no natural community assigned or small lake*

Trophic Status is correlated with the General Assessment Results, and is shown in Table 13. Slightly over half of the State's lakes are Eutrophic, with 3% being Hypereutrophic. Of the State's 94 Hypereutrophic lakes, all are considered to be Poor quality. Eutrophic lakes, however, are often naturally occurring and span the range from Excellent to Poor water quality, with the majority in the Good to Fair categories. All of the State's Mesotrophic (1732) and Oligotrophic (161) lakes are considered to be Excellent or Good quality.

Table 13. Trophic Status Determinations (Number of Lakes) for Lakes with General Condition Assessments, 2011

Trophic State	Excellent	Good	Fair	Poor	All TSI Assessed Lakes	% TSI Assessed Lakes
Hypereutrophic				94	135	3%
Eutrophic	70	933	804	72	2665	57%
Mesotrophic	447	798			1732	37%
Oligotrophic	144				161	3%
Total Number of Assessed Lakes:	**661**	**1731**	**804**	**166**	**4693**	**100%**

One way that WDNR is assessing lake trends over time is by analyzing satellite images taken over a span of almost thirty years to determine water clarity at thousands of lakes across the State. Results from this approximately 30 year assessment were compiled to indicate the condition of Wisconsin's lakes over time. Because each lake was not measured every year, years were grouped into five periods. If more than one value for an individual lake existed for a given time period, the clarity values were averaged. Results were calculated both statewide and by lake classification (natural community), with results shown below.

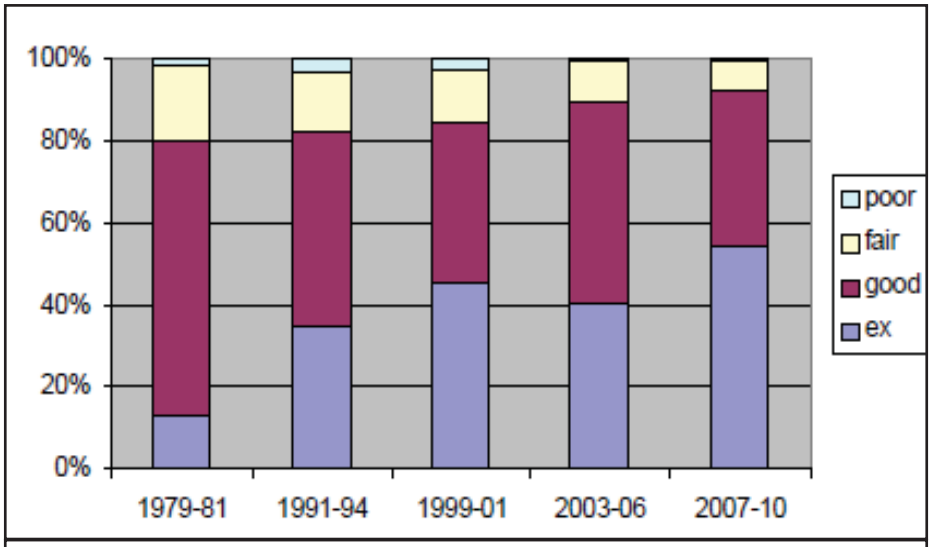


Figure 11. Change in lake clarity based on satelite data, 1980-2010.

Figure 11 illustrates the change in lake condition for the state-wide satellite lakes common to all six time periods (n=2403). Interestingly a slight increase in the percentage of lakes classified as excellent or good was observed during this period. Further analysis of this apparent trend will be explored in the coming year. Aggregated, excellent and good lakes generally comprise approximately 80 percent of the State's lakes.

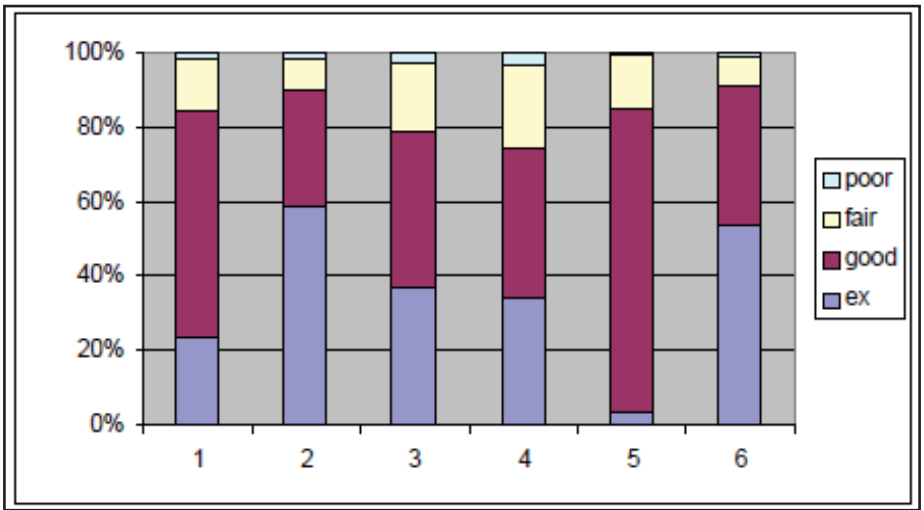


Figure 12. Lake condition by lake class based on satelite data, 2010.

Figure 12 shows the distribution of lake condition by lake class (see lake class names in Table 14). There is considerable variability between lake classes, with class 2 and class 6 (deep headwater drainage, and deep seepage lakes, respectively) having the greatest percentage of excellent lakes.

Table 14. Lake Classes and Ecoregions used in this study and their reference (presettlement) phosphorus concentrations

Class #	Lake Type	Reference P levels (µg/L)
1	Shallow Headwater Drainage	24
2	Deep Headwater Drainage	18
3	Shallow Lowland Drainage	25
4	Deep Lowland Drainage	19
5	Shallow Seepage	16
6	Deep Seepage	13

Ecoregion Abb	Ecoregions	Ref. P levels (µg/L)
SWTP	Southwest Till Plains	19
NCHF	North Central Hardwood Forests	21
NLF	Northern Lakes & Forests	17

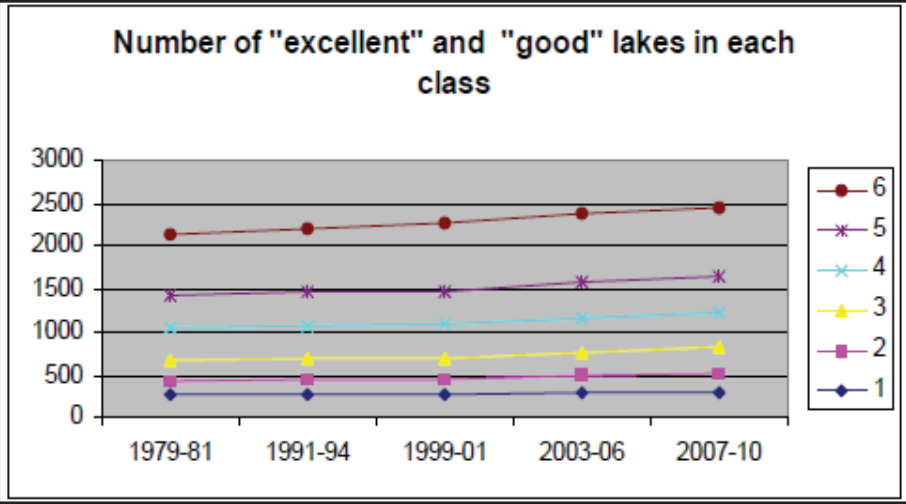


Figure 13. Number of combined Excellent and Good lakes by classification, 1980-2010.

The plot in Figure 13 shows the number of combined Excellent and Good lakes by lake classification (time axis not to scale). Interestingly, parallel and slight increases are observed in most classes, indicating a class-wide response to a common driver, most likely a climatic factor such as temperature or precipitation. The federal Clean Lakes Program was established in 1972 as section 314 of the Federal Water Pollution Control Act, to provide financial and technical assistance to States in restoring publicly-owned lakes. The program has funded a total of approximately $145 million of grant activities since 1976 to address lake problems, but there have been no appropriations for the program since 1994. The section 314 Clean Lakes Program was reauthorized in September 2000 as part of the Estuaries and Clean Water Act of 2000 (PDF), but no funds have been appropriated, (View a copy of section 314 of the Clean Water Act). Clean Water Act Reporting requires the following information regarding the status of lakes in each state.

US EPA's 2012 Integrated Reporting Categories

All waters in the State are assigned one of five EPA categories (or subcategories) that indicate the status of the waterbody. The following categories for Integrated Reporting are:

- **Category 1**: All Designated Uses are met, no use is threatened, and the anti-degradation policy is supported. This category requires that all Designated Uses have been assessed for a given water.
- **Category 2**: Available information indicates one or more Designated Uses are met. This category is applied to waters that have been assessed and considered fully meeting one or more Designated Uses and is usually applied in Wisconsin to waters that have been restored and removed from the impaired waters list.
- **Category 3**: There is insufficient available data and/or information to assess whether a specific Designated Use is being met or if the anti-degradation policy is supported. This category is also used for situations where the state has not yet had time or resources to analyze available data.
- **Category 4A**: All TMDLs needed for attainment of water quality standards have been approved or established by EPA. This does not mean that all other Designated Uses have been evaluated and found to be meeting their Designated Use.
- **Category 4B**: Required control measures are expected to achieve attainment of water quality standards in a reasonable period of time. Environmental Accountability Projects may be proposed as an alternative to TMDL development.
- **Category 4C**: A waterbody where the impairment is not caused by a pollutant. Pollution is defined by US EPA as the human-made or human-induced alteration of the chemical, physical, biological, and radiological integrity of water (Section 502(19)).
- **Category 5A**: Waters where a TMDL is required. Available information indicates that at least one Designated Use is not met or is threatened and/or the anti-degradation policy is not supported, and one or more TMDLs are still needed.
- **Category 5B**: Waters where a TMDL is required. Available information indicates that atmospheric deposition of mercury has caused the impairment of the water. The water is listed for a specific advisory and no in-water source is known other than atmospheric deposition.
- **Category 5C**: Available information indicates that non-attainment of water quality standards may be caused by naturally occurring or irreversible human-induced conditions.
- **Category 5P**: Available information indicates that the applicable total phosphorus criteria are exceeded; however, biological impairment has not been demonstrated (either because bioassessment shows no impairment or because bioassessment data are not available).

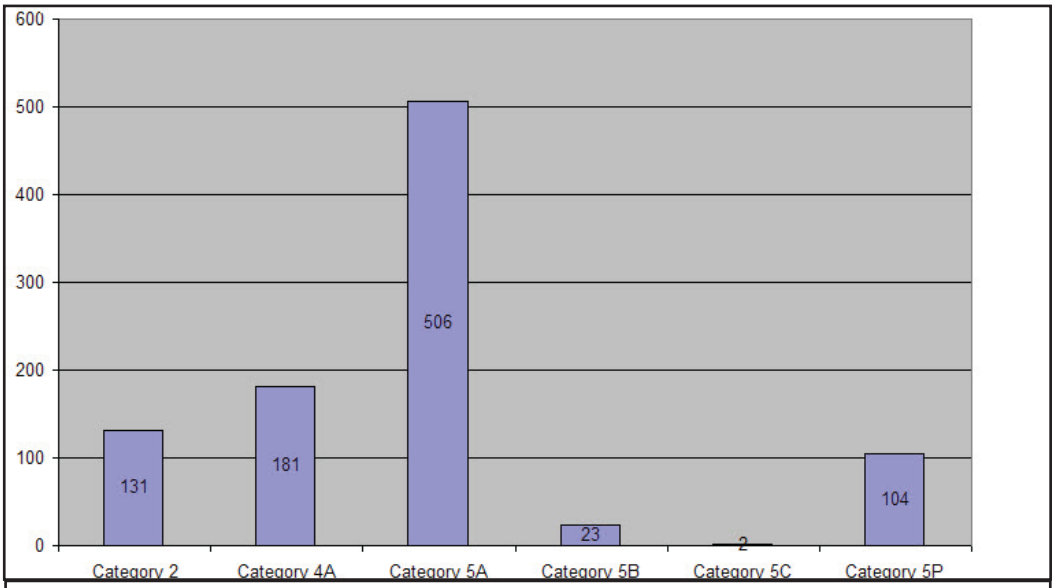


Figure 14. Number of Wisconsin Waters in Each US EPA Category

High Quality Waters: Outstanding & Exceptional Resource Waters

Wisconsin has designated many of the State's highest quality waters as Outstanding Resource Waters (ORWs), or Exceptional Resource Waters (ERWs). Waters designated as ORW or ERW are surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined should warrant additional protection from the effects of pollution. These designations are intended to meet federal Clean Water Act obligations which require Wisconsin to adopt an "antidegradation" policy designed to prevent any lowering of water quality, especially in those waters having significant ecological or cultural value.

Of Wisconsin's 15,000 lakes and impoundments, 114 are designated as ORW (fewer than 1%). For streams, it can be more useful to consider the number of stream *miles* rather than number of streams, since streams can be of widely varying lengths. The State of Wisconsin has a total of approximately 88,000 stream/river miles. Based on the current ORW/ERW list, a total of 3,100 stream miles (3.5%) have been designated as ORW, and 4,613 stream miles (5.2%) have been designated as ERW. Changes in these statistics since the 2010 Integrated Report reflect an update to the ORW/ERW portion of ch. NR 102, Wis. Adm. Code, as well as improvements to WDNR databases that house ORW/ERW information.

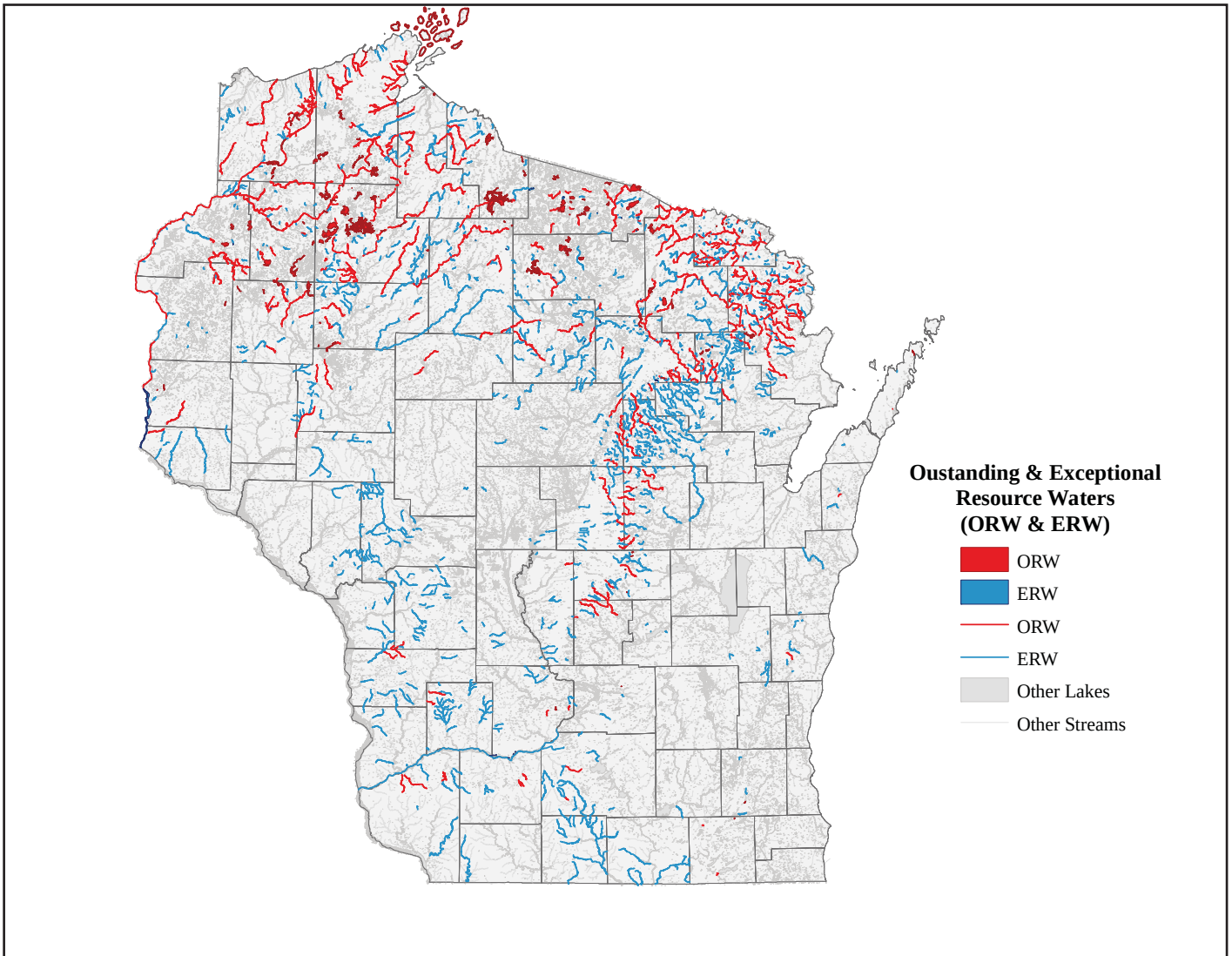


Figure 15. Outstanding and Exceptional Resource Waters in Wisconsin (2011)

D3. Proposed 2012 303(d) Impaired Waters List

Impaired waters, as defined by Section 303(d) of the federal Clean Water Act, are those waters that are not meeting the State's water quality standards (quantitative, numeric criteria or qualitative criteria including use designations). Every two years, states are required to submit a list of impaired waters to EPA for approval. The 2012 Impaired Waters List submitted here reflects the 2008 list updates as well as new updates for 2010 and 2012.

The 2012 Impaired Waters List is being submitted to US EPA electronically. The 2012 Impaired Waters List, as proposed in December 2011, as well as the additional updates that incorporate comments received during the December 20, 2011 - February 20, 2012 public notice period, can be found here: http://dnr.wi.gov/org/water/condition/impaired/. In addition, an impaired waters search tool can also be found at this website, in a format that allows queries and sorting.

Summary of Impairments and Sources

Each impaired waterbody has documented impairments and one or more "sources" of impairment, which represent the actual or expectedlandscape source contributing to the impairment. For each impairment, there can be a wide variety of sources. Impairments and sources are presented in this section in tables by waterbody type and by Designated Use, where that information has been gathered.

Freshwater Lakes and Impoundments/Reservoirs – Impairments and sources for Freshwater Lakes and Impoundments/ Reservoirs are shown in Table 15 and Table 16. For Fish and Aquatic Life Uses in Freshwater Lakes (Table 15), the predominant impairments are Eutrophication, Low Dissolved Oxygen (DO), and Turbidity, each of which impairs approximately 30% of the impaired lake acres in the State. Impoundments and reservoirs (Tables 15 and 16) impaired for Fish and Aquatic Life are primarily impacted by Low DO, Eutrophication, and Elevated pH.

Recreational uses are currently assessed only on a very limited basis for a small number of waterbodies. Of lake and impoundment acres listed as impaired for Recreation, over 90% are due to severe and frequent blue green algae blooms (for impoundments, this high percentage primarily reflects the large acreage of Lake Wisconsin). The main source of impairments for both lakes and impoundments is polluted runoff from nonpoint sources (45%). Lakes are also significantly affected by Municipal Separate Storm Sewer Systems and Non-Irrigated Crop Production. Impoundments, not surprisingly, are significantly impaired by Upstream Sources, which contribute pollutants that are carried into the impoundment through incoming river flow (39%).

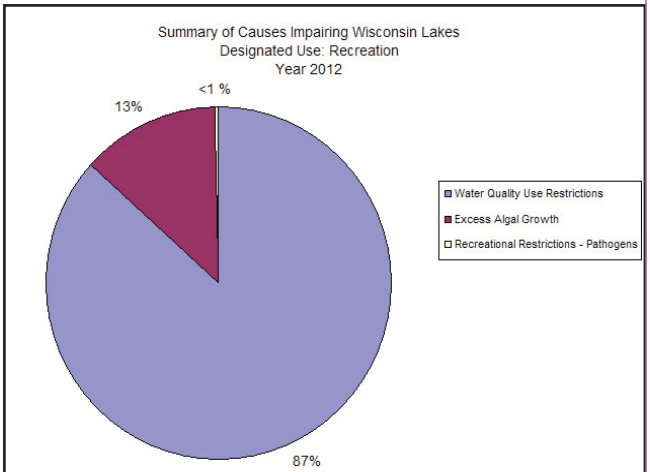


Figure 16. Summary of Causes Impairing Wisconsin Lakes Designated Use: Recreation, 2012

Table 15. Lakes: Causes of Impairments

Summary Causes Impairing Lakes for Fish & Aquatic Life

Name	Total Size (ACRES)	Percentage(%)
Eutrophication	193451.94	33.18%
Low DO	167385.49	28.71%
Turbidity	156630.96	26.86%
Degraded Habitat	39490.2	6.77%
Contaminated Fish Tissue	11923.51	2.04%
Chronic Aquatic Toxicity	5983.47	1.03%
Contaminated Sediment	4222.69	0.72%
Elevated pH	3528.35	0.61%
Elevated Water Temperature	390.23	0.07%
Fish Kills	72.61	0.01%

Causes Impairing Lakes for Public Health and Welfare Use

Name	Total Size (ACRES)	Percentage(%)
Contaminated Fish Tissue	284.8	100%

Causes Impairing Lakes for Fish Consumption Use

Name	Total Size (ACRES)	Percentage(%)
Contaminated Fish Tissue	284333.45	100%

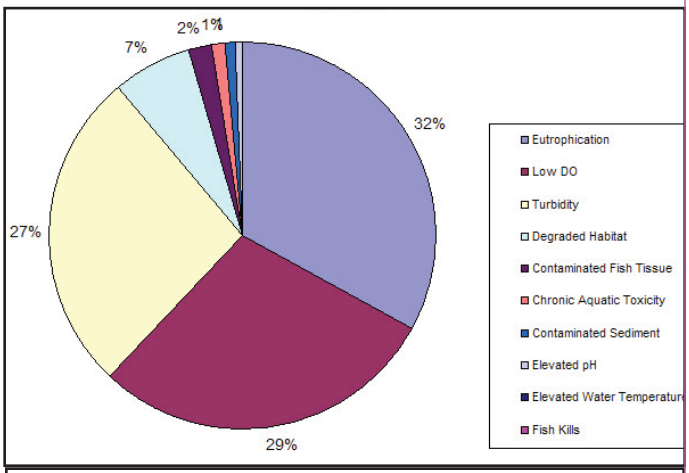


Figure 17. Summary of Causes Impairing Wisconsin Lakes Designated Use: Fish and Aquatic Life, 2012

Table 16. Impoundments: Causes of Impairments

Causes Impairing Impoundments for Fish and Aquatic Life

Name	Total Size (ACRES)	Percentage(%)
Low DO	40198.35	49.37%
Eutrophication	27633.55	33.94%
Contaminated Fish Tissue	5193.44	6.38%
Elevated pH	4734.7	5.82%
Degraded Habitat	3021.26	3.71%
Chronic Aquatic Toxicity	346.28	0.43%
Contaminated Sediment	262.28	0.32%
Turbidity	24.74	0.03%

Causes Impairing Impoundments for Recreation

Name	Total Size (ACRES)	Percentage(%)
Recreational Restrictions - Blue Green Algae	9000	65.06%
Excess Algal Growth	2641.35	19.09%
Water Quality Use Restrictions	2127	15.38%
Recreational Restrictions - Pathogens	64.55	0.47%

Causes Impairing Impoundments for Fish Consumption

Name	Total Size (ACRES)	Percentage(%)
Contaminated Fish Tissue	97418.44	99.28%
Chronic Aquatic Toxicity	353.64	0.36%
Contaminated Sediment	353.64	0.36%

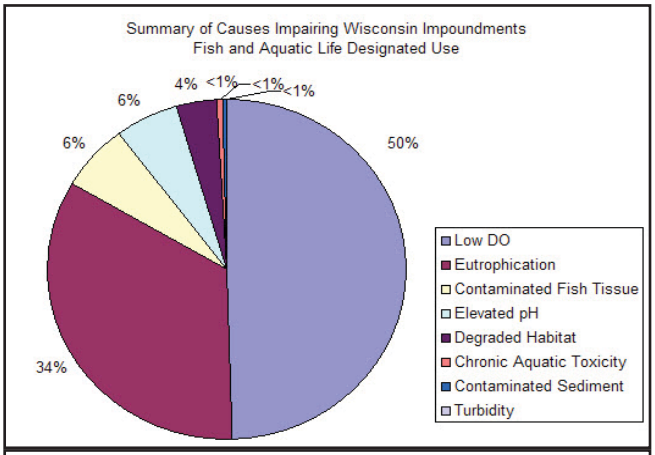


Figure 18. Summary of Causes Impairing Wisconsin Impoundments Designated Use: Fish and Aquatic Life, 2012

Bays and Harbors - Bays and Harbors (Table 17) are impacted by Contaminated Fish Tissue, Degraded Habitat, and Low DO. The sources are primarily Contaminated Sediments and discharges from Municipal Separate Storm Sewer Systems. Bays and harbors impaired for Public Health and Welfare are due to Historic Point Sources.

Table 17. Bays and Harbors - Impairments and their Sources

Causes Impairing Bays & Harbors, Fish and Aquatic Life

Name	Total Size (ACRES)	Percentage(%)
Contaminated Sediment	14024.55	28.66%
Degraded Habitat	13867.36	28.33%
Low DO	13867.36	28.33%
Chronic Aquatic Toxicity	6094.48	12.45%
Eutrophication	724.95	1.48%
Elevated pH	363.87	0.74%

Causes Impairing Bays & Harbors, Public Health & Welfare Designated Use

Name	Total Size (ACRES)	Percentage(%)
Contaminated Sediment	6042.93	100%

Causes Impairing Bays & Harbors, Fish and Aquatic Life Recreation

Name	Total Size (ACRES)	Percentage(%)
Water Quality Use Restrictions	301.77	100%

Causes Impairing Bays & Harbors, Fish Consumption Designated Use

Name	Total Size (ACRES)	Percentage(%)
Contaminated Fish Tissue	19971.73	100%

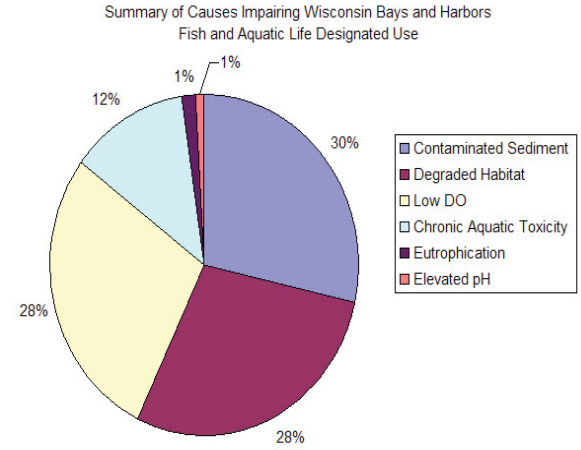


Figure 19. Summary of Causes Impairing Wisconsin Bays and Harbors Designated Use: Fish and Aquatic Life, 2012

Rivers and Streams - Impairment and their sources for rivers and streams are shown in Table 18. Rivers and streams that are impaired for Fish and Aquatic Life Uses are primarily impacted by Degraded Habitat (45%), which refers to siltation of the streambed that reduces feeding and reproduction habitat for aquatic organisms. Rivers and streams are also affected by Low DO (27%). The primary source of these impairments is polluted runoff from Nonpoint Sources (34%), but a wide variety of other sources also impact Wisconsin's river and stream systems.

Although Recreational Uses for Rivers/Streams are not as thoroughly assessed as Fish and Aquatic Life Uses, 120 river/stream miles were assessed as impaired for Recreational Uses due to Pathogens. Fish Consumption Uses were impaired due to Contaminated Sediments or Atmospheric Deposition of Mercury.

Table 18. Rivers and Streams - Impairments and their Sources

Causes Impairing Rivers for Fish and Aquatic Life

Name	Total Size (MILES)	Percentage (%)
Water Quality Use Restrictions	1486.32	29.07%
Degraded Habitat	1416.56	27.70%
Low DO	861.78	16.85%
Degraded Biological Community	420.18	8.22%
Elevated Water Temperature	254.57	4.98%
Contaminated Sediment	197.16	3.86%
Chronic Aquatic Toxicity	179.48	3.51%
Contaminated Fish Tissue	82.01	1.60%
Eutrophication	71.91	1.41%
Degraded Submerged Aquatic Vegetation (SAV)	48.1	0.94%
Acute Aquatic Toxicity	27.12	0.53%
Sediment/Total Suspended Solids	19.47	0.38%
Elevated pH	14.06	0.27%
Turbidity	10.53	0.21%
Excess Algal Growth	8.09	0.16%
Fish Barriers (Fish Passage)	7	0.14%
Low flow alterations	6.15	0.12%
Fecal Coliform	2.83	0.06%
Copper	0.39	0.01%

Causes Impairing Rivers for Recreation

Name	Total Size (MILES)	Percentage (%)
Recreational Restrictions - Pathogens	120.97	85.87%
Water Quality Use Restrictions	19.9	14.13%

Impairing Rivers for General Use

Name	Total Size (MILES)	Percentage (%)
Water Quality Use Restrictions	230.7	100%

Impairing Rivers for Fish Consumption

Name	Total Size (MILES)	Percentage (%)
Contaminated Fish Tissue	1799.23	99.24%
Contaminated Sediment	11.5	0.63%
Acute Aquatic Toxicity	2.25	0.12%

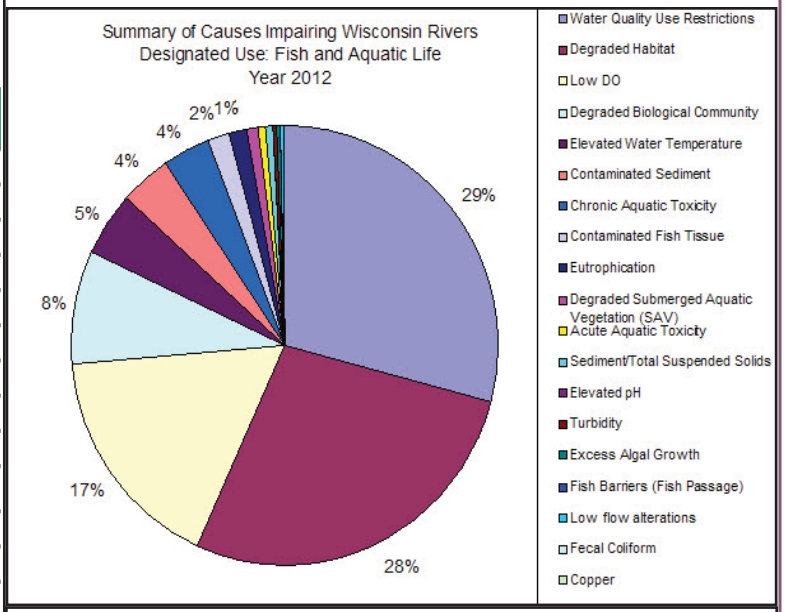


Figure 20. Summary of Causes Impairing Wisconsin Rivers Designated Use: Fish and Aquatic Life, 2012

Wetlands – Of the wetland acres impaired for Fish and Aquatic Life Uses, Table 19 shows that they are equally impaired by Degraded Habitat and Low DO. Sources of these impairments are Crop Production, impacting 40%, and Internal Nutrient Recycling and Nonpoint Sources (20% each). Of the State's assessed 5 million wetland acres, many are impacted by Reed Canary Grass, as described in the Wetlands Chapter of this report. However, because these wetlands provide habitat for many species

and maintain their filtering functions on the landscape, they are not considered impaired and are thus not reflected in Table 19. Wetlands are not currently assessed for Recreation, Fish Consumption, or Public Health and Welfare.

Table 19. Wetlands - Impairments and their Sources

Summary of Causes Impairing Wetlands for Fish and Aquatic Life Uses

Name	Total Size (MILES)	Percentage(%)
Contaminated Fish Tissue	268.33	100%

Great Lakes Shoreline – The 268 miles of Great Lakes Shoreline that have been listed as impaired for Contaminated Fish Tissue are due to Atmospheric Deposition and Contaminated Sediments, as shown in Table 20.

Table 20. Great Lakes Shoreline - Sources of Impairments

Summary of Causes Impairing Great Lakes Shoreline for Fish Consumption

Name	Total Size (MILES)	Percentage(%)
Contaminated Fish Tissue	268.33	100%

Great Lakes and Inland Beaches – Thirty-one miles of Great Lakes Beaches are listed as impaired due to Pathogens (*E. coli*) (Table 21), though the source of the pathogens is undetermined. Sanitary surveys are being conducted by County Health Departments to determine the sources of these pollutants. Only a very small portion of Inland Beaches are currently monitored for Pathogens (Table 22).

Table 21. Great Lakes Beaches - Impairments and their Sources

Causes Impairing Great Lakes Shoreline for Recreational Use

Name	Total Size (MILES)	Percentage(%)
Recreational Restrictions - Pathogens	31.01	100%

Table 22. Inland Beaches - Impairments and their Sources

Causes Impairing Inland Beaches for Recreational Use

Name	Total Size (MILES)	Percentage(%)
Recreational Restrictions - Pathogens	4.75	100%

D4. 2012 Delisting Decisions

A water may be delisted from the 303(d) Impaired Waters List once it meets water quality standards and is no longer impaired. For each water proposed to be delisted in 2012, WDNR provides documentation sheets with the data and delisting rationale to US EPA. This documentation is also available in WDNR's WATERS database or online at http://dnr.wi.gov/org/water/wm/wqs/303d/index.htm using the search queries for specific waterbodies.

E. Water Pollution Control Programs

A broad range of WDNR programs within the Bureaus of Water Quality and Watershed Management contribute to water quality improvements.

E1. Total Maximum Daily Loads (TMDLs)

A Total Maximum Daily Load (TMDL) is an analysis that determines the amount of a pollutant a waterbody can receive and still meet water quality standards. All 303(d) impaired waters require a TMDL to be developed. Vigorous monitoring, complex modeling, and significant public input are all necessary components of implementable TMDLs. Monitoring surface waters for TMDLs depends on multiple factors including: the pollutant of concern, modeling needs (pour point data, flow gage data, land use, hydrology, precipitation), and the size of the watershed. Guidance to determine the proper monitoring needed for TMDL modeling is located in the 2001 document "TMDL Monitoring and Modeling Technical Guidance."

In the past decade, Wisconsin's TMDL Program has evolved to include the development of complex watershed TMDLs; those TMDLs include both point and nonpoint pollutant sources of phosphorus (TP) and total suspended solids (TSS). In the past two years, Wisconsin has completed TMDLs for two major watersheds: the Rock River (101 TMDLs, approved by US EPA September 2011), and the Lower Fox River (45 TMDLs, approval by US EPA pending). As nutrient and sediment impairments continue to be identified through monitoring and assessments, more TMDLs are needed. Currently, several other large watersheds in Wisconsin are undergoing TMDL development. See Figure 21 for the status of TMDLs in Wisconsin. More information on Wisconsin's TMDL program can be found at: http://dnr.wi.gov/topic/tmdls/.

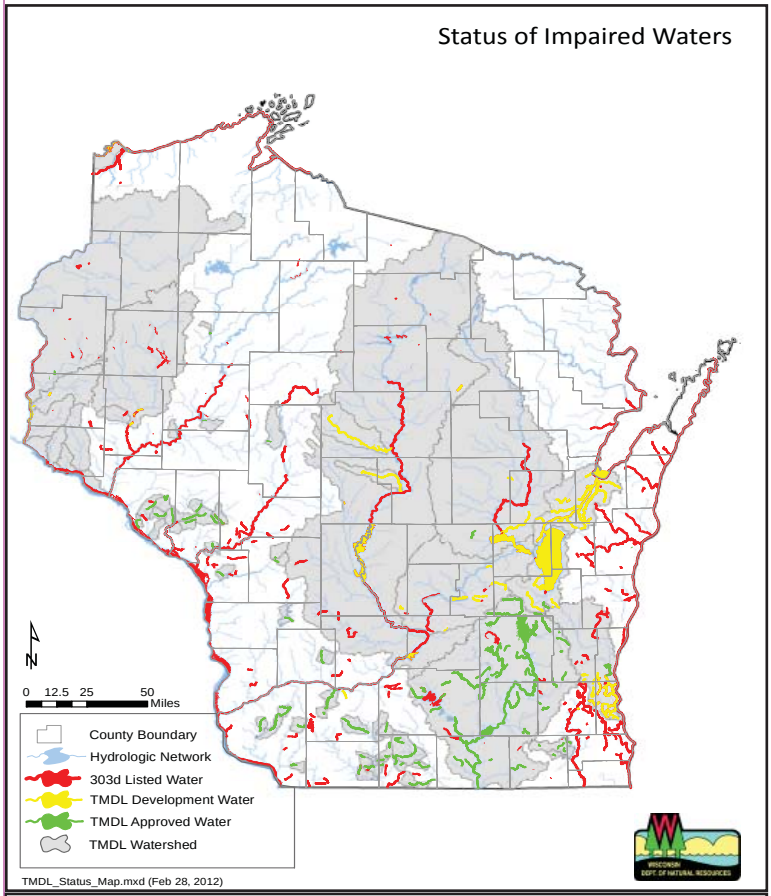


Figure 21. Impaired waters status in Wisconsin, including TMDLs and Impaired Waters.

Implementation of TMDLs in Wisconsin builds upon existing programs and initiatives to control point (Wisconsin Pollutant Discharge Elimination System (WPDES) Program) and nonpoint source pollution (WDNR's Runoff Management Program) as outlined below. Implementation and restoration include identifying the most proper financial and effective regulatory tools. The Department continues to develop a process for stakeholder involvement in the development of TMDL implementation plans. As the framework develops, roles and responsibilities for Department staff and engaged stakeholders will be outlined. Measurable milestones toward restoration, and tracking management activities are key for evaluating program progress.

Post-monitoring of the TMDL should occur in watersheds that have had Best Management Practices installed, to assess the responsiveness of the water to the practices. Once monitoring indicates that the water is no longer

exceeding pollutant and impairment thresholds, the water may be removed from the 303(d) Impaired Waters List.

E2. Wisconsin's Lakes Program

All of Wisconsin's 15,000 plus inland lakes are considered public resources. The great variety of lake types makes management and setting priorities a challenge. Natural lakes range in depth from a few feet to 236 feet (Big Green Lake, Green Lake County), from small ponds to 137,708 acres (Lake Winnebago, Winnebago County), and from clear soft water lakes to hard water lakes prone to extensive algal growth.

Wisconsin's Lake Protection effort combines monitoring, water quality assessment, research, and community financial, organizational, educational, and technical assistance. The purpose is to protect and restore the State's lakes and their ecosystems in partnership with other agencies and citizens. The Wisconsin Lakes Partnership is a team of WDNR, University of Wisconsin-Extension (UWEX) staff, and citizens represented by Wisconsin Lakes Inc., who bring technical expertise, outreach, and stakeholder concerns together to focus on the State's lakes.

The Water Way was the title of the Wisconsin Lake Partnership's 2001 strategic plan intended to "chart a course for the Wisconsin Lakes Partnership for the first decade of the twenty-first century." To help guide it through the second decade, the Partnership spent 2011 developing a new strategic vision that will outline ways to strengthen the Partnership so it can best address the four threats to lakes the plan recognizes: nonpoint source pollution, habitat loss, invasive species, and a changing climate.

On an annual basis, approximately 5% of the State's federal Clean Water Act Section 319 Grant supports the following Clean Lakes Program activities:

Citizen Lake Monitoring Network – All aspects of this program including administration, data management, reporting, and equipment purchase.

Lake Assessment and Technical Assistance – Technical and informational assistance to lake organizations and management units, processing and administering the lake grant program, managing lake data and support for statewide meetings, conferences and training sessions.

Lake Planning and Evaluation – Select regional projects including water quality monitoring, aquatic plant and habitat surveys, and summarizing data and management actions on specific lakes.

Lake Protection and Restoration – Select projects that will protect or improve lake water quality and lake ecosystems.

Lake Research and Demonstration – Select projects that will assess and increase the understanding of experimental and innovative lake management techniques and their ecological and economic implications.

Lake Planning and Protection Grants Fund Projects

WDNR's Lake Planning and Protection Grants have a major and diverse impact on the management of the State's lakes. These grants, which are 75% state cost-shared, are at the core of the partnership between state and local entities that are striving to protect and restore lakes and their ecosystems. Approximately $2.3 million are allocated annually to support a balance of locally-initiated projects ranging from data collection and development of lake management plans, and specific studies and assessments, to land acquisition, local ordinance development, and shoreland restoration management plan implementation.

About $600,000 a year are invested in small and large scale planning projects through State Lake Planning Grants (Table 23).

Table 23. Wisconsin Lake Planning Grants, 2010-2011

Project Type	# Grants	Grant Amount
Comprehensive Planning Studies	115	$1,155,437
Water Quality/Hydrologic Studies	37	$225,404,
Aquatic Plant & Habitat Assessments	12	$42,276
Education/Organizational Development	31	$86,097
TOTAL	195	$1,509,214

More than $3.2 million state dollars were invested in project implementation through State Lake Protection Grants in 2010 & 2011 (Table 24).

Table 24. Wisconsin Lake Protection Grants, 2010-2011

Project Type	# Grants	Grant Amount
Land Acquisition/Easement	5	$419,372
Shoreland/Wetland Restoration	7	$537,266
Lake Classification	9	$413,365
Ordinance Development	54	$302,520
Plan Implementation	10	$1,433,717
Diagnostic/Feasibility	1	$180,996
TOTAL	86	$3,287,236

The Lake Partnership also annually administers $4 million in Aquatic Invasive Species Prevention and Control Grants. Though heavily focused on aquatic plants, these grants also work to protect habitat and fund or leverage a growing amount of water quality monitoring and planning.

Lake Organization and Education Assistance

The Lake Partnership uses science and community-based goal-setting processes to direct the protection and restoration of lake ecosystems and watershed health. Communities of lake enthusiasts help manage the State's rich array of lake resources. While the WDNR has state authority to manage and regulate lakes, provide public assistance, and conduct research, UWEX - Stevens Point provides lake organization and education assistance statewide. Staff at UWEX develop, publish, and distribute printed and electronic media, providing useful information to citizen members of Wisconsin's hundreds of lake management organizations on a wide array of issues, ranging from water law to limnology. UWEX also publishes a quarterly newsletter, *Lake Tides,* which is distributed to 26,500 homes, businesses, and nonprofits. *Lake Tides* and many other publications are also now on-line through the Wisconsin Lakes Partnership website: http://www.uwsp.edu/cnr/uwexlakes/ecology/.

To better prepare the next generation of citizens for positions in lake advocacy, the Lake Partnership founded the Wisconsin Lake Leaders Institute. It graduated its eighth Crew of 28 in 2010, and about thirty citizens participated in a two-day "Advanced" Lake Leaders workshop on emerging shore land and shallow areas management issues October 20-21, 2011.

Approximately 1,200 people are reached annually through conferences and community meetings conducted by UWEX staff. Along with DNR and Wisconsin Lakes, Inc., UWEX hosted eight regional lake workshops for the general public, in addition to two statewide Wisconsin Lake Conventions: http://www.uwsp.edu/cnr/uwexlakes/conventions/.

Mitigating High Acidity in Wisconsin Lakes

Acid rain is the result of sulfur dioxide and nitrogen oxides entering the atmosphere. These two pollutants are mainly produced by human activities. Sulfur dioxide (SO2) is most commonly produced by coal-fired power plants and factories, while nitrogen oxides (NOx) are products of motor vehicles and off-road engines, coal-fired power plants and factories (such as pulp and paper mills in Wisconsin), and home furnaces.

Once these chemicals are released into the atmosphere, they combine with moisture, change chemically, and return to earth in the form of acidic rain, snow or fog. Acidic deposition also may occur in a dry form when acidic compounds attach to particulates (dust) and return to earth. Many factors affect whether, or at what rate, acidification due to acid rain occurs in bodies of water. However, bodies of water that are low in alkalinity or acid neutralizing capacity (ANC) are considered especially vulnerable to the effects of acid rain.

A body of water is considered "acidic" if it does not have any acid neutralizing capacity. That does not, however, mean that it is already devoid of fish and other aquatic life. As a body of water becomes more acidic, it loses some of its biodiversity as the more acid-sensitive species of plant and animal life die off, or experience a decrease in reproductive success. The degree of threat from acid rain depends on the vulnerability of plant and animal species in that body of water to an acidic environment.

Mercury Rule with "Multipollutant Option" Also Addresses Acid Rain Sources

Wisconsin's rule to limit mercury emissions from coal-fired electric utility plants took effect in 2004 and was revised in 2008. The revised rule allows large coal-fired power plants to choose a multi-pollutant alternative, which requires affected power plants to achieve nitrogen oxides (NOx) and sulfur dioxide (SO2) reductions beyond current federal and state regulations, but also gives them an additional six years to achieve the 90 percent mercury emission reduction standard. Only one utility, WE Energies, opted for the multi-pollutant approach for meeting the mercury emission limits.

In 2012, US EPA promulgated a National Emission Standard for Hazardous Air Pollutants (NESHAP) for mercury from coal and oil fired electric utility plants. Because the federal NESHAP does not include a multi-pollutant option that allows additional time to meet mercury emission limits in exchange for NOx and SO2 reductions, it is likely that the additional NOx and SO2 reductions under the State rule will not be achieved as a part of mercury regulations.

A History of Acid Rain Reductions in Wisconsin

Wisconsin passed one of the first and strongest state acid rain control laws in the Nation in 1986, making the State a leader in acid rain policy. The law required Wisconsin's major electric utility companies to reduce their sulfur dioxide emissions by 50 percent from 1980 emission levels, by 1993.

By 1990, overall annual sulfur dioxide emissions from electric utility companies had fallen 46 percent, and in 1992, these companies filed compliance plans indicating that they would easily meet the requirements of the law. Figure 23 shows a sharp decline in sulfur emissions in Wisconsin from 1980 to 1994, even while coal use was increasing over this time span.

Meanwhile, Congress passed the Clean Air Act Amendments of 1990 which also contain strong acid rain control measures. The federal law required electric utility companies nationwide to reduce their collective sulfur dioxide emissions by 10 million tons per year, from 1980 emission levels, by the year 2000. This represents a 40 percent reduction in nationwide sulfur dioxide emissions. Utility sulfur dioxide emissions were capped at about nine million tons per year in the year 2000, and thereafter. The law also was also expected to result in a reduction in nitrogen oxide emissions of about two million tons per year.

In February, 2010, the U.S. Senate introduced Clean Air Act Amendments of 2010, which aim to cut SO2 emissions by 80 percent (from 7.6 million tons in 2008 to 1.5 million tons in 2018), cut NOx emissions by 53 percent (from 3 million tons in 2008 to 1.6

million tons in 2015), and cut mercury emissions by at least 90 percent no later than 2015. To ensure that regulations are cost-effective, the legislation also establishes nationwide trading systems for SO2 and NOx emissions. This bill would replace EPA's 2005 Clean Air Interstate Rule (CAIR), a rule that aimed to dramatically reduce pollution that moves across state boundaries by capping emissions of sulfur dioxide (SO2) and nitrogen oxides (NOx) in the eastern United States, but which was stalled by federal action.

These measures are credited with a reduction in emissions that has been associated with a noticeable decrease in the acidity of rainfall in the State. Studies over the last few decades demonstrate these successes:

- **1984:** A survey done in 1984 by the U.S. Environmental Protection Agency showed that up to 9 percent of lakes in the northeast and north central region were acidic.

- **1990:** A 1990 analysis of wet acid precipitation data indicated that the annual average pH in Wisconsin ranged from 4.59 in the southeast to 5.06 in the northwest. In contrast, the annual average pH in the early 1980s ranged from 4.4 in south-eastern Wisconsin to 4.8 in the northwestern part of the State. The goal established in the State law is to raise the pH of the State's rain to 4.7 or greater across the State.

- **1994:** According to data cited from 1994 from the DNR's Surface Water Resources Data Base, approximately 2 percent of the State's lakes are acidic. An additional 10 percent are "extremely sensitive" to acid rain, 25 percent are "moderately sensitive," and 60 percent are not sensitive. Surveys conducted in northern parts of Wisconsin, however, where most of the State's lakes are located, show that these areas had an even greater incidence of acidic lakes.

- **2009:** US EPA's National Lakes Assessment Report (NLA) included results for lake assessments of Acid Neutralizing Capacity, an indicator of a lake's sensitivity to acid deposition. The study reported that in the Upper Midwest Ecoregion, which covers most of Wisconsin, 99.1percent of lakes assessed in the 2007 NLA scored 'Good' for Acid Neutralizing Capacity, with 0.09 percent scoring 'Fair', and none 'Poor'. Similarly, in the Temperate Plains Ecoregion, which covers the southeastern corner of Wisconsin, 100 percent of lakes assessed were ranked as 'Good' for Acid Neutralizing Capacity.

Although the studies noted above used different methods, and are thus not directly comparable to one another, they indicate a trend of improvement and a positive standing for Wisconsin's lakes today. At this point, the WDNR Lakes Program does not consider acid deposition to be a focal point for lake management in Wisconsin. Although WDNR is aware that there are a few lakes in Wisconsin that are sensitive to acid deposition, these are primarily in the northeast part of the State, due to weather patterns that introduce more acidic rainfall in that area. Planned sampling for the 2012 NLA will continue to monitor these long term trends.

E3. Runoff Management

Control of polluted runoff continues to be one of the most important challenges in the State's effort to protect Wisconsin's water resources. Urban and rural land use activities are the source of runoff pollutants entering Wisconsin's lakes, streams, wetlands, and groundwater. Common pollutants in runoff include the following:

- Sediment from construction sites, croplands, and other urban and rural sources
- Nutrients and pesticides from both urban and rural sources
- Oil, grease, heavy metals, and other toxic materials from impervious surfaces such as streets, highways, roof, and parking lots
- Farm animal wastes from barnyards and pet wastes from urban areas

Polluted Runoff Can Lead To...

- **Fish Kills & Degraded Habitat**
- **Weed Growth**
- **Sedimentation**
- **Loss of Recreation**
- **Drinking Water Contamination**

The effects of polluted runoff can be seen in degraded fish habitat, fish kills, nutrient-loaded waters causing heavy weed growth, degradation of drinking water supplies, siltation of harbors and streams, diminished recreational uses, and changes in the natural hydrology of wetlands, streams, rivers, and lakes.

To address these pollutant problems, water quality managers encourage landowners and municipalities to implement and install "Best Management Practices" (BMPs) in rural and urban areas. BMPs, such as buffer strips, nutrient management, manure storage facilities, or detention ponds, help to prevent movement of pollutants to surface water and groundwater.

The State's efforts to restore water resources affected by polluted runoff center around Wisconsin's runoff management program. The program is embodied in nine administrative rules, promulgated in October 2002, to address urban and rural runoff pollution problems statewide; eight are administered by the WDNR, and one is administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP).

Construction of concrete manure storage facility at a CAFO
Photo Courtesy of WDNR

Manure management practices prevent runoff from feedlots
Photo Courtesy of WDNR

Three primary components of the WDNR's runoff management program include implementation of runoff management grant programs, point source permitting of stormwater and agricultural runoff sources, and implementation of state regulatory performance standards.

Wisconsin has been recognized as a leading state in the effort to control polluted runoff. The runoff management program is a joint effort of the WDNR, the DATCP, county Land Conservation Departments (LCDs), and municipalities, with assistance from a variety of federal, state, and local agencies, particularly the US EPA, the USDA Natural Resources Conservation Service (NRCS), and the University of Wisconsin-Extension.

Agricultural Runoff

Approximately 14,000 active livestock operations exist in Wisconsin. Manure from livestock operations contains organic materials, nitrogen, phosphorus and other water pollutants. Through Wisconsin Pollution Discharge Elimination System (WPDES) permits issued under Wisconsin Statutes section 283, and ch. NR 243, Wis. Adm. Code, the WDNR has helped to avoid many water quality impacts from larger-scale livestock operations. In addition, the WDNR has used the Notice of Discharge (NOD) program under ch. NR 243, Wis. Adm. Code, and the agricultural performance standards and prohibitions promulgated in ch. NR 151, Wis. Adm. Code, in October 2002, to address water quality impacts from many smaller-scale livestock operations in the State.

Fish kills result when excess pollutants enter streams or lakes
Photo Courtesy of WDNR

WPDES Permits for Large Operations

Water quality concerns associated with livestock operations with 1,000 animal units or more (also referred to as Concentrated Animal Feeding Operations, or CAFOs) are addressed through the Wisconsin Pollution Discharge Elimination System (WPDES) permit program. One thousand animal units are approximately equal to 700 milking cows, 1,000 beef cattle, 2,500 swine or 55,000 turkeys. These operations are required to obtain a WPDES permit that addresses storage, runoff, and land application of manure and other process wastewaters from these operations. As of December 31, 2011, there were 230 CAFOs permitted under the WPDES program, and another 18 new permit applications pending. (NOTE: One permit covers approximately 50 poultry operations owned or operated by the same company.) The WDNR has experienced a significant increase in the number of operations applying for permits in recent years, especially in the dairy sector. The WPDES permit program meets or exceeds National Pollutant Discharge Elimination System (NPDES) requirements for livestock operations with 1,000 animal units or more, particularly in the areas of addressing groundwater quality impacts. In 2007, Wisconsin finalized its revisions to ch. NR 243, Wis. Adm. Code, that regulate CAFOs. These revisions reflect changes that were made at the federal level.

Managing Water Quality Impacts from Smaller Operations

The WDNR regulates livestock operations with fewer than 1,000 animal units, having discharges that significantly affect water quality through the Notices of Discharge (NOD) program. In addition, under ch. NR 243, Wis. Adm. Code, operations with 301 to 999 animal units that have discharges meeting the federal definition of a "point source" are also required to apply for a WPDES permit. With the promulgation of agricultural performance standards and prohibitions under ch. NR 151, Wis. Adm. Code, the WDNR has an additional tool to address impacts from smaller-scale livestock operations as well as impacts from crop production. The statutory authority under s. 281 of the Wisconsin Statutes, and the creation of ch. NR 151, Wis. Adm. Code, also provide local governments (e.g., towns and counties) the authority to enforce the agricultural performance standards and prohibitions.

Notices of Discharge Address Problem Areas: Increased Funding

Notices of Discharge (NODs) may be issued to smaller-scale livestock operations if an on-site investigation reveals the presence of a discharge to waters of the State. Technical assistance to control the discharge is typically available through the county Land Conservation Departments (LCDs), and cost-share financial assistance can be obtained through local, state, and federal cost-share programs. If the water quality impact is not the result of a discharge that meets the federal definition of point source, cost sharing must be provided to cover at least 70% of eligible costs. Throughout the process of addressing impacts identified in an NOD, the WDNR may conduct follow-up investigations to monitor compliance. A livestock operator who fails to implement necessary corrective measures within a specified timeframe is subject to a loss of cost-share funding, and may be required to obtain a WPDES permit from the WDNR. Historically, the NOD program has been based on citizen complaints against livestock operations. The WDNR has changed to a targeted approach, investigating impacts from livestock in areas draining to impaired waters (federal 303(d) listed waters) and high quality waters (Wisconsin Outstanding and Exceptional Resource Waters), instead of relying solely on citizen complaints.

Construction site erosion running into a storm drain that eventually makes its way to a local stream or lake. Photo Courtesy of WDNR

Since the mid-1980s DNR has used notices of discharge (NODs) under ch. NR 243, Wis. Adm. Code, to address significant discharges to state waters from small (<300 animal units) and medium (300 – 999 animal units) sized livestock operations. DATCP engineers and county staff provide technical assistance. Both DNR and DATCP provide state funding to address NOD sites, and jointly administer a grant application process that uses a combination of state and federal EPA funding. USDA funding is also occasionally used to address these sites.

During the twelve year period from 2000-2011, 79 notices were issued under ch. NR 243 (this includes both NODs and Notices of Intent (NOIs), which are the precursors to NODs). In 2010, 10 notices were issued, with cost-share funds totaling $653,021, committed by DNR and DATCP, to fund these projects. In 2011, the number rose to 14 notices issued, and DNR/DATCP funding was substantially increased to more than $1.1 million to address these projects.

Runoff Events: A Constant Concern

Surface water and groundwater contamination from manure runoff events is an ongoing concern, and one that the Department continues to work to address. Runoff events can have a serious impact on the health of people and the environment. Both acute (fish kills, well contaminations) and chronic effects (algae blooms and decreased fisheries health over the long term) have been attributed to runoff events.

Between 2005 and 2009, there was an annual average of 60 reported runoff events, with a range of 35 reported events in 2006 to 82 events in 2008. The number of reported runoff events in 2010 was 57 and in 2011 was 75. Many runoff events still go unreported, and WDNR is working with researchers to define what a reportable incident is. By developing a tracking system, farmers and applicator industries can use strategies to reduce the number and severity of future incidents. WDNR spends a great deal of resources documenting the events and mitigating their impact when they occur. Impacts have been seen from WPDES permitted operations, while many are also associated with operations with fewer than 1,000 animal units.

More protective rules

To help avoid these situations, the Department finalized revisions to ch. NR 243 in July of 2007. Chapter NR 243, Wis. Adm. Code, outlines the WPDES permit program and the regulations for the management and landspreading of manure from larger-scale livestock operations. These revisions help to reduce impacts associated with land spreading manure and process wastewater, in part

by including additional restrictions on land application of manure onto frozen or snow-covered ground.

The WDNR has also partnered with state and local agencies to promote farmer education efforts and the creation and implementation of nutrient management plans for producers. Key players in these efforts have been the State Department of Agriculture, Trade and Consumer Protection, the Natural Resource Conservation Service, University of Wisconsin-Extension, including the Discovery Farms project, and county Land Conservation Departments.

These efforts have led to implementation of nutrient management plans through regulation and voluntary cost-share efforts. They have also led to periodic emergency notifications of weather and soil conditions that indicate the potential for runoff events to occur. In addition, the WDNR spearheaded the development of a website designed to assist farmers in finding resources to help avoid runoff events. This website can be viewed at: http://dnr.wi.gov/topic/agbusiness/preventmanurerunoff.html.

Investigation of Impacts

Where impacts have occurred, the WDNR investigates the causes of these instances. Where impacts can be tied to a given farm's practices, the WDNR has pursued enforcement using existing authority to address these events (e.g., WPDES permit enforcement, spills law, citation authority). The result of these efforts range from the payment of a fine to cost-recovery for killed fish to referral to the State's Department of Justice for prosecution and payment of forfeitures. In addition, the WDNR has been able to help some families replace manure impacted wells through the State's well compensation fund.

Stormwater Permits in WI

Municipalities	
Individual Permits	76
General Permit	142
Industrial Sites	5,700 +
Construction Sites	1,300 annual average
2010	1.582
2011	1,476

Stormwater Management

Since the mid-1990s, DNR has administered a program under ch. NR 216, Wis. Adm. Code, to address the issue of polluted urban stormwater runoff. Typical sources for this type of pollution are municipal storm sewers that collect runoff from lawns, streets, and parking lots, and runoff from construction and industrial sites that discharge to surface waters or groundwater without treatment. Research on urban streams in Wisconsin has shown high concentrations of suspended solids, bacteria, heavy metals, oil, grease and polyaromatic hydrocarbons as a result of stormwater discharges from these sources.

DNR has a permit program to regulate stormwater discharges from municipal, industrial and construction site sources. The municipal stormwater program addresses stormwater discharges from municipal separate storm sewer systems (MS4s), including large and medium MS4s (those serving a population over 100,000 people), MS4s in designated urbanized areas, and MS4s that serve a population of 10,000 people or more. The industrial stormwater program regulates industrial facilities based upon the type of industrial activity undertaken. The construction site permit program regulates sites where one or more acres of land is disturbed for new construction or redevelopment.

Municipal Permits

As of December 31, 2011, there were 76 municipalities regulated under individual MS4 stormwater permits in Wisconsin. Additionally, there were 142 MS4s covered under a general MS4 stormwater permit. The general MS4 stormwater permit contains six minimum control measures to reduce pollutants in urban stormwater. Some municipalities have implemented stormwater utilities to fund their local programs.

Industrial Permits

As of December 31, 2011, there were over 5,700 industrial facilities covered by a stormwater discharge permit. Industrial permittees must develop stormwater pollution prevention plans to identify sources of stormwater contamination and pollution prevention measures. The Auto Dismantling and Scrap Recycling permittees, 311 and 174 permits, respectively, are offered the option of joining a Cooperative Compliance Program, developed to establish industry-wide approaches to reducing or eliminating stormwater contamination. These programs provide group training, foster information sharing and promote BMPs.

Urban Nonpoint & Stormwater Management Grants:

- 2000-2011 $42.2 million for 446 projects
- 2009 $2.2 million for 18 projects
- 2010 $1.8 million for 26 projects
- 2011 $2.4 million for 24 projects

Construction Site Erosion Control

On average, the DNR confers coverage to over 1,300 construction sites annually. However, the number of construction site erosion control permits issued the past two years was well over average, with 1,582 permits issued in 2010 and 1,476 permits issued in 2011. Owners of construction sites are required to develop and implement site-specific erosion control and stormwater management plans to prevent pollutants from entering waters of the State.

Implementing Runoff Performance Standards

Wisconsin's approach to controlling polluted runoff from agricultural and urban land uses has included statewide performance standards and prohibitions since October 2002, and an increase in grant dollars toward performance standards implementation. Performance standards and prohibitions are now required components of certain state programs, implementation tools have been put in place, and there is an increased use of regulatory options for serious water quality violations. Urban municipalities that were included in the Phase I federal stormwater requirements have ordinances that include the nonagricultural performance standards.

Targeted Runoff Management Grants (TRM)

- 2000-2011 $42.7 million for 445 projects
- 2009 $6.8 million for 64 projects
- 2010 $5.9 million for 52 projects
- 2011 $5.7 million for 52 projects

Each year more counties and municipalities take on the process of implementation. The number of counties that are evaluating and documenting agricultural farms and fields for compliance, and notifying landowners of compliance status is steadily increasing. Levels of compliance are rising every year. More counties are developing tracking systems with GIS capabilities. In increasing numbers, counties are developing ordinances incorporating some or all of the performance standards and manure management prohibitions.

Runoff Management Grant Programs

The WDNR's runoff management grant programs include the Targeted Runoff Management (TRM) Grant Program, and the Urban Nonpoint Source and Stormwater Management (UNPS) Grant Program. Each of the grant programs offers cost-sharing assistance to local units of government. Counties typically assist landowners in the implementation and installation of BMPs to control nonpoint source pollution. Municipalities usually directly fund BMP construction and stormwater planning within their boundaries. The programs are described in further detail below. These DNR programs fund approximately 500 Best Management Practices each year. However, most of these BMPs are not tracked to determine the resulting pollutant load reductions. Table 25 shows the amount and types of BMPs funded through these programs in 2009 and 2010, the most recent two years for which records are available.

Table 25 Best Management Practices (BMPs) and plans funded through WDNR Runoff Grants

	2009	2010
Cropland BMPs, such as:		
Residue management, green manure crop, grassed waterways, buffers, waterway systems, reduced tillage, grade stabilization, Critical area stabilization (acres)	17,104	407
Critical area stabilization, grade stabilization structures, water and sediment control basins (number)	331	13
Animal trails and walkways, diversions, windbreaks, underground outlets, waterway systems, streambank and shoreline protection (feet)	47,440	4,046
Manure Management BMPs, such as:		
Agricultural sediment basin, barnyard runoff control systems, livestock watering facilities, manure storage facilities, milk center waste controls, roof runoff systems, sediment basins, waste transfer systems (number)	76	101
Access roads and cattle crossings, livestock fencings, wastewater treatment strips (feet)	820	2,560
Heavy use area protection, nutrient management, wastewater treatment strips (acres)	4.8	4,046
Streambank/Shoreline BMPs, such as:		
Streambank/shoreline protection (including fencing), shoreline habitat restoration, stream crossings, streambank rip-rap, streambank shaping and seeding (feet)	17,873	18,181
Shoreline protection, stream crossing, streambank/shoreline rip-rapping (number)	4	0
Urban BMPs and Plans, such as:		
Storm sewer re-routing, urban streambank practices (feet)	1,208	22 Projects
Detention systems, infiltration systems, street sweeping (number)	18	22 Projects
Stormwater management plans, stormwater utility plans, urban BMP designs	0	4
Other BMPs, such as:		
Pesticide management, rotational grazing, wetland restoration (acres)	1,677	3.1
Pesticide management, soil analysis, well abandonments (number)	60	1

Targeted Runoff Management Grant Program

The Targeted Runoff Management (TRM) Grant Program provides financial assistance to rural and urban governmental units to control polluted runoff. The maximum cost-share rate available to TRM grant recipients is 70 percent of eligible project costs, up to a maximum of $150,000 (total state share) for Small-Scale projects and up to $1,000,000 for Large-Scale projects. Local governments that are awarded TRM grants may use the funds on lands they control or make the funds available to private landowners. The projects last from two to four years.

From the first grant cycle in 1999 through December. 31, 2011, TRM grants authorized $42.7 million for 445 projects. As of December 31, 2011, 256 projects were completed. During calendar year 2009, the TRM Grant Program awarded $6,830,930 for 64 projects to local units of government. In 2010, $5,927,876 for 52 projects were awarded, and in 2011, $5,697,255 were awarded for 52 projects. TRM grant funds from this grant cycle have been used to install a variety of agricultural and urban BMPs (see Table 25; BMP data is only available for 2009 and 2010).

Urban Nonpoint Source & Stormwater Management Grant Program

The Urban Nonpoint Source and Stormwater Management (UNPS) Grant Program focuses on financial assistance to governmental units in urban areas to control polluted runoff. To be eligible for a grant, urban areas should have a population density of at least 1,000 people per square mile, have a commercial land use, or include a non-permitted portion of a privately owned industrial site. UNPS Grants can be used to pay for a variety of activities. Eligible planning activity costs for stormwater planning, related informational and educational activities, ordinance development and enforcement, and training and design are cost-shared at

70 percent. Eligible best management practice construction costs may include such projects as stormwater detention ponds, infiltration basins, streambank stabilization, and shoreline stabilization, and are cost-shared at 50 percent. The funded projects last between two and three years.

Urban Nonpoint Source Grant Awards

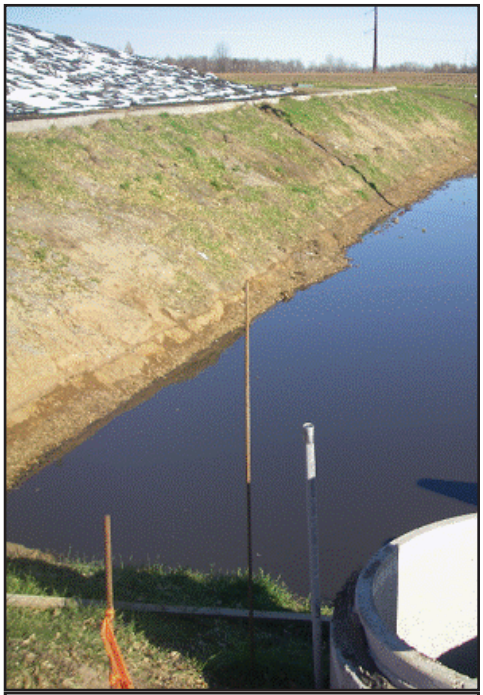
Since 2000, the UNPS Grant Program has awarded $42,164,611 in both planning and construction grants for 446 projects. As of December 31, 2011, 194 of the 215 planning projects, and 165 of the 231 BMP construction projects were completed. (Calendar year 2010 and 2011 grantees have until December 31, 2012 and December 31, 2013, respectively, to complete projects.) During 2009, $2,176,510 were awarded for 18 construction projects; however, no planning projects were funded for 2009 due to budget constraints and lapsed funding. During 2010 $1,637,800 were awarded for 22 construction projects and $182,720 for 4 planning projects, and in 2011, $2,093,560 were awarded to 20 construction projects, and $258,840 awarded to 4 planning projects. Online tools are available for the public to search and explore projects through the runoff management grant programs (http://dnr.wi.gov/runoff/index.htm).

E4. Wastewater Management

The WDNR regulates municipalities, industrial facilities and significant animal waste operations discharging to surface waters or groundwater of the State of Wisconsin through the Wisconsin Pollution Discharge Elimination System (WPDES) Permit Program (See Runoff Management Section E3 for discussion of WPDES permits for stormwater and animal waste). No person may legally discharge to surface waters or the groundwater of the State without a permit issued under this authority. All permits issued under the WPDES permit program are either specific permits or general permits and may contain the following:

- Effluent limits for conventional pollutants and toxic substances in the discharge
- Limitations on the quality and disposal practices for sludge (biosolids) and by-products solids
- Pretreatment requirements, where applicable
- Compliance schedules for facility improvements
- Monitoring and reporting requirements
- Management practices that minimize the release of pollutants

Specific permits are issued to individual facilities that have unique, complex issues. WDNR imposes unique requirements where necessary, and tailors standard requirements to fit circumstances as appropriate. General permits (GPs) are issued to cover a group of facilities with similar discharges which may be located anywhere in the State. Coverage under a general permit is conferred to each individual facility. The WDNR makes a determination on whether a particular facility is appropriately covered by a general or specific permit. There are 25 separate general permits that may be used to cover applicable discharges ranging from non-contact cooling water, to land application, to non-metallic mining operations. Approximately 5650 facilities are covered under all general permits. The newest general permits issued in 2011 were four pesticide GPs and a Large Dairy CAFO GP.



Silage Leachate Sediment Basin in the Mead Lake Watershed
Photo Courtesy of WDNR

Timely Permit Issuance

Timely issuance of WPDES permits is an important goal for WDNR. However, in some instances staff are not able to reissue permits before the 5-year term expires.

During 2011, staff vacancies had an impact on WDNR's permit backlog, as well as a seven-month delay in implementing the new phosphorus rules of ch. NR 217, Wis. Adm. Code. Hence, WDNR's permit backlog has increased. WDNR has recently hired new staff, and they are in the process of learning the WPDES permit program. WDNR has also begun implementation of the new phosphorus rules. The goal of the WPDES permit program is to ensure that the Department does not exceed a statewide backlog of more than 10% at any time. As of January 1, 2012, the backlog of industrial and municipal permits, including both surface and groundwater discharges, was 34%, exceeding the goal. Under Wisconsin law, any permit that has expired continues in effect until it is reissued or revoked. A facility with an expired permit, therefore, is still restricted in the amount of pollutants that it can discharge, as if the permit has not expired.

There are several reasons that a permit may not be issued prior to the expiration date, including: awaiting additional data from the permittee, public or other comment necessitating additional review, or a permittee is not in substantial compliance with the terms of the expired permit, and enforcement action is underway.

Effluent Limitations

Each permit contains effluent limitations based on the type of facility or water quality-based effluent limitations calculated to meet water quality standards. Effluent limitations may regulate the allowable amounts of biochemical oxygen demand, suspended solids, pH, nutrients, chlorine, temperature, other toxic substances, or other conditions, depending on the type of facility and the water to which it is discharged. The need for whole effluent toxicity testing is evaluated for permits that discharge to surface waters.

Biosolids and Sludge Disposal

Most municipal, and many industrial facilities in Wisconsin land apply their wastewater treatment biosolids (or treated sludge) on agricultural land as a soil conditioner or fertilizer. Biosolids either applied to farmland, or distributed for individual use as an exceptional quality product, are generated from approximately 98 percent of Wisconsin's permitted municipal facilities. In 2008, 341 facilities disposed of solids: 333 of these facilities either beneficially reused the material or hauled the material to a facility that beneficially reused it, two incinerated the material, and six disposed of the material by only disposing into a licensed landfill. In addition to these facilities that dispose of biosolids annually, there are 226 permitted facilities which treat wastewater in lagoon systems or other systems which only require removal of sludge on an infrequent basis (10-20 year cycles). Virtually all of the generators that infrequently dispose of their material land apply their biosolids.

Over 40 percent of the costs incurred to construct, operate and maintain a municipal wastewater treatment facility are directly related to processing, handling, treating and recycling the wastewater sludges or biosolids. Phosphorus levels in biosolids have increased, and will continue to increase as Wisconsin continues to limit the concentration of phosphorus in the effluent that is discharged directly to surface waters. Removing the phosphorus in the effluent in wastewater transfers the phosphorus to the biosolids. It is therefore important that biosolids be managed in ways that keep biosolids on the land and minimize the potential for phosphorus runoff to surface waters. Regulations and permit conditions control the amount of biosolids that may be land-applied depending on the soil, slope, time of year, proximity to residences and wells, and other factors. Current application rates are limited by hydraulic rates and nitrogen agronomic needs of the crop to be grown, using 4-year soil testing results to establish baselines.

Reconstruction of a manhole in Stevens Point, WI Photo Courtesy of WDNR

The State also regulates all septage pumped from approximately 700,000 septic systems and approximately 30,000 holding tanks. Over half of the septic systems currently serviced are maintained pursuant to required maintenance schedules, while the other half of the septic systems will have required maintenance schedules prior to Oct of 2012. Septage removed from septic or holding tanks

must either be taken to a wastewater treatment plant for further treatment, or directly land-applied. The same land application site criteria apply to septage as to sludge.

Pretreatment

Pretreatment dischargers are industrial facilities that do not discharge their wastewater directly to the waters of the State, but instead discharge into a municipal sewerage treatment plant. The WDNR has been delegated the authority to administer this federal program. Twenty-six municipal governments in the State are responsible for meeting state and federal requirements for implementation of pretreatment requirements. These "control authorities" regulate discharges to their systems from 545 users through the issuance of permits and other local controls. Industrial discharges that are subject to the pretreatment requirements of the State, but are not within the systems of these municipal control authorities, must obtain permits directly from WDNR. There are a total of 144 facilities that receive permits directly from WDNR.

Compliance Maintenance Program

The Compliance Maintenance program is one of the successful cornerstones of the Wisconsin Department of Natural Resources regulatory municipal point source watershed management, and WPDES program. The only program of its kind in the country, the web-based Compliance Maintenance Annual Report (eCMAR) is a self-evaluation report and grading system for Wisconsin's domestic wastewater treatment plants and sanitary sewer systems. Since its beginning in 1987, the compliance maintenance program has been extremely successful in achieving its purpose of "encouraging and, where necessary, requiring owners of publicly and privately owned domestic wastewater treatment works to take necessary actions to avoid water quality degradation, and prevent violations of WPDES permit effluent limits and conditions. Compliance maintenance has promoted an owner's awareness and responsibility for wastewater conveyance and treatment needs; maximized the useful life and performance of treatment works through improved operation and maintenance, and initiated formal planning, design and construction to prevent WPDES permit violations". Through a conventional and readily understandable grading system, the eCMAR brings awareness and understanding to governing officials about wastewater capital and management needs. Most importantly, it fosters communication among governing officials, operators, and the Department about the wastewater treatment plant and collection system. Governing bodies must review each year's CMAR and pass a resolution regarding it. Low grades require recommendations or action plans by the community to address the cause of any problems or deficiencies, and improve the wastewater treatment system.

Owners of wastewater treatment facilities, as well as collection systems, including satellite systems, are required by the compliance maintenace requirements of ch. NR 208, Wis. Adm. Code, to electronically submit an annual report. The eCMAR has thirteen sections, a grading section, and resolution. Wastewater treatment plants complete various sections of the CMAR depending on their type of treatment system and their effluent limits. Satellite collection systems complete two sections of the CMAR: Sanitary Sewer Collection Systems, and Financial Management. Performance indicators and trend graphs are automatically generated as part of this section of the CMAR to help operators evaluate the success of their Capacity, Management, Operation & Maintenance (CMOM), or Operation & Maintenance (O&M) program. The questions in the collection system sections of the annual report are to guide operators in developing a CMOM program, and in the operation & maintenance, and financial management of their collection system.

Enforcement and Compliance Assistance

The WDNR monitors permitted discharges to assure permittees are complying with the terms and conditions of their permits. This "compliance assurance process" takes several forms and includes:

- Compliance maintenance - working with and assisting facilities to remain compliant
- Compliance assessment - conducting inspections of facilities and on-site assessments, reviews of discharge monitoring reports and other reports for compliance, follow-up on self-reported violations

- Enforcement - formal actions taken when a significant violation is identified, including notification of violation of a permit condition, formal enforcement conferences and/or contacts, and referral to the State Department of Justice (DOJ).

An inspection checklist and detailed guidance was developed so that all wastewater treatment plant inspections are done consistently, and documented in the Department database. Field computers for doing inspections that interface with this database are being pilot-tested by Department wastewater engineers and specialists.

**Ultraviolet Radiation Wastewater Treatment Plant System,
Photo Courtesy of Julia Riley, WDNR**

E5. Groundwater and Drinking Water

The WDNR's Bureau of Drinking Water and Groundwater manages activities that affect the safety, quality and availability of drinking water by preventing contamination of drinking water and groundwater to protect public health.

Groundwater Coordination

In order to increase efficiency and effectiveness of activities in state agencies related to groundwater, the Groundwater Coordinating Council (GCC) was formed.Membership on the GCC includes the Secretaries of the Departments of Natural Resources (DNR), Commerce, Agriculture, Trade and Consumer Protection (DATCP), Health Services (DHS), Transportation

(DOT), the President of the University of Wisconsin System (UWS), the State Geologist, and a representative of the Governor. The GCC is responsible for advising and assisting state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. More information about the GCC and its activities can be found here: http://dnr.wi.gov/org/water/dwg/gcc/index.htm.

Groundwater Quality

Currently, major groundwater quality and quantity concerns in Wisconsin include:

Volatile Organic Compounds (VOCs): Sources of VOCs in Wisconsin's groundwater include landfills, underground storage tanks, and hazardous substance spills. Thousands of wells have been sampled for VOCs, and about 60 different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater. More information on VOCs in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/VOCs.pdf.

Pesticides: Pesticide contamination in groundwater results from field applications, pesticide spills, misuse, or improper storage and disposal. Related chemical compounds that form when the parent pesticide compounds break down in the soil and groundwater are called pesticide metabolites. The most commonly detected pesticide compounds in Wisconsin groundwater are: metabolites of alachlor (Lasso) and metolachlor (Dual), and atrazine and its metabolites. A 2007 DATCP private well survey estimated that the proportion of wells in Wisconsin that contained a pesticide or pesticide metabolite was 33.5%. Areas of the State with a higher intensity of agriculture generally had higher frequencies of detections of pesticides. The two most commonly-detected pesticide compounds were the herbicide metabolites metolachlor ESA and alachlor ESA, which each had a proportion estimate of 21.6%. More information on pesticides in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/Pesticides.pdf.

Nitrate: Nitrate is Wisconsin's most widespread groundwater contaminant and is increasing in extent and severity. Nitrate levels (as nitrate-N) in groundwater are below 1 milligram per liter (mg/L) where pollution sources are absent. Higher levels indicate a source of contamination such as agricultural or turf fertilizers, animal waste, septic systems, and wastewater. At least 90% of nitrate inputs into our groundwater originate from manure spreading, agricultural fertilizers, and legume cropping systems. Concentrations of nitrate in private water supplies frequently exceed the State drinking water standard of 10 mg/L. In 2005 and 2007, DNR aggregated and analyzed data from three extensive statewide groundwater databases. Most recent samples from 48,818 private wells showed 5,686 (11.6 %) equaled or exceeded the 10 mg/L standard. A 2007 DATCP survey estimated the proportion of private wells that exceeded the 10 mg/l enforcement standard for nitrate-nitrogen at 9.0%. More information on nitrate in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/Nitrate.pdf.

Microbial agents: Microbiological contamination often occurs in areas where the depth to groundwater is shallow, in areas where soils are thin, or in areas of fractured bedrock. Microbial agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for young children, the elderly, and those with chronic illnesses. The DNR has recently begun tracking total coliform detects in the raw water samples through its Drinking Water System database.

Viruses in groundwater are increasingly a concern as new analytical techniques have detected viral material in private wells and public water supplies. Research conducted at the Marshfield Clinic indicates that 4-12% of private wells contain detectible viruses. Other studies showed virus presence in four La Crosse municipal wells, in the municipal wells and wastewater system in Madison, and in five shallow municipal wells serving smaller communities.

Public and private water samples are not regularly analyzed for viruses due to the high cost of the tests. The presence of coliform bacteria has historically been used to indicate the water supply is not safe for human consumption. However, recent findings show that coliform bacteria do not always correlate with the presence of enteric viruses. More information on microbial agents in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/MicrobialAgents.pdf.

Radionuclides: Naturally-occurring radionuclides, including uranium, radium, and radon are becoming an increasing concern for groundwater quality, particularly in the Cambro-Ordovician aquifer system in eastern Wisconsin. Federal standards are causing

many communities to search for alternative water supplies or treatment options. More information on radionuclides in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/Radionuclides.pdf.

Arsenic: Naturally occurring arsenic has been detected in wells throughout Wisconsin. DNR historical data show that 3,830 public wells and 3,013 private wells have detectable levels of arsenic. About 10% of these wells exceed the federal drinking water standard of 10 µg/L. Although arsenic has been detected in well water samples in every county in Wisconsin, the problem is especially prevalent in northeastern Wisconsin where increased water use has likely released arsenic from rocks and unconsolidated material into the groundwater. The State continues to proactively address arsenic concerns through well drilling advisories, health studies, well testing campaigns, and studies aimed at improving geological understanding and developing practical treatment technologies. More information on arsenic in Wisconsin groundwater can be found here: http://dnr.wi.gov/org/water/dwg/gcc/rtl/2011/GwQuality/Arsenic.pdf.

Groundwater Quantity

Despite a general abundance of groundwater in Wisconsin, there is a concern about the overall availability of good quality groundwater for municipal, industrial, agricultural, and domestic use, and for adequate baseflow to our lakes, streams, and wetlands. Groundwater use grew from 570 to 804 million gallons per day (Mgal/d) from 1985 to 2000. Groundwater use was estimated to be 983 Mgal/d in 2005, but much of the increase between 2000 and 2005 was due to a shift in how irrigation water use was estimated. Groundwater quantity problems have occurred both naturally and from human activities, and often affect groundwater quality. Regional effects of groundwater withdrawals are well documented in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. Localized effects of groundwater pumping on trout streams, springs, and wetlands have been noted throughout the State. Groundwater quantity legislation enacted in 2004 was the first step towards managing groundwater quantity on a comprehensive basis. The DNR began to implement the provisions of the new law in FY 06 and FY 07, and began implementing a new rule, ch. NR 820, Wis. Adm. Code, regulating high-capacity wells in FY 08. The Great Lakes Compact, signed by Governor Doyle in 2008, requires Wisconsin to have water conservation goals within the Great Lakes Basin. Implementing legislation, 2007 Wisconsin Act 227, is currently in place.

Drinking Water Quality

Safe water is essential for health, business prosperity, and community growth. There are two types of wells: private wells and public wells. Private wells are wells that are not part of a public water supply. Private wells usually serve a single home or farmhouse (typically private wells have fewer than 15 connections and serve fewer than 25 people). Private wells are regulated by the Private Water Supply Program of WDNR under The Well and Pump Code ch. NR 812, Wis. Adm. Code, and The Well Driller and Pump Installer Licensing Code ch. NR 146, Wis. Adm. Code. Some counties (Dane, Waukesha, Trempealeau, Chippewa and Eau Claire) also regulate private wells.

Since 1936, Wisconsin has had well and pump regulations and has been recognized as a national leader in well construction and pump installation standards. The Well and Pump Code is based on the sound premise that if a well and water system is properly located, constructed, installed and maintained the well should provide safe water continuously without the need for treatment. WDNR oversees construction and operation of public water systems to make sure everyone has safe water to drink and use. Part of the responsibility of a public water system owner is ensuring that customers get safe water to use and drink. Public water system owners face many distinct challenges in managing a public water supply, among them, providing adequate supplies to all users, preventing contamination, and planning for a system's future needs.

While the groundwater quality and quantity concerns described above present challenges to public water systems and state heath care providers, the vast majority of consumers served by public water systems can still use their water safely. During 2010, about 96 percent of the State's 11,444 public water systems served safe water that did not have a single water sample in which a regulated contaminant exceeded a standard as a result of conscientious monitoring and treatment. Private well owners continue to be advised to test their water at least annually and if any change in color, odor or taste is observed.

Future Groundwater Priority Recommendations

The following are GCC's recommendations for 2011-2013 for future groundwater protection and management to state agencies, the Governor, the Legislature and the citizens of Wisconsin:

- Evaluate occurrence of recently discovered groundwater contaminants
- Find solutions to groundwater nonpoint pollution problems
- Meet funding needs to develop nitrogen management practices that avoid significant health impacts
- Evaluate the scope of manure pollution of groundwater
- Support Implementation of the Great Lakes Compact
- Define the impacts of groundwater withdrawals
- Address groundwater quantity management issues at both statewide and regional levels

Ongoing Recommendations for 2011-2013 are to:

- Develop methods to assess and protect against health hazards posed by exposure to 'orphan' contaminants as well as multiple contaminants in a water supply
- Support implementation of a Statewide Groundwater Monitoring Strategy
- Investigate extent and origins of naturally occurring substances in groundwater
- Understand the links between land use and groundwater quantity and quality
- Continue to evaluate and catalog Wisconsin's groundwater resources
- Continue to fund groundwater monitoring and research
- Evaluate potential impacts of climate change on Wisconsin's groundwater

F. Science and Innovation – Research In Action

During 2010 and 2011, the Wisconsin DNR's Science Services researchers advanced a number of projects that are helping define how aquatic resources are managed. Below are summaries of watershed-related research projects in Wisconsin's rivers and streams, inland lakes, Great Lakes, and wetlands.

All Aquatic Resources

Wisconsin Initiative on Climate Change Impacts (WICCI)
The Wisconsin Initiative on Climate Change Impacts is a major collaborative effort to assess impacts of climate change on Wisconsin's natural resources, including the quantity and quality of Wisconsin's surface and groundwater resources. Independent from greenhouse gas reduction efforts and global warming related initiatives, this effort is assessing climate change impacts being manifested in lake ice cover, bird migrations, fish ecology, etc. The DNR and other agencies will need scientifically-based information to best respond and adapt to climate change. Climate modelers/scientists and natural resource experts are working together to provide the necessary information to adaptively manage the resources of Wisconsin. Research program staff are major contributors to this effort and include a founding member, Science Council representation, and multiple working group members and chairs.

Research on Rivers and Streams

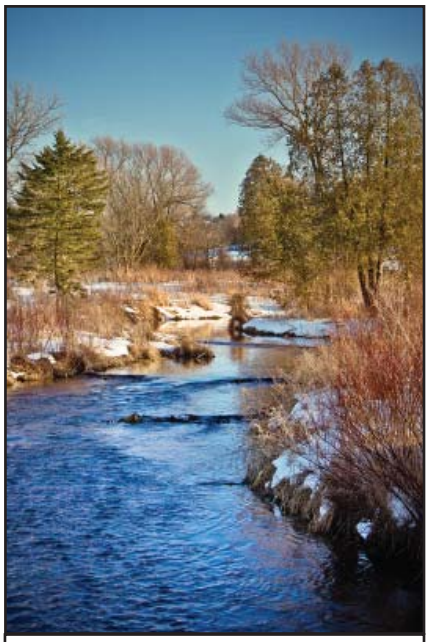
Water Quality Bureau Monitoring and Assessment
The objective is to facilitate standardized stream and river monitoring programs, with quantitative criteria, for managers and policy makers to formulate defensible water quality decisions. Ultimately the appropriate classification and assessment of waterways will serve to protect exceptional fisheries and aquatic resources, and prioritize waterways for protection or improvement.

Development, validation, and application of macroinvertebrate-based index of biotic integrity (IBI) for Wisconsin's nonwadeable rivers
The macroinvertebrate IBI is designed to help detect watershed and local stressors on river ecology. This rapid bioassessment tool has been integrated for use within WisCALM (Attachment C).

Long-term trends in river water quality in Wisconsin
The purpose is to analyze temporal trends in chloride, nutrients, and TSS at river long-term trends sites (USGS).

Evaluation of agricultural and urban Best Management Practices within Water Division's Priority Watershed Program
WDNR is evaluating the performance of agricultural Best Management Practices (BMPs) implemented in the Waumandee Creek watershed (Buffalo Co.), and urban BMPs implemented in the Lincoln Creek watershed (Milwaukee Co.). Practices that help restore ecological integrity will be promoted for use as part of TMDL and other restoration efforts.

Evaluation of forestry management practices for water quality protection and ecological integrity of fish communities in timber harvest units
Best Management Practices (BMPs), such as the establishment of riparian management zones, are practices chosen to reduce erosion and prevent or control pollution resulting from forestry operations. Riparian management zones have existed for many years in



Wisconsin Rivers
Photo by JW Creations

the areas of forestry, agriculture, and urban development, but no quantitative evaluation has been made by direct measurements of in-stream flow and water quality. This investigation will provide an understanding of the efficacy of current riparian management zones and serve as the basis for future evaluations of potential modifications to the recommended zone width, and management activities allowed within the zones.

Biological effects of high N:P ratios in streams
In 2011, the WDNR monitored water quality and biological metrics in streams with high N and low P concentrations to evaluate effects of N on stream biota. This project is an offshoot of an earlier study by Robertson et al. 2006 (http://pubs.usgs.gov/pp/pp1722/pdf/PP_1722.pdf). The 2006 study had few sites with high nitrogen to phosphorus ratios. This study is intended to fill in the informational gap for high N:P streams and will assess whether the previously used biotic indicators (including chlorophyll a and diatom metrics) work as well for assessing nutrient levels in these targeted high N:P streams.

Predicting stream fisheries in response to climate and land use changes
WDNR scientists have developed a landscape-scale GIS-based model that accurately predicts the summer high temperatures and low flows for all stream reaches in the State. Based on these predictions, WDNR classifies streams into their "natural communities" for monitoring and bioassement, and estimates their habitat suitability for 60 different fish species (USGS). The effect of land use changes on fish distributions can also be investigated. The stream model is in the process of being modified to explore how various climate change models and scenarios will change habitat suitability for fish species in Wisconsin streams, and to develop possible conservation/mitigation strategies (Mitro, USGS). This project is working to increase the sensitivity of existing computer models that predict stream suitability for 60 fish species to variation in climate and groundwater inputs. Researchers will predict the response of stream fishes to Wisconsin-specific climate change scenarios over the next 25-50 years, and identify streams particularly vulnerable to climate fluctuations. The results will provide tools for managers and policy makers to plan for and to adapt to future climate changes more efficiently.

United States Environmental Protection Agency National Rivers and Streams Assessment
In this study, river diatoms were used to assess river nutrients and biological integrity, which will inform nutrient and runoff management decisions, as well as listing/delisting of impaired waters.

Research on Inland Lakes

The use of satellite remote sensing for monitoring Wisconsin lakes
Three interrelated projects focused on lake water quality measurements from satellites, including improved methods, data generation and state-wide trends. Satellite remote sensing offers an unbiased sampling approach to simultaneously monitor water clarity in a large number of lakes, essentially sampling the entire population (lakes >10 ha statewide). This technique provides spatial coverage ranging in scale from with-in lake variation to statewide coverage. Water quality parameters quantified from space platforms include suspended solids, chlorophyll-a, temperature, and water color. Remote sensing provides a cost-effective alternative to traditional in-situ monitoring methods. In addition, lake spectral images from satellite data for 15 Wisconsin lakes will be compared to algal assemblages collected at the time of satellite fly-overs. The aim of this project is to assess the feasibility of remote sensing of algal blooms or shifts in algal communities indicative of resource impairment (partners UW-Madison, NASA, Syracuse Upstate Freshwater Institute).

Water quality impacts of shoreline buffer restoration
In partnership with homeowners, both runoff quantity and quality from restored riparian buffer areas are being evaluated, compared to adjacent lawn sites (partners US Geological Survey, Lakes program, Vilas county LWCD).

Devils Lake hypolimnetic (bottom water) withdrawal
Devils Lake State Park is the State's most heavily used park, largely due to the lake. Over the last number of decades, the lake has become eutrophic due to a history of unsewered resorts, agricultural runoff, etc. Virtually all possible inputs of nutrients to the lake were eliminated, making the lake a candidate to be restored by removing in-lake nutrients that lead to eutrophication. The effects of hypolimnetic phosphorus removal have been monitored for approximately 10 years.

Yahara lakes phosphorus loading and lake response (Report 2011)
In order to improve water quality and reduce harmful blue-green algae blooms which have potentially deleterious or deadly

effects, local government and citizens created the "Yahara CLEAN Project" in 2008. An analysis of long-term P loading and lake response data was conducted, that would allow researchers to recommend specific P loading reduction targets that would produce measureable water quality objectives for the four Yahara lakes. Results and recommendations to improve water quality are contained in this report.

Yahara lakes nitrogen loading evaluations
The purpose of this multi-phased project is to elucidate the effect of agriculture on phosphorus (P) and nitrogen (N) concentrations and loadings in the tributary streams and shallow groundwater system in the Lake Mendota watershed. All three project phases continue supporting the long-term USGS monitoring of P loads on two Mendota tributaries (Pheasant Branch and Yahara River) as well as sustain the N monitoring initiated in January 2011 for NO3/NO2-N, NH4-N, and Organic N (via Kjeldahl test) at the two stream monitoring stations.

Chlorophyll:Phosphorus relationships in Wisconsin lakes
Citizen lake monitoring and lake long-term trends data are being evaluated to update the chlorophyll:phosphorus relationship for Wisconsin lakes, and to aid in development of site-specific P criteria for lakes.

Statewide blue-green algae sampling
The DNR has partnered with the Department of Health Services (DHS) in conducting algal bloom and toxin sampling for DHS's Algal Bloom Surveillance System (HABISS), funded by a grant to the DHS from the Centers for Disease Control. The aim of the HABISS project is to track cases of human and animal illnesses possibly related to algal bloom exposure. The HABISS project has also funded additional DNR sampling efforts in areas with chronic algal bloom problems, including Lakes Tainter and Menomin in Dunn County and the Petenwell and Castle Rock Flowages in Juneau County and Adams County. These additional projects have enabled the DNR to assess the role of water quality in promotion of algal blooms.

Paleolimnological study of inland lakes
These studies assess the impact of watershed and shoreline development on lake ecosystems in the context of nutrient management as well as climate change. Sediment core analyses are used to assess the impact of watershed and shoreline impacts as well as watershed Best Management Practices on a lake's trophic status. Information from this study will aid in determining the relative magnitude of external and internal nutrient loading and strategies for lake and watershed nutrient and runoff management.

Current lakes include:
- Bad River Paleolimnology
- Shell Lake Paleolimnology
- Dunes Lake Paleolimnology

Potential effects of climate change on inland glacial lakes and implications for lake-dependent biota in the Great Lakes Region
Loons and other sensitive aquatic species may be particularly sensitive to climate change, especially if changes in climate result in changes in the trophic status of waters. Through hydrologic modeling and paleolimnological investigations, this study assesses potential impacts of climate change on loons and other sensitive species. This study will also test a groundwater model that indicates seepage lakes in northern WI will become more alkaline if climate change results in warmer and drier conditions. This model will be tested by using the historical diatom community to reconstruct the alkalinity levels during the mid-Holocene when the climate was warmer and drier than it is today.

Developing wireless networks to monitor climate change impacts on lakes and wetlands
Using mote technology (a mote is a very small computing device), a model remote network is being developed to detect and monitor changes to water chemical movement in a northern Wisconsin lake and wetland system. Climate change impacts can be difficult to detect due to the geographic and time scales involved. It is thought that a network such as the one being developed will provide useful tools for resource managers to use up to date information in management decisions.

Testing and implementing a statewide protocol for baseline sampling of aquatic plants
The Wisconsin Lakes Partnership expressed a need for standardizing a protocol for characterizing aquatic plant communities, and assessing changes over time. Standardized data collection allows assessment of plant communities in individual lakes, and understanding of effects of human activities on lake communities statewide. Since 2006, the collection of baseline aquatic plant

data have been coordinated with regional staff. This effort resulted in the collection of standardized plant data for 300 lakes, and provided training to regional staff on a new plant sampling protocol.

Macrophyte phenology
Intra-annual variation of aquatic plant frequency and abundance is being compared to help interpret macrophyte data. This will aid in the development of macrophyte species as water quality indicator species.

U.S. Environmental Protection Agency National Lake Assessment project and 2012 Protocol Development
The National Lake Assessment serves as a "check-up" on the condition of the Nation's lakes. The survey is examining the relative importance of nutrients, nonnative species, lakeshore development, pathogens, and other stressors on lake conditions. The information from this survey will improve lake classification efforts in Wisconsin and inform lake and watershed management strategies. Researchers provided national leadership by developing a protocol for rapid assessment of aquatic macrophyte communities by non-taxonomists for use during 2012 National Lakes Assessment.

Great Lakes Studies

C*ladophora* and water quality of Lake Michigan: a systematic survey of Wisconsin nearshore areas
In recent years, *Cladophora* has increased along the Lake Michigan coast, and has been deposited in large quantities on Lake Michigan beaches. In spring 2004, the Wisconsin DNR initiated a working group to develop a monitoring program to observe the density, distribution, and associated water quality of *Cladophora* along Wisconsin's Lake Michigan shoreline. This continuing investigation is intended to test sampling techniques and inform long-term monitoring plans and research needs, assist with developing long-term management plans, identify short-term beach clean-up and odor mitigation options, and address public information needs.

Great Lakes Areas of Concern (AOC) evaluations
Agency scientists are measuring plankton levels in collaboration with the USGS to evaluate the potential delisting of sites that are designated Areas of Concern (AOCs) in Lake Michigan.

Lake Michigan nearshore water quality dynamics
Agency scientists have established a continuous monitoring station off Kewaunee, which will help to understand water quality changes over varying time-scales (hourly, seasonal, annual) (partners-Great lakes Program Office, UW Water Institute).

United States Environmental Protection Agency Great Lakes National Coastal Assessment
Agency scientists participated in EPA's national program to assess the condition of the Nation's marine and Great Lakes coasts. Various indicators and stressors that were evaluated included nutrients, sediment chemistry and toxicity, enterococcus, benthic macro-invertebrate community, and the physical environment.

WDNR researchers use modified rakes to collect submerged plant samples as they survey Wisconsin lakes. A diverse, native aquatic plant community provides critical habitat for fish, invertebrates, and wildlife to thrive. Photo Courtesy of WDNR

National Wetland Assessments

United States Environmental Protection Agency National Wetlands Assessment
This study will evaluate the condition of wetlands by evaluating stressors that may be affecting their ecological integrity.

Science and Research Monitoring Projects

Sentinel lakes – tracking long-term trends in acid rain and mercury pollution
As part of the Northern Wisconsin Long Term Ecological Research Program (LTER), a number of lakes are routinely monitored for a number of parameters. This project has yielded key information for use in establishing scientific information for mercury

legislation and other air deposition challenges. The project is the foundation for other projects that lead to synergistic efforts such as climate change, fisheries changes, etc. The monitoring data are then woven into a larger network of monitoring sites and research studies.

Citizen based monitoring – developing a user-friendly protocol to track lake levels and water tables across Vilas County
In collaboration with local scientists, WDNR has developed standardized protocols that citizens may use to monitor lake levels and groundwater tables. As climate change and other phenomena contribute to water level changes, citizens have become increasingly interested and willing to monitor local water resources of interest.

Ecological limits of hydrologic alteration in Wisconsin streams
This study will evaluate relationships between stream fish species distributions and hydrologic metrics, including low and storm flows. These relationships will then be used to predict changes in fish assemblages that would result from hydrologic modification from groundwater withdrawals and increases in impervious surfaces. This research could support the development of stream flow standards (USGS, WI Groundwater Coordinating Council, Capitol Area Regional Planning Commission).

Baraboo River fishery recovery after dam removal
The Baraboo River is the longest free-flowing river in the Midwest, now that the dams have been removed. This is a unique opportunity to document the sport fish rejuvenation, and the whole fish assemblage in general, after removing four dams that have impeded fish migration for decades. This is an important example of restoring water quality, fisheries, and ecological integrity by removing unsafe, abandoned, or obsolete dams.

Lower Wisconsin River fish communities
This project will monitor long-term fish community and fisheries dynamics over the entire length of the lower Wisconsin River. It will document trends in fish populations and assess responses to changes in environmental conditions. The project also will provide data and interpretation to improve conservation and management of one of the most important fisheries in the State.

Fishes of Wisconsin
This project summarizes the extensive and rapidly increasing new information on all 165 species of fishes in Wisconsin that has become available since the standard reference work Fishes of Wisconsin was published in 1983. The project will make both the new and older information accessible through innovative online applications, including a photo-based fish identification system (http://wiscfish.org), a customizable distribution-mapping tool (http://infotrek.er.usgs.gov/fishmap), a comprehensive searchable bibliography, and an updatable "e-book" of species accounts (in development: http://infotrek.er.usgs.gov/wdnr_fishes/fishes_home.jsp). The project will provide improved interpretation and access to information essential to the conservation and management of fisheries and aquatic resources in Wisconsin.

G. Emerging Issues

G1. Harmful Algal Blooms

The Wisconsin Department of Natural Resources, along with other state and local partners, is working hard to protect human health, domestic animals, and wildlife from harmful algal blooms. In order to achieve this goal, the Department is committed to monitoring and sampling suspected harmful algal blooms, informing the general public about the causes and potential risks of harmful algal blooms, and finding opportunities to improve and expand the harmful algal bloom protection program in the future.

The DNR's current activities, which address harmful algal blooms in Wisconsin, include a partnership with the Department of Health Services (DHS) in conducting algal bloom and toxin sampling, and disseminating results as part of the DHS's Algal Bloom Surveillance System (HABISS), funded by a grant to the DHS from the Centers for Disease Control. The aim of the HABISS project is to track cases of human and animal illnesses possibly related to algal bloom exposure. The HABISS project has also funded additional DNR sampling efforts in areas with chronic algal bloom problems, including Lakes Tainter and Menomin in Dunn County, and the Petenwell and Castle Rock Flowages in Juneau County and Adams County.

Other DNR efforts to inform Wisconsin residents about harmful algal blooms include outreach to individual citizens and lake associations, press releases in the summer to alert citizens to peak algal blooms, press releases in late summer and fall to alert hunters to the risks of algal blooms to waterfowl-retrieving dogs, and information posted on the DNR's website. The website includes a page on blue-green algae, which addresses citizens' concerns about the health and aesthetic impacts of algal blooms, information on personal protective measures and control of blooms, and links to the DHS website and algae-related illness reporting portal.

Algae of Concern

Only a small percentage of algal species can cause harm to humans and the environment through toxin production or excessive growth. Typically in Wisconsin, these algae are "blue-green algae," also sometimes referred to as Cyanobacteria. Many different species of blue-green algae occur in Wisconsin's waters, some of which may produce toxins. Although these algal species may be very different, in great numbers they all produce similar visual warnings which can be seen in Figure 22.

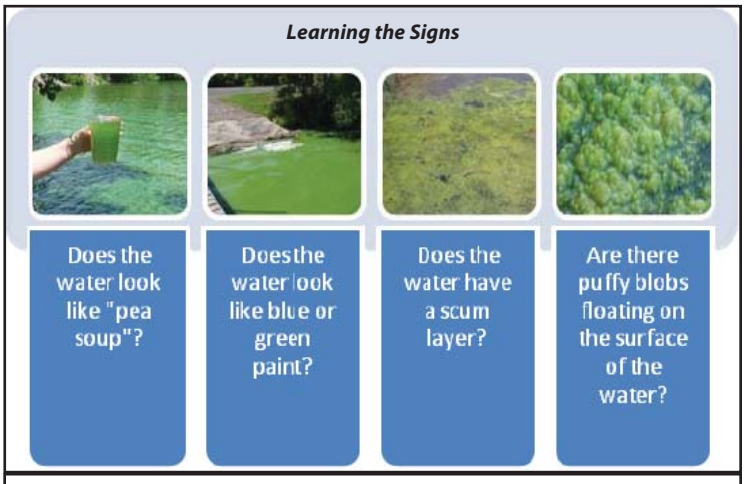


Figure 22. The signs of "blue-green algae," also known as Cyanobacteria.

Controlling Blooms

Unfortunately, there is no method to control or mitigate a bloom once it has started. Therefore, the best way to protect human health is to prevent these blooms from occurring in the first place. Algae, like all plants, require nutrients such as phosphorus and nitrogen to grow. If too much phosphorus and/or nitrogen is added to a lake or river, it can spur more algae to bloom, and can increase the frequency of harmful algal bloom occurrences.

The Department has taken measures to reduce the amount of nutrients, mainly phosphorus, entering surface waters. In December 2010, Wisconsin promulgated water quality standards for phosphorus following the publications of chs. NR 102 and 217, Wis. Adm. Code. These standards are used to reduce the amount of phosphorus discharged from point sources, maintain and protect

healthy water, and improve waters that are already experiencing the adverse effects from excess phosphorus. Additionally, Wisconsin has tightened the nonpoint source performance standards in an effort to try to reduce the amount of nutrients entering surface water from nonpoint sources. These changes took effect January 2011 following the publication of ch. NR 151, Wis. Adm. Code.

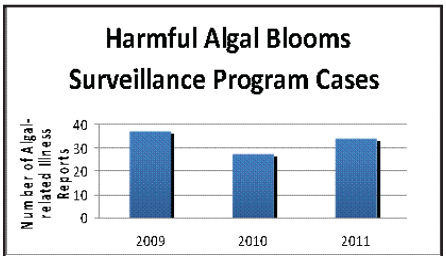


Figure 23. Number of reported Algal-related Illnesses in Wisconsin 2009-2011.

Although these regulatory changes were a great step in reversing the growing number of algal blooms in the State, more can be done. The Department is working to inform citizens about their role in solving these issues. Recommended riparian measures include:

- Maintaining native vegetation along shorelines as buffer areas
- Minimizing activities that result in erosion
- Reducing the amount of fertilizer used on lawns
- Using only phosphorus-free fertilizer when possible
- Fixing leaking septic systems
- Using only phosphorus-free detergents in dishwashing machines

More information about phosphorus reduction strategies can be found at http://dnr.wi.gov/news/mediakits/mk_phosphorus.asp.

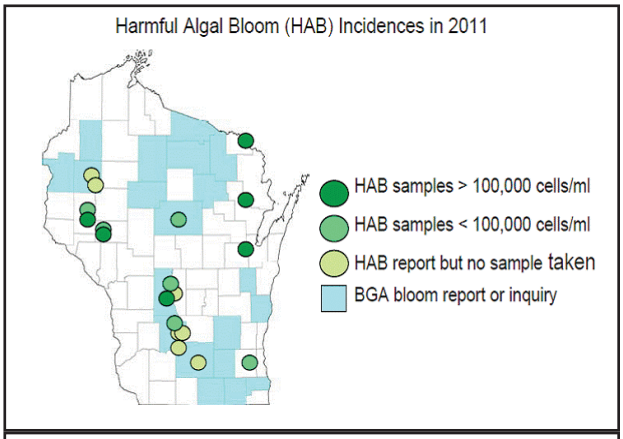


Figure 24. Harmful Algal Bloom Incidences in 2011

Defending Human Health

In Wisconsin, personal discretion and judgment are always the first lines of defense to protect human health from harmful algal blooms. If citizens are concerned that a harmful algal bloom may be occurring, the Department strongly recommends that they should NOT allow children, adults, or family pets to swim, boat, or recreate on these waters. The Department, partnering with the DHS, has set up a citizen-based Harmful Algal Blooms Surveillance system so that citizens can report illnesses related to harmful algal blooms. These reports are priorities and the Department tries to confirm as many blooms as possible, given staffing and resource constraints.

If human or animal illness occurs from a harmful algal bloom exposure, medical attention is strongly advised. Key symptoms of concern include stomach cramps, diarrhea, vomiting, headache, fever, muscle weakness, or difficulty breathing, while pets display symptoms such as seizures, vomiting, or diarrhea. If these symptoms arise, citizens are asked to contact their local doctor or veterinarian, or contact the Poison Information Hotline (800-222-1222) right away. The DNR and Department of Health are working to quantify Harmful Algal Bloom (HAB) incidences reported to their local care provider.

DNR's Commitment

DNR is engaged in monitoring of suspected bloom sites in order to determine 1) if a bloom is actually occurring at the site or not, and 2) if the algae involved in the bloom exceed the World Health Organization standard of 100,000 cells/ml. If these criteria are met, the DNR and DHS work with local health authorities to inform the public on the potential health risks associated with the bloom, and send out advisories to avoid the waterbody until the bloom has subsided. Warning signs have been developed and may be used at the local authorities' discretion. The Department is working to develop clearer protocols about when these signs should be used.

Due to shortages in funding and staff time, not all reports can be investigated by the Department. Additionally, there may be a time lag between when the bloom is reported and when Department staff can collect the sample. The Department is trying to develop strategic plans to address these shortfalls in current harmful algal bloom response program.

The Department hopes to improve and expand Wisconsin's harmful algal bloom awareness and protection program in the future. Specifically, DNR is looking at the following expansion opportunity; DNR will continue to inform its partners of programmatic changes and opportunities to participate moving forward. Additionally, DNR is working with other state programs to learn from these programs, in the hopes of strengthening its own.

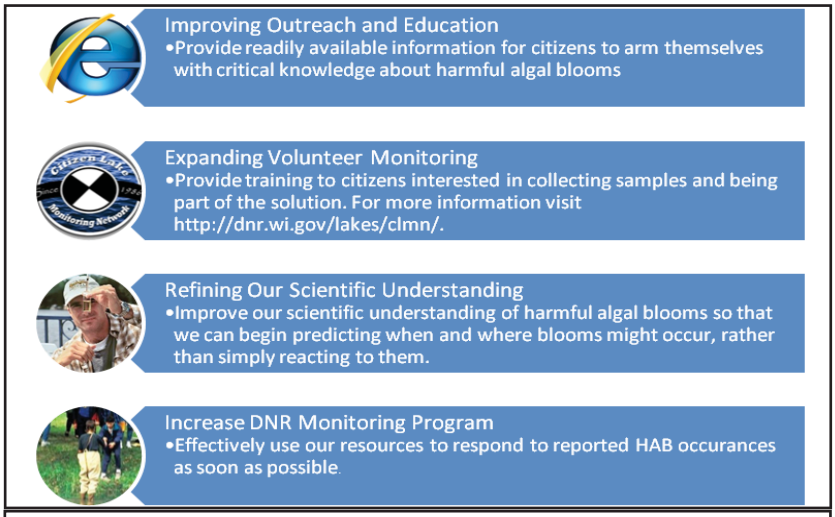


Figure 25. Future Expansion Opportunities for Increasing Awareness and Protection Against Algal Blooms

G2. Climate Change - Adapting to Our Changing Waters

The Wisconsin Initiative on Climate Change Impacts (WICCI) recently released its first climate change assessment report as a product of a statewide collaboration among the University of Wisconsin, the Wisconsin Department of Natural Resources, and other agencies and institutions (WICCI 2011)[7]. A key finding of the report is that climate change has the potential to significantly affect the quality, availability, and functioning of Wisconsin's abundant water resources. The main drivers are increased frequency of large rainfall events, changes in timing and amount of precipitation, and warming air and water temperatures.

Moreover, it is becoming clear that climate changes are already occurring in Wisconsin and that climate will continue to change for the foreseeable future, regardless of any corrective action taken now. Some examples of these observed changes include:

- **Loss of ice cover:** Variability in lake ice cover is considered one of the most sensitive responses of inland waters to climate change[8]. Robust data sets of ice cover in Wisconsin dating back to the 1850s show that average ice cover has decreased between 10 and 40 days, reflecting warmer temperatures, with greater effects in

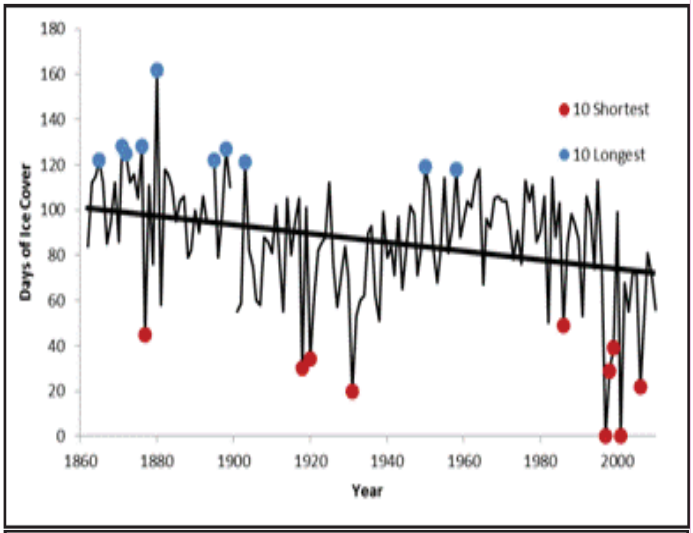


Figure 26. Geneva Lake, located in southeast Wisconsin, has experienced the largest change on record in ice cover. The lake did not freeze at all in 1998 and 2002.

7 Wisconsin Initiative on Climate Change Impacts. 2011. Wisconsin's changing climate: impacts and adaptation. Nelson Institute for Environmental Studies, University of Wisconsin-Madison and the Wisconsin Department of Natural Resources, Madison, Wisconsin: http://www.wicci.wisc.edu.

8 Magnuson, J. J., J. T. Krohelski, K. E. Kunkel, and D. M. Robertson. 2003. Wisconsin's water and climate: Historical changes and possible futures. In Wisconsin's waters: A confluence of perspectives, ed. C. Meine, 23–36. Madison, WI: Wisconsin Academy of Sciences, Arts and Letters.

southern Wisconsin, (Figure 26)[9]. Decreases in the duration of ice cover in lakes throughout the State are the result of a combination of later freeze dates, indicative of warmer fall air temperatures, and earlier breakup dates, indicative of warmer winter and spring air temperatures.

- **Changing precipitation trends:** From 1950-2006, Wisconsin as a whole has become wetter, with an increase in annual precipitation of 3.1 inches. This observed increase in annual precipitation has occurred primarily in southern and western Wisconsin, while northern Wisconsin has experienced some drying. The southern and western regions of the State show increases in stream flow, corresponding to the areas with the greatest precipitation increases (Figure 27)[10 and 11].

- **Declining lake levels in the north:** Lake water levels in northern Wisconsin have gradually decreased and some are currently at the lowest levels in the 70-year record. For example, 74-years of lake level data on Anvil Lake, a northern Wisconsin seepage lake, demonstrate that lake levels are getting progressively lower during each succeeding dry period (Figure 28). Water loss through evapotranspiration associated with warmer temperatures and shorter ice cover periods may be exacerbating drought effects and offsetting changes in precipitation.

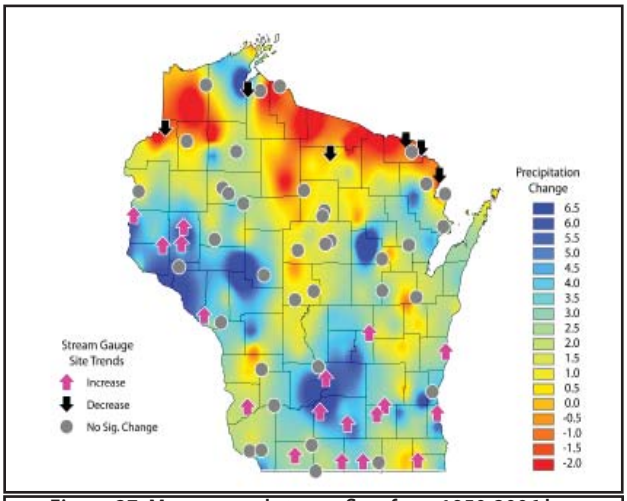


Figure 27. Mean annual stream flow from 1950-2006 has increased overall statewide by about 14% over the past 56 years, consistent with a 10-15% increase in precipitation over the same time period, suggesting a strong relationship between basin precipitation and river flow.

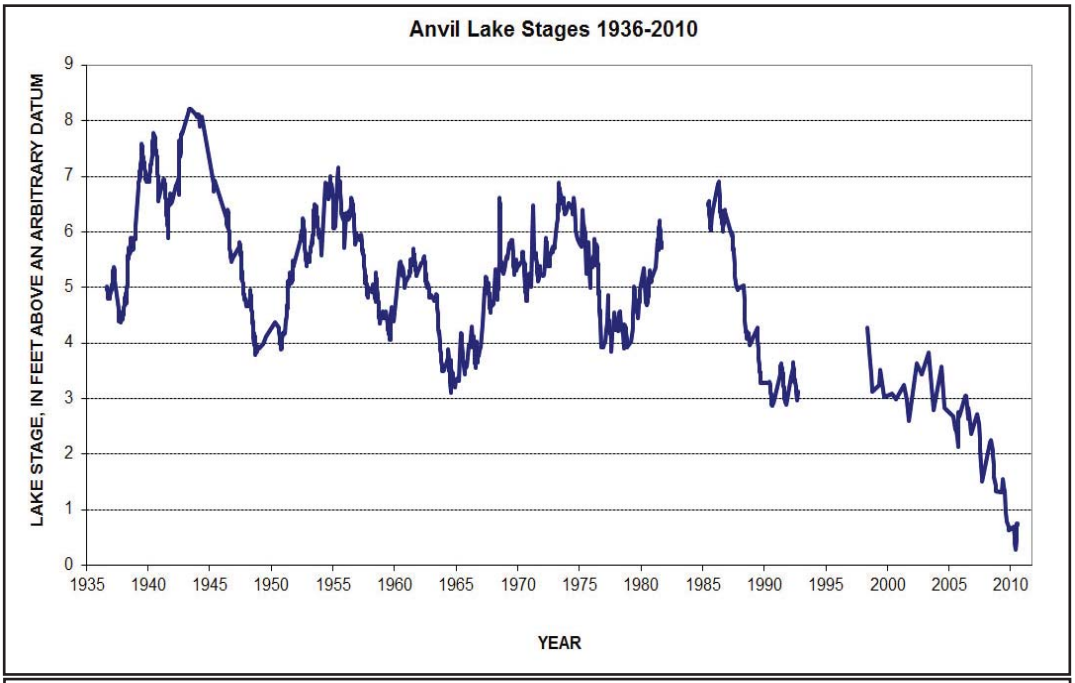


Figure 28. Declining lake levels in Northern Wisconsin, as evidenced by Anvil Lake[7]

9 Betz, C.R., T.R. Asplund, and J.P. Hurley. 2010. Water Resources Working Group Report. Wisconsin Initiative on Climate Change Impacts. Nelson Institute for Environmental Studies, University of Wisconsin-Madison and the Wisconsin Department of Natural Resources, Madison, Wisconsin.

10 Kucharik, C. J., S. P. Serbin, S. Vavrus, E. J. Hopkins, and M. M. Motew. 2010. Patterns of climate change across Wisconsin from 1950 to 2006. Physical Geography 31(1):1-28.

11 Greb, S. R. No date. Historic trends in flows of Wisconsin's rivers and streams. Unpublished data. Madison, WI: Wisconsin Department of Natural Resources.

Some of the key implications of these observed trends for water quality programs in Wisconsin include:

- Increased rainfall intensity and flooding impact dam safety, stormwater and wastewater management, water quality, beach health, and sanitary sewer overflows
- Changing baselines for determining minimum levels and flows, ordinary high water marks, flood frequency curves, floodplains, and wasteload assimilation capacity
- Reduced groundwater availability and increased water demand, especially during dry spells
- Increased likelihood for new aquatic invasive species with warmer climate and less winter freeze
- Reduced habitat for cold-water fisheries – both streams and lakes
- Accelerated eutrophication of surface waters due to increased winter and spring runoff, and hotter, drier summers that favor blue-green algae blooms

In response to these projected impacts, the WDNR Water Division developed a draft climate response strategy in 2010 with four adaptation goals:

1. Minimize threats to public health and safety by anticipating and managing for extreme events (floods and droughts).
2. Increase resiliency of aquatic ecosystems to buffer the impacts of future climate changes by restoring or simulating natural processes, ensuring adequate habitat availability, and limiting population level impacts of human activities.
3. Stabilize future variations in water quantity and availability by managing water as an integrated resource (by "keeping water local"), and supporting sustainable and efficient water use.
4. Maintain, improve, or restore water quality under a changing climate regime by promoting actions to reduce nutrient and sediment loading.

These goals provide the framework for addressing the ramifications of climate change in how water resources over the next 10-20 years, and beyond, are managed.

Key action items that support the strategy are to:

- Identify opportunities to accommodate climate adaptation in program decision-making, such as during rule revisions, workplanning, and budget initiatives
- Review and update water monitoring strategies, as appropriate, to determine whether this monitoring provides appropriate information to anticipate and respond to changing conditions
- Work with the Wisconsin Initiative on Climate Change Impacts (WICCI) to understand climate change scenarios, quantify uncertainties, recommend adaptation strategies, and suggest research priorities and/or additional work groups to address water program needs
- Initiate or support watershed-based "pilot" projects to evaluate and optimize integrated water management decisions in the face of climate change impacts
- Develop mechanisms for communicating Water Division strategies, both internally and externally, for dealing with climate change impacts and adaptations

Future efforts will integrate with ongoing WDNR climate adaptation planning initiatives as they pertain to water resources. Additionally, they will coincide with federal directives, such as the US EPA National Water Program Strategy on Climate Change, the U.S. Fish and Wildlife Service Strategic Plan, and the U.S. Geological Survey's Climate Change Initiative.

H. Models, Databases and Online Tools

H1. Presto

The objective of the Wisconsin Department of Natural Resources' (WDNR) Bureau of Water Quality is to protect and enhance Wisconsin's water resources. As part of this, the Water Quality Modeling Technical Team strives to provide the public with timely information on water quality and decision support tools to guide management decisions. Phosphorus, which is a nutrient that can impair water quality, is the focus of several new water quality regulations in Wisconsin. Reduction of phosphorus concentrations within Wisconsin waterways requires identification of the sources of phosphorus. To assist in achieving phosphorus reductions, a state-wide screening tool was developed that identifies the dominant source (point vs. nonpoint) of phosphorus within a watershed. The regulatory catalysts for this work include:

- Chapter NR 217, Wisconsin Administrative Code, which controls the point source effluent limits for phosphorus
- The Federal Clean Water Act, which requires the prioritization and targeting of TMDLs in order to set limits on pollutant loading

The Pollutant Load Ratio Estimation Tool (PRESTO) is a statewide GIS-based tool that compares the average annual phosphorus loads originating from point and nonpoint sources within a watershed. The comparison provides a screening tool for industrial and municipal dischargers to determine one of the conditions of eligibility for adaptive management as part of ch. NR 217, Wis. Adm. Code. The watershed adaptive management option described in ch. NR 217.18, Wis. Adm. Code, allows a point source to achieve compliance with applicable water quality based effluent limits needed to achieve the phosphorus water quality standards criteria in a more economically efficient manner, through comprehensively managing point and nonpoint sources of phosphorus in the watershed. Under this option the permitted facility is given interim effluent limits, and must work with watershed partners to implement a watershed adaptive management plan. PRESTO also helps industrial and municipal dischargers determine if water quality trading is a feasible option within their watershed. PRESTO provides dischargers with a consistent and transparent method for determining regulatory compliance and allows the DNR to make fast and effective permitting decisions to aid in the permit streamlining effort.

PRESTO was used to evaluate approximately 606 permitted industrial and municipal outfall locations throughout the State. The ratio of point to nonpoint source phosphorus loads for each evaluated facility was calculated. For 82% of the facilities evaluated (494 of 606), point sources of phosphorus were less than 50% of the total annual phosphorus load, thus satisfying one of the eligibility conditions for adaptive management. The PRESTO model, User Manual, and Documentation, Validation, and Analysis Report can be downloaded at http://dnr.wi.gov/org/water/wm/ww/presto/.

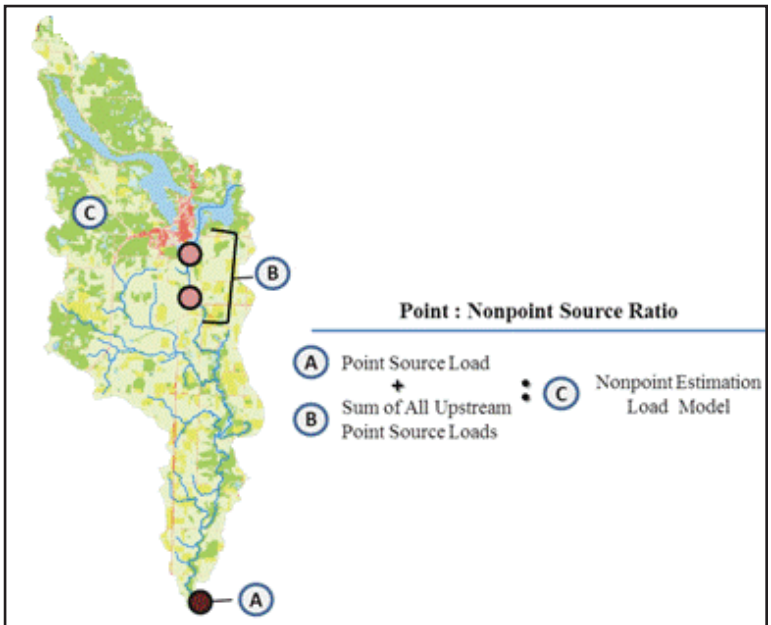


Figure 29. The Pollutant Load Ratio Estimation Tool (PRESTO) is a statewide GIS-based tool that compares the average annual phosphorus loads originating from point and nonpoint sources within a watershed.

"Grid" Tool

Currently under development is a state-wide assessment tool to identify critical source areas of potential nonpoint sediment and phosphorus loss. This tool will subdivide the State into pre-defined grid cells. Each cell will evaluate for potential phosphorus loss based on a set of soil, management, and delivery factors similar to

those applied to Wisconsin's phosphorus index tool, Snap-Plus. Each cell has the potential to produce a qualitative phosphorus loss risk index (very low, low, moderate, high, very high) or a quantitative unit-area load. The benefit of developing the tool within the GIS platform is the ability to quickly modify the tool based on end user suggestions. The final deliverable will allow for prioritization and development of TMDLs, track point and nonpoint source reductions from nonpoint implementation as required by WDNR's Clean Water Act Section 319 grant, aid in ch. NR 151, Wis. Adm. Code, implementation for counties through tracking and prioritization of agricultural areas, and assist in water quality trading. The development of this tool will likely continue through 2013.

H2. Databases and Online Tools

Surface Water Integrated Monitoring System (SWIMS)

The Surface Water Integrated Monitoring System (SWIMS) is a unified system to house and extract data from various disparate databases within several DNR water programs. SWIMS enables all staff, as well as the public, to access comprehensive sets of data for each waterbody, and to view monitoring results geographically using ArcIMS Web mapping applications called Watershed Webviewer and Surface Water Data Viewer. Users can access the system via the Internet using a user ID and password. SWIMS creates
efficiencies by allowing monitors to click and print field forms, allowing automatic generation of station numbers and mailing forms for the State Lab of Hygiene, and thereby enabling timely entry of results into the EPA Water Quality Exchange (WQX) Network. Data from SWIMS are now sent to the EPA WQX, in place of sending it to the old STORET system.

Data sets in SWIMS include:

- Sediment
- Aquatic Invasive Species
- Continuous monitoring data
- Lake Water Quality data
- Rivers and Lakes Long Term Trends data
- Macroinvertebrates
- Satellite water clarity
- Plants (UW-Herbarium & Lakes, starting 2008)
- Rivers
- Citizen Based Stream Monitoring Network data
- Miscellaneous Lakes data

More information about SWIMS is available on the WDNR website http://dnr.wi.gov/org/water/swims/.

Fisheries Database (Fish DB)

The Fisheries Database hosts a wide variety of fish and habitat related information for the Water Division. Fish data are collected for both targeted fish management activities and summary metrics used in Water Quality based assessments for Clean Water Act reporting. The Fisheries database is closely linked to SWIMS through the sharing of monitoring stations and related GIS data, such as the location of Fisheries Propagation Sites, Fish Kills, and Fish Health problems.

Water Assessment Tracking and Electronic Reporting System (WATERS)

WATERS, an intranet-based tabular and spatial assessment database created in 2002, supports implementation and reporting for

the Federal Clean Water Act. Whereas SWIMS houses raw data for each waterbody, WATERS stores summary information for each water and watershed, documentation of decisions regarding each waterbody, and recommendations for management actions. WATERS holds Clean Water Act Section 305(b) and 303(d) data, Designated Uses, codified uses, and other data describing the quality of Wisconsin's rivers, lakes, and Great Lakes shoreline. WATERS uses the table structure and the reporting requirements identified in US EPA's integrated reporting strategy, and programmed into the ADB V 2.0, and also includes additional enhancements specific to the State's water management needs. Data from this system are sent to EPA periodically in fulfillment of the federal Clean Water Act 305(b), 303(d), and 314 grant reporting requirements. During the 2012 reporting period, Wisconsin will transmit its data using the Water Quailty Exchange Network to directly feed the US EPA's ATTAINS Database (the official federal repository for assessment) impaired waters, and TMDL data.

Surface Water Data Viewer (SWDV)

The Surface Water Data Viewer (SWDV) is a publicly-accessible interactive mapping tool providing primarily water-related data. The SWDV displays data from the State's monitoring and assessment databases (SWIMS and WATERS) that can be used for resource management and watershed planning at local, regional, or state levels such as:

- Waterbody physical characteristics
- Water quality assessments and monitoring sites
- Aquatic invasive species
- Wetlands, plants, and habitat
- Grant locations
- Fisheries management waters

The SWDV contains a variety of mapping tools for users to create customized maps of selected cultural, resource, administrative, land, and environmental features. Digital air photo or topographic map layers can also be added. The SWDV can be accessed online at http://dnr.wi.gov/org/water/data_viewer.htm.

Online Query Tools

Online query tools are available for the public to find extensive information on the waters of Wisconsin. Through a search tool, available at: http://dnr.wi.gov/water/, or the Surface Water Data Viewer, information can be acquired about a specific basin, watershed, or waterbody.

The basin tool allows the user to choose from either a drop down box or a map to find information on watersheds, projects, plans, and maps: http://dnr.wi.gov/water/basin/.

The watershed query tool offers numerous options for searching for a watershed, including by waterbody name, WBIC, county, watershed name, and drainage basin. After choosing a watershed there is information available about natural features, water conditions, grants, monitoring and projects, goals, and more.

To search for rivers, streams, lakes, bays, or harbors, a water search is available that allows the user to type in a waterbody name or WBIC. A list is then generated for the user to pick the waterbody of interest to learn more about the water conditions, goals, monitoring and projects, ecosystem challenges, and fish and habitat. The direct website is: http://dnr.wi.gov/water/waterSearch.aspx.

There is also a separate "Find Your Lake" query option, which provides information on fish, water clarity, and public features: http://dnr.wi.gov/lakes/.

Impaired waters can be searched numerous ways to find information about the listing details for a particular waterbody. A link is also available to view water details that are also available through using the water search: http://dnr.wi.gov/water/impairedSearch.aspx.

I. Cost Benefit Assessment

The Clean Water Act requires states to report to Congress on the social costs and benefits of actions necessary to achieve the objectives of the Clean Water Act. WDNR believes that while cost benefit assessments can inform the decision making process, this type of analysis should not override the goals of environmental or ecosystem health as a single dominant decision point.

The complex and multi-jurisdictional nature of environmental protection and water quality regulation and restoration precludes a precise analysis of fiscal outlays in the context of this biannual report. In addition, rapid change in our understanding of the complexity of environmental systems, as well as evolving knowledge of precise endpoints for environmental damage exerted by a single contaminant, further complicate our ability to assess potential benefits of specific actions or regulations. Thus, this section of the report assessment is limited to a brief discussion of some of the major financial outlays related to water quality, including the Environmental Improvement Fund (with special emphasis on the Clean Water Fund Program and the Safe Drinking Water Loan Program), the State's Stewardship Program (Land Acquisitions and Easements) and the State's Polluted Runoff Management Program.

I1. Environmental Improvement Fund

Wisconsin's Environmental Improvement Fund (EIF) consists of two separate financial assistance programs: the Clean Water Fund Program for wastewater treatment and urban runoff projects, and the Safe Drinking Water Loan Program for drinking water projects. The EIF directs limited financial resources to projects with the highest environmental priority score. The programs are administered jointly by WDNR and the Department of Administration.

The EIF is an excellent tool for Wisconsin in meeting its responsibilities under both the Clean Water Act and the Safe Drinking Water Act. EIF programs provide financial assistance to local units of government in the form of subsidized loans and, in some cases, grants, principal forgiveness or interest subsidy payments.

I2. Clean Water Fund Program

The Clean Water Fund Program (CWFP) is the larger of Wisconsin's two revolving loan programs. The CWFP uses funding from the capitalization grant authorized by the Clean Water Act, repayments from previous loans, and supplemental funding from state borrowing to help achieve state water quality goals and the objectives under the Clean Water Act.

Repayments of principal and interest from CWFP loans will make up the primary source of funding for future CWFP projects. The CWFP provides financial assistance to municipalities for planning, design, and construction of surface water and groundwater pollution abatement facilities to process municipalities' wastewater and urban runoff. Over the years an increased emphasis has been placed on preventive maintenance for existing wastewater treatment facilities, and constructing new facilities to manage urban runoff. Financial assistance is administered by the CWFP through: 1) a federal revolving loan program, 2) a state leveraged loan program, 3) a state direct loan and hardship program, and 4) an interest rate subsidy program for small projects. The State programs are a commitment made by the Wisconsin Legislature to exceed the federal funding for surface water pollution abatement.

From 1991 through March 21, 2012, the CWFP entered into 825 financial assistance agreements with Wisconsin municipalities totaling $3.73 billion--$3.51 billion in loans and $221.7 million in grants and principal forgiveness. In addition, the CWFP has executed 80 agreements with 69 municipalities to subsidize interest payments on wastewater treatment project loans made to the

municipalities by a state program other than the CWFP. The amount of financial assistance provided for individual CWFP projects ranges from $25,000 to over $134 million.

The CWFP provides financial assistance for the following types of projects:

- Compliance maintenance projects – These wastewater projects are necessary to prevent a municipality from exceeding effluent limitations contained in their Wisconsin Pollution Discharge Elimination System (WPDES) permit.
- New or changed limits projects – These wastewater projects are necessary for a municipality to meet effluent limitations contained in its WPDES permit which were newly established or modified after May 17, 1988.
- Unsewered projects – These wastewater projects provide treatment facilities and sewers for unsewered or partially unsewered municipalities.
- Urban runoff projects – These stormwater/nonpoint source projects are necessary to meet WPDES permit requirements, meet non-agricultural performance standards, or control urban stormwater problems under WDNR-approved plans.

The CWFP may provide financial assistance to municipalities in the following ways: provide loans at or below market interest rates, provide grants under a state hardship assistance program, purchase or refinance the debt obligations of municipalities incurred for CWFP-eligible water pollution control projects, and make subsidy payments to municipalities to reduce interest on loans made by the Board of Commissioners of Public Lands for CWFP-eligible projects. In recent years, the CWFP has also provided principal forgiveness to some municipalities to meet federal appropriation requirements.

Each CWFP project is prioritized using a system established by Wisconsin Administrative Code. The environmental criteria used to select projects include: impacts to human health, maintenance of Fish and Aquatic Life, maintenance of wildlife, impacts to outstanding and exceptional resource waters, the ability to treat septage and leachate, and the population served by the project. The priority system assigns a score to every project based on the criteria. Projects are ranked numerically, so in the event funding is not available for all requested projects in a given year, awards will be made by the order in which they are ranked. Funding each biennium has been sufficient to fund all eligible CWFP projects, except for those projects requested under the financial hardship assistance program.

I3. Safe Drinking Water Loan Program

The Safe Drinking Water Loan Program (SDWLP) was enacted in 1997 to provide financial assistance to municipalities for the planning, design, construction or modification of public water systems. The SDWLP uses funding from the capitalization grant authorized by the Safe Drinking Water Act and repayments from previous loans.

From the beginning of the program in 1998 through March 21, 2012, the SDWLP entered into 167 financial assistance agreements with Wisconsin municipalities totaling $388.5 million--$347.2 million in loans and $41.2 million in principal forgiveness.To be eligible for SDWLP funding, a project must have one of the following purposes:

- Address Safe Drinking Water Act health standards that have been exceeded, or prevent future violations of health standards and regulations. This includes projects to maintain compliance with existing regulations for contaminants with chronic health effects.
- Replace infrastructure if necessary to maintain compliance with or further the public health protection goals of the Safe Drinking Water Act. This includes projects to rehabilitate or develop sources, install or upgrade treatment facilities, install or upgrade storage facilities, or install or replace transmission and distribution pipes.
- Consolidate existing community water systems that have technical, financial or managerial difficulties. These projects are limited in scope to the service area of the systems being consolidated.
- Purchase a portion of another public water system's capacity if it is the most cost-effective solution.
- Restructure a public water system that is in noncompliance with the Safe Drinking Water Act requirements or lacks the technical, managerial, and financial capability to maintain the system if the assistance will bring the system back into compliance.
- Create a new community water system or expand an existing community water system that, upon completion, will

address existing public health problems with serious risks, caused by unsafe drinking water provided by individual wells or surface water sources. These projects are limited in scope to the specific geographic area affected by contamination.

The SDWLP may provide financial assistance to municipalities as loans at or below market interest rates, or may purchase or refinance the debt obligations of municipalities incurred for SDWLP-eligible projects. In recent years, the SDWLP has also provided principal forgiveness to some municipalities to meet federal appropriation requirements.

Each SDWLP project is prioritized using a system established by Wisconsin Administrative Code. The criteria used to select projects include: risk to human health of acute and chronic contaminants, financial need based on population and median household income of the municipality served by the project, secondary contaminant violations or system compliance with regulations, and system capacity.

The priority system assigns a score to every project based on the criteria. Projects are ranked numerically, so in the event funding is not available for all project applicants in a given year, awards will be made by the order in which the projects are ranked.

I4. Land Acquisitions and Easements

WDNR Bureaus of Facilities and Lands and Community Financial Assistance manage the Stewardship Program, which provides funding for a variety of fee simple and easement acquisitions that protect natural resources and increase public recreational opportunities. Land acquisition is the tool for effective conservation of green space for recreation and provides opportunities for the protection of species and habitats. In Wisconsin, land acquisition leads to creation and expansion of wildlife management areas, fishery areas, natural areas and state parks, and habitat restoration areas. Where possible, the WDNR looks for opportunities to stretch State Stewardship Program funds using federal programs such as the Land and Water Conservation fund (LAWCON), United State Fish and Wildlife Service (USFWS) grants, and USDA Natural Resources Conservation Services (NRCS) Farm Land Protection Grants. Additionally, the WDNR accepts gifts of land from landowners and various non governmental organizations.

This funding, $60 million dollars a year through the year 2013 (actual bonding allotment), is to provide for both land acquisition and property development. Portions are to be used by non-profit conservation organizations and local governments, both for acquisition and property development purposes. Examples of projects funded by Stewardship in the past several years include establishment of the Willow Flowage Scenic Water area, Peshtigo River State Forest, Capitol Springs State Park, and the Lower Chippewa River State Natural Area. In addition, substantial expansions to several water-based properties have occurred, including the Turtle Flambeau Scenic Waters Area and Tomahawk River State Natural Area. Additionally, WDNR looks for opportunities to partner with other organizations or to cost-share project costs with federal dollars available for acquisition of lands protecting wildlife, fishery, or water quality.

Two of the five acquisition priorities for Stewardship funding are lands that preserve or enhance the State's water resources. This includes land along the Lower Wisconsin State Riverway; land abutting wild rivers and wild lakes, and land along the shores of the Great Lakes. In addition, the Stewardship program focuses on efforts to protect water quality and fishery habitat by acquiring buffer areas along streams. Since the programs inception, the WDNR has invested $11.4 million on fisheries easements to protect over 13,000 acres of land along stream corridors around the State (as of December 2011). In most cases the easements protect a corridor 66 feet wide along both banks. These fishery easements prevent development along this corridor, give the WDNR the right to do in stream habitat work, and in most cases provide public access for anglers.

The program also provides cost sharing to municipalities and nonprofit organizations. Municipalities can apply for local assistance grants for nature based outdoor recreation, and the nonprofit organizations can apply for grants for up to 75% for property acquisition. Additionally under the Stewardship Program, the Nonpoint Source Pollution Abatement Program provides funding for WDNR easements to reduce polluted runoff. In total this program has funded approximately $2.0 million for purchase of easements totaling 1,717 acres (as of December 2011).

Management of properties owned by the WDNR is outlined in master plans for each property. These plans cover maintenance, management, and development that will occur on the property for at least 15 years. Contained in the plans are recommendations for a variety of land management and recreational activities, especially for those properties that include large water features that are aimed at protecting water quality and scenic natural features. Master plans for properties such as the Lower Wisconsin Riverway, Brule River State Forest, Turtle-Flambeau Flowage Scenic Waters Area, Chippewa Flowage, and Dells of the Wisconsin River State Natural Area contain provisions for protection of water quality and scenic beauty.

I5. Runoff Management Implementation Programs

Implementation and enforcement of recent revisions to the runoff-related Performance Standards contained in ch. NR 151 Wis. Adm. Code require a significant expenditure to realize significant reductions in polluted runoff. WDNR's Runoff Management program has an extensive network of grant opportunities for communities to implement runoff management practices. Information regarding costs and benefits of these programs is provided in the Runoff Management Section E3 in this report.

Expenditures for polluted runoff that are described in that chapter include:

- Targeted Runoff Management (TRM) Grant Program
- Urban Nonpoint Source and Stormwater Grant Program
- Notice of Discharge (NOD) cost sharing

J. Public Participation

WDNR staff believe transparency in decision making and input from the public are needed in determining the condition and health of our waters during every Integrated Reporting cycle. To accomplish this, public participation opportunities this past Integrated Reporting cycle included:

Public Data Solicitation: Interested parties were encouraged to submit data from October 1 through December 30, 2010. WDNR solicited information from over 580 interested parties that may have collected or have access to water quality data for Wisconsin waters in 2005-2010. Included in this solicitation were academia, regional planning commissions, environmental advocacy groups, WPDES permit holders, and federal agencies like the United States Geological Survey, and Natural Resources Conservation Service. An online data submittal form was used to streamline data submittal and WDNR review. This data solicitation was also publicized on the following WDNR website: http://dnr.wi.gov/org/water/condition/2012_IR/submitdata.htm. Ten entities submitted data for consideration and are listed on the WDNR website. All public data were required to meet certain quality assurance measures to qualify for use in 303(d) listing decisions.

Web Pages: WDNR's Impaired Waters web pages were updated prior to the public comment period. The website currently offers: background information for each proposed listing during this cycle, searchable Impaired Waters List data, a link to the methodology used to make listing decisions (WisCALM 2012, Attachment C), and background materials on related programs. An electronic mailbox (ImpairedWaters@wisconsin.gov) was used to encourage feedback and comment submittal.

Public Comment Period For Draft 2012 List: A 60-day public comment period on the Draft 2012 Impaired Waters list was held from December 15, 2011 to February 15, 2012. A webinar on January 5, 2012 drew 120 participants to learn about: Wisconsin's methodology for listing waters as impaired, 2012 updates, and how to find related information on the WDNR website. The webinar is archived and available at: http://dnr.wi.gov/org/water/condition/impaired/. A live "chat" option during the webinar allowed participants to submit questions and comments. All comments were summarized and included in the overall comment and response document located in Attachment E. In total, 69 entities commented on the 2012 Impaired Waters List.

Conclusion

Wisconsin has some of the most extraordinary water resources in the Nation including: over 15,000 lakes, 54,000 discrete rivers and streams covering 88,000 miles, and large quantities of groundwater. WDNR staff value managing these unparalleled resources that contribute so much to Wisconsin's identity.

This 2012 Water Quality Report to Congress represents the cumulative progress in water quality and water resources program work through the end of December 2010, for the Impaired Waters List, and through December 2011 for general assessment data. Using satellite data to assess lake condition and networks of trained volunteers has allowed WDNR to increase the number of waters for which baseline data are gathered on an annual basis. Altogether, these advances have allowed Wisconsin to assess approximately 4,200 lakes (28% of the total number of lakes in the State and 64% of lake acres) and approximately 2,700 rivers and streams (5% of the total number of rivers and streams in the State and 16% of river/stream miles).

In addition, water quality criteria to regulate phosphorus were promulgated in Wisconsin in 2010. Improved data evaluation and analyses were used statewide to increase the number of waters assessed and thus evaluated for standards exceedances. Many new waters were found to be impaired by phosphorus, one of Wisconsin's most menacing pollutants. WDNR will continue to increase the number of waters monitored and assessed, while ensuring that fiscal and staff resources are used as efficiently as possible.

Vern Wildlife Area, Wolf Lake Flowage,
Photo Courtesy of WDNR

Wisconsin is taking an active approach to assessing and improving overall water quality. For more information regarding the materials contained in this report, please refer to the WDNR's website: http://dnr.wi.gov/, and search the specific program or geographic area of interest to you.