2010 Wisconsin Water Quality Report to Congress

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Jump River, Price County **Photo: Wisconsin Dept. of Tourism**

WISCONSIN
DEPT. OF NATURAL RESOURCES

2010 Wisconsin Water Quality Report to Congress

The Wisconsin DNR is required by the Federal Clean Water Act Sections 305(b) and 303(d) to prepare a *Water Quality Report to Congress* every two years. Also known as an 'Integrated Report' because it combines elements of both the former "305(b) Report" and "303(d) Report", it contains both an overall summary of water quality conditions in the state and an updated Impaired Waters List. The state must also provide electronic data reporting of waterbody assessments on an annual basis.

Wisconsin's *2010 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. It can be accessed at WDNR's website at http://dnr.wi.gov/org/water/condition/2010_IR/report.htm.

Previous reports were published in 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.

Bad River Bend, Wisconsin WDNR Photo

2010 Integrated Reporting Team: Nicole Clayton, Lisa Helmuth, Kristi Minahan, Bob Masnado

Authors of this report include:

Tim Asplund, Tom Bauman, Kate Barrett, Corinne Billings, Greg Breese, Jeanne Cargill, Nicole Clayton, Terry Dukerschein, Eric Ebersberger, Jennifer Filbert, Jim Fischer, Meg Galloway, Paul Garrison, Steve Greb, Jennifer Hauxwell, Jeff Helmuth, Lisa Helmuth, Jeff Janvrin, Terry Lohr, Larry Lynch, Mike Lemcke, Bob Masnado, Kristi Minahan, Candy Schrank, John Sullivan, Susan Sylvester, Carol Holden, John Pfender, Carroll Schaal, Kris Stepenuck, Danielle Valvassori

Letter to Citizens


Fly fishing on Timber Coulee Creek, Vernon County, WI

Every two years, Wisconsin provides a *Water Quality Report to Congress*. This report summarizes the condition of the State's water resources (i.e., lakes, rivers, streams, drinking water, groundwater, Great Lakes) and describes Wisconsin's programs to manage, protect and enhance those water resources that are so vital to our culture and our economy.

As part of the Department of Natural Resources' mission, staff in the Water Division work hard to use the resources available – in the most efficient manner possible – to ensure that our efforts are focused on meeting the needs of the state's citizens and visitors. With the vast water resources in Wisconsin, it is critical to conduct our work in an organized manner that can be evaluated regularly and improved upon as needed. To that end, the Water Division has created four strategic objectives that help define our program goals and guide the work that we do. They are:

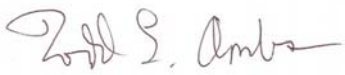
- Protecting the Public Trust
- Sustaining Healthy Fisheries
- Implementing the Clean Water Act
- Providing Safe Drinking Water and Groundwater

This strategic framework is important as we plan for the future which will inevitably be affected by our Nation's current state of economic hardship. In partnership with citizen groups, tribal partners and other state and federal agencies, staff will continue to seek opportunities for collaboration to assess and improve our water resources. Further, staff will work closely with others to seek private and public funding to help meet clean water goals.

Most recently, the Department of Natural Resources has actively pursued outside sources of funding through the American Recovery & Reinvestment Act (ARRA) and the Great Lakes Restoration Initiative (GLRI). To date, more than $150 million of ARRA funding has been awarded to the Water Division. This money has been put to use to assist in creating jobs, stimulating local economies, and protecting public health and the environment through surface water improvement and drinking water projects. In addition, the Water Division recently submitted a total of 17 GLRI project proposals worth approximately $9 million. If funded, these water-related projects will help implement management practices that are identified in our Wisconsin Great Lakes Strategy.

The following report satisfies federal reporting requirements and provides insights into the multitude of programs managed by the Water Division. Looking forward, I am confident that you'll agree that Wisconsin is well prepared to continue to evaluate, protect and improve our precious water resources for the citizens of Wisconsin.

Sincerely,



Todd Ambs, Water Division Administrator

Table of Contents

PART A. INTRODUCTION

Wisconsin residents are fortunate to live in a state bountiful with natural resources, including our many and varied lakes, streams, wetlands, aquifers, and springs. Every other year, the Wisconsin DNR reports on the quality of these water resources to the United States Environmental Protection Agency (USEPA), which in turn shares this information with the United States Congress. The information we provide is considered by federal legislators as rule making, budget appropriations, and programs are evaluated or considered.

New combined report includes enhanced assessment methods

2010 is the first year that Wisconsin is submitting an 'integrated report', combining both the 305(b) Clean Water Act reporting requirements and the 303(d) Impaired Waters List into a single report. This new submittal process should streamline getting data to U.S. EPA and allow the public to find comprehensive information on the status of Wisconsin's waters in one place.
This year's report introduces Wisconsin's special efforts to use new assessment approaches to determine whether waterbodies are meeting their designated uses for fish and aquatic life, recreation, and public health. These significantly improved assessment methods have been under development by WDNR staff for several years, and reflect science and methods advocated by national experts and regional liaisons. While continuing improvements are under way, this work will be a significant element of Wisconsin's water quality planning and management program in the coming years.

Healthy waters key to healthy economy and quality of life

A high priority for Wisconsin DNR's Water Program is the preservation and management of shorelines and sensitive waters throughout the state. Thousands of people each year visit our state's treasures. Many residents and visitors alike appreciate the beauty of dusk over a quiet lake in summer, with only a loon's call or the buzz of damselflies to stir the imagination in tranquil moments. Conversely, a growing number of visitors find pleasure in active water sports. Regardless of the preferred water-based fun, it is clear that water recreation is a major theme in Wisconsin, providing an important component of our tax base , as well as a valuable incentive for better understanding, protecting and managing our water related resources. Even as our nation contended with an unprecedented economic crisis and severe weather in 2008, Wisconsin's $13 billion tourism industry remains one of the core strengths of the state's economy[1]. In fact,

1 Wisconsin Dept. of Tourism. The Economic Impact of Expenditures By Travelers On Wisconsin, Calendar Year 2008.

tourism posted a 2.7% gain in 2008, and generated over 310,000 full-time job equivalents. On the resource side, Hemken and Ivers[2] (2005) evaluated adult recreational activities over a 10-year period (1992-2002), finding that rates of participation in hunting and fishing remained stable in Wisconsin, compared to declines in other regions of the United States.

The trends we've seen in the past look like they will continue. Detailed projections of recreational uses, including water related outdoor activities (see: 2005-2010 Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP)[3]) indicate that water (and associated resources) is becoming increasingly valued for a wider variety of activities by a broader base of individuals.

Perhaps not coincidentally, this trend is clearly emerging at the same time that water and land resources preserved in a natural state are becoming more scarce. A 2008 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[4]) projects Wisconsin's population to grow from 5.36 million in 2000 to 6.65 million in 2035, an increase of nearly 1.3 million people. The state's population is projected to grow by 7.1 percent from 2005 to 2015, with an overall increase of 24.1 percent from 2000-2035.

The DOA report projected the county level growth rates shown in Figure 1, showing population pressure in the northeast and northwest as well as the throughout the south and southeast corridor of the state. Wisconsin leaders recognize the connection between population growth and pressures on our natural resources, and have passed Smart Growth legislation to help address the need for thoughtful, considered growth especially near those areas that help define 'who we are' as a state.

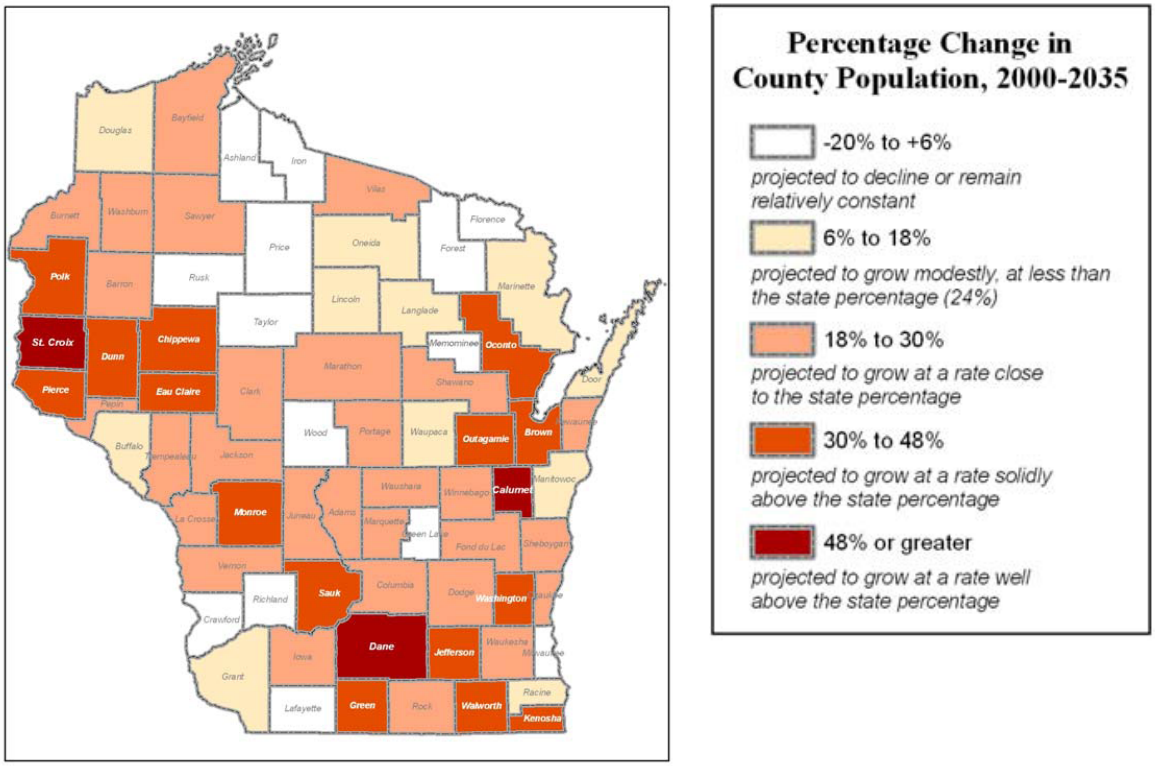
Despite, *and* because of, these trends, Wisconsin is redoubling efforts to strategically manage water. The Water Division has identified four critical objectives and a series of goals and performance measures and a forum for describing successful steps taken ("Success Stories") to provide meaningful evaluation of our progress over time. This *2010 Water Quality Report* describes the condition of our water today through the prism of existing knowledge, an eye on future trends, and strategies for protecting and preserving this irreplaceable resource.

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. 2006. The 2005-2010 Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP). WNR Pub PR-026-2006.

4 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.

Figure 1. Wisconsin County projected growth rates, 2000-2035



A1. Wisconsin Recommendations to Congress & U.S. EPA

Many of Wisconsin's recommendations to USEPA and to the Congress can be addressed through a reauthorization of the Clean Water Act. These needs include national leadership on criteria, program guidance and funding commensurate with the range of activities required to fully implement the Clean Water Act. Wisconsin recommends the following actions to Congress and USEPA:

Congress and U.S. EPA should address the following areas:

General Funding

- Increase funding for Clean Water Act Section 106, 319, 104b(3) and 604(b) related water quality efforts without sacrificing funding from other programs.

Runoff Management

- Provide support for agricultural runoff programs by:
  - identifying potential best management practices for addressing discharges from subsurface drainage systems,
  - providing additional guidance on how to establish alternative discharge limitations for large CAFOs,
  - identifying methods for determining equivalent practices for the 100 foot setback for land application of large CAFO manure and process wastewater,
  - establishing clearer guidelines for regulation of small and medium-sized CAFOs.
- Increase federal funding for staff to deliver technical assistance for conservation programs and evaluation of these programs.
- Work with states to develop biologically-based quantitative methods for identifying waters with high biological integrity as candidates for protection through prohibitions on lowering of water quality
- Craft a Farm Bill that stresses and rewards nutrient conservation.

Wastewater

- Focus more on NPDES outcomes (permit quality, permit backlog, permit compliance, sanitary sewer overflow prevention), and less on intermediate bureaucratic steps (number of inspections, number of enforcement cases, majors; consider whether the pretreatment program is outdated).
- Reinstate a grant program for nutrient removal and building of new treatment plants.
- Promulgate the federal Sanitary Sewer Overflow rule.

Waterways/Shorelands

- Create a generalized NEPA report form that states could use to cover a broad spectrum of issues rather than individual forms for individual projects.
- Develop technical guidance and resources to support research and decisions related to wetland and riparian zone protection and management, particularly buffers for sensitive areas vulnerable to runoff.
- Conduct a national investigation of the environmental fate of marine dock coatings (especially epoxy coatings, bisphenol a).

Wetlands

- Pursue passage of the Clean Water Restoration Act legislation to correct loss of wetlands; work on implementation with states.
- Modify existing wetland regulations to include excavation and disturbance of wetlands (currently, filling wetlands is regulated but other disturbances such as excavation are not).
- Share EPA draft wetland monitoring guidance and protocols with states for comments during development.

Aquatic Invasive Species (AIS)

- Develop guidance on how AIS should be considered in the 303(d) listing process.
- Provide regulatory and technical tools for managing AIS.
- Identify what level of flexibility exists in federal laws to allow state and local governments to impose management/control/eradication actions for AIS.
- Create a federal strategy for use of herbicides/pesticides to be used on an emergency basis.
- Assess water quality implications of AIS control techniques.

Water Quality Standards

- Provide national guidance on developing biologically based water quality standards for Fish and Aquatic Life, including:
  - Aquatic Life Uses for Upper Midwest Region landscape ecosystems,
  - Guidance on anti-degradation implementation.
- Address discrepancies between regulatory clean up levels for PCBs under Superfund and clean up levels needed for water quality and aquatic life.
- Establish a reasonable schedule for implementation of the revised BEACH Act that recognizes the need for training and infrastructure to accommodate new rapid testing methodology.
- Lead an effort to standardize the evaluation of data collected under the BEACH Act for purposes of making 303(d) assessment decisions. Assist states with development of their beach monitoring QAPPS. Disseminate beach guidance documents.
- Develop guidance to facilitate integration of water program standards and regulation of substances through the Toxic Substances Control Act (TSCA); the Resource Conservation and Recovery Act (RCRA); the Clean Air Act and the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA).

Total Maximum Daily Loads (TMDLs)

- Establish a more clearly defined and achievable program to develop and implement TMDLs, including:
  - developing national criteria to support consistency in the decisions made by states to list and de-list 303(d) impaired waters – especially inter-state waters,
  - leading multi-state efforts for regional issues, such as development of mercury TMDLs,
  - establishing guidelines and methodologies for addressing nonpoint source impairments in TMDL watersheds.
- Encourage increased participation by NRCS in TMDL implementation.

Monitoring

- Fully fund monitoring programs and require states to use the same conceptual approach for biologically based water quality criteria and assessment protocols with an expansion on the use of remote sensing techniques for statewide assessments.
- Collaborate with states on developing and implementing monitoring network designs to increase the percent of waters assessed. Provide assistance on how to include results of probability designs in the Integrated Report.
- Provide clear guidance on how best to use data from citizen monitoring as an integral part of a state monitoring strategy, and provide funding for implementation.

Sediment

- Establish a schedule for the completion of national sediment quality criteria guidance.
- Develop a sediment remediation program which includes:
  - specific standards or quality criteria,
  - timelines for implementation,
  - a funding system to provide assistance to states for building state capacity and conducting remedial projects for sites identified in remedial action plans and lakewide management plans.

Data Management

- Provide a consistent source of fiscal support necessary to manage and share data with the Water Quality Exchange Network and the federal STORET Warehouse.
- Develop a continuing appropriation for USEPA and delegated states to support data systems needed to implement the Clean Water Act and related programs including monitoring, assessment, and permitting activities using new technologies that integrate complex data and allow dissemination of that data to partners, stakeholders and the public.
- Complete ICIS system to allow electronic submittal of remaining data through exchange network.

Climate Change

- Adopt legislation to address the sources of greenhouse gases.
- Include provisions for water resources and climate change in the Clean Water Act.
- Provide funding for states to initiate science-based planning for geochemical, hydrologic, and biological impacts associated with climate change (e.g., re-evaluate hydrologic models as well as parameters used by managers and regulators such as "100-year floods", wetland delineations, ordinary high water marks; refining hydrologic models and linking to ecological responses; designing a monitoring framework for a climate response network; assessing thermal impacts to water resources and effects on biological communities, nutrient and carbon cycling).

PART B. BACKGROUND INFORMATION

B1. Total Waters and Watershed Planning

Wisconsin's Abundant Water Resources

Wisconsin is a water rich state, with many thousands of streams stretching nearly 84,000 miles in length. Based on 1:24,000 scale USGS Topographic Quandrangle Maps (publish date varies), and GIS interpretation of those maps, Wisconsin has over 40,000 perennial stream miles and an equal number of intermittent miles.

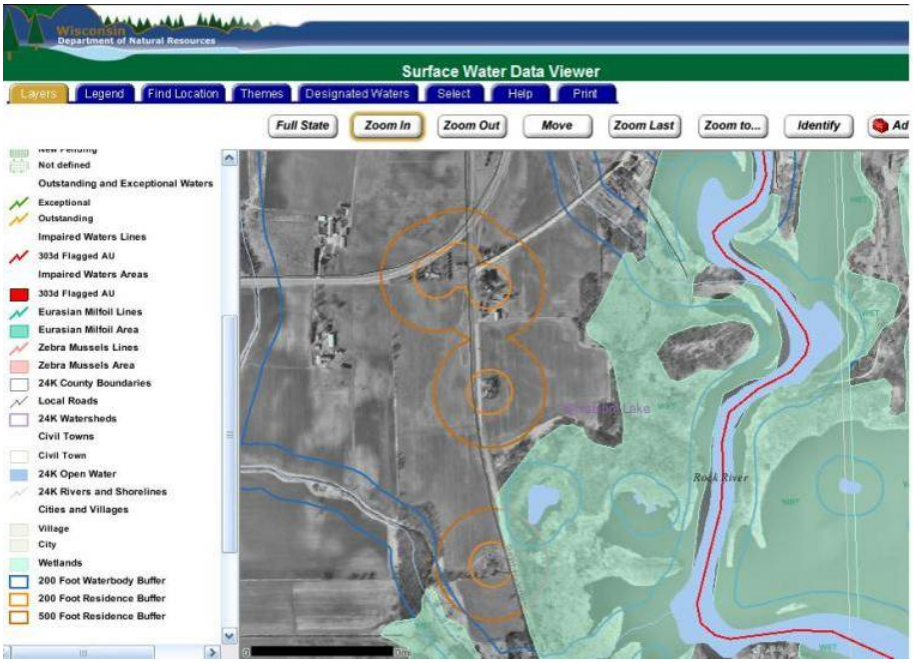
The state's many inland lakes span over 1.2 million acres. Wisconsin also has over 1,000 miles of Great Lakes shoreline on lakes Michigan and Superior and over 5 million acres of wetlands. Groundwater in the state is similarly naturally rich, with human-induced stressors precipitating the need for increased management.

Wisconsin's Water Resources At a Glance

Lakes	
Number of Lakes	15,000 +
Lake Acres	~1 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

Wisconsin manages water over this expanse by divvying the task among 32 basins and 330 watersheds, with the watersheds roughly equivalent to the 10-digit HUC codes. Below are the water management units. To interactively view surface water resources online, see the state's Surface Water Data Viewer. The map in Figure 2 shows an example of what type of data you can obtain in the viewer.

Figure 2. Sample map from Wisconsin DNR's online Surface Water Data Viewer



Wisconsin's Water Management Approach

Wisconsin manages resources using two key concepts—Ecosystem Management and the Watershed Approach. Ecosystem Management is based on the fundamental ecological concept of interconnectedness. The Watershed Approach applies that same concept to the presence, movement, and interaction of water in the landscape. In applying the Watershed Approach to protect and restore water quality, WDNR focuses on aquatic and landscape areas of ecoregions, basins, and watersheds.

Basins and watersheds are interconnected areas of land draining from surrounding ridge tops to a common point such as a lake or stream confluence with a neighboring land area. All lands and waterways can be found within one watershed or another. Picture a raindrop making its way from the very top of the mountain, through and over the land, joining more water on a journey down through gullies, streams and rivers to a lake. The land where all the water comes from is a watershed...it's easy to see that what the water picks up on its journey will affect the receiving waters—lakes, rivers, and wetlands located downstream.

Wisconsin's Hydrologic Areas At a Glance

Major Basins	3
Basins	24
Watersheds	334

Delineation of these hydrologic areas identifies where surface waters drain across the land surface of the state. Based on the drainage areas, the WDNR then develops water quality management plans by watersheds or basins for protecting our water resources.

Other federal natural resource agencies have delineated hydrologic drainage areas as well. These areas are known as Hydrologic Unit Codes known or "HUCs". To the extent possible, state and federal agencies have tried to be consistent with one another. But for various management purposes, some differences in the hydrologic boundaries are necessary. 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.

About WDNR's Hydrologic Areas

The following descriptions are taken from the web page: About WDNR Hydrologic Areas: Watersheds, Basins, WMUs and GMUs.

Major Basins
The three Major Basins identify the major drainage patterns of Wisconsin, and are named for the primary waterbody into which the basin drains. In Wisconsin, they are the Lake Superior Basin, Mississippi River Basin and the Lake Michigan Basin. Figure 3 shows the Wisconsin Major Basins.

Relationship to HUCs (exit DNR): Closely resemble the HUC "Regions" (Level 1, 2-digit Hydrologic Unit Hierarchy HUC)).

Basins
Basins are hydrologically based subdivisions of the larger 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). Within each Basin, watersheds are assessed on a rotating basis. Figure 4 shows Wisconsin's 24 Basins.

Relationship to HUCs (exit DNR): Approximately equivalent to "Regions" (Level 4, 8-digit Hydrologic Unit Hierarchy (HUC)).

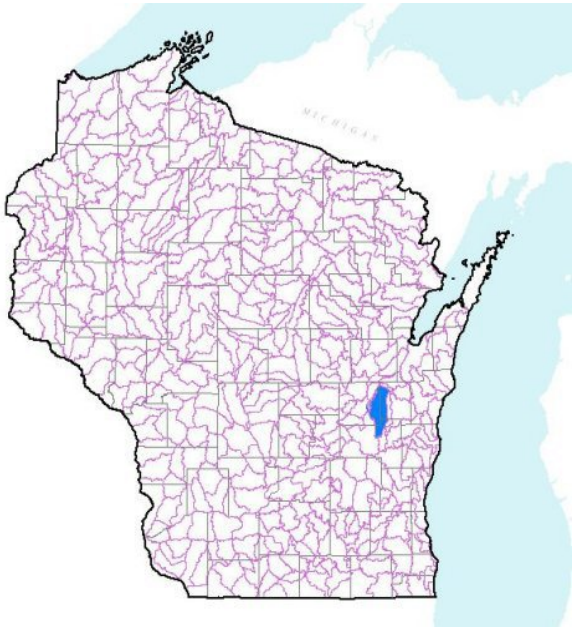
Figure 3. Wisconsin's 3 Major Basins

Figure 4. Wisconsin's 24 Basins

Watersheds
Watersheds are a further hydrologic subdivision of the Basins. Currently water management efforts are shifting toward a watershed scale approach for implementing both nonpoint and point sources controls. Figure 5 shows Wisconsin's 334 Watersheds.

Relationship to HUCs (exit DNR):
Approximately equivalent to HUC "Watershed" (Level 5, 10-digit Hydrologic Unit Hierarchy (HUC)).

Figure 5. Wisconsin's 334 Watersheds



Watershed Planning

The State's 32 major rivers fall into 24 basins and 334 watersheds. During this reporting period, WDNR created a new approach to updating water quality assessment information. Using the state's *Wisconsin Consolidated Assessment and Listing Methodology* (WisCALM), as well as new information technology tools, the Watershed Bureau began updating 25 of the state's watersheds through Watershed Planning.

Watershed Plans are considered updates to the State's *Areawide Water Quality Management Plans* under Wisconsin Administrative Rule NR121. These plans provide the following key pieces of information critical to the Water Division:

- General Assessments of lakes/impoundments, streams, wetlands, Great Lakes shoreline, and beaches.
- Specific or detailed assessments for determining whether waterbodies are impaired, for the state's Clean Water Act 303(d) Impaired Waters List.
- Updates to key watershed information including: land use change, population growth, key resource priorities or issues and recommendations, resource management projects in place or planned, and narrative summaries of waters and watersheds.

The state's 2009-2010 Watershed Planning activities make this critical information available to the public online – in real time – for display and review. The watersheds listed in

Figure 6 are in the process of being updated for the 2009-2010 planning year, which began with the state's fiscal year cycle in July, 2009.

Figure 6. List of Watersheds being updated in 2009-2010

List of 2009 Watersheds for Updates

- Bad Axe/LaCrosse - Rush Creek (BL01), Bad Axe LaCrosse (BL02)
- Buffalo-Trempealeau/Black River - Elk Creek (BT03)
- Central Wisconsin Basin, Little Roche-A-Cri (CW01)
- Fox II, Frame Creek Park (Upper Fox River - Illinois, FX07)
- Grant Platte Basin - Galena River (GP01), Little Platte Watershed (GP03)
- Headwaters Basin - Springbrook Creek (CW21)
- Lake Superior Basin St. Louis River/Lower Nemadji (LS01)
- Lakeshore (Twin Door Kewaunee), West Twin River (TK01)
- Lower Chippewa, North Fork Eau Claire Watershed (LC17)
- Lower Rock, (Six Mile and) Pheasant Branch (LR10)
- Lower Wisconsin - Bear Creek (LW14)
- Milwaukee - Menomonee (MI03), Kinnickinnic (MI01)
- Sheboygan - Mullet River (SH05)
- Southeast Basin - Pike River (SE02)
- Sugar Pecatonica Basin - Lower East Branch Pecatonica (SP03)
- St. Croix Basin - Willow River (SC03, SC02)
- Upper Chippewa Basin - Upper North Fork Flambeau River (UC13)
- Upper Green Bay/ Lower Fox, Middle Inlet and Lake Noquebay Watershed (GB09)
- Upper Rock Basin - Upper Rock (UR12)
- Winnebago Area (UFB), Fond du Lac River (UF03)
- Wolf Basin, Shawano Lake Watershed (WR15)
- Western Upper Fox (UFB), Montello River (UF-13)

B2. Water Pollution Control Programs

A broad range of WDNR programs contribute to improvements to water quality. These correspond to WDNR's Sections within the Bureau of Watershed Management.

Runoff Management

Control of polluted runoff continues to be one of the most important challenges in the state's effort to protect the quality of 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; and
- 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 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 9 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).

Three primary components of the WDNR's runoff management program include implementation of runoff management grant programs, point source permitting of storm water 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 USEPA, 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 ch. 283, Wis. Stats., 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.

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 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, 2009, there were 189 CAFOs permitted under the WPDES program and another 45 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 federal 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 regulates CAFOs. These revisions reflect changes that were made at the federal level.

Construction of a concrete manure storage facility at a CAFO

Managing Water Quality Impacts from Smaller Operations

The WDNR regulates livestock operations with fewer than 1,000 animals units that have discharges that significantly affect water quality through the NOD Program. In addition, under ch. NR 243, operations with 301 to 999 animal units that have discharges that meet 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, 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 ch. 281, Wis. Stats., and the creation of ch. NR 151 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; Funding Increased

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.

Scraping manure from the floor of a feedlot helps prevent runoff from the opereration

Since the mid-1980s DNR has used notices of discharge (NODs) under ch. NR 243 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 ten year period from 2000-2009, 49 notices were issued under NR 243 (this includes both NODs and Notices of Intent (NOIs), which are the precursors to NODs). In 2008, seven notices were issued, with cost-share funds totaling $641,000 committed by DNR and DATCP to fund these projects. In 2009, the number rose to 15 notices issued, and DNR/DATCP funding to address these projects was substantially increased to $1,185,000.

Runoff Events are Ongoing Concern
Surface water and groundwater contamination from manure runoff events is an ongoing concern, and one that the Department continues to work to address. Recent years have seen a reduction in reported runoff events since the winter/spring of 2004-2005 saw 52 manure-related runoff events. The 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.

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.


Fish kills can result when polluted runoff enters local streams or lakes.

New Rules More Protective
To help avoid these situations, the Department finalized revisions to ch. NR 243 in July of 2007. NR 243 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 frozen and 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 (http://dnr.wi.gov/runoff/ag/manure.html) designed to assist farmers in finding resources to help avoid runoff events.

Investigations of Impacts Ongoing
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.

Storm Water Management

Since the mid-1990s, DNR has administered a program under Chapter NR 216 of the Wisconsin Administrative 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 sites 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.


Construction site erosion, Dunn County.

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 certain 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.

Construction Site Erosion Control
On average, the DNR confers coverage to over 1,000 construction sites annually. 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.

Stormwater Permits in WI

Industrial Sites	**5,000 +**
Municipalities	
Individual Permits	**76**
General Permit	**141**
Construction Sites	**1,000 annually**

Industrial Permits
As of December 31, 2008, there were over 5,000 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 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.

Municipal Permits
As of December 31, 2008, there were 76 municipalities regulated under individual MS4 stormwater permits in Wisconsin. Additionally, there were 141 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.

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. Since that time there has been an increased focus of grant dollars toward performance standards implementation. Performance standards and prohibitions are now required components of certain state programs, more implementation tools have been put in place and there is an increased use of regulatory options for serious water quality violations (see sidebar). Urban municipalities that were included in the Phase I federal storm water requirements have ordinances that include the non-agricultural performance standards.

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.

Implementation Highlights -- 2008 and 2009

- Nearly half of Wisconsin counties dedicate 50% of their staff resources towards implementing performance standards and prohibitions.
- About 75% of the counties inventoried farms for compliance.
- Around 50 – 75% of counties reported seeing medium to high levels of compliance with the agricultural performance standards and prohibitions.
- Compliance field demos brought local, state and federal agency staff together to observe compliance situations and challenges.
- More educational materials and information are at http://runoffinfo.uwex.edu/.

Runoff Grants Help Communities Keep Their Waters Clean

The WDNR's runoff management grant programs include the recently ended Priority Watershed/Lake Program, its successor the Targeted Runoff Management (TRM) Grant Program, and the Urban Nonpoint Source and Storm Water 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 three programs are described in further detail below. These programs fund approximately 3,200 best management practices each year. However, most of these BMPs are not tracked to determine the resulting pollutant load reductions. Table 1 shows the amount and types of BMPs funded through these programs.

Table 1. Best Management Practices (BMPs) and plans funded through Runoff Grants

	2008	2004-08
Cropland BMPs, such as:		
Critical area stabilization, grassed waterways, green manure crop, high residue management, reduced tillage, waterway systems (acres)	30,664	352,616
Animal trails and walkways, diversions, underground outlets, waterway systems (feet)	5,512	688,453
Grade stabilization structures, water and sediment control basins (number)	11	762
Manure Management BMPs, such as:		
Agricultural sediment basin, heavy use area protection, nutrient management, wastewater treatment strips (acres)	12,254	276,859
Access roads and cattle crossings, livestock fencing (feet)	17,072	302,288
Barnyard runoff control systems, livestock watering facilities, manure storage facilities (new, abandonments, closures), milk center waste controls, roofs, sediment basins, waste transfer systems (number)	251	1,753
Streambank/shoreline BMPs, such as:		
Streambank/shoreline protection (including fencing), shoreline habitat restoration, stream crossings, streambank rip-rapping, streambank shaping and seeding (feet)	35,758	536,812
Shoreline protection, stream crossing, streambank/shoreline rip-rapping (number)	6	1,540
Urban BMPs and Plans, such as:		
Storm sewer re-routing, urban streambank practices (feet)	4,797	27,013
Detention systems, infiltration systems, street sweeping (number)	91	625
Stormwater management plans, stormwater utility plans, urban BMP designs	59	167
Other BMPs, such as:		
Pesticide management, rotational grazing, wetland restoration (acres)	532	15,117
Well abandonment, well decommissioning (number)	161	1,714

Priority Watershed/Lake Program Closes Out Thirty Years of Progress

The Priority Watershed/Lake Program was an ambitious, 30 year watershed-based grant program that ran from 1978 to the end of 2008, with funding for the final projects ending in 2009. It provided financial assistance to local units of government in selected watersheds to address land management activities which contributed to urban and rural runoff. The WDNR issued grants for the implementation of these watershed/lake projects through a cost-share approach. The grantees used the funds to reimburse costs to landowners for voluntarily installing BMPs. From the inception of the program to its close on Dec. 31, 2009, approximately $211 million in cost-share grants were provided to the priority watershed/lake projects.

Since the program began, 86 of the state's watersheds and lakes were designated as Priority Watershed or Lake Projects. In 1997, the Wisconsin legislature significantly changed the direction of the state's runoff grant management program. The 1997 Wisconsin Act 27 placed the Priority Watershed/Lake Program into a multi-year phase-out period with funding ended in 2009.

Priority Watershed/Lake Project goals focused on water quality improvements or protection resulting from reductions in pollutant levels delivered to streams, rivers, and

lakes. Each year, project grantees submitted reports to the WDNR, showing progress made towards meeting pollutant reduction goals in the watersheds/lakes. For a given project, information could be submitted as reductions in sediment/soil loss from uplands, streams, gullies, and/or phosphorus reductions from barnyards and croplands. Other projects focused on protecting shoreline and habitat in a watershed or lake.

Results from Projects During 2004-2008

Data for the results shown here came from projects that were open during 2008 along with projects that had closed in the previous five years, but were still in the operation and maintenance period. 2009 pollutant loading data were not available at the time of this report.

Thirty Years of Progress: Wisconsin's Priority Watershed Program

• Program Years	1978-2008
• Watersheds or lakes in program	86
• Total cost-share dollars provided	$211 million
Most Recent 5-Year Results—2004-2008:	
• Cropland erosion reduced	533,000 tons/yr
• Streambank erosion reduced	152,000 tons/yr
• Farm phosphorus reduced	225,000 lbs/yr

All Priority Watershed Projects inventoried sources of soil erosion. Most developed goals to control sediment resulting from cropland soil erosion. Many also set specific goals to control gully erosion. By the end of 2008, 50 documented projects had achieved cropland and gully erosion pollutant reductions of 365,662 tons per year on targeted sites. This amount is 70% of the goal of 519,787 tons per year, which is about 28% of the estimated load of 1,327,929. There was an additional sediment reduction of 13,141 tons per year reported by grantees that did not identify either loadings or goals.

Priority Watershed and Lake Projects inventoried all barnyards and feedlots in the project areas and identified phosphorus from livestock manure in these areas as a key water quality problem. Several projects also identified excess phosphorus problems related to improperly stored or applied manure and milkhouse waste, and developed reduction goals for those sources. As of the end of 2008, three projects reported reductions of 307,395 pounds per year in chemical oxygen demand (COD) from installing BMPs and making management changes associated with barnyards and feedlots. This was 75% of their combined reduction goal of 411,568 pounds per year. Other projects reported phosphorus reductions of 147,640 pounds per year or 69% of their combined reduction goal of 213,235 pounds per year. There was an additional 77,066 pounds per year of phosphorus reduction reported by grantees that did not identify initial loadings or goals. Data came from projects that were open during 2008 along with projects that had closed in the previous five years, but were still in the operation and maintenance period.

The majority of the Priority Watershed and Lake Projects established goals to reduce the amount of sediment that erodes from streambanks and shorelines by 66,403 tons per year. These goals are based on total load estimates of 150,644 tons per year, or 69% of the reduction goal. There was an additional 1,700 tons per year of sediment reduction reported by grantees that did not identify initial loadings or goals. Data came from projects that were open during 2008 along with projects that had closed in the previous five years, but were still in the operation and maintenance period.

Priority Watershed Critical Sites

While most participation in Priority Watershed and Lake Projects was voluntary, projects selected after 1993 were required to address the most critical sites needed for water quality improvement. Owners of critical sites were required to either participate voluntarily or be subject to legal orders to abate pollution. Local project managers help landowners install BMPs or change management practices on these sites.

As of the end of 2008, 93% of all types of critical sites were resolved (livestock—96.3% uplands—92.6%, streambanks/shorelines—96.8%, other—44.4%). Most of these critical sites were resolved voluntarily by the landowner with cost sharing for BMPs and technical assistance.

Targeted Runoff Management Grant Program: Successor to Priority Watershed 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). Local governments that are awarded TRM grants may use the funds on lands they control or make the funds available to private landowners. From the first grant cycle in 1999 through Dec. 31, 2009, TRM grants authorized $29.7 million for 292 projects. As of Dec. 31, 2009, WDNR reimbursed grantees $18.9 million of this amount for completed BMP installations. The projects last from two to four years.

During calendar year 2009, the TRM Grant Program awarded $5,908,980 in 56 grants to local units of government ($972,288 has been reimbursed for completed BMPs so far). TRM grant funds from this grant cycle have been used to install a variety of agricultural and urban BMPs (see Table 1).

Runoff Grant Funds Awarded

Targeted Runoff Grants (TRM)

- **2000-2009 $29.7 million for 292 projects**
- **2009 $5.9 million for 56 projects**

Urban Nonpoint & Stormwater Management Grants:

- **2000-2009 $35.8 million for 378 projects**
- **2009 $2.2 million for 18 projects**

Urban Nonpoint Source & Storm Water Management Grant Program

The Urban Nonpoint Source and Storm Water 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 storm water planning, related informational and educational activities, ordinance development and enforcement, training and design are cost-shared at 70 percent. Eligible best management practice construction costs may include such projects as storm water detention ponds, infiltration basins, streambank stabilization, and shoreline stabilization and are cost-shared at 50 percent. The funded projects last between two to three years.

Since 2000, the UNPS Grant Program has awarded $35,815,181 in both planning and construction grants for 378 projects. As of December 31, 2008, 160 of these 207 planning projects and 130 of the 171 BMP construction projects were completed.

(Calendar year 2008 grantees have until December 31, 2009 to complete projects.) During 2009 $2,176,510 was awarded for 18 construction projects; however, no planning projects were funded for 2009 due to budget constraints and lapsed funding.

Wastewater Management

WPDES Permit Program Requires Management of Point Sources

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 Section on Runoff Management 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, and/or
- 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 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 19 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 4,500 facilities are covered under all general permits. The newest general permit to be issued in November 2009 covers ballast water discharges from vessels discharging into the Great Lakes at Wisconsin Ports.

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. With the current key vacancies in the department's permit drafting area, our permit backlog has increased. The number of expired permits, however, is a small fraction of the total number of WPDES permits that are in effect at any given time. 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, 2009, the backlog of industrial and municipal permits, including both surface and groundwater discharges, was 17.2%, 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 permits may not be issued prior to the expiration date, including awaiting additional data from the permittee, public or other comment

necessitates additional review, rules that are inadequate to address concerns with the discharge, or a permittee is not in substantial compliance with the terms of the expired permit and enforcement action is underway.

Effluent Limitations Set to Meet Water Quality Standards
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, 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 Provides Beneficial Reuse
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.

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 Cleans Wastewater Before Discharge
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 575 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 150 facilities that receive permits directly from WDNR.

Wisconsin's Compliance Maintenance Program is a National Leader

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 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.

The Wisconsin CMOM Booklet (2010) provides sanitary sewer collection system owners with guidance and checklists to help them better manage, operate, and maintain their community sewer systems.

Owners of wastewater treatment facilities, as well as collection systems, including satellite systems, are required by Wisconsin Administrative Code NR 208- Compliance Maintenance 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).

Due to the excellent record of compliance of major permittees, the Department has revised its inspection strategy to allow it to focus greater attention on minor permittees who more frequently experience compliance difficulties. In November 2009, WDNR developed an updated inspection strategy. An inspection checklist was developed so that all inspections will have a minimum report which will be entered into the department database.

Cleaning out a sewer in Stoughton, WI.

Reconstruction of an old manhole in Stevens Point, WI.

Lakes

All of Wisconsin's 15,000 plus inland lakes are considered significant public resources. The great variety of lake types makes management 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 and water quality assessment, research, and community financial, organizational, educational and technical assistance. The purpose is to plan, 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 the Wisconsin Association of Lakes, who bring technical expertise, outreach and stakeholder concerns together to focus on the state's lakes.

County government is an increasingly important partner in lake management as their role grows in implementing shoreland protection, watershed management, and aquatic invasive species prevention, containment and control. The DNR and counties are working together to implement revisions to the State's Shoreland Protection Program (NR115) and new State Invasive Species Control Laws.

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. *Aquatic Plant Management in Wisconsin* is a recent significant addition to the Lake

Extension Library helping guide communities and consultants through this key aspect of lake management planning. http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp

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 7th Crew of 30 in 2008, and Crew 8 is planned for 2010. Forty citizens participated in a two-day "Advanced" Lake Leaders workshop on emerging shore land issues in October 2009.

Approximately 1,200 people are reached annually through conferences and community meetings conducted by UWEX staff. Along with DNR and the Wisconsin Association of Lakes (WAL), 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/

Aquatic Plant and Habitat Management

Nuisance aquatic plants can limit aesthetic and recreational enjoyment of lakes and replace beneficial native plants that provide food and cover for fish and other wildlife. Historically permits were issued for chemical treatment only to alleviate severe problems in specific areas; manual and mechanical harvesting went largely unregulated. Much of Wisconsin's aquatic plant management—especially preventing and managing the spread of invasives, particularly Eurasian water milfoil—relied primarily on educational efforts.

A permit is now required for all methods of control including manual and mechanical removal as well as the introduction of nonnative aquatic plants. Plan approval for enacting most control methods is required by rule.


Mechanical harvesting of aquatic plants

One key component of the renewed aquatic plant management program is a greater emphasis on protecting native species and greater focus on controlling the spread of invasive species. The increased availability of Aquatic Invasive Species Prevention and Control Grants has been instrumental in forging a more progressive aquatic plant strategy by increasing the size and scale of local management efforts.

The identification of sensitive areas for protection that provide critical or unique fish and wildlife habitat, scenic beauty and other factors has always been encouraged as part of aquatic plant management and lake planning activities. Wisconsin recently compiled standardized methods for conducting these activities statewide under the *Critical Habitat Designation* program that broadens these efforts beyond aquatic plant and fisheries management concerns to include other "public rights features", including scenic beauty and adjacent shoreland and upland habitat. These more comprehensive designations have broader applicability among the WDNR's water regulatory and management programs.

So far, 151 lakes have official Critical Habitat Designations with another 59 proposed or pending approval. 4,152 acres of designations were made on 41 lakes in the 2008-09 time period. http://dnr.wi.gov/lakes/criticalhabitat/

Clean Lakes Program Activities Support Communities

WDNR receives approximately $300,000 annually from the U.S. EPA for Clean Lakes Program Activities. Currently, this funding (section 319) is used to support Lake Program activities including:

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

Lake Assessment and Technical Assistance – Providing 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 – Support to 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.

Citizen Lake Monitoring Network an Ongoing Success

Wisconsin's Lake Partnership nurtures public involvement. High quality monitoring data supports sound management. WDNR relies on the public to gather data, and this data collected by volunteers forms the backbone of Wisconsin's lake assessment efforts. Information about the highly successful Citizen Lake Monitoring program and its 2008 monitoring results can be found in the Citizen Monitoring section of this report in Chapter C1, or online at http://dnr.wi.gov/lakes/clmn/.

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 $2.5 million is allocated annually to support a balance of locally-initiated projects ranging from data collection and development of lake management plans, specific studies and assessments, to land acquisition, local ordinance development, shoreland restoration and management plan implementation.

About $600,000 a year is invested in small and large scale planning projects through State Lake Planning Grants (Table 2).

Table 2. Wisconsin Lake Planning Grants, 2008-2009

Project Type	# Grants	Grant Amount
Comprehensive Planning Studies	89	$669,088
Water Quality/Hydrologic Studies	49	$323,078
Aquatic Plant & Habitat Assessments	36	$210,445
Education/Organizational Development	22	$78,566
TOTAL	**196**	**$1,281,177**

More than $3.5 million state dollars were invested in project implementation through State Lake Protection Grants in 2008 & 2009 (Table 3).

Table 3. Wisconsin Lake Protection Grants, 2008-2009

Project Type	# Grants	Grant Amount
Land Acquisition/Easement	8	$1,323,368
Watershed BMPs	5	$891,839
Shoreland Restoration	11	$830,153
Lake Classification	5	$250,000
Ordinance Development	2	$81,375
Diagnostic/Feasibility	1	$79,530
In-lake Restoration	1	$36,000
Wetland Restoration	1	$22,451
TOTAL	**34**	**$3,514,716**

The Lake Partnership also annually administers $4.3 million in Aquatic Invasive Species Prevention and Control Grants. Though heavily focused on aquatic plants, these grants work to protect habitat and fund or leverage a growing amount of water quality monitoring and planning.

Lake Restoration Produces Results

Approximately $100,000 in federal s. 319 Clean Lakes funds are administered by the WDNR for the remediation of 303(d) listed impaired waters. Recent projects completed or underway and the federal cost share include:

Little Green Lake Best Management Practice ($75,000)
The Green Lake County Land and Water Conservation Department completed construction of a sediment control basin that serves 327 acres, almost exclusively cropland (92%). Overall trapping efficiency is 89%, and reduces sediment loading to Little Green Lake at an average rate of 260 tons per year (210-400 lbs of phosphorus). The total cost of the project (inclusive) was $194,970. Additional funding came from a variety of project partners, the Town of Green Lake contributed $4,670, Green Lake County contributed $56,270, Great Lake Grants contributed $30,000, $1500 was raised by selling the timber, Little Green Lake Contributed $8,455, County Cost-Share contributed $19,232. The structure was built on property purchased by the Lake District

as a Conservancy/Basin site in 2005 with a 75% cost share Lake Protection Grant from the DNR.

Tainter Lake Nutrient and Sediment Reduction Project ($25,000)
A Conservation Project Specialist from Dunn County and the River Country Resource Conservation & Development Agency (RC&D) conducted a barrier/incentive analysis and tested other innovative social marketing techniques with the landowners in Grant Township. The purpose of this project was to get feed back on ways to improve participation in conservation implementation programs to reduce nutrient and sediment load as a first phase to TMDL implementation.

Lake Modeling TMDL Support ($76,320)
These funds supported development of a new version of the Wisconsin Lake Management Spread Suite (WiLMS) water quality modeling software in partnership with the U. W. Stevens Point. WiLMS provides WDNR staff and consultants with a consistent tool—specific to fit conditions in Wisconsin—for analyzing current and predicted lake water quality conditions.

Cedar Lake TMDL Update ($23,680)
With this grant the Department is partnering with the Army Corps of Engineers' Research and Development Center, the University of Minnesota, and Polk County Land Conservation to conduct two years of lake and tributary monitoring to develop a detailed lake and watershed model and nutrient budget. The federal funding complements a $200,000 State Lake Protection Grant awarded in 2007.

Lake Tomah Restoration ($25,000)
The Lake Tomah rotenone treatment and restoration project is in its final stages. On October 6, WDNR crews installed and started eleven drip barrels in the watershed upstream of the lake, to slowly add rotenone (fish toxicant) to the tributaries to kill carp and move them into the lake. The lake was drawn down to eight feet below normal pool, and a helicopter contractor aerially treated the lake with rotenone, resulting in a 100% fish kill in the lake to eliminate carp. Fish stocking of desirable species will take place in the spring and fall of 2010. The City of Tomah received a Lake Protection Grant for shoreland restoration and habitat enhancement in September. Shoreland and habitat work will begin on the ice in January with the removal of seawalls and the placement of rock and wood.


Treating Lake Tomah with rotenone to kill carp in preparation for fish restocking and restoration work. DNR Photo: Ed Culhane

Supples Marsh Restoration ($75,000)
The City of Fond du Lac will contract for fabrication of two carp barriers this winter with installation planned for the summer of 2010. The project will prevent carp from adjacent Lake Winnebago from entering Supples Marsh, the largest remaining deep water marsh connected to Lake Winnebago.

Shorelands

Shorelands and Shallows is a key initiative in the Water Division's new strategic objectives. A primary goal of the shoreland management program is to ensure clean water is available to be enjoyed for generations to come. In order to achieve that goal, minimum shoreland development standards were set in place to limit the amount of stormwater and pollutants reaching Wisconsin's lakes and rivers.


Egret. Photo: Haily Samples, U.S. Fish & Wildlife Service

Current standards are intended to protect a 35-foot deep corridor of natural vegetation along the water's edge of lakes and rivers. This corridor provides an area to slow and soak up water as it runs off of roads, driveways, and roofs, and across lawns. Water flowing over these surfaces picks up dirt, lawn fertilizers, pesticides, herbicides, toxic heavy metals, pet waste and other pollutants[5] that do not belong in lakes and rivers.

Revisions to Shoreland Protection Rules a Major Step Forward

In January 2010, forty years after they were first adopted, state shoreland development rules have been updated to better protect lakes and rivers while allowing property owners more flexibility on their land. These improvements were made after more than 30 public hearings, more than 70,000 public comments, and hundreds of hours of research, over the course of several years.

The key changes are:

- Impervious surface limitations within the shoreland zone,
- Required mitigation to offset the impacts of human activity and development in the littoral zone,
- Removal of a monetary regulation of non-conforming structures in favor of a performance-based environmental consideration,
- Strengthening of vegetative protection in the littoral zone, and
- Recognition of needed activities to control or remove exotic or invasive species from the landscape.

County governments will have two years to update their shoreland development rules to be consistent with or exceed the state's rules. These changes are setting a new course for our shoreland zones which will guide existing and future development to lesser impacts.

Why Protect Shorelands?


Denuded shoreland at a new construction site

A corridor of natural shoreland vegetation traps and filters sediment and debris from runoff. Depending on the size (length and depth) and complexity of the shoreland, 50% - 100% of the solid particles can settle out as plants slow sediment-laden runoff[6]. When natural shorelands are replaced with lawn and houses, this important filtering system is lost, allowing polluted runoff to flow directly into the lake or stream. In general, deeper shorelands are more effective than shallow shorelands, and trees, shrubs, and grasses are more effective than just grass. Most studies recommend shoreland buffers be at least 35 to 100 feet deep to help protect water quality, fisheries and wildlife habitat[6,7]. In certain cases, such as on steeply sloping sites, buffers greater than 100 feet may be required to slow and infiltrate runoff.

Wisconsin Shorelands and Shallows Stewardship

In 2004 the Water Division took on the task of developing a creative strategy to improving Wisconsin's waterways by protecting and restoring sensitive areas known as the shorelands and shallows zone - the areas where land meets water in lakes, rivers, streams and wetlands. Wisconsin has a long tradition of protecting these areas, because of their significant environmental sensitivity and important contributions to water quality and biodiversity - however Water Division staff and Wisconsin citizens observe an ongoing degradation of these sensitive areas. At the end of 2004 Water Division staff presented a draft strategy, which is still in use, highlighting several key areas: Shorelands and Shallows stewardship, the need for a scientific assessment tool, the importance of combining regulations, incentives and enforcement to protect these areas, and providing state agency leadership on DNR managed lands.

Overwhelming in the conclusion of the initial draft strategy was the need for broader engagement with partners that impact and manage shorelands and shallows around the state. Thus in June 2006, the Water Division co-hosted a Shorelands and Shallows Summit in Stevens Point with UW-Extension and the Wisconsin Lakes Association. This summit brought together approximately 80 representatives of state agencies, local government, conservation organizations, forestry, agriculture, recreation, tourism, humanities, real estate, and construction and focused on discussion of challenges and

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[5] Lehner, P., G.P. Aponte Clark, D.M. Cameron, and A.G. Frank. 1999. Stormwater Strategies: Community Responses to Runoff Pollution. Natural Resources Defense Council. New York, NY. NRDC Website

[6] Wenger, S. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation. Office of Public Service and Outreach, Institute of Ecology, University of Georgia. Athens, GA.

[7] Fischer, R.A., and J.C. Fischenich. 2000. "Design Recommendations for Riparian Corridors and Vegetated Buffer Strips." EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR-24), U.S. Army Engineer Research and Development Center. Vicksburg, MS.

opportunities for enhancing shorelands and shallows. Out of this meeting the summit planning team identified key goals and recruited partners to accomplish these ideas.

The following are some initial goals that the DNR strategy team developed in 2004, which still serve as the programs guiding principles.

1. Goal: Build common values and a sense of stewardship on shorelands and shallows by working with partners.

Performance Measures/Activities:

- Hold a Shorelands and Shallows Summit with participation from a diverse group of stakeholders.
  Completed; the Summit was held June 14, 2006 in Stevens Point.
- Engage DNR staff from all Divisions in planning the summit.
  Completed; the Summit had broad participation including from WDNR divisions.
- Complete an assessment of attitudes towards shorelands and shallows.
  In progress; currently in testing phase.
- Analyze and select a marketing approach to foster sustainable shoreline behaviors by landowners.
  In progress; currently in testing phase.

2. Goal: Support science-based decision-making for shorelands and shallows.

Performance Measures/Activities:

- Working with the Monitoring Team, develop a shoreland assessment tool.
  Not begun.
- Working with the Monitoring Team, ensure that all newly collected monitoring data is geo-referenced.
  In progress.

3. Goal: The WDNR should take a leadership role in shorelands and shallows restoration and protection on its properties and through its programs.

Performance Measures/Activities:

- Annually restore degraded WDNR-managed shorelands and shallows on two properties per region (total 10 properties per year).
  Ongoing annually.
- Annually review 20% of WDNR grants programs and modify them to promote good shoreland stewardship.
  Ongoing annually.

Waterway Regulations and Protection

The job of water regulation programs is to protect public rights and interest in our waterways, and to allow projects that will not cause harm. Water regulation means the protection of your water rights. Consider the ways in which water regulations work for the citizens of Wisconsin:

- If you enjoy fishing or boating on Wisconsin's lakes and streams, water regulations work for you. Maintaining water levels and flows, protecting habitat, and keeping streams free of obstructions help provide top quality water recreation.
- If you farm, you might use Wisconsin's waterways for irrigation or drainage. Water regulations help make your water supply and drainage capacity more reliable while protecting the water rights of others.
- If you own waterfront property, water regulations work for you. Regulating erosion control projects and dam or pier construction are a few of the programs which help people avoid dangers and unnecessary costs to themselves or other water users.

Water regulations are needed because:

- Conflicts often arise between the many different users of Wisconsin's waterways.
- Water regulations are an alternative to going to court whenever we affect or are affected by our neighbors' water related activities.
- Clear lakes and free-flowing streams are necessary for healthy fish, wildlife and human populations.

Changing Protection for Changing Water Needs

Since 1787, when the Northwest Ordinance was adopted to govern the Wisconsin Territory, the State's navigable waterways have been considered public - for the use of all citizens. Article IX of Wisconsin's Constitution provides that navigable waters are held in trust, and "forever free."

When most Wisconsinites' nearest neighbors were wolves and deer, small dams or bridges on streams had little effect on other water users. As lumbering, milling and farming drew settlers to Wisconsin, the variety of water uses and the number of users grew. By the 20th century, recreational hunting, fishing, boating and swimming increased the variety of water needs.

Over the years, the courts and state legislature have developed laws and rules for protecting the rights of waterfront property owners, as well as public rights. This body of law is known as the Public Trust Doctrine. First the Railroad Commission, then the Public Service Commission, and finally the Department of Natural Resources have been charged with the duty to protect the public trust in our navigable waters.

Today, the state helps protect your water rights as well as public safety by ensuring adequate planning and design of projects that may affect public waters. This is done through permit and plan approval requirements for individual projects. Wisconsin

Statutes, Chapter 30, "Navigable Waters, Harbors and Navigation" (PDF, Exit DNR), and Chapter 31, "Regulation of Dams and Bridges in Navigable Waters" (PDF, Exit DNR) establish the permit programs.

Sharing Responsibility for Water Protection

The DNR has Water Management Specialists in Service Centers around the state whose job is to help people understand their water rights, and to administer and enforce the laws which protect them. The Bureau of Fisheries Management and Habitat Protection in Madison provides policy development and technical support for the field staff.

The U.S. Army Corps of Engineers may require permits for dams, dikes and other structures in federal navigable waters and for the discharge of dredged or fill material into waters and wetlands. The U.S. Coast Guard regulates the construction of bridges and causeways over federal navigable waters.

Local governments use floodplain and shoreland zoning to control development along lake shores and streams. Local zoning officials administer permit programs for buildings, land disturbance and other activities in shoreland and floodplain areas.

We are all responsible for water rights protection. You can protect water rights by following proper procedures and obtaining needed permits for activities in public waters. You can also report activities which may be in violation of laws so that damages can be avoided or corrected, and voice your opinions to state and local governments to help keep water rights protection up to date.

Permits or Approvals for Shoreland Alterations

Many activities affecting navigable waters require permits or approvals from Wisconsin's Department of Natural Resources (DNR). Most of the physical alterations to navigable waters which require permits are listed in Table 4. Information and permit application materials are available online.

Table 4. Types of waterway alterations that require permits

Construction	*Recreation*	*Shoreline & Habitat*	*Water Levels & Crossings*
• Dredging • Dry Hydrants • Cranberry Projects • Grading • Intake/Outfall Structures • Miscellaneous Structures • Nonmetallic Mining • Pilings • Ponds	• Beach Maintenance • Boathouse Repair • Boat Ramp (landings) • Boat Shelter • Buoys • Pea Gravel Blanket • Piers, Docks, Wharves • Swimming Rafts • Water Ski Platforms	• Aquatic Plant Control • Beaver Damage • Cranberry Projects • Fish or Wildlife Habitat • Lake Shore Erosion Control • Streambank Erosion Control • Stream Realignment • Wetlands	• Bridges • Culverts • Dams • Fords • Diversions & Irrigation • Lake Levels • Temporary In-Stream Crossing • Utility Waterway Crossing

Dam Safety & Floodplain Management

Dam Management

Wisconsin's 3,500+ dams have a significant impact on the state's river systems. Many dams in Wisconsin serve useful purposes, ranging from the generation of power to supporting recreational opportunities and agriculture. Responsible individuals or municipalities own the vast majority of these dams. When faced with a decision to repair or reconstruct a dam, owners are always provided with a range of options, including removal. WDNR does not issue orders to remove a dam in situations where owners want to repair a failing structure and have the financial capability to do so. In selected cases the WDNR advocates for removal of a dam or may establish financial incentives to facilitate removal.

Dams can also cause water level fluctuations, changes in water temperature and oxygen levels, sedimentation leading to inhibition of fish movement, habitat loss, and fish mortality. Under the authority of Wis. Stat. NR 31, created in 1917 under the Water Power Law, the state has responsibility for and oversight of:

- Dam permitting
- Dam safety, construction, operation and maintenance
- Alteration or repair of dams
- Dam transfer and dam removal
- Water level and flow control

Dam Safety a Key Component

Wisconsin's Dam Safety Program was developed under Chapter 31 to ensure that dams are safely built, operated and maintained. State Natural Resources regulations provide structure to the program. **NR 330** regulates signing at dams, **NR 333** provides design and construction standards for large dams, **NR 335** covers the administration of the Municipal Dam Repair and Removal Grant Program, and **NR336** covers the administration of a program to remove abandoned dams or provide grants to any dam owner who wants to remove their dam.

A WDNR dam safety engineer inspects the Neshonoc Dam on the LaCrosse River

The authority under Chapter 31 includes approval of plans for dams, alteration or additions to existing structures, and dam removal. Chapter 31 requires the owner of a dam to operate and maintain their dam in a safe condition. The owner can initiate repair, reconstruction or removal actions.

Statutes give the department the authority to inspect any dam in the state and require the department to inspect some large dams once every 10 years. Chapter 31 was

recently revised to also require owners of large dams to have their dams inspected on a periodic basis, based on the hazard rating of the dam.

Dam Removal Can Provide Economic & Ecological Benefits

The decision to remove a dam is usually an economic decision made by the dam owner. Dam removal, which requires WDNR approval, must follow specific guidelines to assure protection of life, health, and property, as well as the surrounding environment. There is also a public notice component which would allow entities that want the dam to remain to try to take responsibility for the dam.

In the last 20 years, 100 dams have been removed from the state's waterways. Most of these were economic-based decisions made by the dam's owner or were abandoned dams where a responsible owner could not be found. There is a growing awareness of the negative effects dams can have on river ecosystems. Where dams have been removed, many sites have shown significant improvements in water quality, habitat and biodiversity. In recent years, the DNR has been more proactive in discussing potential habitat and water quality benefits from dam removal. Integrated management plans identify rivers that would benefit from dam removal in a given basin. WDNR has worked with partners to advocate for the removal of a dam or helped establish financial incentives to facilitate removal.

Dam Relicensing Ensures Safety

The Federal Energy Regulatory Commission (FERC) is responsible for licensing the state's hydropower plants and reviews the 30- to 50-year-old leases to ensure that they meet federal regulations for safety and resource protection. Most facilities operate under interim annual licenses until FERC completes its reviews. DNR is actively involved in the FERC relicensing. The Department's regulatory role was expanded through Federal court cases to require facility receipt of a State water quality certification under Section 401 of the Clean Water Act. FERC facilities must evaluate both direct and indirect impacts to water quality, reflecting a recognition of the role of nearby land use on water quality, for example. Issuing a Water Quality Certification requires the applicant to conduct studies and provide information about intentions concerning anticipated changes in land use of owned properties near the dam and reservoir. Utilities often own substantial acreage of wild and scenic property adjacent to the dam and reservoir.

Floodplain Management Protects People and Property

The goal of Wisconsin´s Floodplain Management Program is to protect people and their property from unwise floodplain development, and to protect society from the costs which are associated with developed floodplains. The department also partners with the Federal Emergency Management Agency (FEMA) to implement the National Flood Insurance Program (NFIP). Through floodplain zoning and the NFIP, local governments regulate how development can

Flooding at Madison Area Technical College (Sept. 2009)

actually occur within floodplains. Under this program, counties, cities and villages are required to zone their flood-prone areas. The state has set minimum standards for local regulation, but local governments can set more restrictive standards.

A Victorian home in Soldier's Grove, WI being elevated to protect it from flood events (Fall, 2008).

The basis for decision making in floodplain management is floodplain mapping. In the past, these maps were produced by FEMA and distributed on paper. In 2003, FEMA implemented the Map Modernization Initiative to upgrade the map development process so that the maps would be created and distributed in a GIS format rather than on paper. In addition, the best available terrain data were used in the mapping process, which results in higher quality mapping products than were previously available. The new digital product is called a Digital Flood Insurance Rate Map (DFIRM).

Since 2001, the department has been a cooperating technical partner in FEMA's effort to modernize and improve floodplain maps in the state. To date, work is in progress or complete for new floodplain mapping in 52 counties and preliminary maps have been delivered to the communities in 45 counties. New maps will be effective in 33 counties by the end of the 2010.

Lake Delton, an impoundment in south central Wisconsin, breached through an adjacent county highway (at arrow) and emptied into the Wisconsin River in June 2008. These photos show 'before' and 'after' conditions (June 4 and Aug. 8). Emergency measures were taken to protect residents, and lake levels and an improved fishery have since been restored.

Water Evaluation: Water Quality Standards & Assessment

The activities of the **Water Evaluation Section** form the core of Wisconsin's Clean Water Act Programs. The Clean Water Act identifies water quality goals for the nation and outlines processes and legal foundations for monitoring, assessment, and management to ensure water protection and use for a variety of purposes.
Water quality information is obtained by measuring current conditions, such as the number and type of fish present, against a set of criteria or quality guidelines that identify expected values for a range of condition from excellent to poor quality. The guidelines are derived based on the water quality standards, use designations and related water quality criteria established in code. Water quality standards for surface waters are described in Chapters NR 102, 104, and 105 of the Wisconsin Administrative Code.

Water Quality Standards Define Our Goals

Water quality standards are the foundation of the water quality-based pollution control program mandated by the federal Clean Water Act. Specifically, standards help to identify water quality problems in streams, rivers, or lakes that may have been caused by human activities like improperly treated wastewater discharges, runoff or discharges from active or abandoned mining sites, excessive sedimentation from runoff of soil, over-application of fertilizers and chemicals from agricultural areas, or erosion of stream banks caused by improper grazing practices.

Water Quality Standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. A water quality standard consists of three basic elements:

- Designated uses of the water (e.g., fish and aquatic life, recreation, fish consumption) (see below),
- Water quality criteria to protect designated uses (numeric pollutant concentrations and narrative requirements), and
- An antidegradation policy to maintain and protect existing uses and high quality waters.

Water quality standards for surface waters are described in Chapters NR 102, 104, and 105 of the Wisconsin Administrative Code. These rules include general policies and detailed provisions describing implementation issues such as mixing zone provisions, variances, etc.

Classifying waters according to their Designated Uses

Under the Clean Water Act, each waterbody is classified according to its Designated Uses. Assigning a use designation, such as Fish and Aquatic Life, is one of the first steps in managing water quality. Designation is a scientific process that involves evaluation of the resource and its natural characteristics. Each Use Designation category carries with it a set of goals with expectations for a waterbody's performance. For some designations, such as Fish and Aquatic Life, detailed sub-categorization occurs to classify the water according to its specific potential.

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. Currently, Wisconsin recognizes five subcategories of Fish and Aquatic Life Use Designations; these are described in detail in Table 11 in Section C2 of this report.

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 water bodies are also identified as public water supplies and have associated water quality criteria to account for human consumption[8]. *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 rely on it to provide food for existence.

Assessing Wisconsin's Waterbodies

See Section C2 of this report for a detailed description of Wisconsin's waterbody assessment program.

Water quality standards are used in assessing the condition of waterbodies. Detailed discussion of this process is found in Section C2 of this report.

The first level of evaluation is a *General Condition Assessment* that determine whether a waterbody is in Excellent, Good, Fair, or Poor condition. The second level of evaluation is an *Impairment Assessment*, to determine whether a waterbody should be included on the 303(d) Impaired Waters List. Results of this process are reported in Section C3. Additionally, waters in Excellent condition may be eligible for Outstanding or Exceptional Resource Water status, described below.

Impaired Waters Program – The First Step Toward Improvement
Section 303(d) of the Clean Water Act requires states to list water bodies as impaired if they are not meeting water quality standards or use designations after application of technology-based standards. This list is due to the U.S. EPA every two years. The Impairment Assessment process described in Section C2 of this report enables WDNR staff to determine which waterbodies should be proposed for the 303(d) Impaired Waters List. Results of that process for the 2010 listing cycle are included in Section C3 of this report, with the actual proposed list shown in Appendices A and B. Once waterbodies are listed as Impaired, an analysis of pollutant levels and sources is done, called a Total

[8] 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.

Maximum Daily Load (TMDL) analysis. This is described in Section C3B of this report. Implementation of management plans is then undertaken with the goal of restoring waterbody health to a level where they are no longer considered Impaired and can be removed from the Impaired Waters List.

Outstanding & Exceptional Resource Waters – Protecting the Best
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 warrant additional protection from the effects of pollution. These designations are intended to meet federal Clean Water Act obligations requiring Wisconsin to adopt an "antidegradation" policy that is designed to prevent any lowering of water quality – especially in those waters having significant ecological or cultural value.

Of Wisconsin's over 15,000 lakes, 103 are designated as ORW—fewer than 1%. Of Wisconsin's 53,413 streams and rivers, 254 are designated as ORW, and 1,544 are designated as ERW. However, it can be more useful to consider stream statistics in terms of the number of stream miles rather than number of streams, since streams can be of widely varying lengths. Wisconsin has a total of ~42,000 stream/river miles in the state. Based on the current ORW/ERW list, a total of 3,179 stream miles (7.6%) have been designated as ORW, and 4,668 stream miles (11%) have been designated as ERW.

Table 5. Number of ORW/ERW Waterbodies (2009)

	ORW (# of waters)	ERW (# of waters)
Streams	254	1,544
Lakes	97	NA
Impoundments	6	NA
Total	**357 ORW**	**1,544 ERW**

Laying the Foundation for Management Actions

Once the water condition is established, management actions are planned or carried out, such as point source discharge limits or placing a waterbody on the state's impaired waters list. Standards developed in this program also support efforts to achieve and maintain protective water quality conditions, including:

- Total maximum daily loads (TMDLs), waste load allocations (WLAs) for point sources of pollution, and load allocations (LAs) for non point sources of pollution,
- Water quality management plans which prescribe the regulatory, construction, and management activities necessary to meet the water body goals,
- NPDES water quality-based effluent limitations for point source discharges,
- Water quality certifications under CWA § 401 for activities that may affect water quality and that require a federal license or permit, and
- Reports, such as the reports required under CWA § 305(b), that document current water quality conditions.
- CWA § 319 management plans for the control of non point sources of pollution.

Science and Innovation – Research In Action

During 2008 and 2009, 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:

The use of satellite remote sensing for monitoring Wisconsin lakes
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.

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 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.

Development and validation of macroinvertebrate-based index of biotic integrity (IBI) for Wisconsin's nonwadeable rivers
The macroinvertebrate IBI will be designed to detect watershed and local stressors on river ecology. This rapid bioassessment tool is proposed for use within the Bureau of Watershed Management's Assessment Methodology Program framework for U.S. Environmental Protection Agency Clean Water Act reporting (303d, 305b) and TMDL monitoring.

Evaluation of agricultural and urban best management practices within Water Division's Priority Watershed Program
We are 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.

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.

Paleolimnological study of inland lakes
This study is assessing the impact of watershed and shoreline development on the 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 the 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.

National Lake Assessment project
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.

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.

Implementation and interpretation of lakes assessment data for the Upper Midwest
In this study, we evaluated the sensitivity of various biological indices to anthropogenic stressors at various spatial scales, to progress toward developing a comprehensive bioassessment strategy for application to Wisconsin lakes. Wisconsin has over 15,000 lakes and is representative of the northern Lakes area of the upper Mid-West that includes lakes in Minnesota and Michigan. The first component of the study addresses issues of statistical methodology and geographic scale in development of a lakes classification framework for lake assessment. The second component evaluates relations between potential biological indicators, habitat-based indicators, and water quality based indicators and anthropogenic stressor variables. The third component tests concordance between stressor variables and three alternative sets of lake assessment tools based upon bioassessment, habitat, and traditional water quality measures of lake ecosystem condition. These tools will be evaluated for power and sensitivity to detect responses to anthropogenic stressors within defined lake classes at multiple spatial scales.

U.S. Environmental Protection Agency National Rivers and Streams Assessment nonwadeable rivers project (2008-2010)
In this study, diatoms will be used to assess stream and river nutrients and biological integrity, which will inform nutrient and runoff management decisions, as well as listing/delisting of impaired waters.

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 us to assess plant communities in individual lakes and to understand effects of human activities on lake communities statewide. Since 2006, we coordinated the collection of baseline aquatic plant data with regional lakes staff. This effort resulted in the collection of standardized plant data for 150 lakes in the Baseline sampling program and provided training to regional staff on a new plant

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.

B3. 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.

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.

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 2009, the CWFP entered into 721 financial assistance agreements with Wisconsin municipalities totaling $3.2 billion--$3.0 billion in loans and $194.5 million in grants and principal forgiveness. In addition, the CWFP has executed agreements with 61 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. For Federal Fiscal Years (FFY) 2009 and 2010, in order to meet requirements contained in the American Recovery and Reinvestment Act and the FFY 2010 appropriations bill for EPA, the CWFP is also providing principal forgiveness to some municipalities.

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.

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 2009, the SDWLP entered into 133 financial assistance agreements with Wisconsin municipalities totaling $338.5 million--$310.1 million in loans and $28.4 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 to 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.

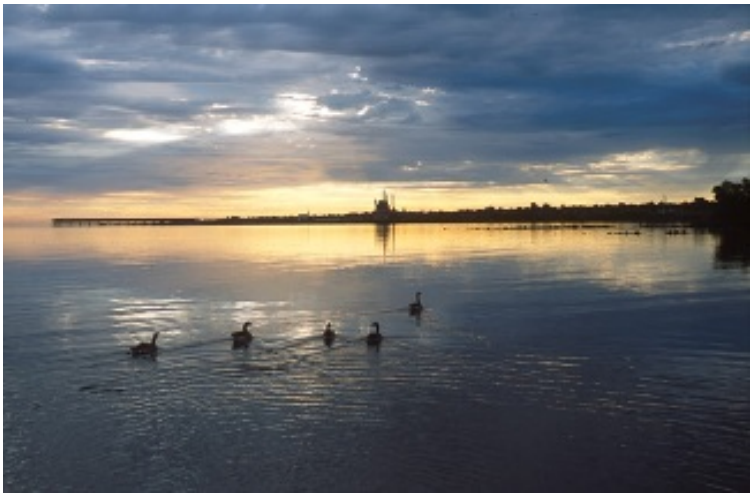
- Create a new community water system or expand an existing community water system that, upon completion, will address existing public health problems with serious risks caused by unsafe drinking water provided by individual wells or surface water sources. These projects are limited in scope to the specific 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. For Federal Fiscal Years (FFY) 2009 and 2010, in order to meet requirements contained in the American Recovery and Reinvestment Act and the FFY 2010 appropriations bill for EPA, the SDWLP is also providing principal forgiveness to some municipalities.

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.

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 2010 (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. The WDNR has acquired 1,395 fishery easements to protect 13,824 acres of land along stream corridors around the state. 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. This program has funded approximately $3.3 million for purchase of 78 easements totaling 1,687 acres (as of July 2009).

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.

Runoff Management Implementation Programs

Runoff Management Grants

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 of Chapter B2 in this report.

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

- Priority Watershed/Lake Program (ended 2009)
- Targeted Runoff Management (TRM) Grant Program
- Urban Nonpoint Source and Storm Water Grant Program
- Notice of Discharge (NOD) cost sharing

Financing Runoff Performance Standards Compliance

Currently, a major effort is under way to revise the runoff-related Performance Standards contained in Admin. Code NR 151. Implementing and enforcing the existing performance standards along with the new modifications to these standards will require a significant expenditure to realize significant reductions in polluted runoff. As part of both the initial 2002 rulemaking package and the current (2009) rulemaking package for NR 151 Performance Standards, detailed fiscal estimates were prepared. The detailed fiscal information can be obtained from the WDNR Runoff Management Section.

B4. Special State Concerns

****See Section A1 of this report for Wisconsin's Recommendations to U.S. EPA and Congress.**

Along with Wisconsin's water pollution control program areas described in Section B2, Wisconsin places special focus on certain geographic areas of concern (such as the Great Lakes and Mississippi River) and key issues affecting the state. These are described below.

Great Lakes

Wisconsin is truly defined by the Great Lakes, having over 1,000 miles of shoreline along Lake Michigan and Lake Superior and more than 30% of the state's land area within the Great Lakes basin. Over 50% of our population lives within this area. The Great Lakes serve as a critical source of drinking water and for industrial and commercial process and cooling water. They support a significant transportation system and are highly desirable tourist destinations for fishing, boating and recreating.

Courtesy of: MODIS Rapid Response System

In 2004 the WDNR established the Office of the Great Lakes to focus Water Division efforts on this important feature of Wisconsin's water resources, and to serve as liaison to other WDNR programs on issues related to the Great Lakes. The Office of the Great Lakes manages a Great Lakes monitoring program that includes collection of water quality, sediment, phosphorus, and nutrient data. Monitoring efforts include a tributary monitoring program to analyze long term trends for phosphorus loads to Lake Michigan. Monitoring efforts also include a Lake Michigan nearshore water quality survey from 2004 to 2007 to understand Cladophora and associated water quality parameters.

Keeping mercury and medicine out of the waters has been another important initiative undertaken by the Office of the Great Lakes. With a grant from the Great Lakes Protection Fund, Green Bay Metropolitan Sewerage District worked with dental offices in Brown and Outagamie counties to provide rebates for installing amalgam separators. Amalgam is the material of silver dental fillings and contains approximately 50% mercury and 50% other metals. The separators can reduce the amount of amalgam flushed down the system by as much as 95%. The captured mercury is then recycled. Unused

or outdated medicines often end up in waste water treatment facilities because people flush them down the toilet mistakenly thinking that the facilities can filter them before discharging to waterbodies. Several cities in Wisconsin are giving people an alternative by collecting old medicines. About 3.5 tons of medicines were turned in during a Milwaukee area collection alone.

Collaboration is an important component to restoration and protection efforts in the Great Lakes basin. The WDNR has built strong partnerships through local groups such as those working to remove sources of impairments to beneficial uses in Areas of Concern. These groups and others have been instrumental in the development of project proposals under the Great Lakes Restoration Initiative provided by the Obama Administration to U.S. Environmental Protection Agency's 2010 budget. If funded, these projects will represent the start to the implementation of the Great Lakes Regional Collaboration Strategy and Wisconsin's Great Lakes Strategy both developed with the help of scores of people around the State. Continued focus on the issues framed in these two Strategies and through the combined efforts of all stakeholders will ensure that we leave the Great Lakes system in good health for current and future generations.

Great Lakes Compact Implementation Moves Forward

On May 27, 2008 Governor Doyle signed 2007 Wisconsin Act 227, ratifying the Great Lakes-St Lawrence River Basin Water Resources Compact (Compact) in Wisconsin. Act 227 also directs the Department to implement the Compact in Wisconsin, including several new requirements related to water use in the state, such as:

- Statewide registration of water supply systems with the capacity to withdraw an average of 100,000 gallons-per-day or more in any 30-day period;
- Statewide annual water use reporting for all persons withdrawing 100,000 gallons per day or more in any 30-day period;
- Requiring water use permits for Great Lakes basin withdrawals exceeding 100,000 gallons-per-day;
- Developing and implementing a decision-making standard to evaluate proposals for new or increased withdrawals exceeding 1 million gallons-per-day;
- Developing and implementing a statewide water conservation and efficiency program;
- Requiring water supply service area plans for any public water system serving a population of 10,000 or more;
- Instituting a public participation process for water use permitting and diversion applications;
- Developing a water resources inventory consisting of information about the waters of the state, including information about the location, type, quantity, and uses of water resources.

The Department has created a new Water Use program within the Water Division's Bureau of Drinking Water and Groundwater to implement the Compact and the companion state legislation.

The Water Use Section has compiled baseline withdrawal data on water supply systems within the portion of Wisconsin lying within the Great Lakes Basin that have the capacity to withdraw 100,000 gallons-per-day, and has submitted this information to the Council of Great Lakes Governors.

In addition, the Water Use Section is in the process of drafting administrative rules to implement the Compact in Wisconsin, including rules pertaining to water use registration and reporting, water conservation and efficiency, water supply service area planning, public participation, water loss, and water use permitting. Water use permits will be required effective December 8, 2011 for persons withdrawing an average of 100,000 gallons-per-day or more in any 30-day period within the portion of Wisconsin lying in the Great Lakes basin.

The Water Use Section has also worked in concert with the Wisconsin Department of Commerce and the Public Service Commission to compile water conservation and efficiency goals and objectives for the state, and is developing a statewide water conservation and efficiency program.

Water Quantity Issues

While Wisconsin generally has abundant water resources over most of the state, there are isolated areas where excessive groundwater pumping has resulted in impacts to surface water bodies and springs and has reduced the availability of good quality drinking water. Concern over impacts to springs and valuable surface water resources as a result of a proposed water bottling operation in central Wisconsin led to the 2004 adoption of comprehensive groundwater quantity legislation (2003 Wisconsin Act 310). Act 310 expanded the authority of the Wisconsin Department of Natural Resources (WDNR) in regard to high capacity wells to include reviews of certain high capacity wells to ensure that proposed wells do not cause significant adverse environmental impacts to large springs, trout streams and other high quality surface waters. The law also designated two regional groundwater management areas for which a coordinated water management strategy is needed to alleviate pressures of increasing water demands and ensure sustainable future water supplies. These areas, one centered on Waukesha County in Southeast Wisconsin and the other near Brown County in Northeast Wisconsin, have experienced several hundred feet of groundwater drawdown which has resulted in impacts to surface waters and springs and has contributed to water quality problems in the deep aquifer.

In late 2009 the Wisconsin legislature began considering changes to the groundwater quantity provisions of the statutes which would build on the protections created under 2003 Wisconsin Act 310. The legislature is contemplating detailed provisions related to designation of areas with groundwater quantity problems in addition to the two groundwater management areas mentioned previously, along with mechanisms and guidance for completing coordinated planning and water management activities within those areas. In addition, the legislature is considering further expansion of the WDNR's authority over high capacity wells by broadening the scope of waters considered in the review of high capacity wells and enlarging the area within which the department must consider the significance of impacts.

Aquatic Invasive Species

In June of 2009, WDNR submitted its *2007-08 Summary Report to the Legislature on Aquatic Invasive Species*. This report provides information, maps, and fact sheets about each of the major aquatic invasive species that Wisconsin is contending with. The following is an excerpt from this report. View the entire report online at http://dnr.wi.gov/lakes/aisreport2008/index.asp?page=Introduction.

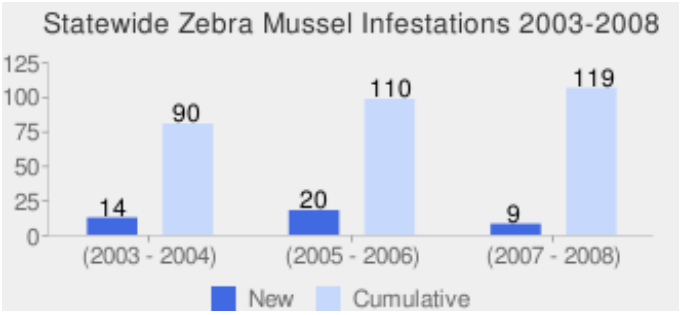
Our Waters

Wisconsin is working hard to slow the spread of aquatic invasive species in our lakes and rivers. Once these species become established in a waterbody it is basically impossible to eradicate them, so preventing their spread is the best strategy. DNR staff and citizens throughout Wisconsin help this effort by monitoring lakes and rivers for the most problematic aquatic invasive species. DNR uses this data to make management decisions, and to educate boaters and anglers. We also use it to evaluate our work, because, ultimately, our success will be measured on the landscape. Our goal is to keep established invaders like zebra mussels and Eurasian water-milfoil from spreading, and to keep new invaders like quagga mussels and Asian carp from crossing our borders. There is reason for optimism. The majority of our waters are still free from the most problematic species, and our data show that the rate of spread for several key species has slowed in recent years.

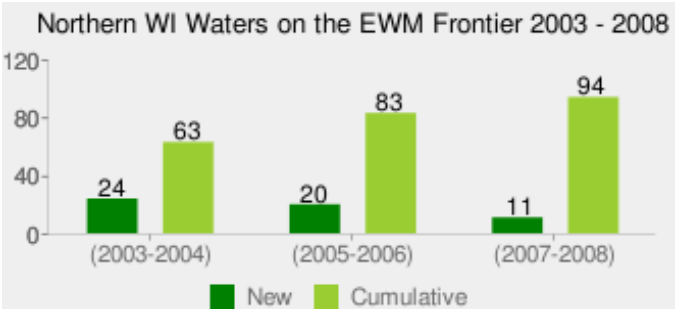
Controlling Aquatic Invasives in Wisconsin Waters:

- **75%** of our lakes with public access are free of Eurasian water-milfoil and zebra mussels
- **120** inland waters have zebra mussels
- **479** waters have Eurasian water-milfoil
- **0** new waters with VHS virus in 2008. Disease successfully contained in Lake Winnebago and Great Lakes

Figure 7. Zebra Mussel and Eurasian Water Milfoil spread, 2003-2008



Zebra mussels have been monitored and reported on by the DNR and citizens for years, so the number of new discoveries per year helps measure the effectiveness of prevention and containment efforts. In recent years, the rate of new infestations has slowed.



Even though Eurasian Water Milfoil (EWM) is well established in many Southern Wisconsin waters, we are slowing its spread to Northern Wisconsin waters on the frontier of its invasion.

Our Partners

The fight against aquatic invasive species in Wisconsin is truly a team effort. State agencies, universities, county governments, Native American tribes, non-profit organizations and citizens all play a vital role in preventing the spread of aquatic invaders. The many dedicated volunteers who willingly spend their weekends and holidays educating boaters or conducting plant surveys deserve special recognition. They form the backbone of Wisconsin's campaign to prevent the spread of aquatic invasive species and are a testament to the passion and dedication that our lakes inspire.

Partnerships at all levels allow us to leverage our investments and complete key activities—such as watercraft inspection, lake monitoring, and biological control of purple loosestrife—efficiently. Partners also help us direct our resources toward strategic goals. The DNR and its partners are working to increase our focus on "source waters" such as the Great Lakes, Lake Winnebago and the Mississippi River. These large and heavily used waterways contain species that we do not want to see in the rest of the state, and we are working with our partners to build a "culture of containment" to ensure that those species do not spread.

Our Investments

Over the past several years Wisconsin has increased its financial commitment to fight aquatic invasive species. The majority of those funds are distributed through aquatic invasive species grants administered by the DNR. While the amount of state money invested in these grants is impressive—over $10 million since the first grants were awarded in 2003—that is only the beginning of the story. Grant recipients are required to provide matching funds (50% through 2007, 25% 2008 and beyond), so the total amount leveraged is actually much higher. Many recipients dramatically exceed the minimum required match, yielding an even greater return on the state investment. DNR works closely with grant applicants and partners to ensure that these dollars are being invested strategically in projects that further the goals of preventing the introduction, limiting the spread, and minimizing the damage from aquatic invasive species throughout Wisconsin.

Investing in Local Communities:

- **$4.3 million** in DNR grants available annually to local communities for aquatic invasive species prevention and control
- **$10.5 million** in DNR grants since 2003 to local communities for aquatic invasive species prevention and control

Bolder Goals for 2010

Wisconsin's goals build on what is working. We will learn from investments in research and listen to our partners in setting bolder goals for AIS prevention, containment and control. For the first time Wisconsin is ready to set resource-based goals to reduce the invasion rate of our most troublesome invasive species, to contain new threats from the Great Lakes and Mississippi River and to discover better control strategies for Eurasian water-milfoil.

To help us achieve these goals we will:

- **Strengthen local, county and state partnerships** - State partnerships with local units of government, especially counties, is an effective way of heightening awareness, changing boater behavior and networking with citizens and citizen-based organizations. We will continue to invest state AIS Prevention Grant funds with interested counties and explore regional and basin approaches for expanding the network to areas along the Great Lakes, the Mississippi River and other source water areas where local partnerships are lacking.

- **Enhance watercraft inspection** - Wisconsin's Water Guard creates an enforcement presence that compliments citizen-based Clean Boats, Clean Waters watercraft inspection. We will continue to support and seek opportunities to expand the outstanding work of the Water Guard and the Clean Boats, Clean Water Network. Smart Prevention research will guide watercraft inspection statewide and locally by helping to identify waters that are most susceptible to invasive species. We will seek to create a Culture of Containment by investing in paid watercraft inspectors on source waters where volunteer efforts are lacking. Importantly, we will seek to regulate and control ballast water discharge to the Great Lakes.

- **Increase AIS monitoring/tracking** - Early detection can lead to rapid response in controlling pioneer invasions. Using renewed funding in Governor Doyle's Budget, we will expand citizen-based monitoring networks for lakes, streams and wetlands for early detection as well as to guide control projects and report on the status of invasive species in our waters. We will continue to be vigilant for VHS. Web-based maps and reports will update continuously and be made available to our partners through "GovDelivery" which notifies customers of updates.

- **Create a campaign to change behavior** - Anglers and boaters must change behavior to Stop Aquatic Hitchhikers. We will use media research to target awareness-heightening campaigns along with community-based social marketing techniques to reach this audience and achieve prevention behavior. We will earn media coverage by creating local watercraft inspection events.

- **Provide assertive response to contain and control Eurasian water-milfoil** - We will work with our partners to achieve better environmental outcomes on projects aimed at controlling new and established stands of Eurasian water-milfoil. AIS Control Grant funds will be available up-front to local sponsors to respond to new infestations quickly. Together we will track the effectiveness of control strategies regionally on new and established populations undergoing control. Discoveries will be shared so others can learn what leads to nuisance conditions and what works to control them in our lakes.

Riparian Development

Few natural scenes are more treasured than a golden sunrise over a mist-covered lake. Perhaps it is the sense peace this scene provides that, ironically, has resulted in the tremendous changes in the state's shoreland areas. The sense that many, if not most, of the state's lakes and increasingly its riparian shore areas were fully or nearly completely developed prompted the WDNR to initiate its Northern Initiative in the early 1990s. Surveys in 1994 and 1995 indicated that residents and visitors were very concerned about retaining northern Wisconsin's wild and scenic qualities. Follow-up surveys of land use change in the northern part of the state confirmed suspicions that undeveloped riparian areas were being lost at a rapid rate. Generally, land cover data and land use analyses show extraordinarily rapid growth throughout the entire state. Development pockets are occurring in the Milwaukee to Madison corridor, the Fox Valley/Green Bay area, the Hudson/Eau Claire/Chippewa Falls region (tributary to the Twin Cities) and a generalized growth pattern stretching across the entire northern portion of the state. Within each of these areas and beyond, land values for shorelands have escalated while the same land parcel becomes even more critical (as it becomes more rare) for its ecological functions.

Shoreland Rule Updates A Major Step Forward

A critical step toward protecting lakes and rivers while allowing property owners more flexibility on their land was completed In January 2010, with an update to state shoreland development rules. These rule updates are discussed in Chapter B2 of this document, under the *Shorelands* section.

Working with Communities and the Public

Many local communities have adopted local land use policies that exceed the state minimum standards recognizing the need to protect Wisconsin's resources, however, turnover is often high in local government. As a result there is a continuous need to provide education and training to local governments.

Private property rights groups are becoming more active in the State, and many local communities are turning to the Department for help in understanding the legal implication of proposed regulations, as well as implications of State and Federal Supreme Court cases. Concerns range from regulation and takings to when a variance can be issued. Education and training is needed for local Corporation Counsels, as well for the general public. Land prices have skyrocketed surrounding Wisconsin lakes and rivers. One result is that it is more expensive to preserve the remaining undeveloped land, and the State is often at odds with developers for the same piece of land. The other problem is more and more people are turning to "marginal" pieces of property to develop, often with large areas of wetlands that are difficult to develop and often, the landowners have unrealistic expectations of how the property can be managed.

Ongoing Initiatives Provide Land Use Oversight

In addition to the recent regulatory updates, several initiatives, at the federal, state and local levels, are ongoing to address the issue of land use generally—and riparian development specifically—including:

- **The Northern Initiative** (WDNR), a geographically-based framework for focusing interest and resources on preserving the fundamental values of wild places in the north;

- **Land Legacy** (WDNR), a proposed 50-year land acquisition framework for public land purchase and easement development in the state;

- **Conservation Reserve and Enhancement Program** (Federal), a federal match program to secure buffers through easement and acquisition;

- **Smart Growth** (Local), a series of state level requirements for comprehensive planning and the local level which involves identifying key natural resource features in a community. This may result in some type of local protection for key riparian resources.

- **Shoreland Management Program** (State/Local). In the 1960s Wisconsin established an administrative code known as "NR 115" to protect water quality, wildlife habitat and natural shoreline beauty through statewide minimum standards for land uses and development adjacent to lakes, rivers and streams in unincorporated areas. NR 115 was implemented via mandated county shoreland ordinances. NR 117 is a similar provision applying to shoreland-wetlands in incorporated areas. NR 118 covers shoreland management associated with the Lower St. Croix Riverway.

- **Lakes Planning, Protection and Classification Grants** (State/Local) have provided funds for careful resource planning and protection at the local level, resulting in initiatives designed to meet the resource protection needs of lakes based on waterbody characteristics and development potential.

- **Rivers Planning and Protection Grants** (State/Local) have provided funds to protect rivers through resource planning at the local level to help prevent water quality, fisheries habitat, and natural scenic beauty from deteriorating as residential, recreational, industrial and other uses increased along rivers.

Lake Tomahawk

Mississippi River

Environmental Management Program - Long Term Resource Monitoring Program


Two USGS workers seining the Mississippi River

The Long Term Resource Monitoring Program (LTRMP) was authorized by Congress in 1986 as part of the U.S. Corps of Engineers' Environmental Management Program on the Upper Mississippi River (UMR). This program is being implemented by USGS with assistance and field support by the five UMR States (MN, IA, WI, IL and MO). It has been in place since 1988 and provides information on water quality, vegetation, fisheries and land-cover/land-use and other resource information used to assess the trends and ecological health of the River. The Department's field station at La Crosse, WI carries out this monitoring program.

In 2009, an updated Strategic and Operational Plan for the LTRMP 2009--2014 was approved by the partnership. The plan defines a process for prioritizing research and also reinstates some fisheries and water quality monitoring that was cut in the previous plan.

LTRMP Reports

- 2007 Fish Life History Report
- 2008 Vegetation Indicators Report
- LTRMP Data and Reports

Major products and reports or publications completed in 2007 –2009 have included:

- Annual data summaries for fish, water quality, and vegetation for each year;
- The second program-wide Status and Trends Report, which includes 24 indicators of ecological condition for the upper Mississippi and Illinois Rivers and uses LTRMP data through 2004;
- A 2009 USGS report, Nonnative Fishes in the Upper Mississippi River System, which relies on LTRMP fish data from all 6 state field stations, including Wisconsin's;
- An updated LTRMP fact sheet (http://pubs.usgs.gov/fs/2009/3045/) ;
- Refined indicators to be used in the 2010 Report To Congress and future Status and Trends Reports for the Environmental Management Program;
- A Fish Data graphical browser, which is user friendly for the river managers and the public, which continues to be updated (related: Water Quality Fixed Site graphical browser and Water Quality Random Site Graphical Browser; *Aquatic Vegetation Graphical Browsers)*; and
- A manuscript about aquatic vegetation as related to habitat rehabilitation (island building) projects in Lower Pool 8.

US EPA Great River Environmental Monitoring and Assessment Program (EMAP-GRE)

The Great River EMAP project was an EPA-led demonstration project in cooperation with state resource agencies to develop biological methods for assessing the condition of the Mississippi, Missouri and Ohio Rivers (Angradi et al. 2009[9]). Wisconsin's LTRMP field station was directly involved in comprehensive field surveys and evaluation of fish sampling and assessment protocols. It also worked with Minnesota DNR in the development of a biotic index for submersed aquatic vegetation that utilized a hybridization of sampling designs from EMAP and LTRMP.

US EPA developed river-specific biological indices for fish and macro-invertebrates based on sampling in the main channel border using day time electro shocking of fish and collecting marcroinvertebtrate samples with D-framed nets along shore (Angradi et al. 2009[10] and Angradi et al. 2009[11]). An example of the fish and macroinvertebrate results for the Mississippi River reach extending from the Twin Cities, Minnesota to Dubuque, IA are illustrated in Figure 8A and B for years 2004-06. The biotic index for submersed aquatic vegetation is presented in Figure 8C and represent samples collected from the main channel and side channel borders over this same reach of river during the summers of 2006-08.

The results from the three biotic communities are segmented into six assessment reaches (2-7), which represent segments of the Mississippi River between major tributary inflows (Minnesota, St. Croix, Chippewa, Black, Root and Wisconsin Rivers). The results from all three biotic indices indicate a generally lower quality in the river's condition in assessment reaches adjacent to or immediately below the Twin Cities area. This is consistent with previous water quality surveys which have indicated greater pollutant inflows associated with the Minnesota River and the Twin Cities Metropolitan Area.

Fish sampling methods used to derive the Great River fish index EMAP differed from those used in fish biotic indices for large rivers by the Minnesota Pollution Control Agency (MPCA) and WDNR (Lyons et al. 2001[12]). Wisconsin LTRMP Field Station cooperated with MPCA to evaluate method differences. In general, greater differences in the assemblage of fish collected were observed between EMAP and Wisconsin methods and were primarily attributed to boat speed and dipnet mesh size. Wisconsin will be working with Minnesota and others states through the Upper Mississippi River Basin Association Water Quality Task Force to develop consistent methods for conducting and evaluating future biological assessments for Clean Water Act reporting on the Mississippi River, an important goal identified in Wisconsin's strategic monitoring plan for the river.

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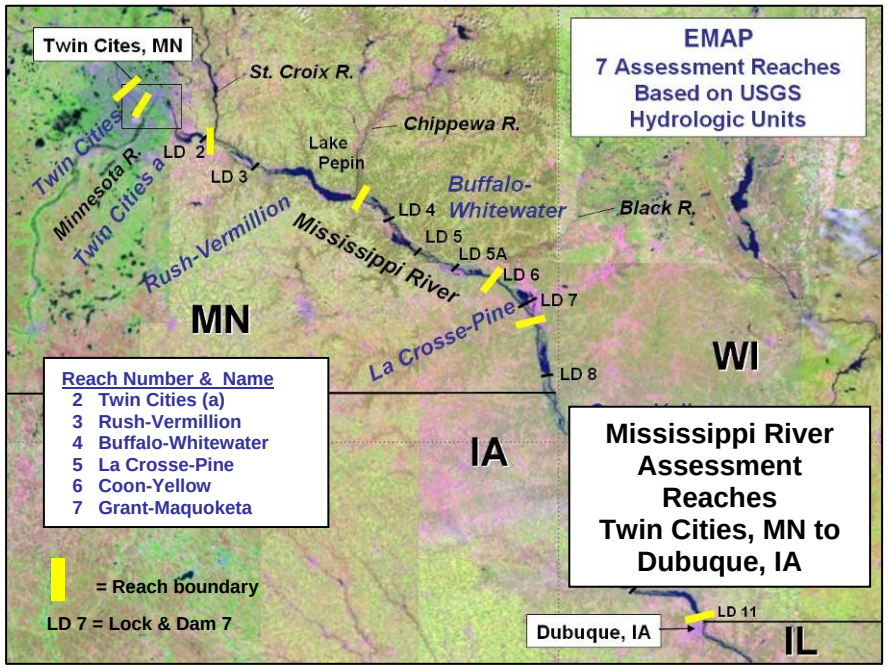
[9] Angradi, T.R., Bolgrien, D.W., Jicha, T.M., Pearson, M.S., Hill, B.H., Taylor, D.L., Schweiger, E.W., Shepard, L., Batterman, A.R., Moffett, M.F., Elonen, C.M., & Anderson, L.E. 2009[a]. A Bioassessment Approach for Mid-Continent Great Rivers: the Upper Mississippi, Missouri, and Ohio (USA). *Environmental Monitoring and Assessment, 152*(1-4), 425-442.

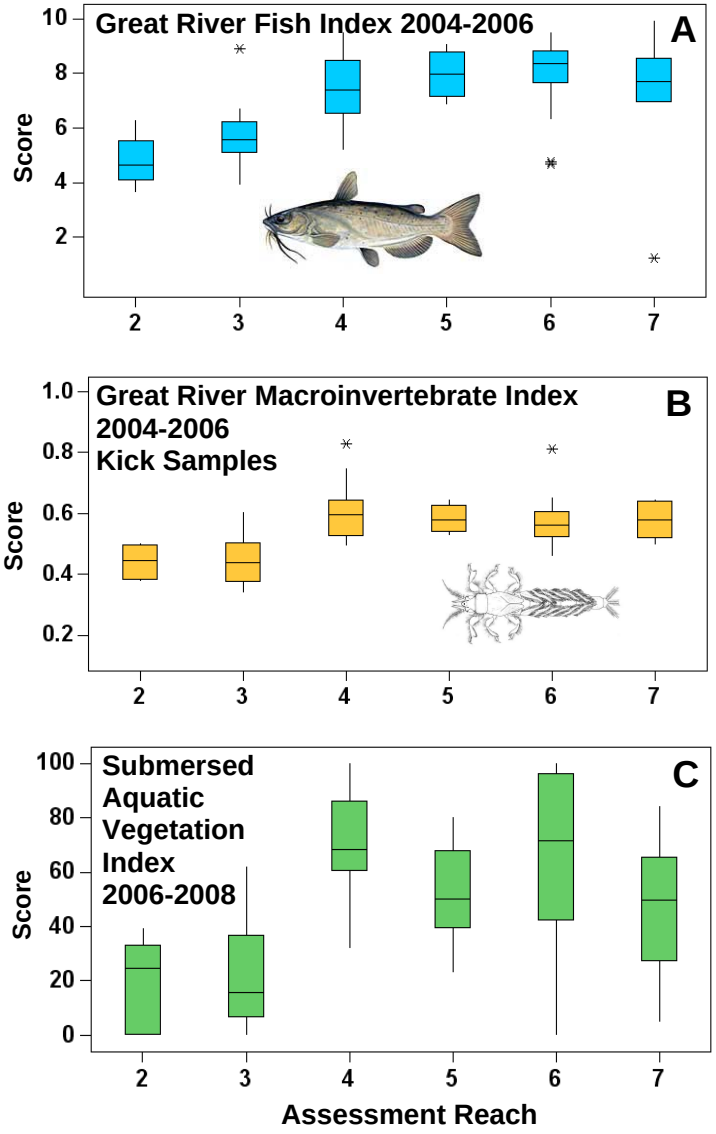
[10] Angradi, T.R., Pearson, M.S., Jicha, T.M., Taylor, D.L., Bolgrien, D.W., Moffett, M.F., Blocksom, K.A., & Hill, B.H. 2009[b]. Using Stressor Gradients to Determine Reference Expectations for Great River Fish Assemblages. *Ecological Indicators, 9*(4), 748-764.

[11] Angradi, T. R. M. S. Pearson, D. W. Bolgrien, T. M. Jicha, D. L. Taylor, and B. H. Hill. 2009[c]. Multimetric macroinvertebrate indices for mid-continent US great river**s.** *Journal of the North American Benthological Society*, 28(4):785-804. DOI: 10.1899/09-003.1

[12] Lyons, J., Piette, R.R., & Niermeyer, K.W. 2001. Development, Validation, and Application of a Fish-Based Index of Biotic Integrity for Wisconsin's Large Warmwater Rivers. *Transactions of the American Fisheries Society, 130*(6), 1077-1094.

Figure 8. Example biological indices used in the US EPA Great River Environmental Monitoring and Assessment Program (EMAP)* for the Upper Mississippi River





Cooperators:
Minnesota Dept. of Natural Resources
Minnesota Pollution Control Agency
Wisconsin Dept. of Natural Resources
and others

*Partial data from a US EPA-led assessment of the Mississippi, Missouri and Ohio Rivers.

Environmental Management Program – Habitat Rehabilitation and Enhancement Projects

Section 1103 of the Water Resources Development Act of 1986 (P.L. 99-662) authorized the construction of Habitat Rehabilitation and Enhancement Projects (HREPs) as one element of the Upper Mississippi River System Environmental Management Program (UMRS-EMP). These projects are selected by biologists and designed by multi-agency teams led by the Corps of Engineers. Input from the public is an important element of planning these habitat projects and is accomplished through public meetings and personal contacts.

Pool 8 Islands, Phase III, represents the 18th HREP constructed in Wisconsin waters. Phase III is the largest restoration project undertaken to date in Wisconsin, encompassing a planning area of 3,000 acres in lower Pool 8, south of La Crosse, Wisconsin. Construction of the 20 islands in the Phase III area began in 2006 and is scheduled to be completed by 2012, with an estimated total cost of $19 million.

The project includes conventional and experimental techniques to restore and enhance fish and wildlife habitat degraded by human activities that have altered the river ecosystem. The main features of the project are islands (Photo 1). One purpose of the islands is to break up wind fetch which reduces wave-induced resuspension of fine sediment and protects aquatic vegetation beds. Another purpose of the islands is to restore a diversity of water velocities in channel and backwater habitats for aquatic fish and wildlife species.

Staff from the Wisconsin Department of Natural Resources participated in the development of the "Upper Mississippi River System Environmental Management Program Environmental Design Handbook" (USACE, 2006) (http://www.mvr.usace.army.mil/EMP/designhandbook.htm). The handbook provides technical summaries of many of the engineering lessons learned through implementation of HREPs throughout the Upper Mississippi River System.

Photo 1. Construction of Pool 8 Islands, Phase III, on the Mississippi River south of La Crosse, WI. The view is looking west towards Minnesota along a secondary side channel (Raft Channel) of the Mississippi. Photo courtesy of USGS-Upper Midwest Environmental Sciences Center, La Crosse, WI.

NESP and Reach Planning Process for Ecosystem Restoration

The Navigation and Ecosystem Sustainability Program (NESP) is a US Corps of Engineers led program to guide future navigation improvements and ecological restoration on the UMR. WDNR participates with other federal, state, NGO and other stakeholders through various NESP planning efforts including the development of reach-specific ecosystem objectives and ecosystem restoration planning.

Through ongoing collaborative efforts, the US Corps of Engineers and participating stakeholders created a shared vision for management of the UMR System (UMRS). This was formalized in February 2009 when both the Navigation Environmental Coordination Committee (NECC) and the Environmental Management Program Coordinating Committee (EMP-CC) adopted a vision statement and set of systemic goals for the UMRS. Planning teams are developing specific objectives for geomorphic reaches within four major floodplain reaches of the UMRS.

Wisconsin DNR has participated with a reach planning team to develop a set of objectives for the future river ecosystem condition. The team evaluated historic conditions and identified future without-project conditions, the unique and important characteristics of each geomorphic reach, and factors that limit the abundance and distribution of native biota. The draft objectives are intended to address ecologically realistic targets for future conditions and will aid in future ecosystem restoration efforts.

Quantitative performance criteria for each objective are being identified through a combination of UMRS ecological literature, LTRMP data, water quality criteria, state TMDL efforts, and from lessons learned through previously constructed restoration projects. The performance criteria will establish target values (e.g., species frequency, abundances, acres of habitat, etc.) to help evaluate whether an objective is being met. In addition to performance criteria, indicators for condition of the river ecosystem are being developed as appropriate for geomorphic reaches of the UMRS. The indicators will be selected or derived from the performance criteria.

A reach plan that identifies potential future project areas and adaptive ecosystem management activities is also being developed. The draft reach plan will be provided to inter-agency coordinating teams and other stakeholder groups for review, refinement, and endorsement. By building on past successes, these efforts will continue to serve as a scientifically sound basis for development, monitoring and evaluation of future ecosystem restoration efforts in the UMRS.

Upper Mississippi River Basin Association (UMRBA) Water Quality Task Force Activities

The UMRBA Water Quality Task Force provides a forum for water resource management program coordination and consultation among the five state (IA, IL, MN, MO, and WI) water quality management agencies and US EPA Regions 5 and 7. The focus of the Task Force's activities in the past two years has been on the coordination of 305(b)/303(d) assessment activities on the Upper Mississippi River and the development of consistent aquatic use designations for aquatic life. This latter project will not only consider aquatic life use within the main channel but will also consider the need for

different aquatic life use designations for off-channel areas such as backwaters areas far removed from flowing channels. Monitoring data collected as part federal Long Term Resource Monitoring Program is expected to facilitate this effort since this program has physical, chemical and biological information for major aquatic areas in several study reaches in the Upper Mississippi River. The Task Force attention in 2010 will include working with an environmental consulting firm, Midwest Biodiversity Institute, in the development of a biological assessment guidance document for the River.

Lake Pepin Nutrient/Turbidity TMDL

Minnesota and Wisconsin have identified the Mississippi River as impaired by excessive turbidity or sediment in the reach between the mouth of the St. Croix River at Prescott, Wisconsin to Lake Pepin. In addition, Minnesota has included Lake Pepin on their impaired waters list due to excessive nutrients, which contributes to eutrophication problems in this natural riverine lake. Wisconsin has been participating on technical and stakeholder work groups established by the Minnesota Pollution Control Agency as part of efforts to develop water quality goals and total maximum daily loads (TMDLs) for sediment and nutrient related water quality problems. Wisconsin led a team of water quality and vegetation experts in the development of submersed aquatic vegetation and TSS targets for the turbidity-related impairment. Minnesota is using this information as a basis for establishing site-specific water quality standards to enhance and protect submerged aquatic vegetation in the turbidity-impaired reach of the Mississippi River from the Minnesota River mouth in Pool 2 to Lake Pepin (Figure 9).

Figure 9. Turbidity-impaired reach of the Mississippi River from the Minnesota River to Lake Pepin

Nutrient Studies

The impact of nutrients in Mississippi River backwaters and wetland areas have been the focus of new research and monitoring efforts in the past few years by state and federal agencies. A central part of these studies is evaluating factors influencing excessive growths of filamentous algae and duckweeds (metaphyton, Photo 2) that often form thick extensive mats during the summer months in backwater areas (Sullivan 2008[13]). Initial findings indicate that these thick plants mats can have a serious negative impact on dissolved oxygen concentrations which is vital to aquatic life. Further, these nuisance growths were associated with high levels of phosphorus and nitrogen and may be an indication of nutrient impairment problems in backwater areas. In 2009, the Department began a research project with USGS and the US Corps of Engineers to conduct a more extensive evaluation of factors influencing nutrients and metaphyton in ten backwaters areas of Pool 8. This work included the evaluation of internal loading of nutrients from sediments, the influence of connectivity to flowing channels, and the impact of metaphyton on submersed aquatic vegetation.

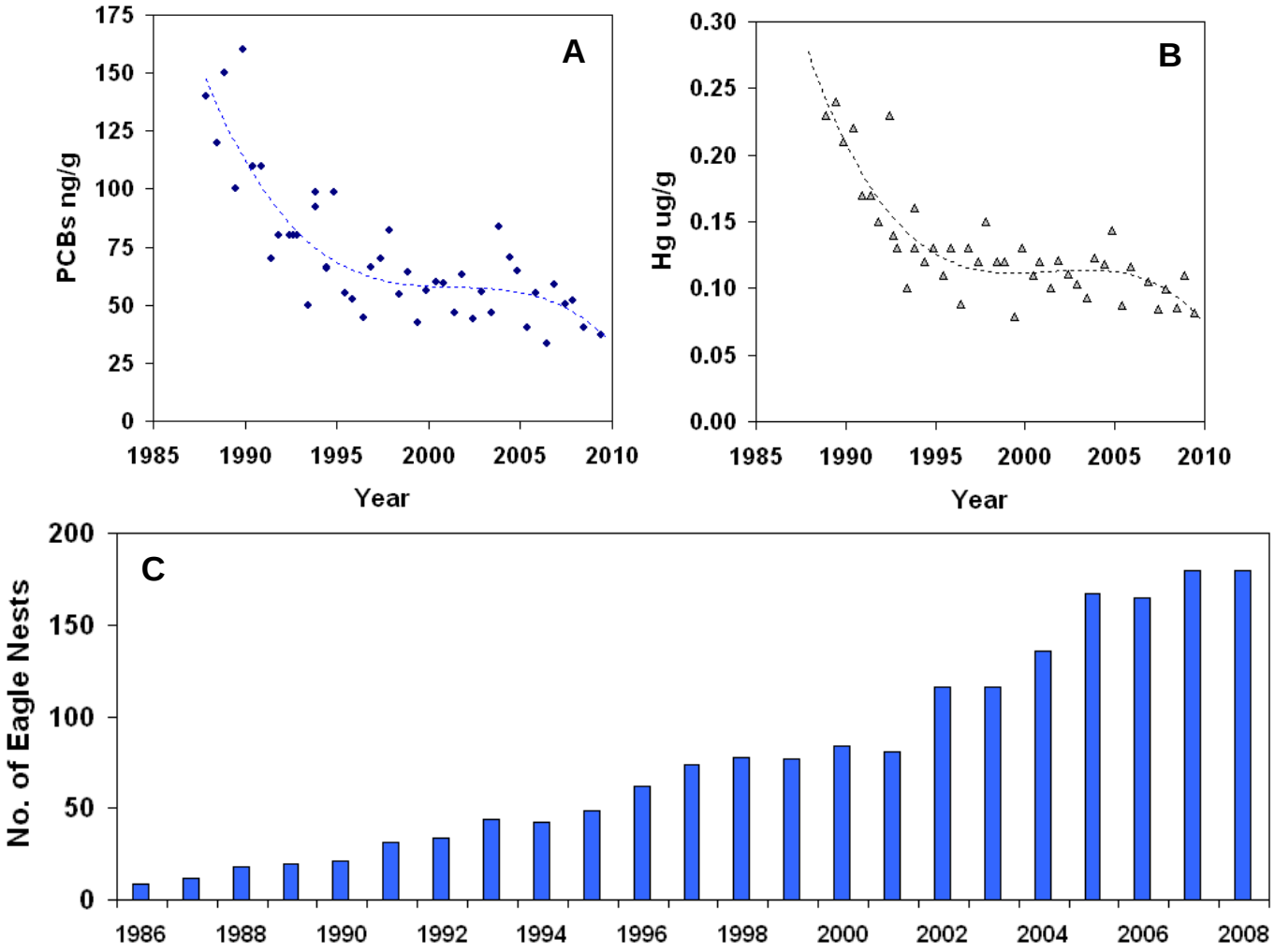
Photo 2. Filamentous algae mat on the surface of Lake Onalaska, Pool 7, Mississippi River (J. Sullivan, WDNR)

Trends in Suspended Sediment PCBs and Total Mercury Concentrations in the Mississippi River

Long term monitoring of polychlorinated biphenyls (PCBs) and total mercury concentrations in suspended sediment have been conducted since the late 1980s at Mississippi River Navigational Lock and Dams 3 near Red Wing, MN and 4 at Alma, WI. Suspended sediment was collected during spring and fall periods using vertically-integrated sediment traps placed in the auxiliary lock chambers at the upstream side of both dams. Monitoring results for Lock and Dam 3 are presented in Figure 10. Both PCBs and total mercury concentrations in suspended sediment have decreased roughly 60% over about 20 years and indicate success in controlling the use and releases of these contaminants into the environment. The reduction of these contaminants and others in the Upper Mississippi River may have been an important factor contributing to increased bald eagle use and reproduction based on USFWS surveys in the Upper Mississippi National Wildlife and Fish Refuge, which extends from lower Pool 4 near Alma, WI to Pool 14 near Savannah, IL.

[13] Sullivan. J.F. 2008. The use of metaphyton to evaluate nutrient impairment and proposed nutrient criteria for wetlands and backwaters in the Upper Mississippi River. Wisconsin Department of Natural Resources. La Crosse, WI.

Figure 10. Suspended sediment PCBs (A) and total mercury (Hg) (B) concentrations in the Mississippi River collected with sediment traps at Lock and Dam 3, Red Wing, Minnesota. Number of eagle nests (C) in the Upper Mississippi River National Wildlife & Fish Refuge Pools 4-14 based on USFWS surveys.



Climate Change

Climate change has been an emerging focal area for the WDNR's Water Division over the last two years. Many of the potential impacts of a warmer and wetter climate on Wisconsin's water resources are relatively well documented, though there is still a fair amount of uncertainty about the shorter term and local impacts of climate change.

Regardless of this uncertainty, it is becoming clear that 1) climate extremes are already occurring in Wisconsin, and 2) climate will continue to change for the foreseeable future regardless of any corrective action taken now. We need to prepare now to deal with the ramifications of climate change in how we manage our water resources over the next 10-20 years.

Some examples of climate change impacts in Wisconsin include:

- Recent experiences with increased rainfall intensity and extreme flooding, and implications for dam safety, stormwater and wastewater management, drinking water quality, beach health, aquatic invasive species, etc.
- Changing baselines for determining minimum levels and flows, ordinary high water marks, flood frequency curves, and floodplains
- Increased conflicts over water availability and increased water demand, esp. during dry spells
- Changes in species distributions with warmer climate and less winter freeze, and impacts for fish and other aquatic life, including aquatic invasive species
- Accelerated eutrophication of surface waters due to increased winter and spring runoff and hotter, drier summers that favor blue-green algae blooms

Despite these challenges, there are also opportunities for WDNR's Water Division to be involved in mitigation and minimizing climate change impacts, through wetland management, forest hydrology, land use, and water conservation strategies. To this end, the Water Division is partnering with the Wisconsin Initiative on Climate Change Impacts (WICCI) to develop a *Water Division Climate Change Strategy*[14]. This *Strategy* is intended to guide the Water Division in beginning to address these issues within the context of existing program structures and staff resources.

[14] References for the Water Division Climate Change Strategy are as follows:

U.S. EPA Office of Water. 2008 **National Water Program Strategy: Response to Climate Change**: http://www.epa.gov/water/climatechange/index.html

USDA 2008. **The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States.** Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research http://www.usda.gov/oce/global_change/files/CCSPFinalReport.pdf

Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009, **Climate change and water resources management—A federal perspective**: U.S. Geological Survey Circular 1331, 65 p. (Also available online at http://pubs.usgs.gov/circ/1331/.)

US Fish and Wildife Service, **Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change** http://www.fws.gov/home/climatechange/strategic_plan.html

Goals of the Water Division Climate Change Strategy

The four overall goals of the strategy are:

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 & efficient water use.

4. Maintain, improve, or restore water quality under a changing climate regime by promoting actions to reduce nutrient and sediment loading.

It is hoped that this partnership with WICCI will help develop adaptation strategies for managing impacts to water and aquatic resources. The effort will also include review and implementation of mitigation strategies from the Governor's Global Warming Task Force Recommendations. Additionally, it will match federal directives such as the EPA Water Program Strategy on Climate Change, the US Fish and Wildlife Service Draft Strategic Plan, and the USGS Climate Change and Water Resource Management documents.

Coldwater streams providing habitat for native brook trout may be influenced by climate change. WDNR scientists are investigating potential ways to reduce these impacts.

PART C. SURFACE WATER MONITORING AND ASSESSMENT

C1. Monitoring Program

Wisconsin's Three-Tiered Monitoring 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 online. Sampling protocols within the *Strategy* are developed by Monitoring Technical Teams, comprised of staff with a high level of technical knowledge and applied field sampling experience.

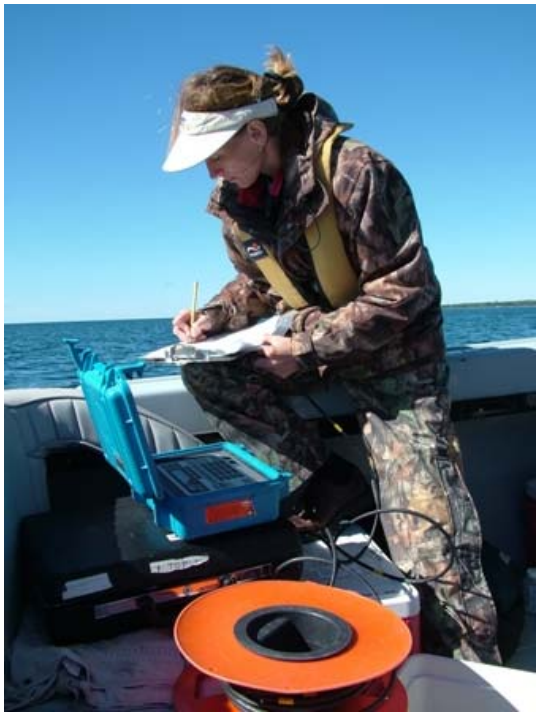
The WDNR's *Water Division Monitoring Strategy* is organized into a three-tiered approach:

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. Sampling under Tier 1 is usually less rigorous at each site, but is done on a broad geographic scale, statewide, to determine trends and to assess statewide health of waters. Sampling in Tiers 2 and 3 is usually done on a smaller number of specifically targeted sites, but employs a more rigorous sampling design to pinpoint problems and management actions needed (Tier 2) or the effectiveness of management or compliance actions that have been taken (Tier 3).

Tier 1: Statewide Baseline Monitoring

Trend establishment and problem identification



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. 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, these problem areas are identified and prioritized for further study under Tier 2.

Tier 2: Targeted Evaluation Monitoring

Site-specific monitoring of targeted areas

Waterbodies identified under Tier 1 as falling below designated minimum levels for certain parameters are prioritized and monitored more intensively under Tier 2. Under this tier, confirmation of the problem is made, along with documentation of the cause(s). Thus, it is a more comprehensive evaluation of individual waterbodies, often requiring cross-program collaboration.

Two common applications of Tier 2 monitoring are:

a) Determining the extent of a waterbody's degradation and whether it should be placed on the Impaired Waters 303(d) List, and

b) Analyzing an impaired water's pollutant sources and determining the level of pollutant reduction needed (Total Maximum Daily Load analyses).

Tier 3: Management Effectiveness & Compliance Monitoring

Determining effectiveness of management measures & permit conditions

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.

Fish & Aquatic Life Monitoring

Wisconsin conducts a wide variety of monitoring related to fish and aquatic life. These monitoring approaches are primarily conducted under Tier 1 and Tier 2. A detailed description of these monitoring programs is found within the *Water Division Monitoring Strategy*.

WDNR water monitoring

Recreation Monitoring

Wisconsin's Beach Monitoring and Notification Program

Great Lakes Beaches
A Federal Act, entitled the *Beaches Environmental Assessment and Coastal Health,* known as the 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 and public notification programs. Wisconsin receives an annual allotment from the U.S.EPA to continue development and implement Wisconsin's Beach Monitoring and Notification Program.

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 storm water 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 (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 U.S. EPA. Sanitary surveys were first conducted in 2008 and have been continued in 2009 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. The Beach Health Hotline was discontinued in 2006 due to lack of public interest and funding. 2009 marked the seventh successful summer of Great Lakes beach monitoring in Wisconsin.

Inland Lake Beaches

Monitoring for *E. coli* also occurs at several inland beaches in Wisconsin. The Inland Beach Program is modeled after Wisconsin's 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 www.wibeaches.us.

Public Health Monitoring

Toxic Substance Monitoring: 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) or the U.S. EPA, or as a part of special projects and research.

Samples from the Great Lakes are analyzed for 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 is also used to make natural resource and environmental management decisions.

Table 6. Number of Fish Tissue Sites Sampled and Samples Collected from Pre-1980 to 2009

Time Period	Sites Sampled**	Samples Collected**
Prior to 1980	234	3,003
1980-1989	969	11,139
1990-1996	564	8,955
1197-2000	308	3,466
2001	118	1,000
2002-2006	472	6,099
2007	87	1,458
2008	55*	827*
2009	46*	486*
Total Cumulative	**1,665***	**34,408****

*Samples still being tallied, total interim number as of December 2009.
**Total cumulative number of sites does not include duplicate visits to a site. Includes samples collected and/or analyzed by cooperators (e.g. GLIFWC, DNR Research, DNR Bureau of Watershed Mgmt., and others).

Fish Consumption Advisories

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 U.S. 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. Table 7 and

Figure 11 show Wisconsin's 2009 General Advisory guidelines.

Table 7. Wisconsin General Fish Consumption Advisory tissue guidelines, 2009

Contaminant	Population	Concentration	Advice
PCBs polychlorinated biphenyls	All people	< 0.05 ppm	Unlimited
		0.05-0.2 ppm	1 meal per week
		0.2 - 1 ppm	1 meal per month
		1-1.9 ppm	6 meals per year
		≥ 2.0 ppm	Do Not Eat
Mercury	Children under age 15, pregnant women and women of childbearing age	< 0.05 ppm	Unlimited
		0.05-0.2 ppm	1 meal per week
		0.2 - 1 ppm	1 meal per month
		≥ 1.0 ppm	Do Not Eat
	Men and women beyong childbearing age	< 0.16 ppm	Unlimited
		0.16 - 0.65 ppm	1 meal per week
		> 0.96 ppm	1 meal per month
Dioxin	All people	< 10 ppt	no advice
		> 10 ppt	Do Not Eat
PFOS perfluorooctane sulfonate	All people	< 40 ppb	Unlimited
		40 - 200 ppb	1 meal per week
		200 - 800 ppb	1 meal per month
		> 800 ppm	Do Not Eat

Figure 11. Safe eating guidelines for inland lakes

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 fish have been found to contain 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 concentration 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.

Citizen Water Monitoring Key Part of State Effort

The DNR is committed to engaging citizens in helping meet our water monitoring needs. This interest in building our 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.

Citizen Stream Monitoring Network

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 Strategy. Because of the Department'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 the Network website (http://watermonitoring.uwex.edu/level2/funding.html).

Citizen Stream Monitoring Volunteers

During the 2009 monitoring season approximately 300 adults and 1,600 students conducted volunteer monitoring.

- In Level 1, 50 local programs participated to monitor 185 sites (773 site visits)
- In Level 2, 17 local programs participated to monitor 178 sites (712 site visits)

A total of 663 stream sites have been monitored since the program's inception.

Citizen Lake Monitoring Network

Wisconsin's Lake Partnership nurtures public involvement. High quality monitoring data supports sound management. WDNR relies on the public to gather data. Volunteer clarity and chemistry data is used by loon research and climate change staff and USGS. Volunteer data is used to identify impaired waterbodies for the state's 303(d) Impaired Waters List and for lake restoration projects. Data is used to make management decisions and by all levels of government to make water quality determinations.

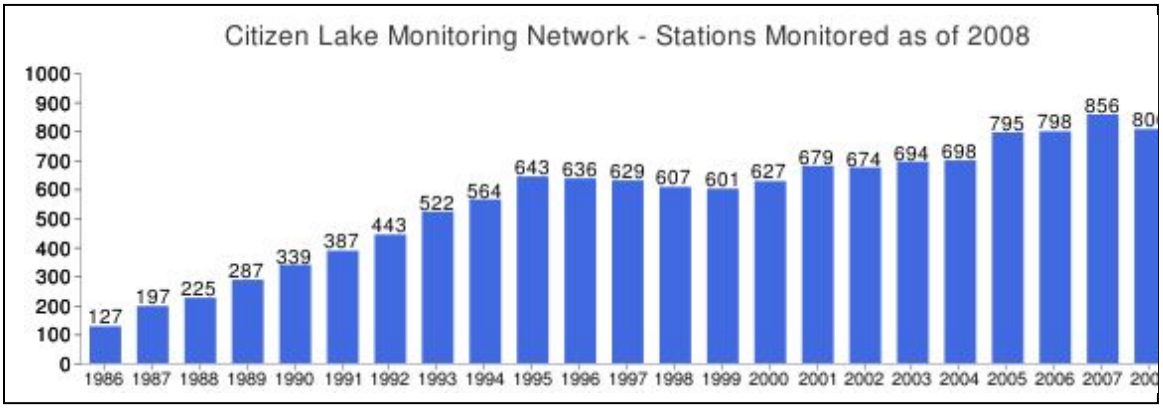
2008 data were quality assured and checked for completeness. Annual reports for 2008 (available online at http://dnr.wi.gov/lakes/clmn/) were produced and distributed. More than 75% of the lake monitoring stations are now reporting data online into WDNR's SWIMS database by volunteers. The rest of the volunteers submitted data through a touchtone telephone line or on paper. The eventual goal is to work towards 100% of data reported online. This shift will decrease mailing costs and staff time, which will allow the Citizen Lake Monitoring Network to grow. Data collected by volunteers forms the backbone of Wisconsin's lake assessment efforts.

Citizen Lake Monitoring Volunteers

During the 2008 monitoring season:

- 978 volunteers monitored water quality at over 806 monitoring stations
- Over 155 new Secchi volunteers and 110 new chemistry volunteers participated.
- 467 lakes were registered as monitoring for Aquatic Invasive Species.

(Data for 2009 were still being compiled and quality checked at the time of publication.)



C2. 2009-2010 Assessment Methodology

Chapter NR 102.04 (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. Assessments result in a picture of the status of waterbodies for "305b" reporting, as well as background information to evaluate listing impaired waterbodies for possible Total Management Daily Load (TMDL) work based on evidence of impairment and written documentation.

Major Improvements in 2010 CWA Section 305(b)/303(d) Methods

Through 2006, WDNR provided its general assessment submittal in the form of a dataset and narrative Water Quality Assessment Report to Congress and its 303(d) List as two separate products. In 2008 the Department worked with U.S. EPA to integrate its mainframe database for general and impaired water assessment submittals. This complex data integration process was the first step for Wisconsin to provide a truly integrated assessment and listing report.

WDNR's Goals for 2010 Assessment and Impaired Waters Listing:

1. Improved scientific methods and documented decision making
2. Increased public participation and transparency
3. Timely submittal of the *Water Quality Report to Congress* and Impaired Waters List to EPA

For this 2010 submittal, WDNR's priority was to create and use clearly defined, publicly accessible methods for collection and analysis of data to ensure defensible decisions regarding water quality. To this end, the WDNR built upon its 2008 work by creating a new *Wisconsin Consolidated Assessment and Listing Methodology* (WisCALM, 69 pp.) to conduct general and specific assessments for determining the attainment of designated uses. In the creation of the WisCALM document, WDNR relied heavily upon the U.S. 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.

PLEASE NOTE: The information provided in the remainder of Section C2 describing the 2009-2010 Assessment Methodology is a brief synopsis of the much more detailed WisCALM document. Please see WDNR's website for a copy of the complete WisCALM guidance: http://dnr.wi.gov/org/water/condition/wiscalm.htm.

Data Used for Assessment

Data used for assessment include three main categories, as illustrated in Figure 12: data submitted by the public, data from WDNR's tiered monitoring program (including Tier 1and targeted sites from Tier 2), and data reviewed through WDNR's Watershed Planning efforts. All data used for assessment must meet WDNR's quality assurance requirements.

Staff make a conscious decision to determine if available data are representative of the conditions (e.g. trout IBI for a warm water stream indicating "poor" would not be applicable). Additionally, they may consider whether a Use Attainability Analysis should be considered to justify an alternative use. If DNR staff chooses to exclude data, these decisions are documented within our database, along with recommendations for management actions.

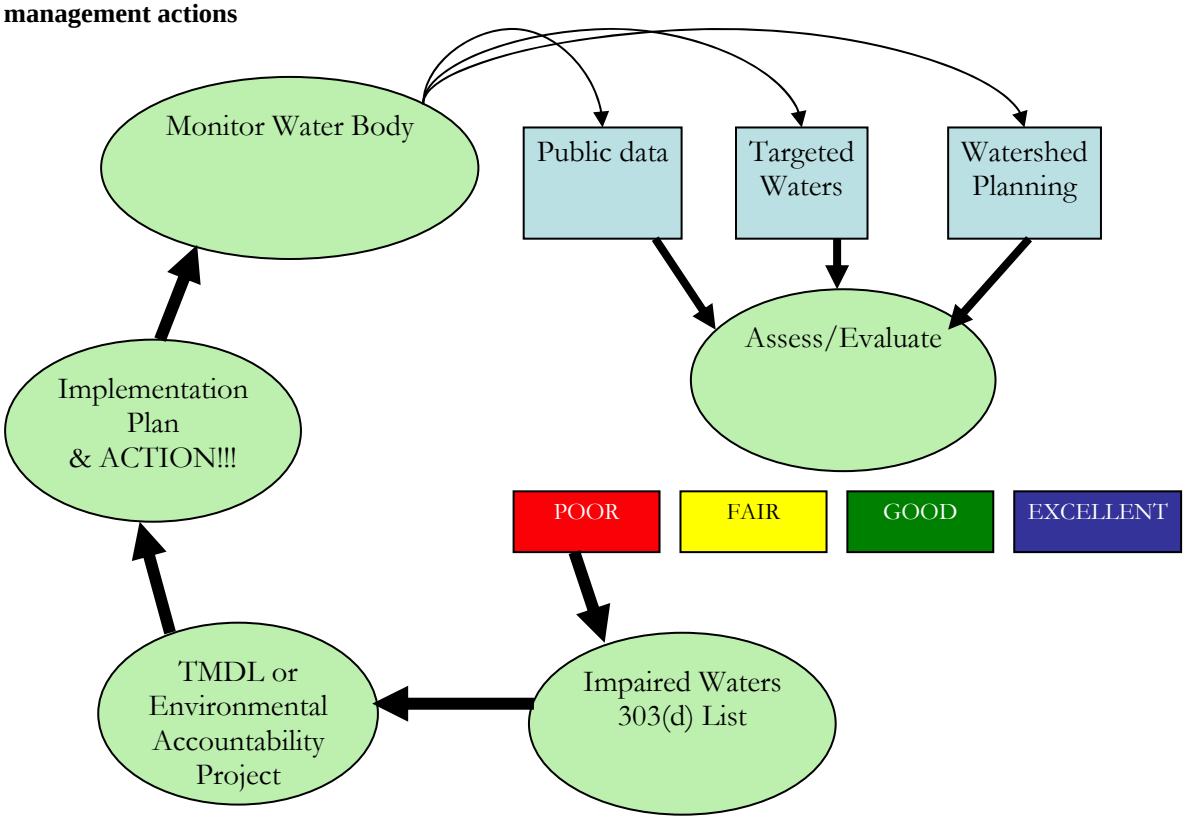
A more detailed discussion of which data are used or not used for assessment is contained in Chapters 3 and 5 of the WisCALM.

General Condition Assessment Process

Available data that meet WDNR requirements are used to identify where a specific river or stream falls on a continuum of water condition, which is the core *assessment* to determine if a waterbody is attaining its applicable designated uses.

WDNR uses four levels of water condition to represent water's placement in the overall water quality continuum (Figure 12 and Figure 13). Waters described as *excellent* and *good* clearly attain each assessed designated use; waters described as *fair* are also meeting their designated uses, but may be in a state that warrants additional monitoring in the future to assure water conditions are not declining. Waters that are described as *poor* **may** be considered *impaired,* and may warrant placement on Wisconsin's Impaired Waters List in accordance with Section 303(d) of the federal Clean Water Act.

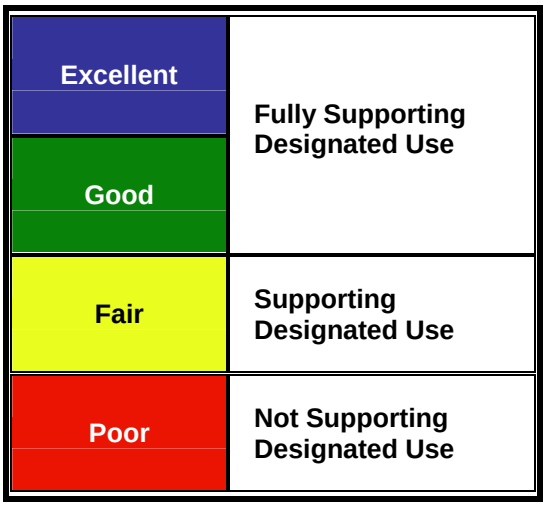
Figure 12. WDNR cycle for monitoring and assessing waterbody condition, and implementing management actions



Assessment Thresholds

When it is determined that a waterbody should be placed within a particular condition group (Excellent, Good, Fair, or Poor), the assessment threshold will be applied when placing waters on the Impaired Waters List. These thresholds are based on numeric water quality criteria included in Chapters NR 102-105 (Wis. Adm. Code), WDNR technical documents, and federal guidance. In some cases, qualitative thresholds based upon narrative standards may be used to make assessment decisions. In those cases, a thoroughly documented analysis of the contextual information should be used in conjunction with professional judgment to collectively support a decision.

Figure 13. WDNR's General Water Condition Continuum



Fish & Aquatic Life Use Assessments

Fish & Aquatic Life Use: Lake Classification and Assessment Methods

For assessment of each lake, three processes are necessary. First, the lake is classified by assigning it to a natural community category. Second, a General Condition Assessment is conducted to determine the overall status of the lake. Third, if a lake's status is Poor, it is further assessed to determine if it warrants addition on the 303(d) Impaired Waters List. A brief description of these processes is excerpted from the WisCALM guidance and provided below.

1. Classification of Lakes

Lakes have different assessment thresholds based on the type of lake, or *natural community*, that the lake is categorized in. WDNR has classified or grouped similar lake types based upon physical data. Specifically, lake size, stratification characteristics, hydrology and watershed size are identified as the primary influences to a lake and, to a large degree, these determine the natural communities each lake type supports. Using this information, lakes should fall into one of 10 natural community types (Table 8).

Table 8. Lake Natural Communities

Natural Community	Stratification Status	Hydrology
Lakes <10 acres – Small	Variable	Any
Lakes ≥10 acres		
• Shallow Seepage	Mixed	Seepage
• Shallow Headwater	Mixed	Headwater Drainage
• Shallow Lowland	Mixed	Lowland Drainage
• Deep Seepage	Stratified	Seepage
• Deep Headwater	Stratified	Headwater Drainage
• Deep Lowland	Stratified	Lowland Drainage
Other Classification (any size)		
• Spring Ponds	Variable	Spring Hydrology
• Two-Story Lakes	Stratified	Any
• Impounded Flowing Waters	Variable	Headwater or Lowland Drainage

2. General Condition Assessment for Lakes

General Condition Assessments for lakes are primarily based on the Trophic Status Index (TSI) of a lake. TSI is a statistic indicating the level of lake eutrophication. Each lake's TSI score is compared to the lake condition assessment threshold TSI values in Table 9, established for each of the different lake classification categories. As described previously, the lake condition assessment thresholds create four categories: Excellent, Good, Fair and Poor.

Table 9. Trophic Status Index (TSI) Thresholds - Assessment of Lake Natural Communities

Condition Level	Shallow			Deep			
	Headwater	Lowland	Seepage	Headwater	Lowland	Seepage	Two-Story
Excellent	< 53	< 53	< 45	< 48	< 47	< 43	< 43
Good	53 – 61	53 – 61	45 – 57	48 – 55	47 – 54	43 – 52	43 – 47
Fair	62 – 70	62 – 70	58 – 70	56 – 62	55 – 62	53 – 62	48 – 52
Poor	≥ 71	≥ 71	≥ 71	≥ 63	≥ 63	≥ 63	≥ 53

3. Impairment Assessment for Lakes

Not all waters categorized as Poor in the General Condition Assessment should be considered Impaired or warrant 303(d) listing. Whether or not a waterbody should be listed as impaired is dependent on the strength of the data used to make the assessment. To submit a lake for the 303(d) List, it must exceed certain numeric listing thresholds or meet narrative listing criteria. A General Condition Assessment status of "Poor" or "Fair" based on TSI score serves as a flag that TSI values and other parameters such as total phosphorus, temperature, dissolved oxygen, and pH should be evaluated against the impairment thresholds outlined in Table 10. Other tables showing thresholds for acute and chronic aquatic toxicity are also provided in Chapter 6 of WisCALM. If values exceed the impairment thresholds for a pollutant and impairment, the waterbody is a candidate for Impaired Waters listing.

Table 10. Impairment Thresholds for Lake Natural Communities – Fish & Aquatic Life Use

Note: All data used should be from within the most recent 5 year period.

TBA Indicators	Min. Data Requirement	Exceedance Frequency	Impairment Threshold - LAKES - Fish & Aquatic Life Use						
			Shallow			Deep			
			Headwater Drainage Lake	Lowland Drainage Lake	Seepage Lake	Headwater Drainage Lake	Lowland Drainage Lake	Seepage Lake	Two-story fishery lake
Eutrophication indicators									
TSI (Trophic State Index based on Chl *a*)	2 Chl *a* values collected during summer (July 15 - Sept. 15) from 3 different years	1 TSI value	≥71	≥71	≥71	≥63	≥63	≥63	≥53
Conventional physico-chemical indicators									
Total Phosphorus[5]	3 monthly values for 2 years (May - October)	Mean	≥0.04 mg/l	≥0.04 mg/l	≥0.04 mg/L	≥0.03 mg/L	≥0.03 mg/L	≥0.02 mg/L	≥0.015 mg/L
Dissolved oxygen	10 discrete[1] epilimnetic values (May – October)	10% or more of all values	< 5 mg/L						(value TBD; based on DO profile)
Temperature	20 discrete[1] values	Vary (see thresholds)	Daily (mean) and seasonal T˚ fluctuations (min. & max. daily mean) [2] not maintained; and Maximum T˚ increase exceeding 3˚F above natural temperature[2]						
pH	10 discrete[1] values	Vary (see thresholds)	- Outside the range of 6.0-9.0 - Change greater than 0.5 units outside natural seasonal maximum (mean) & minimum (mean) [2]						
Turbidity	10 discrete[1] values	*(to be determined)*	*(reserved until sufficient data available)*						
TSS	10 discrete[1] values	*(to be determined)*	*(reserved until sufficient data available)*						
Aquatic Toxicity-based indicators									
Acute aquatic toxicity	8 values [3]	Maximum daily concentration not exceeded more than once every 3 years	≥ values provided in Tables A & B below						
Chronic aquatic toxicity		Maximum 4-day concentration not exceeded more than once every 3 years	≥ values provided in Tables A & B below						
Biological indicators									
AMCI (aquatic macrophyte community index)[6]	1 AMCI value	1 AMCI value	< 52	< 36	< 49	< 50	< 45	< 49	< 49

(1) Discrete values refer to samples collected on separate calendar days. Dissolved oxygen, temperature and pH criteria are taken from Wisconsin State Administrative Code NR 102.04, Water Quality Standards for Wisconsin Surface Waters.

(2) Based on historical data or reference site.

(3) Toxicity tests with 1 or more species in at least 8 different families provided that of the 8 species specified in NR 105.05(1); OR calculate secondary acute values according to NR 105.05(4) if 8 values not met.

(4) Toxicity tests with 1 or more species in at least 8 different families provided that of the 8 species specified in NR 105.06(1); OR calculate secondary chronic values according to NR 105.06(6) if 8 values not met.

(5) Total phosphorus thresholds are based on draft proposed nutrient criteria under internal review (February 2008)

(6) There was enough not representative data collected on lakes to allow listing based on AMCI in this iteration. Additional plant data has been collected and revised criteria will be available for the next cycle.

Fish & Aquatic Life Use: Stream/River Classification and Assessment Methods

For assessment of each stream or river, three processes are necessary. First, the stream or river is classified by assigning it to a stream community or Subcategory. Second, a General Condition Assessment is conducted to determine the overall status of the waterway. Third, if its status is Poor, it is further assessed to determine if it warrants addition on the 303(d) Impaired Waters List. A brief description of these processes is excerpted from the WisCALM guidance and provided below.

1. Classification of Streams/Rivers
WDNR has identified five different types of stream classes based upon the water temperature and the capacity of the stream or river to support a diverse and healthy fish community. These Subcategories are shown in Table 11, along with their corresponding dissolved oxygen levels, temperatures, and stream community expectations.

2. General Condition Assessment for Streams/Rivers
Whereas the lakes assessment methods use the same TSI metric and prescribe different threshold values for lake condition rating for different lake classes, WDNR fisheries research staff have developed specific Fish IBI (F-IBI) for different stream and river classes. Currently there are three different F-IBI used to assess wadeable stream condition and one IBI used to assess non-wadeable river condition. The three wadeable stream F-IBIs have been developed for cold, warm and small warm/cool water streams.

In addition, WDNR recently began using a Macroinvertebrate IBI (M-IBI) developed by Weigel (2003). The M-IBI metric responds to the watershed scale impacts of agricultural and urban land uses, riparian habitat degradation, sedimentation problems, and scouring.

To determine the General Condition of each stream or river, its F-IBI and/or M-IBI scores are calculated using the appropriate statistical analysis. These scores are then compared against the appropriate threshold for that waterbody's stream or river subcategory, as shown in Table 12.

3. Impairment Assessment for Streams/Rivers
After a stream or river has been assigned to a stream community, if its General Condition Assessment results in poor F-IBI and/or M-IBI values, additional assessment work is required prior to submitting the waterway as a potential 303(d) impaired water.

If additional monitoring is required, the selection of indicators should be based on the nature of the stream or river issues known to the biologist. In addition to the collection of supplemental F-IBI and M-IBI data, studies may be designed to collect data over a larger river or stream reach and/or to evaluate other factors influencing water condition.

Data that meet quality control guidelines are then compared to the impairment thresholds shown in Table 13. Additional tables providing the thresholds for aquatic toxicity thresholds are provided in Chapter 6 of the WisCALM guidance. If values exceed the impairment thresholds for a pollutant and impairment, the waterbody is a candidate for Impaired Waters listing.

Table 11. Fish and Aquatic Life Use Sub-Category minimum expectations
Modified from Appendix 2 of "Guidelines for Designating Fish and Aquatic Life Uses for Wisconsin Surface Waters" (WDNR PUBL-WT-807-04)

Fish and Aquatic Life Subcategory with *Proposed New Subcategory Names in Italics*	**Minimum Dissolved Oxygen**	**Minimum Stream Community Expectations**
Coldwater Community *(Coldwater A)*	6 mg/L or 7 mg/L during periods of spawning or nursery activity	**Potential to meet all expectations** 1. Naturally reproducing salmonid community containing more than one age group above the age of one year. 2. Year-to-year salmonid survival. 3. Will typically maintain good water quality and habitat. 4. Generally continuous stream flow. 5. More than 2 individual salmonids per 100 meters. 6. Maximum daily mean temperature approximately 22º C (77º F)
Coldwater Community *(Coldwater B)*	6 mg/L	**Potential to meet all expectations** 1. No natural salmonid reproduction with community sustained by stocking or migration. 2. More than 2 individual salmonids per 100 meters. 3. Will typically maintain good water quality and habitat. 4. Maximum daily mean temperature approximately 22º C (77º F)
Warmwater Sport Fish Community & Warmwater Forage Fish Community *(Diverse Fish & Aquatic Life)*	5 mg/L	**Potential to meet one or more expectations** 1. Game fish community with more than 2 individuals per 100 meters (except Green Sunfish, Black Bullheads and Yellow Bullheads). 2. Non-game fish community with 5 to 25% or more of the individuals present characterized as being not tolerant of low dissolved oxygen. 3. Macroinvertebrate community with a significant number of individuals (5 to 25% or more) belonging to taxa with HBI tolerance values of 5 or less. 4. Any fish, macro-invertebrates or other aquatic or semi-aquatic species listed as endangered, threatened or special concern species.
Limited Forage Fish *(Tolerant Aquatic Life)*	3 mg/L	**Potential to meet one or more expectations** 1. No potential to meet above criteria. 2. Non-game fish community dominated by individuals (75 to 100%) belonging to species that are tolerant to low dissolved oxygen. 3. Macroinvertebrate community with a significant number of individuals (numerically 75 to 100%) belonging to species with HBI tolerance values of greater than 5.
Limited Aquatic Life *(Very Tolerant Aquatic Life)*	1 mg/L	1. No potential to meet the above criteria. 2. No potential to contain a fish community. 3. Any macroinvertebrate community is dominated (75 to 100%) by individuals belonging to species with an HBI tolerance value of greater than 8.

Table 12. Fish and Aquatic Life – Streams and Rivers General Assessment Thresholds

Designated Use	Condition Gradient	Management Recommendation	Fish IBI	Macroinvertebrate IBI
Cold Stream Stream Supports coldwater fish and macroinvertebrate species	Excellent	Consider O/ERW Listing	Cold IBI 90-100	7.5-10.0
	Good	Maintain Condition	Cold IBI 60-80	5.0-7.4
	Fair	Restoration	Cold IBI 30-50	2.6-4.9
	Poor	Consider 303(d) Listing	Cold IBI 0-20	0-2.5
Small Cold Stream Trout absent, but other coldwater fishes/inverts self-sustaining.	Excellent	Consider O/ERW Listing	Cold IBI 50-60	7.5-10.0
	Good	Maintain Condition	Cold IBI 30-40	5.0-7.4
	Fair	Restoration	Cold IBI 10-20	2.6-4.9
	Poor	Consider 303(d) Listing	Cold IBI 0-10	0-2.5
Warm Water Sport Fish*River or Non Wadeable Stream* WWSF	Excellent	Consider O/ERW Listing	Large River IBI 80-100	
	Good	Maintain Condition	Large River IBI 60-79	
	Fair	Restoration	Large River IBI 40-69	
	Poor	Consider 303(d) Listing	Large River IBI 0-39	
Warm Water Sport Fish *Wadeable Stream* WWSF	Excellent	Consider O/ERW Listing	Warm IBI 65-100	7.5-10.0
	Good	Maintain Condition	Warm IBI 50-64	5.0-7.4
	Fair	Restoration	Warm IBI 30-49	2.6-4.9
	Poor	Consider 303(d) Listing	Warm IBI 0-29	0-2.5
Warm Water Forage Fish Stream WWFF	Excellent	Consider O/ERW Listing	Small Stream IBI 100	7.5-10.0
	Good	Maintain Condition	Small Stream IBI 70-90	5.0-7.4
	Fair	Restoration	Small Stream IBI 40-60	2.6-4.9
	Poor	Consider 303(d) Listing	Small Stream IBI 0-30	0-2.5
Limited Forage Fish Stream LFF	Attaining	Consider O/ERW Listing	Small Stream IBI 40-100	2.6-10.0
	Not-Attaining	Maintain Condition	Small Stream IBI 0-30	0-2.5
Limited Aquatic Life Stream LAL	Attaining	Consider O/ERW Listing		2.6-10.0
	Not-Attaining	Maintain Condition		0-2.5

Table 13. Impairment Thresholds for Rivers/Streams

Indicators/Parameters	Minimum Data Requirement	Exceedance Frequency	Cold Waters	Warm Waters (WWSF, WWFF)	Limited Forage Fish	Limited Aquatic Life
Conventional physical and chemical indicators						
Temperature**	20 discrete daily values (May through October) * Samples must be collected at a frequency of no less than 1 sample per hour with a continuous recording thermograph or thermistor.	10% of Mean Daily Temperature values exceeds specified maximum for applicable use designation (Mean Daily Temperature is the arithmetic mean of all equally spaced samples colleted within a 24-hour period)	>73°F	>86°F	>86°F	>86°F
			Mississippi R., Rock R., Wisconsin R: >86°F Lower Fox River: >87°F Inland Lakes North of State Highway 10: >86°F Inland Lakes South of State Highway 10: >87°F Green Bay – South: >83°F Green Bay – North: >78°F Lake Michigan – South: >76°F Lake Michigan – North: >73°F Lake Superior: >73°F Chequamegon Bay: >76°F			
pH	10 discrete * values	10% or more of all values within a continuous sampling period or for instantaneous w/in season	Outside the range of 6-0 to 9.0 or if a change is greater than 0.5 units outside natural seasonal maximum (mean) and minimum (mean)			
Dissolved oxygen	3 days of continuous measurements (no less than 1 sample per hour) in July or August; minimum of 3 years of data	10% or more of all values	<6.0 mg/L and <7.0 mg/L during spawning season	<5.0 mg/L	<3.0 mg/L	<1.0 mg/L
Total Phosphorus	10 base flow values (May - October)	Median or 10% or more of all values	≥0.100 mg/l for rivers listed in proposed rule NR 102.06(3); ≥0.075 mg/l for other rivers or streams			
Flow conditions	11 base flow values (May - October)	Annual 90% exceedance flow [(2)]	≤0.03	≤0.03	N\A	N\A
Biological indicators						
Fish IBI	2 Fish IBI Values	Either in 1 value per 2 consecutive field seasons or 2 or more studies within one field season with corroborating data.	See associated Natural Community/ Designated Use - Fish IBI Chart			
Macroinvertebrate IBI	3 Macroinvertebrate IBI Values	Either in 1 value per 2 consecutive field seasons or 2 or more studies within one field season with corroborating data.	See associated Natural Community/ Designated Use – Macroinvertebrate IBI Chart			

Aquatic Toxicity-Based indicators			
Acute aquatic toxicity indicators			
Cadmium*, Chromium$^{(3+)}$*, Copper*, Lead*, Nickel*, Zinc*, Pentachlorophenol, and Ammonia *(*total recoverable form)*	8 values [3]	Maximum daily concentration not exceeded more than once every 3 years	≥ values provided in Table A below
Arsenic$^{(+3)}$*, Chromium$^{(+6)}$*, Mercury$^{(+2)}$*, free Cyanide, Chloride, Chlorine (total residual), Gamma - BHC, Dieldrin, Endrin, Toxaphene, Chlorpyrifos, and Parathion (**total recoverable form)*			≥ values provided in Table B below
Chronic aquatic toxicity indicators			
Cadmium*, Chromium$^{(3+)}$*, Copper*, Lead*, Nickel*, Zinc*, Ammonia and Pentachlorophenol *(*total recoverable form)*	8 values [3]	Maximum 4-day concentration not exceeded more than once every 3 years	≥ values provided in Table C below
Arsenic$^{(+3)}$*, Chromium$^{(+6)}$*, Mercury$^{(+2)}$*, free Cyanide, Chloride, Chlorine (total residual), Dieldrin, Endrin, and Parathion (**total recoverable form)*			≥ values provided in Table B below

** Discrete values refer to samples collected on separate calendar days*

*** Temperature values represent maximum temperatures as proposed in subch. 5 of ch. NR 102, as of June 2009.*

Recreational Use Assessments

Recreational Use: Beach Assessment Methods

Many, but not all, beaches are evaluated for Recreational Uses in Wisconsin. Federal criteria for *Escherichia coli* (*E. coli*) are applicable to the open waters of the Great Lakes – including beaches. In Wisconsin, inland beaches follow the same monitoring and assessment protocol as the Great Lakes beaches. *E. coli* is a species of bacteria that serves as an indicator of the presence of fecal matter in the water – suggesting that there may be harmful bacteria, viruses, or protozoans present that elevate risk to humans.

Impairment Assessment for Beaches
U.S. EPA has established two different water quality criteria for *E. coli* – a single sample maximum of 235 cfu[15]/100 mL and a long-term geometric mean maximum of 126 cfu/100 mL. Beach closure decisions are routinely made considering the single sample value. However, when evaluating *E. coli* data to determine if a beach should be included on the Impaired Waters List, the Department relies on data collected throughout the entire beach season because of the variability of *E. coli* populations in a beach environment on a day-to-day or hour-to-hour basis. Accordingly, the Department requires a minimum of 15 samples collected during a beach season to calculate a long-term geometric mean. Datasets with fewer than 15 samples are considered insufficient. Table 14 shows the beach listing thresholds based on the rolling geometric mean, which, if exceeded, would place a beach on the Impaired Waters List. This threshold was selected to represent the number of weekly samples typically collected during a Wisconsin "beach season." In Wisconsin, the typical swimming season lasts about 15 weeks – Memorial Day through Labor Day.

Table 14. Beach Listing Thresholds for Rolling Geometric Mean

Years of Information Available	Beach Listed If:
1 year of data	>35% of geomeans exceed 126 cfu/100 mL
2 years of data	>25% of geomeans exceed 126 cfu/100 mL
3 years of data	>15% of geomeans exceed 126 cfu/100 mL

When a beach is included on the proposed Impaired Waters List, the pollutant is listed as *E. coli* and the impairment is identified as "Recreational Restrictions – Pathogens." The Department believes this is an appropriate way of recognizing chronic risk to human health associated with recreational activities in water with long-term elevated levels of *E. coli.*

Recreational Use: Stream/River Assessment Methods

Federal criteria for *E. coli* were developed after consideration of risk to the swimming public. All of the data used to establish the federal criteria were collected from swimming beaches. In general, flowing rivers and streams in Wisconsin do not provide comparable recreational activities for full body immersion. For those water bodies, the Department utilizes that the long-standing water quality criterion for fecal coliform that is

[15] CFU = colony forming unit. This is the standard unit of measurement of bacteria in a laboratory test.

reflected in Chapter NR 102.04(5) of the Wisconsin Administrative Code. That section reads:

> (a) *Bacteriological guidelines.* The membrane filter fecal coliform count may not exceed 200 per 100 ml as a geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 ml in more than 10% of all samples during any month.

When a flowing stretch of a river or stream is included on the proposed Impaired Waters List, the pollutant is listed as fecal coliform and the impairment is identified as "Recreational Restrictions – Pathogens." In many instances where fecal coliform counts are high, *E. coli* data or other pathogen data are also collected for streams and rivers and may be used in lieu of or supplementary to fecal coliform data to make best professional judgment decisions to list or not list the waterbody as impaired.

Recreational Use: Lake Assessment Methods (for blue-green algae)

Blue-green algae are naturally occurring organisms found throughout the state and are an important part of Wisconsin's freshwater ecosystem. However, excessive nutrient loading (particularly phosphorus) can cause blue-green algae populations to grow rapidly under certain environmental conditions and form "blooms" that can impact water quality and pose health risks to people, pets, and livestock. Most species of blue-green algae are buoyant and when populations reach bloom densities, they float to the surface where they form scum layers or floating mats. In Wisconsin, blue-green algae blooms generally occur between mid-June and late September, although in rare instances, blooms have been observed in winter, even under the ice.

Blue-green algae blooms can cause many water quality problems including: a) reduce light penetration affecting the ability of macrophytes to thrive; b) discoloration of water; c) taste and odor concerns, and d) reduction of dissolved oxygen concentrations due to massive decomposition of the cells when they die-off. Another important consequence of blue-green algae is their ability to produce naturally-occurring toxins.

Algal toxins can be harmful to humans and animals alike through skin contact, inhalation, or ingestion. Some of the species commonly found in Wisconsin that produce algal toxins include, *Anabaena* sp., *Aphanizomenon* sp., *Microcystis* sp., and *Planktothrix* sp. Where monitoring of blue-green algae occurs, notices are provided to local public health agencies when concentrations are presumed to exceed 100,000 cells/mL. That value represents the threshold for moderate risk to humans as established by the World Health Organization (WHO). Illnesses related to blue-green algae can occur in both humans and pets. People may be exposed to these toxins through contact with the skin (e.g., when swimming), through inhalation (e.g., when motor boating or water skiing), or by swallowing contaminated water. In 2009, the Wisconsin Department of Health Services documented over 41 cases statewide of human health exposure related to blue-green algae blooms including respiratory ailments (coughing), watery eyes and rashes. Animals can be even more susceptible to risks by drinking water directly from water bodies with dense algal blooms or by licking their fur after swimming.

When a waterbody is proposed to be included on the Impaired Waters List due to frequent and elevated algal cell counts, and data are available suggesting high total phosphorus concentrations, the pollutant is listed as Total Phosphorus and the

impairment is identified as “Recreational Restrictions – Blue-green Algae.” In the absence of meeting minimum data requirements for total phosphorus, the professional judgment of the Regional Biologist is used to consider listing any waterbody that experiences frequent and severe blue-green algal blooms where there is strong reason to believe that nutrient levels may be contributing to such blooms.

Public Health Use Assessments

Public Health Use: Fish Consumption Assessment Methods

Waterbodies are listed for fish consumption advisories due to atmospheric deposition of mercury, PCBs, dioxin and furan congeners, and Perfluoroctane sulfonate or PFOs. In 1998, 241 waters were added to the 303(d) list in category 5B "Waters Impaired by Atmospheric Deposition of Mercury," using the criterion that mercury-based fish consumption advisories had been issued for these specific waterbodies. Since that time, all waters in the state have been placed under a general fish consumption advisory which recognizes that most fish from most waters in the state contain mercury in at least low levels of concentration. Since 2002, waters have been added to the 303(d) list as they are added to the fish consumption advisory publication for *specific* advisories, and de-listed where the special fish consumption advisory no longer applies.

When specific data are available for certain game and panfish species for individual water bodies, the Department will use the following fish consumption program guidance to include those waters on the Impaired Waters List:

> ***Mercury:*** If a waterbody has special mercury based consumption advice of one meal per month or less frequent for panfish (applied when panfish concentrations reach 0.21 to 1 parts per million (ppm), or is "do not eat" for gamefish (applied when gamefish concentrations exceed 1 ppm).
>
> ***Polychlorinated Biphenyls (PCBs):*** if a waterbody has special PCB-based fish consumption advice of one meal per week or less frequent for panfish species or one meal per month or less frequent for gamefish (applied when PCB concentrations reach total PCB concentration in the range of 0.21 ppm or >2 ppm). Some of these sites are due to general residual environmental PCB contamination and some are due to specific deposits of PCBs.
>
> ***Dioxin and Furan Congeners:*** if a waterbody has special dioxin/furan based advice of "do not eat" (applied when dioxin equivalents exceed 10 parts per trillion and (ppt) based on 2, 3, 7, 8-substituted dioxin and furan congeners).
>
> ***Perfluoroctane sulfonate (PFOS):*** if a waterbody has a special PFOS-based fish consumption advice of one meal per week or less frequent for panfish species or one meal per month or less frequent for game fish species. A segment of the Mississippi River is being added for PFOs in 2008, making it the only water on the list for PFOs.

Specific waters will be proposed for de-listing where fish are collected and analyzed but no longer meet the criteria for specific fish consumption advice for mercury, PCBs, or other chemicals. The general, statewide fish consumption advisory will still apply to these waters but they will no longer be included on the 303(d) list.

More information about the specific consumption advisory can be found in the publication: Choose Wisely, A Healthy Guide for Eating Fish in Wisconsin (PUB-FH-824 2007.) It is available on line at http://dnr.wi.gov/fish/consumption/.

C3. 2009-2010 Assessment Results

Assessment Database and Georeferencing Information

Assessment data for the state's Integrated Report and data submittal under Clean Water Act Section 305(b) and 303(d) are stored in the state's Waterbody Assessment, Tracking and Electronic Report System (WATERS). Much of the state's Watershed Planning data is also stored in 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. Each of these is described below.

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 is 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 Fish Database hosts a wide variety of fish and habitat related information for the Water Division. Fish data is collected for both targeted fish management activities as well as 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 under the Federal Clean Water Act. Whereas SWIMS houses raw data for each waterbody, WATERS stores summary information for each waterbody and documentation of decisions regarding each waterbody. For instance, 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 USEPA'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 is sent to EPA periodically in fulfillment of our Clean Water Act 305(b), 303(d), and 314 grant reporting requirements.

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.

Explanation of EPA's Integrated Reporting Categories (5-Part Categorization)

All waters in the state are assigned one of five EPA categories that indicate the status of the waterbody. This relates to issues such as whether the waterbody is meeting its designated uses (i.e. whether or not it is impaired), and whether a TMDL or Alternative Project is needed or is in progress. Table 15 provides a summary of the number and how many miles/acres of waterbodies in Wisconsin fall into each of these categories. Table 16 provides a definition of each of these EPA categories. In the Impaired Waters List tables in Appendices A and B, there is a column that indicates which category ("U.S. EPA CODE") each individual waterbody has been assigned to.

Table 15. Size of Surface Waters Assigned to Reporting Categories

Waterbody Type		Category								Total in State Database	Total Assessed
		1	2	3	4a	4b	4c	5a	5b		
River/stream	# Records	0	45	6,676	64	0	0	344	3	7,132	456
	Miles	0	450	31,619	310	0	0	3,014	17	35,409	3,790
Lake	# Records	0	56	18,504	3	0	0	44	170	18,777	273
	Acres	0	43,810	549,076	1,365	0	0	225,145	55,417	874,814	325,738
Impoundment	# Records	0	8	292	0	0	0	25	30	355	63
	Acres	0	8,279	12,842	0	0	0	66,269	31,863	119,254	106,412
Spring Lake	# Records	0	0	247	0	0	0	0	0	247	0
	Acres	0	0	1,501	0	0	0	0	0	1,501	0
Great Lakes Shoreline	# Records	0	0	1	0	0	0	3	0	4	3
	Miles	0	0	700	0	0	0	268	0	968	268
Great Lakes Beach	# Records	0	10	0	0	0	0	35	0	45	45
	Miles	0	5	0	0	0	0	26	0	31	31
Inland Beach	# Records	0	1	9	0	0	0	14	0	24	15
	Miles	0	0	3	0	0	0	3	0	6	3
Bay/Harbor	# Records	0	0	51	0	0	0	11	0	62	11
	Acres	0	0	5,230	0	0	0	20,827	0	26,058	20,828
Riverine Backwater	# Records	0	0	3	0	0	0	0	0	3	0
	Acres	0	0	2	0	0	0	0	0	2	0
Freshwater Wetland	# Records	0	0	6	0	0	0	1	0	7	1
	Acres	0	0	5,010,408	0	0	0	1,000	0	5,011,408	1,000

Table 16. U.S. EPA's Integrated Reporting Categories

Integrated Reporting Category	Description / How this is applied in Wisconsin
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 data and/or information indicate 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 4: Waters where a development of a Total Maximum Daily Load (TMDL) is not or no longer needed.	
Category 4A	All TMDLs needed for attainment of water quality standards have been approved or established by EPA. Implementation and monitoring schedules should then be supplied to U.S. EPA. This category is used for situations where one or more of the designated uses has been identified as impaired and a TMDL has been created and approved. This does not mean that all other designated uses have been evaluated and found to be meeting their designated use. These waters were previously stored in Category 5C.
Category 4B	Alternative Project to TMDL: Required control measures are expected to achieve attainment of water quality standards in a reasonable period of time. States are required to provide adequate documentation that the proposed control mechanisms will address all major pollutant sources and establish a clear link between the control mechanisms and water quality standards[16].
Category 4C	A waterbody where the impairment is not caused by a pollutant. Pollution is defined by U.S. EPA as the human-made or human-induced alteration of the chemical, physical, biological, and radiological integrity of water (Section 502(19)).
Category 5: A TMDL is required.	
Category 5A	Available data and/or information indicate 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 TMDL are still needed. The majority of Wisconsin impaired waters fall in this category.
Category 5B	Available data and/or information indicate 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.

[16] In Wisconsin, Environmental Accountability Projects remain in 5A until a waterbody is restored and delisted.

Results of General Condition Assessments

As described in Section C2, General Condition 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 each 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 that are 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.

How Many Waterbodies Are Supporting Their Designated Uses?

As discussed in the monitoring section of this report, because of the vast water resources in the state of Wisconsin, only a portion of the state's waters can be monitored or assessed at any given time. For example, the state has over 54,000 individual streams covering 88,000 miles; of this amount, only 7100 (35,000 miles) are entered into our assessment database and of those entered, about 40% of the miles are considered assessed. Assessed waters include those that are both directly monitored with recent data ("monitored") and those that are "evaluated" (data from greater than 5 years old or more). WDNR generally prioritizes the entry of water information for impaired or degraded waters due to resource limitations. As resources allow additional waters will be entered and updated in the assessment database to make the documentation of the state's waters as comprehensive as possible.

Wisconsin's 2010 Assessed Waters

Lakes

- *Total Number:* Wisconsin has over 15,000 lakes (~1 million acres).
- *Number Assessed:* Approximately 4,200 lakes in the state are assessed (762,741 acres). This is equivalent to ~23% of the total number of lakes, and ~83% of the lake acres in the state, reflecting that the majority of Wisconsin's lakes over ten acres are assessed but most smaller lakes are not.
- *Number Impaired:* Of those assessed, 21% of lake acres are impaired. Of impoundments in the database, about 50% of impoundment acres are impaired.

Rivers

- *Total Number:* Wisconsin has over 54,000 individual rivers and streams (88,000 miles). Many of these are very small streams that are not documented in WDNR's database.
- *Number Assessed:* 2683 rivers and streams are assessed (13,778 miles). This is equivalent to 5% of the total number of rivers in the state and 16% of river/stream miles.
- *Number Impaired:* 390 rivers and streams are known to be impaired (9% of the river/stream miles in the database).

Table 17 through Table 26 summarize the status of Wisconsin's waters entered in DNR's assessment database[17]. The tables show how many miles or acres of the resource were assessed or not assessed, and of those assessed, and how many are *Fully Supporting, Supporting, or Not Supporting* each of the four designated uses.

Lakes - Table 17 below shows that Fish and Aquatic Life uses for lakes have been more thoroughly assessed than other designated uses. This is due to the 2010 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 photos. The state's Citizen Lake Monitoring Network contributed greatly to the high-quality work represented below, with almost 1,000 volunteers sampling approximately 800 monitoring stations for fish and aquatic life use support each year.

Table 17. Lakes - Summary of acres supporting Designated Uses

Designated Use	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		17658.49	99884.52	757254.6	874797.61
Fish and Aquatic Life	167167.65	409194.72	186379.22	112056.02	874797.61
Public Health and Welfare				874797.61	874797.61
Recreation	23.29	16.98	2509.33	872248.01	874797.61

Impoundments - Impoundments, a highly popular recreational resource in Wisconsin, are unfortunately disproportionately impaired, with 50 percent of documented impoundment acres impaired for Fish and Aquatic Life uses (Table 18). This is frequently due to the build up of contaminants behind riverine structures such as dams. As sediment collects behind a dam, contaminants that tend to attach to sediment such as organic contaminants and metals tend to collect in these deposits as well. Eighty percent of the assessed impoundment acres are not supporting fish consumption uses.

Table 18. Impoundments - Summary of acres supporting Designated Uses

Designated Use	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		5384.21	20497.6	93375.21	119257.02
Fish and Aquatic Life	5327.77	48019.03	59821.78	6088.44	119257.02
Public Health and Welfare				119257.02	119257.02
Recreation		64.55	9000	110192.47	119257.02

Bays/Harbors - Table 19 for the state's Great Lakes and inland bays does not begin to represent the number of bays in the state. As the table indicates, most of the bay acres are considered impaired in one or more use designations and few –61 acres—are considered fully supporting. Inland bays on the state's many thousands of lakes are currently not adequately documented in the assessment database.

Table 19. Bays/Harbors - Summary of acres supporting Designated Uses

Designated Use	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption			19946.72	6110.91	26057.63
Fish and Aquatic Life	61.97		20827.36	5163.75	26053.08
Public Health and Welfare			6042.93	20014.7	26057.63
Recreation				26057.63	26057.63

Rivers/Streams, and Riverine Backwaters - Table 20 indicates that 35,000 river and stream miles are documented in WATERS, but in actuality the state has over 54,000 rivers and streams covering 88,000 river/stream miles. The percentage of rivers/streams that are indicated as assessed represents a small fraction of river/stream miles in the state (only about 5% of the individual rivers or about 18% of the river miles).

Of those miles assessed, about 22% of river miles are not supporting their Fish and Aquatic Life use. Only a very small fraction of river miles have been assessed for Fish Consumption (2%) or Recreation (0.3%) uses.

Table 20. Rivers & Streams - Summary of miles supporting Designated Uses

Designated Use	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		106.38	511.93	34791.78	35410.09
Fish and Aquatic Life	6554.38	4164.17	3059.95	21622.11	35400.61
General			230.7		230.7
Public Health and Welfare				35410.09	35410.09
Recreation		8.09	111.24	35290.76	35410.09

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 21 are part of Slaughterhouse Creek, a contaminated site in Marathon County.

Table 21. Riverine Backwater - Summary of acres supporting Designated Uses

Designated Use	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size (Acres)
Fish Consumption				1.73	1.73
Fish and Aquatic Life			1.28	0.45	1.73
Public Health and Welfare				1.73	1.73
Recreation				1.73	1.73

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, shown in Table 22. Many of these waters are considered impaired due to sediment contamination from historic discharges or "legacy" pollutants. As resources permit, a more comprehensive assessment of Great Lakes Shorelines will be conducted in future years.

Table 22. Great Lakes Shoreline - Summary of miles supporting Designated Uses

Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption			8.94	959.39	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 and Inland Beaches - As with the other resource areas, the state's Great Lakes Beaches are represented in Table 23 only where resources and data have provided specific 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, 26 miles are considered impaired for Recreational Uses.

Table 23. Great Lakes Beaches - Summary of miles supporting Designated Uses

Designated Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size (Miles)
Fish Consumption		1.22		29.94	31.16
Fish and Aquatic Life		11.82	9.31	10.03	31.16
Public Health and Welfare				31.16	31.16
Recreation		5.15	26.01		31.16

As with Great Lakes Beaches, inland beaches are under-represented in the state's assessment 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 24. 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 24. Inland Beaches - Summary of miles supporting Designated Uses

Designated Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size (Miles)
Fish Consumption				6.43	6.43
Fish and Aquatic Life	0.07	0.36		6	6.43
Public Health and Welfare				6.43	6.43
Recreation		2.13	3.38	0.92	6.43

Springs - The state's documented springs, again, do not come close to representing the actual resource in the state. While millions of springs once dotted the Wisconsin landscape, and while some inventories of springs do exist, these springs have not been entered into the WATERS database and are therefore not reflected in Table 25. Future work will involve incorporating updated springs data into the assessment database for management purposes.

Table 25. Springs - Summary of acres supporting Designated Uses

Designated Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption				1500.79	1500.79
Fish and Aquatic Life	446.07	300.09	38.25	716.38	1500.79
Public Health and Welfare				1500.79	1500.79
Recreation				1500.79	1500.79

Wetlands - It is difficult to determine exactly how many acres of wetlands were in Wisconsin prior to European settlement. Initial state surveys conducted in the early 1800s estimated the entire state contained approximately five million wetland acres. We now know these estimates were low by about 100 percent! There are many reasons for this discrepancy. The original surveyors of the state did not use similar interpretations of what were considered wetlands, nor were the survey methods used very accurate. More recently, soil scientists estimate that Wisconsin once contained 10 million acres of wetlands. This figure is based on much more accurate data from classifying wet soils (those that are somewhat poorly, poorly and very poorly drained) 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 26 will likely change once these more sophisticated tools are implemented.

Table 26. Wetlands - Summary of acres supporting Designated Uses

Designated Use Category	Fully Supporting	Supporting	Not Supporting	Not Assessed	Total Size (Acres)
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

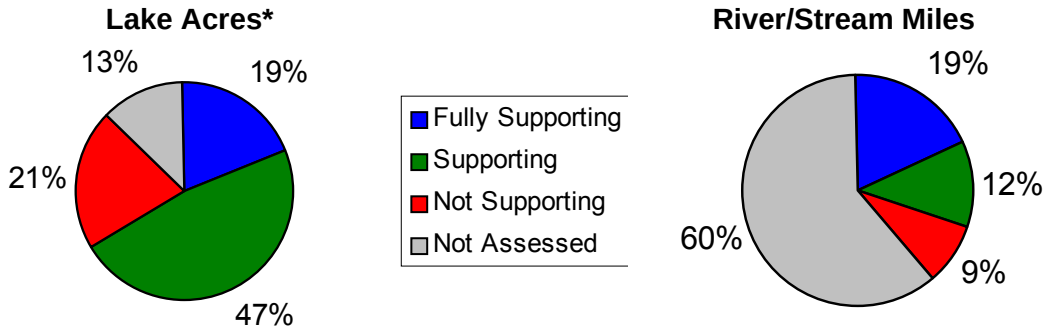
**Note: A considerable portion of the state's wetlands are dominated by Reed Canary Grass.

Fish & Aquatic Life Uses

The pie charts below provide a visual representation of the tabular data in Table 17 and Table 20. Of the waterbodies in WDNR's database[17], the charts show the percent of waters that have been assessed as Fully Supporting, Supporting, or Not Supporting their Fish & Aquatic Life (FAL) Designated Uses. Due to the availability of satellite assessments of water clarity for lakes and a standardized method for translating that data into general condition assessments, a much higher percentage of lakes in the state was assessed in 2009 than ever before (87% of lake acres). For river and stream miles, due to the labor-intensive nature of sampling and the vast number of stream miles in the state, only 40% of the waterbodies in WDNR's databases have been assessed.

For Lakes, 66% of lake acres either Fully Support or Support their FAL uses, with 21% not supporting FAL uses. For Rivers/Streams, 31% of the miles in the database Fully Support or Support their FAL uses, with 9% Not Supporting and 60% unassessed.

Figure 14. Percent of Lakes acres and River/Stream miles in WDNR databases that support Fish & Aquatic Life Designated Use



*Does not include impoundments

Recreational Uses

There are 192 public beaches along Wisconsin's Great Lakes coastline. Wisconsin monitors over 120 sites on public beaches along the Great Lakes. Beach data collected for at least 14 weeks during the beach season (Memorial Day through Labor Day) were evaluated. In total, the 2010 Impaired Waters List includes 33 Great Lakes beaches listed for Recreational Use Impairments due to an exceedance of the geometric mean of 126 CFU/100 mL for *E.coli* over 15% of the time for a 3-year period. The geometric mean is used to even out the variability associated with *E.coli* as an indicator species. Beaches may be listed or delisted dependent on the amount of data available, and whether these data exceed listing criteria outlined in the WisCALM document. Several beaches are proposed to be delisted for 2010 because they no longer exceed the listing criteria.

[17] Not all waters of the state are documented in the WDNR databases.

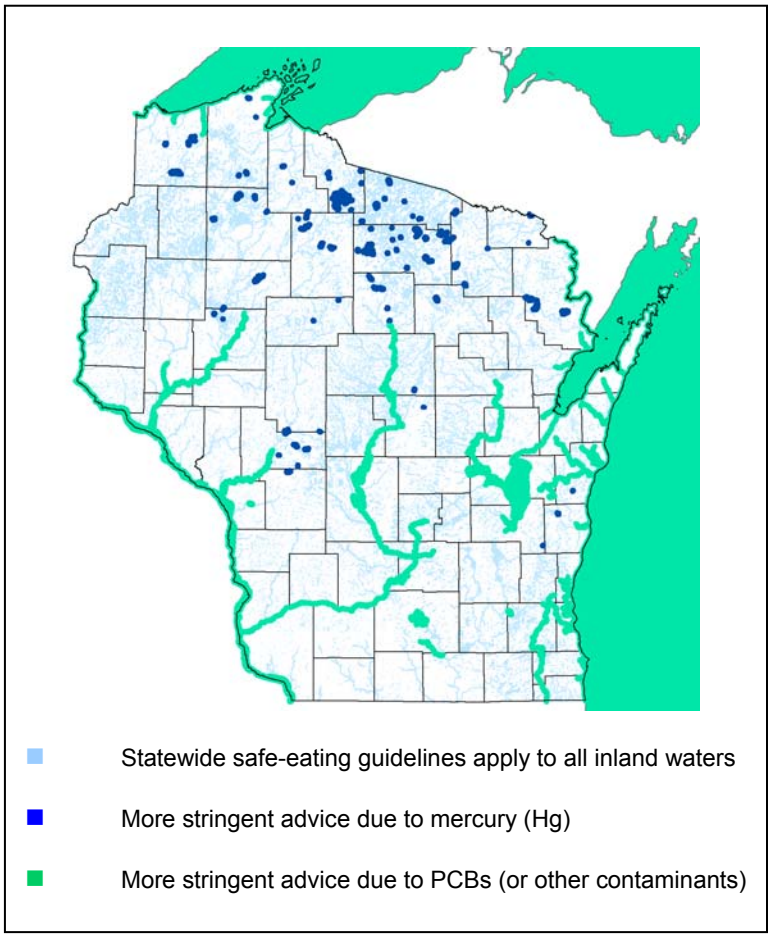
Public Health and Welfare Uses

Toxic Substance Monitoring: Fish Tissue Monitoring & Fish Consumption Advice
All waters of Wisconsin are covered under *statewide general fish consumption advice*, as described in Section C1. In addition, fish tissue is sampled from various waterbodies each year to assess the tissue for higher levels of mercury, or the presence of PCBs or other toxic substances. If these levels exceed certain thresholds, the waterbody is assigned *specific consumption advice*, more stringent than the statewide general advice.

During calendar years 2008-2009, over 1300 fish samples were collected as a part of the fish contaminant monitoring program. The data include samples 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) or the U.S. EPA, or as a part of special projects and research. The 2008-2009 samples were collected from approximately 101 locations including sites in lakes, flowing waters, Green Bay and Lakes Michigan and Superior.

Using these data, the 2009 update of the Wisconsin Fish Consumption Advisory contains *specific consumption advice* for some species of fish from 49 of the more than 2,000 lakes, river segments, and border waters. These are waters for which testing indicated the presence of PCBs, dioxin/furans, and perflourochemicals. Additionally, more stringent advice applies to some species from 102 specific surface waters due to higher concentration of mercury. See Figure 15 for a map showing where general and specific fish consumption advisories apply.

Figure 15. 2009 map of general and specific fish consumption advisories



Additionally, in 2007, Wisconsin examined mercury concentrations in walleye collected from inland lakes over the time periods of 1982 to 2005. Statistical analysis of this data suggests that mercury concentrations in walleye decreased over that time period in the northern part of the state but appear to have increased in the southern part of the state (Rasmussen et al. 2007).

Proposed 2010 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 2010 Impaired Waters List submitted here reflects the 2008 list updates as well as new updates for 2010.

The 2010 Impaired Waters List is being submitted to US EPA as Attachments B and C of Wisconsin's 2010 Integrated Report Submittal Package. Attachment B contains the entire 2010 Impaired Waters List, while Attachment C contains only the 2010 updates to the list. A summary of findings is presented here to provide an overall characterization of waters included in the Impaired Waters List. These lists can also be found online, in a format that allows queries and sorting, at http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html. GIS shapefiles showing maps of proposed impaired waters are also available at this site.

Major 2010 Modifications to Wisconsin's Impaired Waters List

- Multiple streams in the Kinnickinnic and Menomonee watersheds are being listed for recreational restrictions due to high levels of fecal coliform bacteria.
- 12 lakes, including Lake Wisconsin, are being listed for high levels of phosphorus that lead to eutrophication (low dissolved oxygen, harmful algal blooms).
- Bass Lake in Marinette County and Silver Lake in Manitowoc County are proposed for delisting because state and local management actions have improved water quality and habitat.
- 15 beaches are proposed to be delisted due to decreased *E. coli* levels in the past 3-5 years. However, due to variability of *E. coli*, potential sources of pollution to beaches should be identified to keep beaches off the list in future years.
- For Fish Consumption Uses, WDNR staff reviewed data from the past 10 years. If fish tissue data showed no specific advisory for PCBs or mercury, the waterbodies were removed from the Impaired Waters List and moved to the general fish consumption advisory.

Summary of Impairments and Sources

Each impaired waterbody has documented impairments[18] and one or more "sources" of impairment, which represent the actual landscape source contributing to the impairment.

For each impairment, there can be a wide variety of sources. These impairments and sources are presented in this section in tables for each waterbody type. For each waterbody type, the table toward the left shows the impairments, and the table toward the right shows the sources of these impairments. The impairments and sources are categorized by Designated Use (e.g. Fish and Aquatic Life, Recreation, etc.). Table 35 provides EPA's definition of each source.

Freshwater Lakes and Impoundments/Reservoirs – Impairment and sources for Freshwater Lakes and Impoundments/Reservoirs are shown in Table 27 and Table 28.

For Fish and Aquatic Life Uses in Freshwater Lakes (Table 27), 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 (Table 28) 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%).

[18] These Impairments are also referred to by US EPA as "Causes"; the terms are interchangeable. Along with Impairments and Sources, Wisconsin also documents Pollutants for each impaired waterbody. All three—Impairments, Pollutants, and Sources—are reflected in the Impaired Waters List.

Table 27. Freshwater Lakes – Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Eutrophication	196520	33%
Low DO	167559	29%
Turbidity	156631	27%
Degraded Habitat	39024	7%
Contaminated Fish Tissue	11696	2%
Chronic Aquatic Toxicity	5983	1%
Contaminated Sediment	4223	1%
Elevated pH	2918	1%
Fish Kills	2698	0.5%
Elevated Water Temperature	390	0.1%
Excess Algal Growth	255	0.0%
RECREATION USES		
Recreational Restrictions - Blue Green Algae	2287	91%
Recreational Restrictions - Pathogens	239	9%
FISH CONSUMPTION USES		
Contaminated Fish Tissue	275369	100%
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Non-Point Source	61896	45%
Discharges from Municipal Separate Storm Sewer Systems (MS4)	21191	15%
Non-irrigated Crop Production	21191	15%
Atmospheric Deposition - Toxics	10543	8%
Contaminated Sediments	6415	5%
Historic Point Sources - Legacy Pollutants	4223	3%
Internal Nutrient Recycling	2770	2%
Site Clearance (Land Development or Redevelopment)	2136	2%
Crop Production (Crop Land or Dry Land)	1534	1%
Grazing in Riparian or Shoreline Zones	1534	1%
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	1534	1%
Streambank Modifications/destablization	1534	1%
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)	189	0.1%
Source Unknown	197	0.1%
Livestock (Grazing or Feeding Operations)	169	0.1%
Transfer of Water from an Outside Watershed	73	0.1%
Total Retention Domestic Sewage Lagoons	60	0.0%
RECREATION USES		
Historic Point Sources - Legacy Pollutants	2287	50%
Internal Nutrient Recycling	2287	50%
FISH CONSUMPTION USES		
Atmospheric Deposition - Toxics	233156	58%
Contaminated Sediments	162386	40%
Historic Point Sources - Legacy Pollutants	9781	2%
PUBLIC HEALTH & WELFARE USES		
NA		

Table 28. Impoundments/Reservoirs - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Low DO	40198	45%
Eutrophication	27634	31%
Elevated pH	17120	19%
Degraded Habitat	3021	3%
Chronic Aquatic Toxicity	346	0.4%
Contaminated Fish Tissue	284	0.3%
Contaminated Sediment	262	0.3%
Turbidity	25	0.0%
RECREATION USES		
Recreational Restrictions - Blue Green Algae	9000	99%
Recreational Restrictions - Pathogens	65	1%
FISH CONSUMPTION USES		
Contaminated Fish Tissue	102328	99%
Chronic Aquatic Toxicity	354	0.3%
Contaminated Sediment	354	0.3%
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Non-Point Source	41065	45%
Upstream Source	35386	39%
Crop Production (Crop Land or Dry Land)	3170	3%
Sediment Resuspension (Clean Sediment)	2953	3%
Streambank Modifications/destablization	2142	2%
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	1994	2%
Municipal (Urbanized High Density Area)	1387	2%
Contaminated Sediments	649	1%
Channelization	621	1%
Site Clearance (Land Development or Redevelopment)	621	1%
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)	310	0.3%
Source Unknown	310	0.3%
Atmospheric Deposition - Toxics	266	0.3%
Discharges from Municipal Separate Storm Sewer Systems (MS4)	49	0.1%
RECREATION USES		
Source Unknown	9000	100%
FISH CONSUMPTION USES		
Atmospheric Deposition - Toxics	97418	43%
Contaminated Sediments	47305	21%
Upstream Source	44386	19%
Source Unknown	38340	17%
Non-Point Source	985	0.4%
Historic Point Sources - Legacy Pollutants	354	0.2%
PUBLIC HEALTH & WELFARE USES		
NA		

Bays and Harbors - Bays and Harbors (Table 29) that are impaired are impacted equally by Contaminated Fish Tissue, Degraded Habitat, and Low DO. The sources for these impacts are primarily Contaminated Sediments and discharges from Municipal Separate Storm Sewer Systems. Those bays and harbors that are impaired for Public Health and Welfare are due to Contaminated Sediment from Historic Point Sources.

Table 29. Bays and Harbors - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Contaminated Sediment	14025	29%
Degraded Habitat	13867	28%
Low DO	13867	28%
Chronic Aquatic Toxicity	6069	12%
Elevated pH	364	1%
Eutrophication	725	1%
RECREATION USES		
NA		
FISH CONSUMPTION USES		
Contaminated Fish Tissue	19972	100%
PUBLIC HEALTH & WELFARE USES		
Contaminated Sediment	6043	100%

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Contaminated Sediments	13919	35%
Discharges from Municipal Separate Storm Sewer Systems (MS4)	13867	35%
Historic Point Sources - Legacy Pollutants	6076	15%
Grazing in Riparian or Shoreline Zones	1089	3%
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)	1089	3%
Site Clearance (Land Development or Redevelopment)	1089	3%
Streambank Modifications/destablization	1089	3%
Crop Production (Crop Land or Dry Land)	728	2%
Non-Point Source	728	2%
Source Unknown	96	0.2%
RECREATION USES		
NA		
FISH CONSUMPTION USES		
Contaminated Sediments	6104	25%
Atmospheric Deposition - Toxics	6068	25%
Historic Point Sources - Legacy Pollutants	6043	25%
Source Unknown	5939	25%
Upstream Source	25	0.1%
PUBLIC HEALTH & WELFARE USES		
Historic Point Sources - Legacy Pollutants	6043	100%

Rivers and Streams - Impairment and their sources for rivers and streams are shown in Table 30. 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 30. Rivers and Streams - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Degraded Habitat	1452.93	45%
Low DO	866.05	27%
Elevated Water Temperature	238.99	7%
Contaminated Sediment	197.16	6%
Chronic Aquatic Toxicity	177.45	5%
Contaminated Fish Tissue	104.2	3%
Eutrophication	60.1	2%
Degraded Submerged Aquatic Vegetation (SAV)	48.1	1%
Elevated pH	28.65	1%
Acute Aquatic Toxicity	26.73	1%
Sediment/Total Suspended Solids	19.47	1%
Turbidity	10.53	0.3%
Excess Algal Growth	8.09	0.3%
Fish Barriers (Fish Passage)	7	0.2%
Low flow alterations	6.15	0.2%
Recreational Restrictions - Pathogens	2	0.1%
RECREATION USES		
Recreational Restrictions - Pathogens	119.68	100%
FISH CONSUMPTION USES		
Contaminated Fish Tissue	1681.84	99%
Contaminated Sediment	11.5	1%
Acute Aquatic Toxicity	2.25	0.1%
PUBLIC HEALTH & WELFARE USES		
NA		
GENERAL USES		
Water Quality Use Restrictions	230.7	100%

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Non-Point Source	2031	34%
Streambank Modifications/destablization	545	9%
Livestock (Grazing or Feeding Operations)	494	8%
Discharges from Municipal Separate Storm Sewer Systems (MS4)	438	7%
Non-irrigated Crop Production	318	5%
Contaminated Sediments	308	5%
Loss of Riparian Habitat	246	4%
Historic Point Sources - Legacy Pollutants	213	4%
Impacts from Hydrostructure Flow Regulation/modification	185	3%
Animal Feeding Operations (NPS)	125	2%
Site Clearance (Land Development or Redevelopment)	122	2%
Channelization	115	2%
Crop Production (Crop Land or Dry Land)	111	2%
Industrial Point Source Discharge	87	1%
Post-development Erosion and Sedimentation	85	1%
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	73	1%
Dairies (Outside Milk Parlor Areas)	60	1%
Source Unknown	54	0.9%
Municipal (Urbanized High Density Area)	53	0.9%
Sediment Resuspension (Clean Sediment)	44	0.7%
Highways, Roads, Bridges, Infrasturcture (New Construction)	38	0.6%
Freshettes or Major Flooding	31	0.5%
Upstream Source	29	0.5%
Grazing in Riparian or Shoreline Zones	28	0.5%
18 other Sources each less than .5%		*Less than 0.5% each*
RECREATION USES		
Livestock (Grazing or Feeding Operations)	5	28%
Non-Point Source	5	28%
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	4	21%
Source Unknown	3	16%
Dairies (Outside Milk Parlor Areas)	1	7%
FISH CONSUMPTION USES		
Contaminated Sediments	1140	43%
Atmospheric Deposition - Toxics	899	34%
Source Unknown	533	20%
Historic Point Sources - Legacy Pollutants	56	2%
Upstream Source	29	1%
Industrial Point Source Discharge	2	0.1%
Non-Point Source	2	0.1%
PUBLIC HEALTH & WELFARE USES		
NA		
GENERAL USES		
Historic Point Sources - Legacy Pollutants	31	100%

Wetlands – Of the Wetland acres impaired for Fish and Aquatic Life Uses, Table 31 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 31. Wetlands are not currently assessed for Recreation, Fish Consumption, or Public Health and Welfare.

Table 31. Wetlands - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Degraded Habitat	1000	50%
Low DO	1000	50%
RECREATION USES		
NA		
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
Crop Production (Crop Land or Dry Land)	2000	40%
Internal Nutrient Recycling	1000	20%
Non-Point Source	1000	20%
Source Unknown	1000	20%
RECREATION USES		
NA		
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

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 32.

Table 32. Great Lakes Shoreline - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
NA		
FISH CONSUMPTION USES		
Contaminated Fish Tissue	268	100%
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
NA		
FISH CONSUMPTION USES		
Atmospheric Deposition - Toxics	259	50%
Contaminated Sediments	259	50%
PUBLIC HEALTH & WELFARE USES		
NA		

Great Lakes and Inland Beaches – Thirty-one miles of Great Lakes Beaches have been listed as impaired due to Pathogens (*E. coli*) (Table 33), though the source of these pathogens is currently unknown. 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 34).

Table 33. Great Lakes Beaches - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
Recreational Restrictions - Pathogens	31	100%
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
Source Unknown*		
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

*Sanitary surveys are being conducted by County Health Departments to determine sources of pollutants.

Table 34. Inland Beaches - Impairments and their Sources

USE DESIGNATION Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
Recreational Restrictions - Pathogens	4	100%
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

USE DESIGNATION Source of Impairment	Total Size (ACRES)	Percentage (%)
FISH & AQUATIC LIFE USES		
NA		
RECREATION USES		
Source Unknown*		
FISH CONSUMPTION USES		
NA		
PUBLIC HEALTH & WELFARE USES		
NA		

*Sanitary surveys may be available from County Health Departments.

Table 35. EPA definitions of impairment 'Sources'
(this list is a subset of all 154 EPA Source definitions, showing only those referenced in this report)

Source	EPA Definition
Atmospheric Deposition - Toxics	Pollution involving toxics from wet or dry atmospheric deposition. See background information in -- Deposition of Air Pollutants to the Great Waters: Third Report to Congress (EPA-453/R-00-005).
Channelization	Impacts resulting from straightening, dredging, and the entrenchment within levees or pilot channels of natural river systems. See background information in Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group (FISRWG) A 57.6/2:EN 3/PT.653; CZARA management measure guidance (EPA-840-B-92-002B).
Contaminated Sediments	Impacts related to elevated levels of pollutants such as PCBs in sediments. See background information in National Sediment Quality Survey (EPA 823-R-97-006); EPA's Contaminated Sediment Management Strategy <www.epa.gov/OST/cs/manage/stratndx.html>
Crop Production (Crop Land or Dry Land)	Crop Production (Crop Land or Dry Land). Insufficient information exists to identify a particular type of crop production. Can include any type of farming area planted in cropland.
Dairies (Outside Milk Parlor Areas)	Holding or feeding areas, stabilization lagoons and pastures for dairy cows. May often resemble large cattle feedlots. See information in CZARA management measure guidance (EPA-840-B-92-002B). See also USDA/EPA - Unified National Strategy for Animal Feeding Operations, March 9, 1999 <http://www.epa.gov/owm/finafost.htm>
Discharges from Municipal Separate Storm Sewer Systems (MS4)	Involves pollution impacts from separate storm sewer systems -- see Storm Water Phase II Final Rule summary in EPA-833/F-00-001.
Freshettes or Major Flooding	Pollution impacts accentuated by flooding from large rainfall events (e.g., hurricanes). Loadings and salinity changes to Chesapeake Bay from Hurricane Agnes in 1972 are an example. See background information in Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance (EPA-822-B-00-024).
Grazing in Riparian or Shoreline Zones	Livestock production using relatively unmanaged grasslands in proximity to riparian zones or shorelines. See sections in CZARA management measure guidance (EPA-840-B-92-002B); Profile of the Agricultural Crop Production Industry (EPA/310-R-00-001.)
Highways, Roads, Bridges, Infrasturcture (New Construction)	New construction involving infrastructure (roads, bridges, pipelines, etc.) or buildings. SIC Group 16: Heavy Construction; also Group 15: Building Construction. Relevant information in CZARA management measure guidance (EPA-840-B-92-002B). Various aspects of construction activities now regulated under the Phase II Stormwater Regulations -- see Storm Water Phase II Final Rule: An Overview (EPA-833/F-00-001) <http://www.epa.gov/npdes/pubs/fact1-0.pdf>
Historic Point Sources - Legacy Pollutants	Legacy Pollutant discharges affecting bottom sediment.
Industrial Point Source Discharge	End-of-pipe NPDES permitting for discharges other than publicly owned treatment works (POTWs -- or municipal dischargers). See effluent guidelines for certain industrial groups in 40 CRF - Subchapter N - Effluent Guidelines and Standards. Additional background information in Industrial User Permitting Guidance Manual (EPA-833/R-89-001); NPDES Permit Writer's Manual (EPA-833-B-96-003)
Internal Nutrient Recycling	Persistent pollution problems related to reintroduction of nutrients such as phosphorus from sediments within a waterbody. Often related to past history of pollution loadings. Found in lakes that show seasonal turnover -- also encountered in some estuaries. See background information in -- Phosphorus Inactivation and Wetland Manipulation, Kezar Lake, NH (EPA 841-F-95-002).
Livestock (Grazing or Feeding Operations)	Livestock (Grazing or Feeding Operations). Insufficient information exists to specifically identify a particular type of animal feeding operation. Includes grazing and unpermitted animal feeding operations. Also includes CAFOs until a permitted facility is identified.
Municipal (Urbanized High Density Area)	High density (ultra-urban) areas in cities and towns (e.g., central business districts) with high percentages of impervious surfaces. Relevant information in CZARA management measure guidance (EPA-840-B-92-002B); (NURP) Nationwide Urban Runoff Program (EPA-841-S-83-109). See also Storm Water Phase II Final Rule: An Overview (EPA-833/F-00-001) <http://www.epa.gov/npdes/pubs/fact1-0.pdf>

Non-irrigated Crop Production	Dryland farming involving crops from SIC Group 01 (Agricultural Production - Crops); see sections on agriculture from CZARA management measure guidance (EPA-840-B-92-002B); Profile of the Agricultural Crop Production Industry (EPA/310-R-00-001).
Non-Point Source	Non-Point Source. Source is unknown, but there are no permitted point sources upstream.
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)	Problems from poorly installed or maintained onsite domestic waste treatment systems (septic systems or other small flows decentralized systems). See background information in Safe Drinking Water Act, Section 1429 Ground Water Report to Congress (EPA-816-R-99-016); Small Systems Manual: Wastewater Treatment/Disposal for Small Communities (EPA-625/R-92-005); Onsite/Septic systems Design Manual: Onsite Wastewater Treatment and Disposal Systems (EPA-625/1-80-012)
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	Supplemental feeding of livestock that can lead to major nutrient and other pollution concerns as animal unit densities increase. EPA, in cooperation with the USDA, is developing regulations for concentrated animal feeding operations (CAFOs). SIC Group 02: Agricultural Production - livestock. See background information in the USDA/EPA - Unified National Strategy for Animal Feeding Operations, March 9, 1999 <http://www.epa.gov/owm/finafost.htm>; CZARA management measures (EPA-840-B-92-002B).
Post-development Erosion and Sedimentation	Post-construction impacts from land development in cities or urbanized areas. See information in CZARA management measure guidance (EPA-840-B-92-002B); (NURP) Nationwide Urban Runoff Program (EPA-841-S-83-109); and Storm Water Phase II Final Rule: An Overview (EPA-833/F-00-001) <http://www.epa.gov/npdes/pubs/fact1-0.pdf>
Sediment Resuspension (Clean Sediment)	Sediment Resuspension (Clean Sediment). Bottom sediment is resuspended into the water column.
Site Clearance (Land Development or Redevelopment)	Can involve new construction or redevelopment (infilling) in existing urbanized areas. Can also involve industrial parks or other construction outside municipal boundaries. Various activities under SIC Division C: Construction. Relevant information in CZARA management measure guidance (EPA-840-B-92-002B). Various aspects of construction activities now regulated under the Phase II Stormwater Regulations -- see Storm Water Phase II Final Rule: An Overview (EPA-833/F-00-001) <http://www.epa.gov/npdes/pubs/fact1-0.pdf>
Source Unknown	Source Unknown. Insufficient data exists to be able to identify a source at this time.
Streambank Modifications/destablization	Impacts -- often downstream of site with the initial disturbances -- from destabilization of streambanks or other modifications such as rip-rapping. See background information in Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group (FISRWG) A 57.6/2:EN 3/PT.653; CZARA management measure guidance (EPA-840-B-92-002B).
Total Retention Domestic Sewage Lagoons	Application of stabilization lagoons for domestic waste no discharge systems as an alternative to septic systems. EPA National Environmental Services Center (NESC) Small Flows Clearinghouse <http://www.nesc.wvu.edu/nsfc/nsfc_index.htm>; Report to Congress: Municipal Wastewater Lagoon Study (EPA-832/R-87-108A and 108B).
Transfer of Water from an Outside Watershed	Transfer of Water from an Outside Watershed. Water being transferred from one location to another changes the dynamic of the receiving stream or lake.
Upstream Source	Upstream Source. After studies, the source continues to be unknown, but it is known to be upstream of the boundaries of the Assessment Unit.

2010 Delisting Decisions

Waters are de-listed from the state's impaired waters list as the state and the U.S. EPA document and declare that the waters are no longer impaired. This process usually happens during the biennial data system update, which occurs every other year on even numbered years. Some common reasons for delisting are described below. For each waterbody WDNR is proposing for delisting in 2010, documentation sheets providing the delisting rationale are being provided to US EPA. These are also available in the WATERS database or online at http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html using the search queries for specific waterbodies.

Waterbody No Longer Impaired
WDNR de-lists waters that have been restored. New monitoring data collected through Tier 3 monitoring evaluates the response of the waterbody to some sort of implementation or restoration strategy. Waters will be assessed through the same process identified as listing a waterbody on the 303(d) Impaired Waters List and must meet water quality standards to be removed from the list. This situation is often related to discrete, single sources of impairment listings where the immediate source has been managed or removed, such as stream bank pasturing on trout water; if the cows are removed from the stream, the water often recovers rapidly.

Waterbody Listing Validation Found No Impairment
WDNR has identified some waters on Wisconsin's historical 303(d) Impaired Waters List that may be inappropriately listed. Common reasons include improper documentation of a past assessment, misidentification of a waterbody, and/or incorrect description of the reach and its specific location within a watershed. In those cases, contemporary information will be documented and WDNR may propose to de-list those waters if the most recent assessment indicates all designated uses are achieved.

EPA Approved TMDL
When U.S. EPA approves a TMDL, the water is removed from the list of impaired waters that 'need a TMDL created'. For Wisconsin, the water is still considered impaired until its water quality standards have been met. However, for the purposes of listing the stream and managing the stream or lakes that require a TMDL, the water is moved from a category 5A or 5B to a Category 4A waterbody. Once the water is restored, it may move to a Category 1 or Category 2 water.

C3A. Clean Lakes Program: Clean Water Act Section 314

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.

Trophic Status of Lakes

As described in Section C2, Lake assessments were done to determine the General Condition of each lake for which there were enough chlorophyll a, satellite, or secchi data to run a Trophic Status Index (TSI) calculation. 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. As shown in Table 36, 87% 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 5% of lakes. Secchi data, collected primarily by citizen lake monitoring volunteers, were available for 7%. Using a combination of these tools, 70% of Wisconsin's total number of lake acres had a General Condition Assessment conducted.

Results of the General Condition Assessment in Table 37 show that 14% of assessed lakes are considered to be in Excellent condition, 41% Good, 16% Fair and only 3% Poor[19]. Of those that were considered Poor, some but not all are designated as Impaired if there were enough data to warrant listing under the WisCALM criteria.

Trophic Status is correlated with the General Assessment Results, and is shown in Table 38. Slightly over half of the state's lakes are Eutrophic, with 2% being Hypereutrophic. Of the state's 79 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 (1224) and Oligotrophic (157) lakes are considered to be Excellent or Good quality.

[19] Lakes assessed using satellite and Secchi data (where chlorophyll data were unavailable) may be healthier than the Excellent, Good, Fair, Poor ratings suggest. This is because water clarity can be impacted by natural tannins from sources like trees or wetland vegetation. Secchi disk and satellite data cannot differentiate between water impacted by algae and naturally stained water. Chlorophyll is the most direct measure of trophic state, but is not available for many of Wisconsin's lakes.

Table 36. Lakes for which Trophic Status was assessed using various TSI analysis tools, 2010

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	232	5%	1%	257,700	37%	26%
Satellite[19]	3713	87%	20%	334,596	48%	34%
Secchi[19]	302	7%	2%	101,482	15%	10%
Total TSI Assessed Lakes*	**4,247**	**100%**	**23%**	**693,779**	**100%**	**70%**
Total Statewide Lakes	**18,380**		**100%**	**995,568**		**100%**

Table 37. Summary of General Condition of TSI Assessed Lakes, 2010

All Lakes Assessed by 2010 TSI Methodology	Number Lakes	Percent (# Lakes)	Lake Acres	Percent (# Acres)
Excellent	604	14%	129,789	19%
Good	1762	41%	231,677	33%
Fair	680	16%	264,128	38%
Poor	127	3%	35,825	5%
No Condition Rating*	1074	25%	32,360	5%
Total TSI Assessed Lakes	**4247**	**100%**	**693,778.57**	**100%**

**Either no natural community assigned or small lake*

Figure 16. Trophic State of Assessed Wisconsin Lakes, 2010

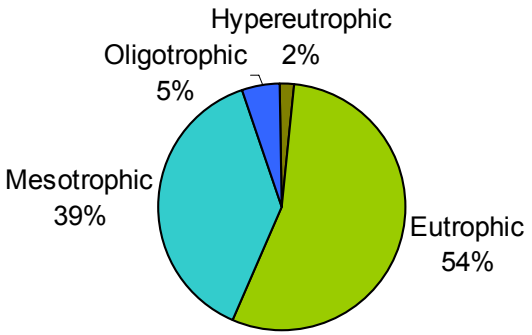


Table 38. Trophic Status Determinations (Number of Lakes) for Lakes with General Condition Assessments, 2010

Trophic State	Excellent	Good	Fair	Poor	All TSI Assessed Lakes	% TSI Assessed Lakes
Hypereutrophic				79	79	2%
Eutrophic	53	932	680	48	1713	54%
Mesotrophic	394	830			1224	39%
Oligotrophic	157				157	5%
Total Number of Assessed Lakes:	**604**	**1762**	**680**	**127**	**3173**	**1%**

Methods for Controlling Lake Pollution and Restoring Quality

WDNR's Lakes Section administers many programs for controlling lake pollution and restoring lake health, and for providing grants to communities for lake management. See Section B2 of this document for a more detailed description of the following programs:

- Lake Planning and Management
- Lake Organization and Education Assistance
- Aquatic Plant Management
- Clean Lakes Program

In addition, other WDNR program areas aim to control pollution sources that impact lakes. Chief among these are programs and rules related to:

- Runoff Management
- Wastewater Management
- Shorelands and Waterways

More information on these programs is also found in Section B2.

Once a lake is added to the Impaired Waters List, Total Maximum Daily Loads (TMDLs) are a significant tool for analyzing the extent of pollution problems. Plans for implementing management actions can be created concurrent with, or subsequent to, the TMDL process. TMDLs are discussed in Chapter C3B.

Mitigating High Acidity

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.

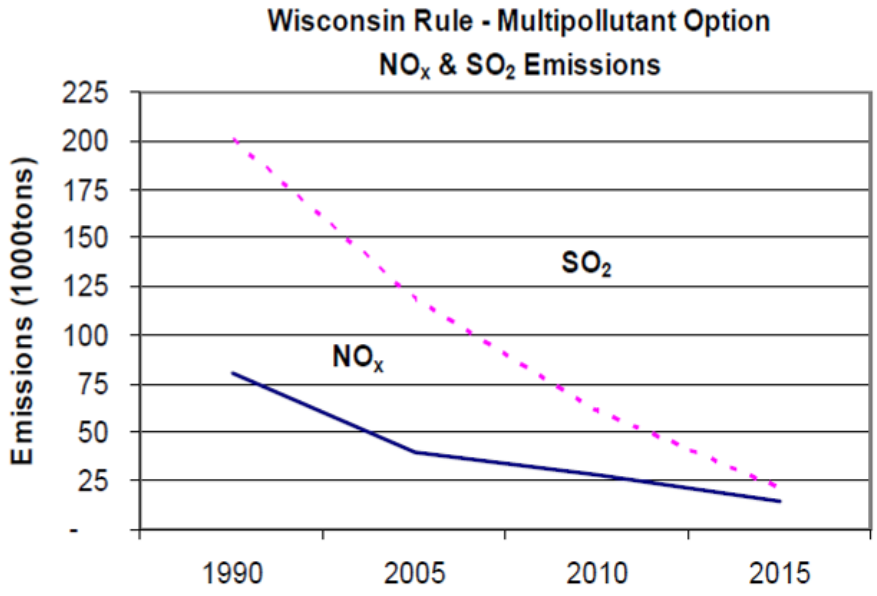
Mercury Rule with "Multipollutant Option' Also Addresses Acid Rain Sources

In November, 2008, a rule controlling mercury emissions, Admin. Code NR 446, became effective. Though primarily targeted at mercury reduction, the rule contains an option called the "multipollutant option" which addresses sulfur dioxide and nitrogen oxides, the two pollutants most responsible for acid rain. Through this option, electric utilities can elect to take advantage of pollution control equipment which can control multiple pollutants in a more cost effective manner, or to stage installations of equipment appropriately for both mercury control and in response to other regulations for sulfur dioxide and nitrogen oxides.

Under the multipollutant approach and in combination with previously enacted air pollution rules, the largest coal burning utilities could, by 2015, achieve both an 85 percent reduction in sulfur dioxide and a 50 percent reduction in nitrogen oxides beyond current regulations. Mercury reduction targets are 70 percent reduction by the 2015 date, 80 percent by 2018 and 90 percent by 2021.

In total, the multipollutant option would stop release to the environment of 2,634 pounds of mercury and potentially 97,000 tons of sulfur dioxide and 66,000 tons of nitrogen oxide compared to 2005 levels. Figure 17 shows projected reductions of emissions for sulfur dioxide and nitrogen oxides.

Figure 17. Projected emissions reductions of nitrogen oxides and sulfur dioxide under the Mercury Rule's 'Multipollutant Option'

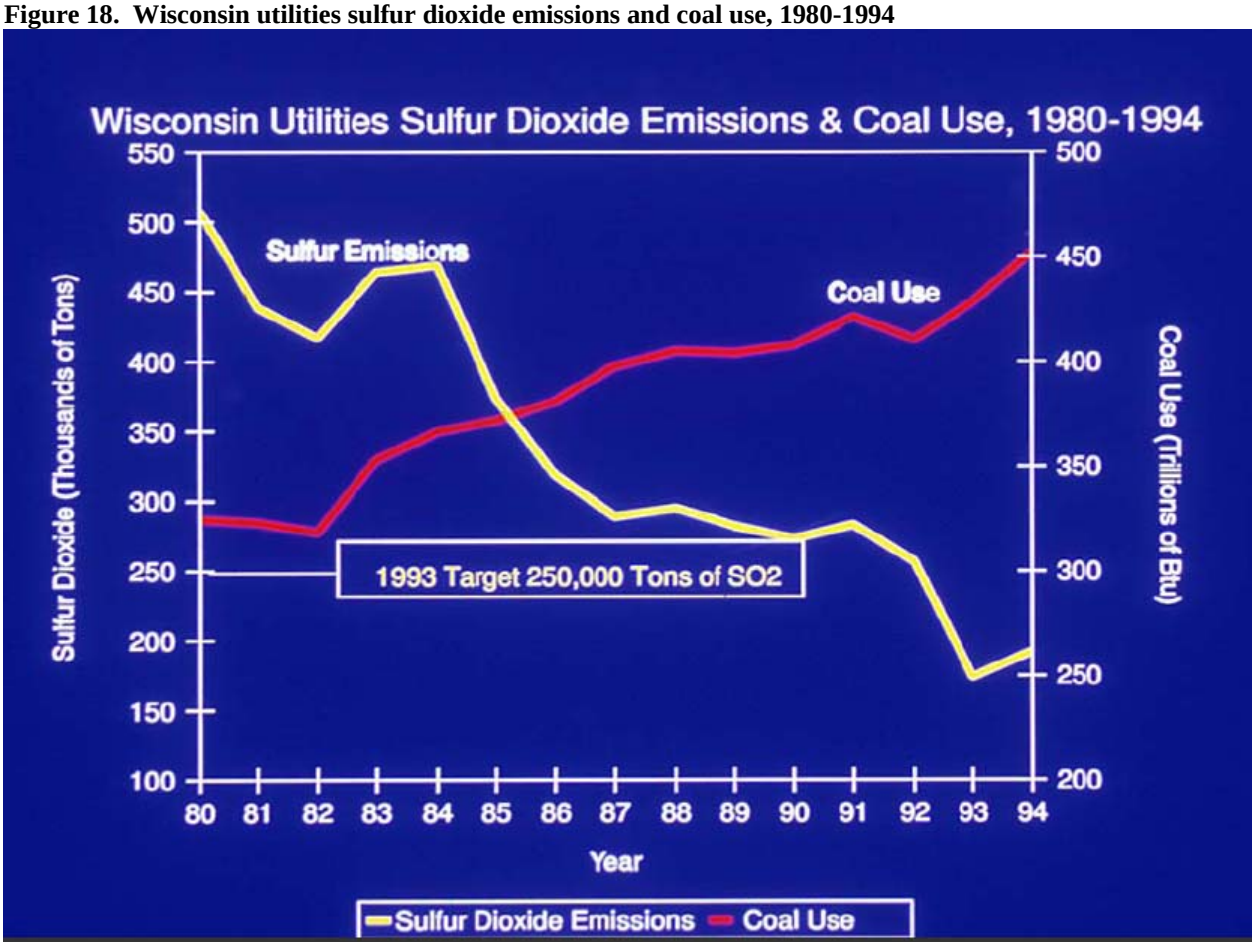


A History of Acid Rain Reductions in Wisconsin

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 18 shows a sharp decline in sulfur emissions in Wisconsin from 1980 to 1994 even while coal use was increasing over this time span.

Figure 18. Wisconsin utilities sulfur dioxide emissions and coal use, 1980-1994



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 was 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 southeastern 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 were acidic. An additional 10 percent are "extremely sensitive" to acid rain, 25 percent are "moderately sensitive" and 60 percent are not sensitive. Surveys done in northern parts of Wisconsin, however, where most of the state's lakes are located, showed that these areas had an even greater incidence of acidic lakes.

- **2009:** U.S. EPA's National Lakes Assessment Report (2009) 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, 99.1% of lakes assessed scored 'Good' for Acid Neutralizing Capacity, with 0.09% scoring 'Fair', and none 'Poor'. Similarly, in the Temperate Plains Ecoregion, which covers the southeastern corner of Wisconsin, 100% of lakes assessed were ranked as 'Good' for Acid Neutralizing Capacity.

Although the studies noted above were done using different methods and are thus not directly comparable to one another, they indicated 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.

Trends in Lake Water Quality

Water clarity trends by lake type, assessed using satellite data

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. 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 were converted to Secchi depth values, these values were used to calculate lakes' Trophic Status Index (TSI) scores. The TSI scores were then used in the General Assessment framework described in section C2 of this report to determine if each lake was in Excellent, Good, Fair, or Poor condition at the time the images were taken.

Results from this ~30 year assessment were compiled to indicate the condition of Wisconsin's lakes over time. This was calculated both statewide and by lake classification (natural community), with results shown below.

Figure 19 illustrates the change in lake condition for the state-wide satellite lakes common to all six time periods (n=1625). No obvious state-wide trend is seen over the 28 year time period, with aggregated excellent and good lakes generally comprising approximately 80 percent of state's lakes.

Figure 19. Change in lake clarity based on satellite data, 1980-2008

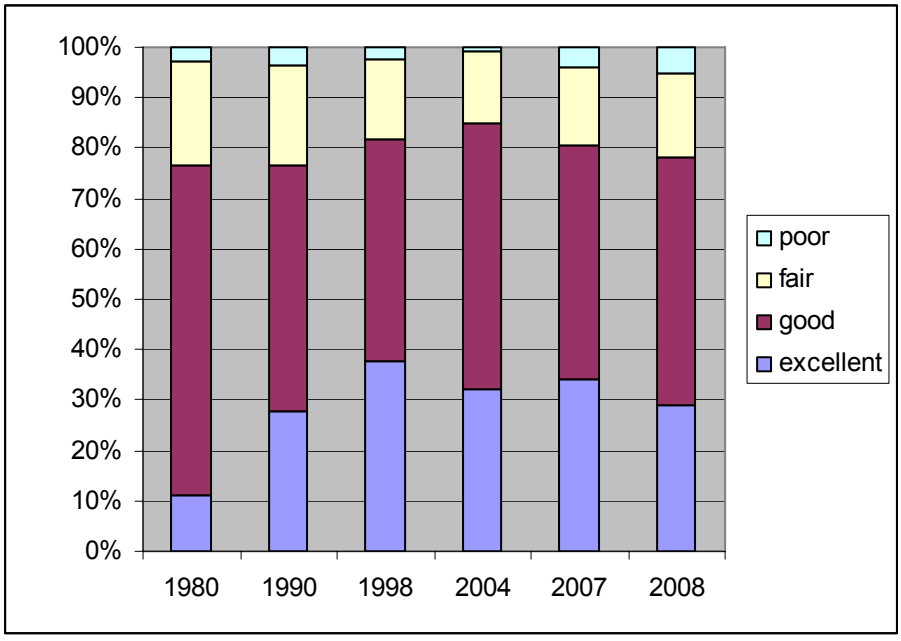
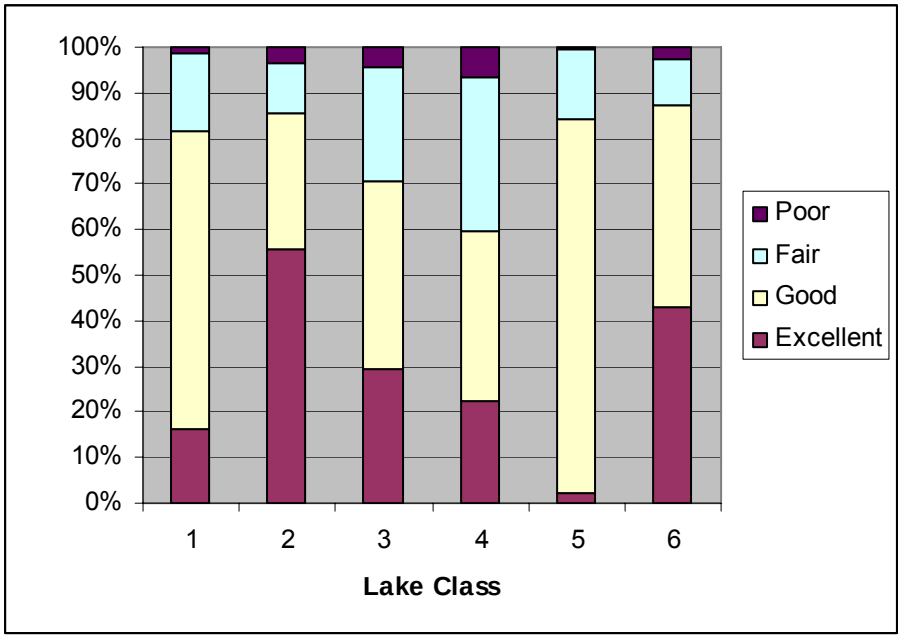


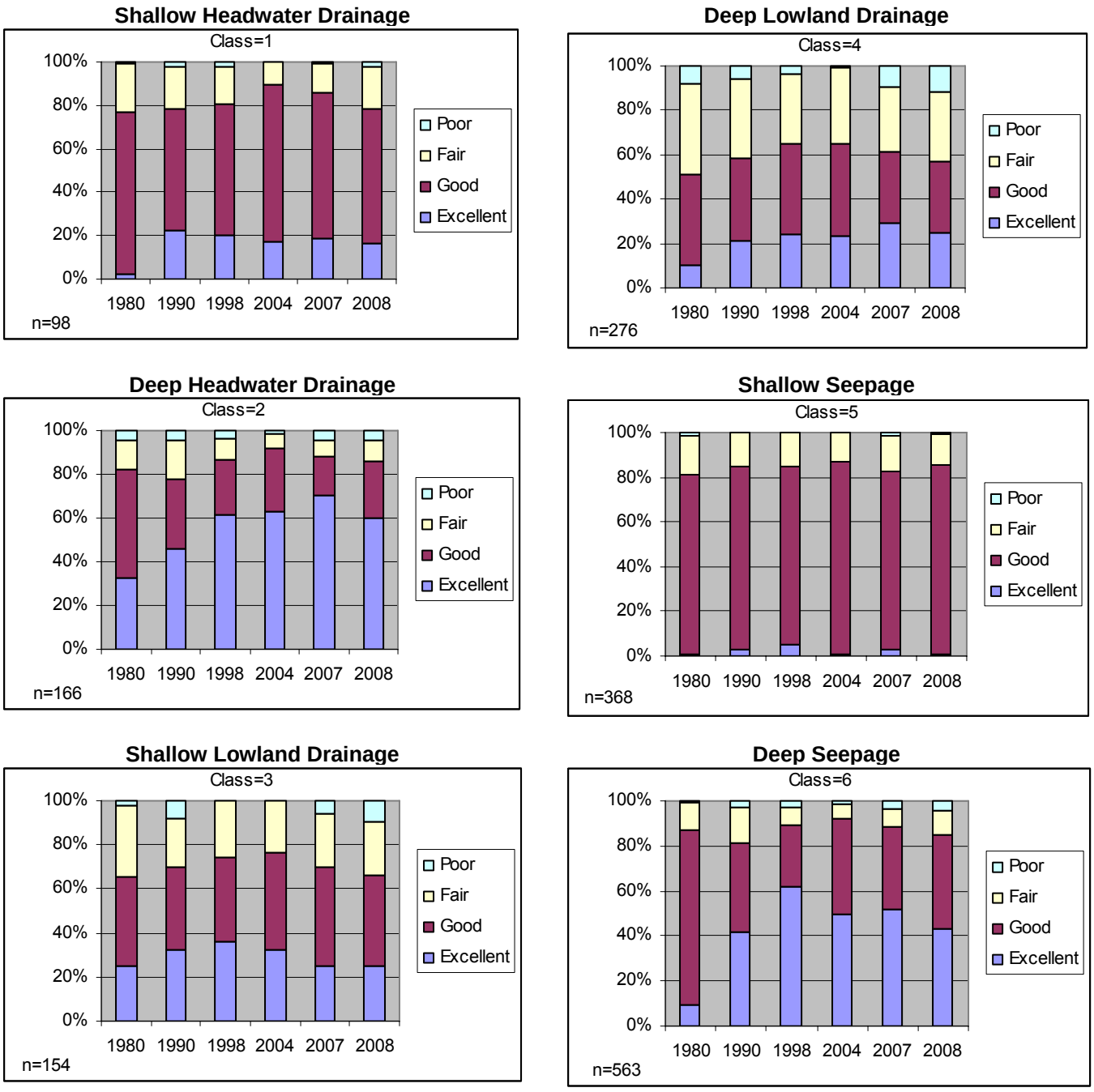
Figure 20 shows the distribution of lake condition by lake class (see lake class names in Table 39). There's considerable variability between lake classes with class 2 and class 6 (deep headwater drainage and deep seepage lakes, respectively) having the greatest percentage of excellent lakes.

Figure 20. Lake condition by lake class, based on satellite data



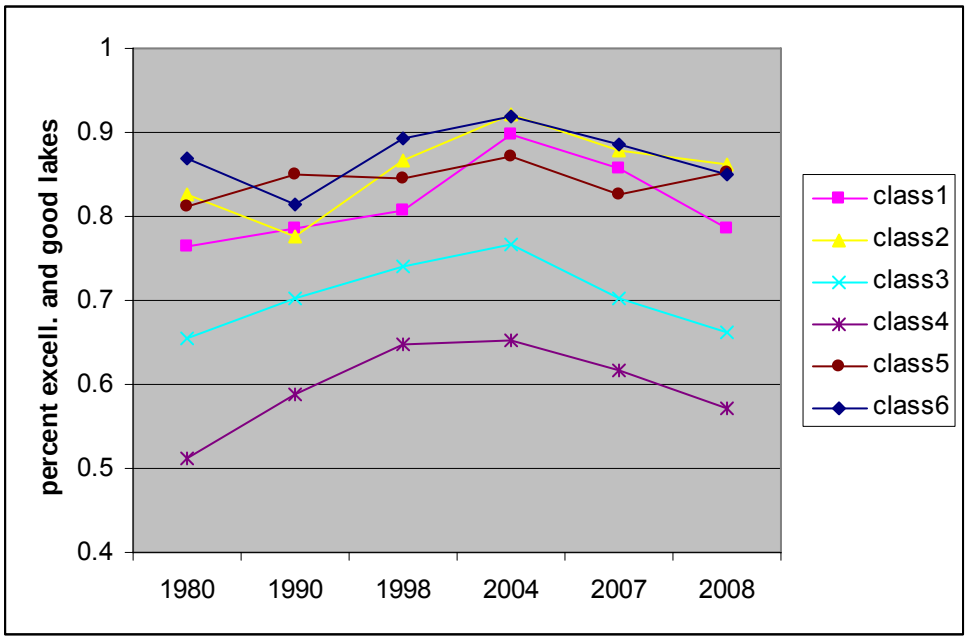
The six bar charts in Figure 21 illustrate the changes in lake condition for the six lake classifications. In general, headwater classes and seepage lakes (1, 2, 5, 6) have better conditions; conversely, the lowland lakes (3 and 4) had worse conditions over the 28 year period. Fir all six lake classes, little overall improvement or degradation with time was indicated.

Figure 21. Changes in lake clarity by lake classification, based on satellite data from 1980-2008



The plot in Figure 22 shows the percent of combined Excellent and Good lakes by lake classification (time axis not to scale). Interestingly, parallel fluctuations are observed (an improvement in lake condition during the first four reported time periods, followed by a decrease in condition for the latter two time periods). This would indicate a class-wide response to a common driver, most likely a climatic factor such as temperature and precipitation.

Figure 22. Percent of combined Excellent and Good lakes by classification, 1980-2008



Phosphorus Concentrations Inferred from Sediment Core Data: Presettlement to Current Day

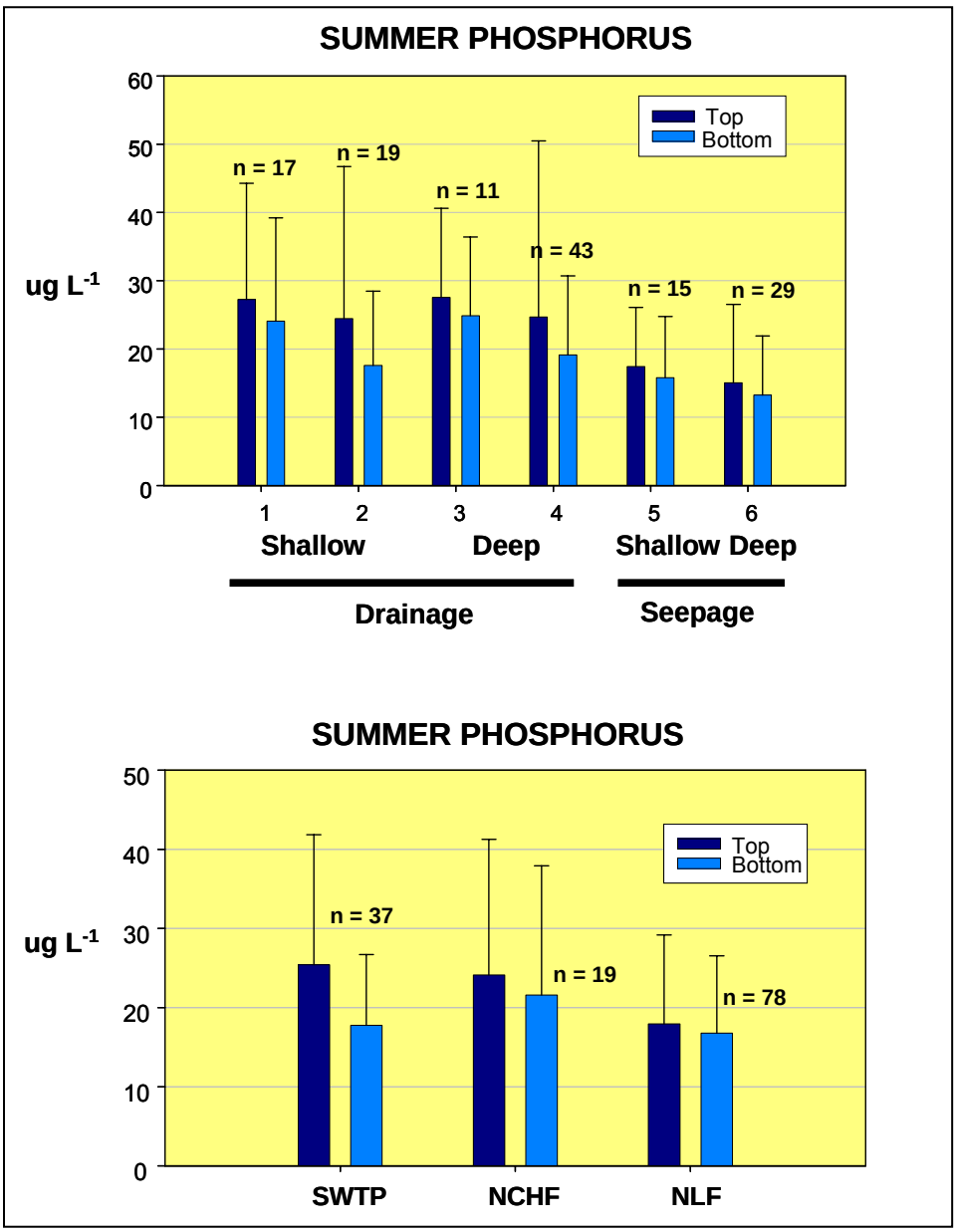
One method of assessing trends in lake phosphorus concentrations is by using sediment core data to compare inferred phosphorus levels from presettlement times (bottom of the core) and present day (top of the core). This method analyzes the diatom assemblages present at the top and bottom of each lake's sediment core. These diatom assemblages are correlated to certain phosphorus levels, thus providing an inferred phosphorus concentration. The presettlement (top) and present day (bottom) values for a given lake are compared to one another to determine how much the lake's phosphorus level has changed over the course of time.

A WDNR research project analyzed sediment top and bottom diatom assemblages from 134 natural lakes in Wisconsin to determine historical phosphorus concentrations. The lakes were divided amongst the 6 lake classes. The most numerous lakes were in class 4 which are deep, lowland drainage lakes. This is the lake class with the most lakes in the state. The least common were class 3 which are shallow, lowland, drainage lakes. Many lakes in this class are reservoirs and there are not a lot of natural lakes in this class. The concentration in the bottom sample was used to establish reference phosphorus concentrations for the lake classes. Not surprisingly, findings showed that in all of the lake classes, average current phosphorus concentrations (top of sample) were higher than the presettlement (bottom) phosphorus concentrations. In some individual lakes the present day concentration is the same as the historical value, but within each class historical levels were lower (Figure 23 and Table 39). Study details

and further results are provided in the 2008 *Implementation and interpretation of lakes assessment data for the Upper Midwest, Final Report to U.S. EPA*[20].

The differences in the variables that determine the historical phosphorus values and present day concentrations indicate the importance of anthropogenic influences. A lake's phosphorus concentration in presettlement time was determined by its hydrologic type, and for drainage lakes maximum depth was an important variable. With the landscape having little impact from anthropogenic sources, the size of the lake's watershed was not an important determining factor in the phosphorus concentration of drainage lakes. Now that the land use in the watersheds has been altered, the size of the watershed as well as the amount of agriculture in the watershed are important factors in determining the water quality of a lake, regardless of the lake's hydrology. While seepage lakes tend to have lower phosphorus levels, the size of their watershed is important.

Figure 23. Comparison of current and presettlement phosphorus concentrations in Wisconsin lakes, by lake class and ecoregion



20 Garrison, Paul, et al. November 2008. Implementation and interpretation of lakes assessment data for the Upper Midwest. Final Report to U.S. EPA. Wisconsin Department of Natural Resources, PUB-SS-1044 2008.

Table 39. Lake Classes & Ecoregions used in this study and their reference (presettlement) phosphorus concentrations

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

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

C3B. Total Maximum Daily Loads (TMDLs): Monitoring, Modeling and Development

A Total Maximum Daily Load, or TMDL, is an analysis of the various pollutant sources that pollute or impair a given waterbody, and a determination of how much pollutant reduction is needed to meet water quality standards. The development of a TMDL is required for 303(d) impaired waters. TMDL Monitoring and Modeling Technical Guidance (2001) was developed to identify pollutants to be monitored and the duration and frequency that samples are collected in order to accurately model the watershed to develop the TMDL. TMDL monitoring is funded by Wisconsin's Tier 2 Monitoring Program.

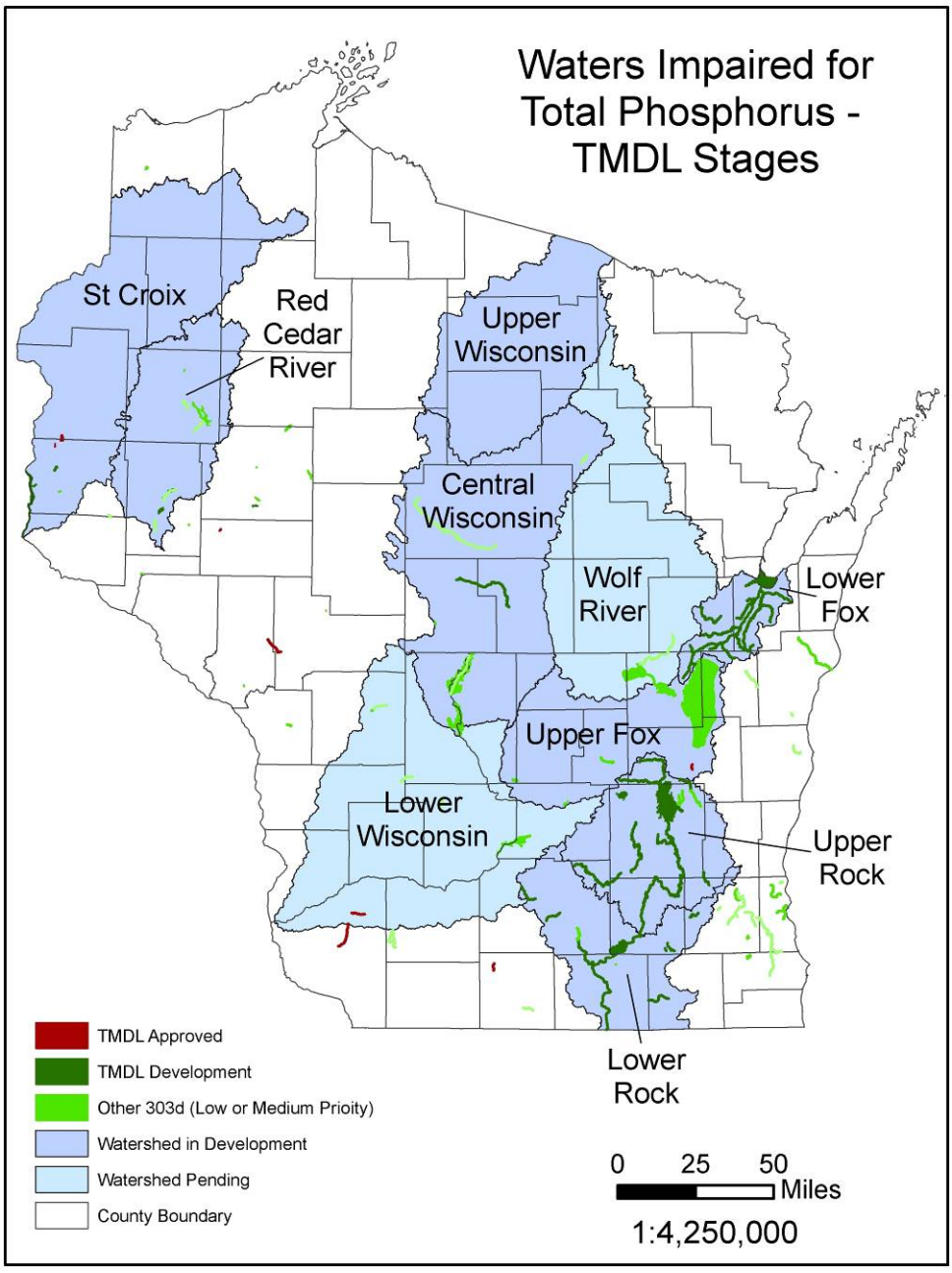
TMDL Development in Wisconsin

In the past few years, Wisconsin's Impaired Waters Program has evolved to include the development of more complex TMDLs. As nutrient impairments continue to increase, impacting water quality of our lakes and streams, TMDLs are being developed statewide to determine what sources (point and nonpoint) are contributing nutrients, and what reductions are needed to meet water quality standards. Currently, several large basins in Wisconsin are undergoing Phosphorus TMDLs. Table 40 and the map in Figure 24 show TMDLs in development across the state to address excess phosphorus.

Table 40. TMDL Development Status
Note: Wisconsin is moving to a watershed approach for TMDLs. Each Watershed listed below has numerous impaired stream/river segments and/or lakes.

Watershed	Pollutant/Impairment Combination	Project Status	Projected TMDL Submittal Date
Little Lake Wissota	Phosphorus/Sediment, pH Exceedances/Eutrophication	Draft TMDL	February 2010
Tainter Lake/Lake Menomin TMDL	Phosphorus, Eutrophication	Draft TMDL	May 2010
Lower Fox River Basin	Phosphorus/Sediment, Low DO/Water Clarity/Degraded Habitat	Ongoing	Summer 2010
Upper and Lower Rock River Basins	Phosphorus/Sediment, Low DO/Degraded Habitat	Ongoing	Summer 2010
Willow River TMDL	Phosphorus, Low DO, BOD	Ongoing	Fall 2010
St. Croix Basin	Phosphorus	Ongoing	Fall 2010
Wisconsin River TMDL	Phosphorus, Eutrophication	Monitoring	2016

Figure 24. Map of TMDLs in development to address excess phosphorus



Completed/Approved TMDLs in Wisconsin

Over the last decade, Wisconsin has been primarily developing TMDLs for nonpoint source pollution. A list of all completed and approved TMDLs in Wisconsin is shown in Table 41 and more information can be found at: http://dnr.wi.gov/org/water/wm/wqs/303d/Approved_TMDLs.html.

Table 41. Completed/approved TMDLs in Wisconsin

Name (Approved TMDL)	County	Pollutant	Approval Date
Dougherty Creek [PDF 313KMB]	Green	Phosphorus, BOD	08/22/08
Little Willow Creek [PDF 1.87MB]	Richland	Total Suspended Solids (TSS)	09/09/08
Cedar Creek [PDF 1.8MB]	Ozaukee	PCBs	09/22/08
Otter Creek [PDF 1.04MB]	Iowa	Total Suspended Solids (TSS)	10/02/08
Mead Lake [PDF 551KB]	Clark	Phosphorus, Sediment	10/02/08
Hardies Creek [PDF 1.8MB]	Trempealeau	Sediment	02/01/08
Parsons Creek [PDF 4MB] *	Fond du Lac	Sediment, Phosphorus, Ammonia	09/28/07
Martin Branch, Martinville Creek, and Rogers Branch [PDF 1MB]	Grant	Sediment, Phosphorus	09/28/07
Gills Coulee Creek [PDF 4MB]	La Crosse	Sediment	09/26/06
Snowden Branch [PDF 1.1MB]	Grant	Sediment	09/22/06
Sediment Impaired Streams in the Waumandee Creek Watershed [PDF 573KB]	Buffalo	Sediment	11/01//05
Becky Creek [PDF 78KB]	Rusk	Sediment	09/27/05
Sediment Impaired Streams in the Sugar-Pecatonica River Basin [PDF 1278KB]	Dane, Rock, Lafayette, Green and Iowa	Sediment	08/24/05
Carpenter Creek [PDF 90KB]	Waushara	Sediment	12/14/04
Half Moon Lake [PDF 277KB]	Eau Claire	Phosphorus	09/08/04
Castle Rock (Fennimore) Creek and Gunderson Valley Creek [PDF 215KB]	Grant	Sediment, Phosphorus	08/20/04

Trump Coulee Creek [PDF 96KB]	Jackson, Trempeleau	Sediment	05/06/04
Silver Lake [PDF 179KB]	Manitowoc	Phosphorus	03/30/04
Cedar Lake [PDF 139KB]	Polk, St. Croix	Phosphorus	08/19/03
Eagle Creek [PDF 232KB]	Buffalo	Sediment	03/13/03
Joos Valley [PDF 232KB]	Buffalo	Sediment	03/13/03
Swinns Valley Creek [PDF 271KB]	Buffalo	Sediment	03/13/03
Irvin Creek [PDF 271KB]	Trempealeau	Sediment	03/13/03
Newcomb Valley Creek [PDF 271KB]	Trempealeau	Sediment	03/13/03
North Creek [PDF 271KB]	Trempealeau	Sediment	03/13/03
Welch Coulee Creek [PDF 271KB]	Trempealeau	Sediment	03/13/03
Tappen Coulee Creek [PDF 271KB]	Trempealeau	Sediment	03/13/03
Jug Creek [PDF 160KB]	Vernon	Sediment	03/13/03
Perennial Stream A (SPPI) [PDF 1427KB]	Walworth	Sediment	03/13/03
Perennial Stream B (TM2) [PDF 1427KB]	Walworth	Sediment	03/13/03
Perennial Stream D (B4) [PDF 1427KB]	Walworth	Sediment	03/13/03
Perennial Stream E (B5) [PDF 1427KB]	Walworth	Sediment	03/13/03
Spring Creek [PDF 1427KB]	Walworth	Sediment	03/13/03
North Branch Spring Brook [PDF 1427KB]	Walworth	Sediment	03/13/03
Token Creek [PDF 113KB]	Dane	Sediment Barrier	07/01/02
Squaw Lake [PDF 144KB]	St. Croix	Phosphorus	08/24/00

TMDL Implementation

The Department continues to develop a statewide TMDL Implementation Program. The program centers around existing programs and initiatives to control point and nonpoint source pollution. The Department is outlining a process for stakeholder involvement and the development of TMDL implementation plans, and is identifying the financial and regulatory tools necessary to effectively implement the plans. As the program framework develops, it will establish the roles and responsibilities for WDNR staff and stakeholders and include a process for tracking implementation activities and evaluating program progress.

At this time, implementation activities to address impairments due to nonpoint source pollution are being administered largely through the WDNR's Runoff Management Program. However, as the larger, basin-wide TMDLs are completed and approved, the issuance of wastewater permits by the Wisconsin Pollutant Discharge Elimination System (WPDES) will play a key role in controlling point source pollution in TMDL areas.

Post-TMDL Monitoring

Post-monitoring of the TMDL should occur on streams that have had best management practices installed, to assess the responsiveness of the stream to the practices. Once monitoring indicates that the waterbody is not longer exceeding impairment thresholds, the waterbody may be removed from the 303(d) Impaired Waters List.

C4. Wetlands

Recent Wisconsin wetland assessment efforts have focused on characterizing the condition and status of wetlands by watershed to support the state's watershed planning efforts. The presence and loss of historic wetlands, existing land use status, and estimates of potentially restorable wetlands in each watershed were provided along with detailed maps. This information is critical for designing protection and restoration projects by DNR teams and partners the local level.

Reed Canary Grass Mapping Data

Reed canary grass, *Phalaris arundinacea*, is the most significant invasive species in Wisconsin wetlands. Where it dominates wetland plant communities, these communities are drastically reduced to a very small number of species. After a USEPA Wetland Grant project demonstrated the feasibility of mapping the invasive species using 30 m Landsat satellite imagery, the Department received a Wetland Grant to map wetlands dominated by this species (greater than 50% cover) across the entire state at a minimum map unit of ½ acre. Imagery from 11 different Landsat scenes was mosaiced together to create the statewide layer. Accuracy assessment performed on each scene revealed a range of 61-83% overall accuracy and 72-92% user's accuracy (ground-truthed accuracy). Documented in *Mapping Wisconsin Wetlands Dominated by Invasive Reed Canary Grass (Phalaris arundinacea): A Landscape Level Assessment*, that mapping effort assessed 5,065,419 acres of wetlands and found 498,250 acres dominated by reed canary grass, or 9.84%. There were 17,188 acres of wetlands that could not be classified because of cloud cover in the Landsat scenes. These were dropped from subsequent calculations.

Though floristic quality is degraded and habitat is simplified in these wetlands, there still is the likelihood that they function to protect downstream water quality and provide some habitat for wildlife. Therefore we report these wetlands are "supporting" fish and aquatic life use.

Using the different broad wetland cover type classes from the WISCLAND (1991) land use/land cover map of Wisconsin, Table 1 shows how much of each wetland cover type is dominated by reed canary grass. By far the cover type most affected is Emergent wetlands (marshes and meadows) with 305,878 acres dominated by reed canary grass. Table 2 breaks out the total acreage of reed canary grass dominated wetland that is found among the four broad WISCLAND classes of wetlands.

Reed canary grass is a pervasive problem in many Wisconsin wetlands. Photo: WDNR

Table 42. Wetland Classes Dominated by Reed Canary Grass – Total RCG Acres and Percent of Class Dominated

WISCLAND class	Total # of RCG Acres	% Dominated by RCG
Emergent Wetlands	305,878	26.64%
Floating Aquatic Herbaceous Vegetation Wetlands	1,178	9.15%
Forested Wetlands	82,218	3.36%
Lowland Shrub Wetlands	109,976	7.40%
Total	**498,250**	

Table 43. Reed Canary Grass Domination by Wetland Class – Percent of Total RCG Acres Found Within Major WISCLAND classes of Wetlands

% of RCG Dominated Wetlands that are:	
Emergent (marshes and meadows)	61.39%
Floating Aquatic Herbaceous Vegetation	0.24%
Forested	16.30%
Lowland Shrub	22.07%
Total	**100.00%**

The map in Figure 25 from the project report shows reed canary grass dominated wetlands in red, and "non-dominated" wetlands in green or pink, along with the very broad land use classes of urban, agriculture and forested/other. Note that reed canary domination is particularly pervasive in agricultural areas and is not widespread in northern forested wetlands.

The map in Figure 26 shows the same major Basins, with their corresponding percent of wetlands dominated by reed canary grass lumped into three classes. This provides a measure of where reed canary grass domination has the most impact on wetland condition.

A wetland dominated by reed canary grass. Photo: Elizabeth J. Czarapata

Figure 25. Wisconsin Wetlands, Agriculture, and Reed Canary Grass Domination

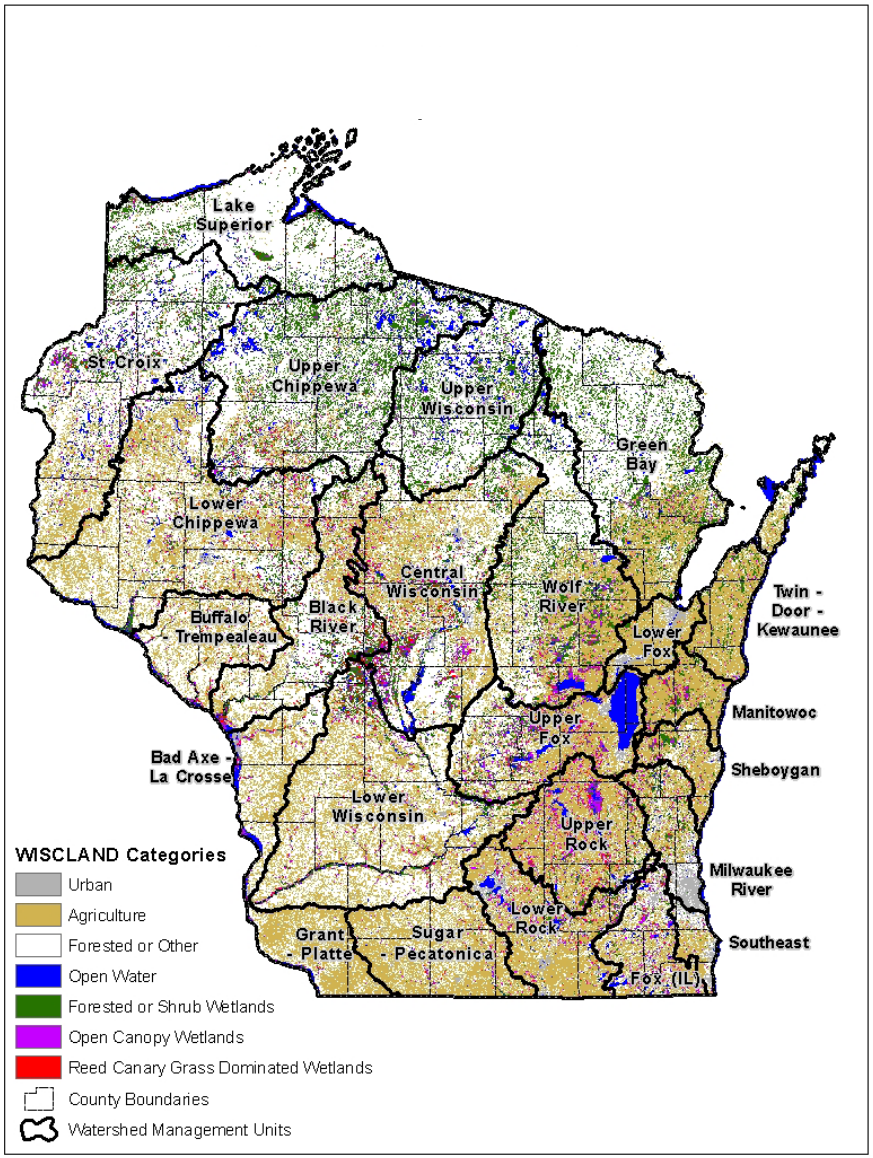
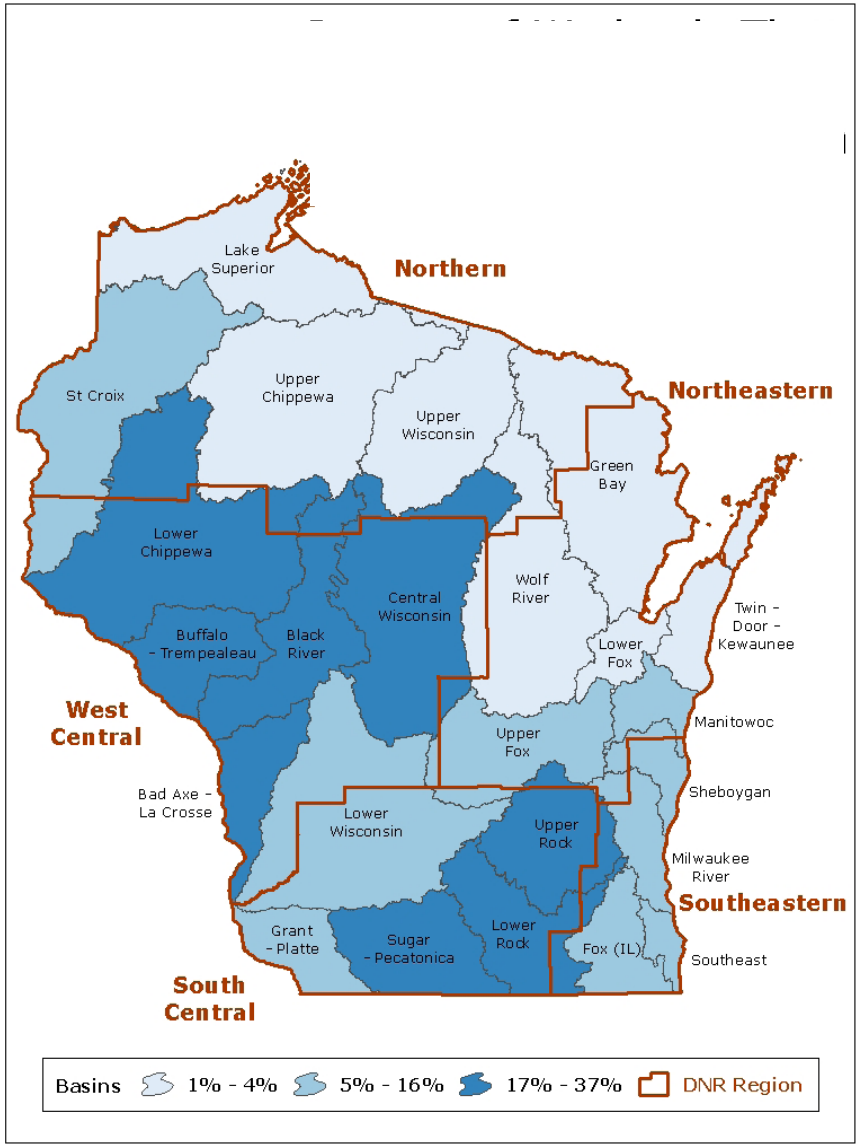


Figure 26. Percent of Wetlands that are Dominated by Reed Canary Grass, per Basin



Wetland Activity Tracking

The Department also used Wetland Grant funds to develop a system to track both positive and negative activities that affect wetlands, as described in *Tracking Wetland Gains, Losses and Conservation Activities in Wisconsin: A Unified Tracking and Reporting System for Wetland Projects*. Data is gathered from the major regulatory and conservation agencies that keep records on permits for fill and disturbance, compensatory mitigation projects and voluntary conservation projects. Activities are classified into positive and negative effects on wetland quantity and presumed effect on wetland quality. Where wetlands are re-established on formerly drained hydric soils the activity is considered a gain in acres and in quality. Some restorations take place to improve conditions in existing wetlands. These are considered gains in quality, but are "acre-neutral" because they don't increase the wetland acreage. Likewise some permits allow for wetland disturbance, but not fill, so we presume these have a detriment to wetland quality, but don't result in loss of wetland acreage. These are termed "acre-neutral" disturbances. Fill permits result in loss of both wetland acres and quality. The system only tracks data that can be linked to a mapped location.

To date two annual reports have been published on activities during 2006 and 2007. A report on activities in 2008 and 2009 is in preparation.

For 2007 the cumulative totals were:

Trackable Positive Benefits totaled 3,615 acres.

- Gains. 2,788 acres were gained through re-establishment of formerly drained wetlands. Just over half of the gain was accomplished by a partnership of federal, state and local conservation organizations conducting restoration projects.
- Acre-Neutral: Positive. 827 acres of existing wetlands were enhanced or rehabilitated.

Trackable Negative Impacts totaled 537 acres.

- Losses. 312 acres were lost through permitted fill. Permits for fill are granted only for unavoidable impacts that are minimized to the extent practicable. Of these, transportation projects accounted for 210 acres of direct loss.

- Acre Neutral: Negative. 225 acres were permitted for construction work in existing wetlands. These are mostly linear utility projects over large distances. This is a significant drop from 1,274 acres of permitted disturbance in 2006. This category is expected to fluctuate widely depending on the occurrence of permit applications for large utility projects in any given year.

The graph in Figure 27shows cumulative results for 2006 and 2007 by WDNR Region.

Potentially Restorable Wetlands Mapping Data

A coarse scale, GIS-derived data layer has been developed for characterizing the history and current status of wetland quantity in any chosen landscape unit, whether watershed-based, governmental unit, or an ecoregional unit. It is derived from the Wisconsin Wetland Inventory (WWI) and the statewide SSURGO soils data now available from the National Resources Conservation Service (NRCS) resulting in mapping of what can be called "potentially restorable wetlands" (PRWs).

The mapping process is based on the assumption that hydric soils that are not mapped as wetlands on the WWI give an estimate and a snapshot of where the original 10 million acres of wetland were in the state. Combined with the current data on existing wetlands, one can estimate how much wetland has been lost in a watershed, what remains, and point to areas where re-establishment of wetlands may be feasible. The methods used in mapping "potentially restorable wetlands" were documented in three successive USEPA Wetland Grant reports; *Milwaukee River Basin Wetland Assessment Project*, *Mead Lake Watershed Wetland Assessment*, and *Mapping Restorable Wetlands in the Rock River Basin*. As better digital soils data has become available and as the WWI is updated the resulting PRW layers have improved with each project. Currently the process is being used to produce wetland status characterizations and maps for the 18 Wisconsin watersheds where targeted watershed planning is underway.

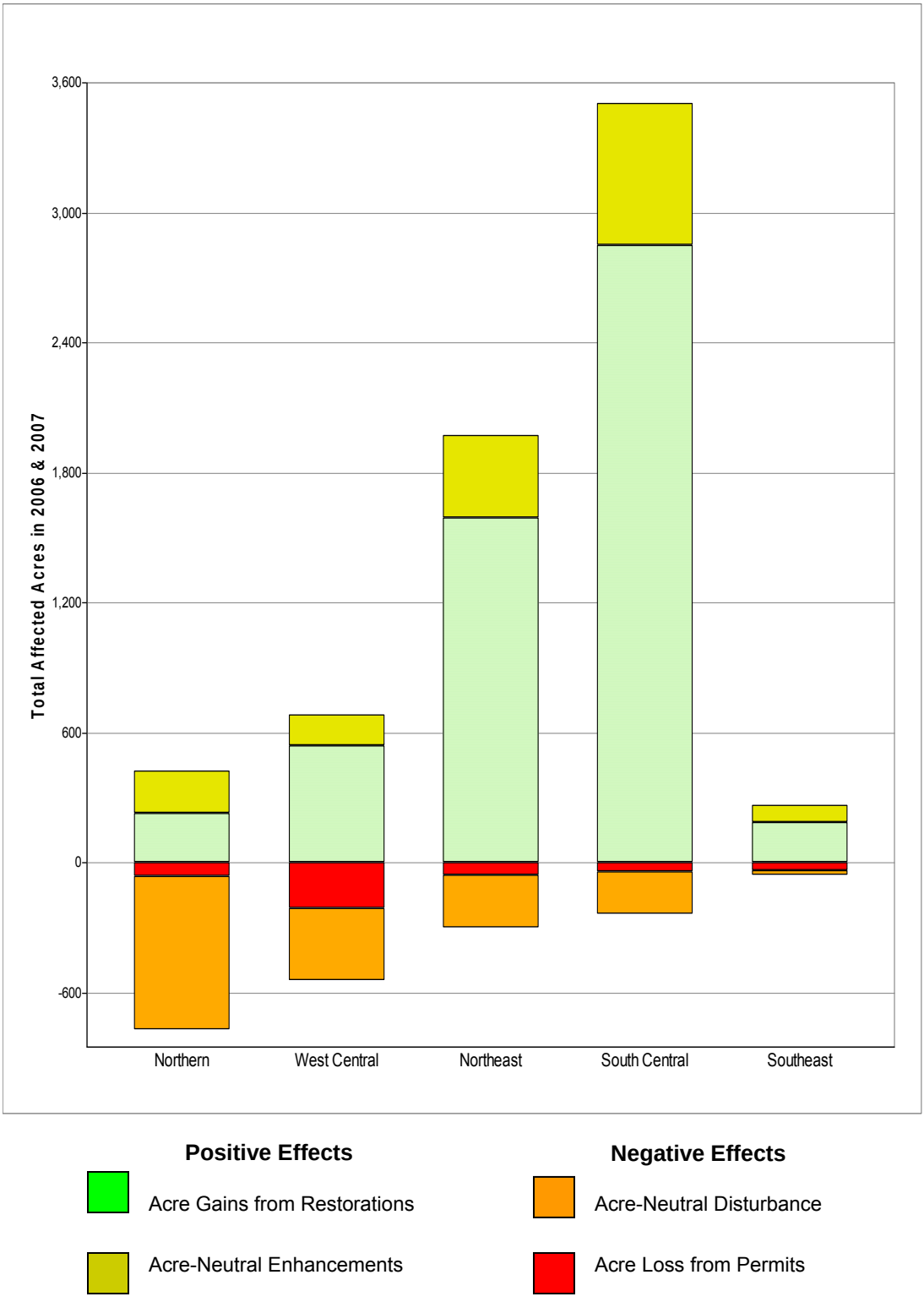
Floristic Quality Assessment

Floristic Quality Assessment (FQA) produces an assessment of plant community integrity, based on a species inventory. The basis for this method was an expert-group assignment of a "coefficient of conservatism" for each plant species in the complete flora of Wisconsin, funded by a USEPA Wetland Grant. The project summary and resulting list of coefficients is described in *Development of A Floristic Quality Assessment for Wisconsin*. The method requires a complete plant inventory of a site. The coefficient of conservatism for each species found on the site is used to generate the "mean site conservatism" or mean C, and the "floristic quality index" or FQI, is computed by multiplying the mean C by the square root of the total number of species on the site. Non-native species are assigned a zero. Together these two measures indicate the floristic quality of a given site.

To develop a regional framework to relate FQA measure to relative disturbance and development benchmarks for categorizing floristic quality the Department has conducted an initial survey of 116 wetlands in the Southeast Glacial Till Plains ecoregion. Species lists were assembled from recent site inventories and new surveys were conducted and disturbance measures taken for each wetland. Preliminary benchmarks for three separate wetland plant communities—meadows, marshes and lowland hardwoods—have been proposed for low, medium and high floristic quality as reported in *Floristic Quality Assessment Benchmarks for Wetlands in Southeast Wisconsin*. Further studies will be made for additional ecoregions as funding becomes available.

To date floristic quality assessment has been applied for specific projects and studies, but has not yet been routinely used as part of a watershed wetland assessment. Floristic measures have been used in lake assessments and floristic data will be gathered in the National Wetland Condition Assessment.

Figure 27. Activities Affecting Wetlands during 2006 and 2007, by WDNR Region



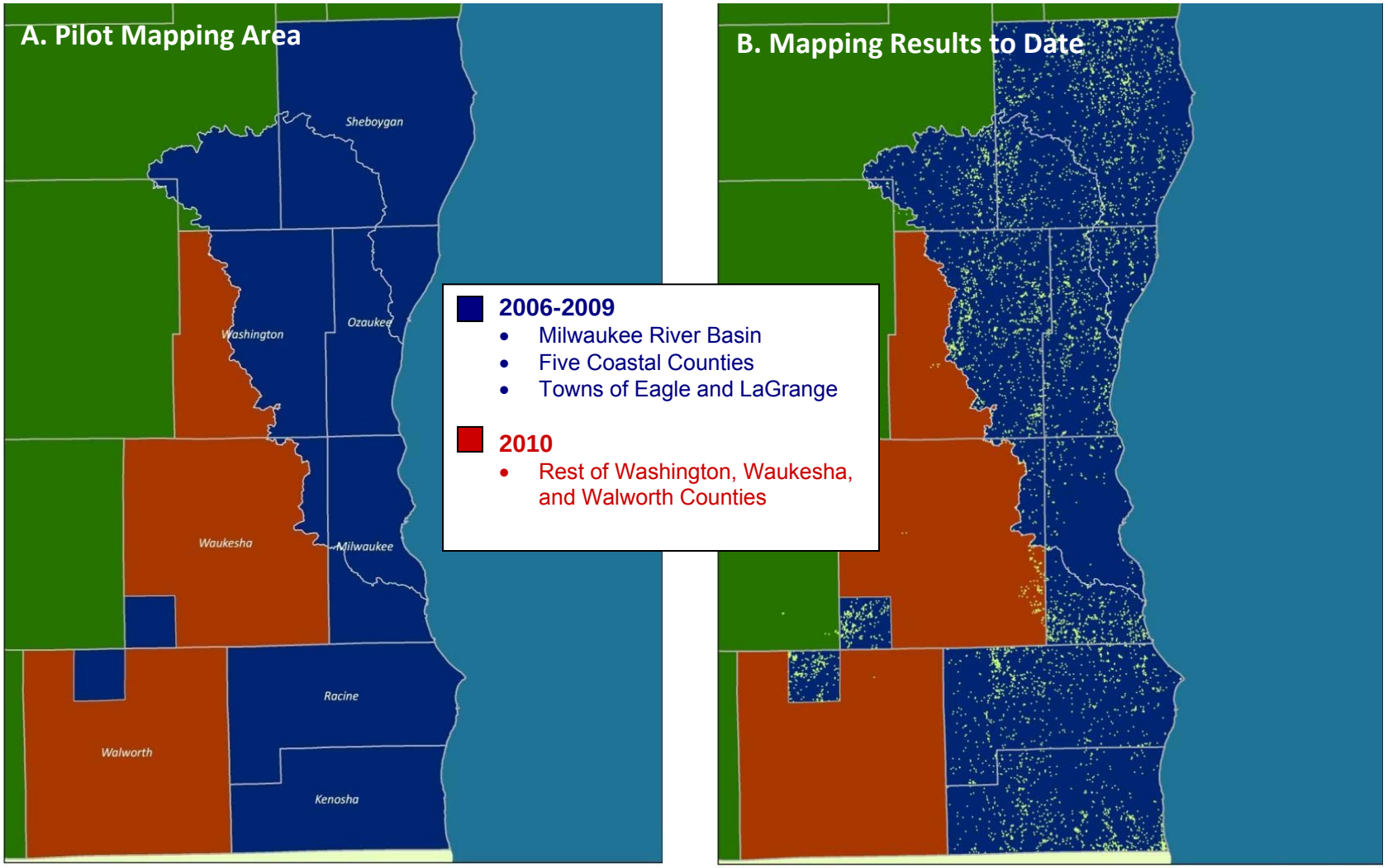
Ephemeral Ponds Monitoring and Mapping

In 2005, the Department formed a partnership with the Southeastern Wisconsin Regional Planning Commission (SEWRPC) to map ephemeral ponds in the Milwaukee River Basin, funded by a US EPA Wetland Grant. Additional funding to map ephemeral ponds in the coastal counties outside the Basin and develop a citizen monitoring network to groundtruth mapped ponds was obtained through two successive Coastal Grants from Wisconsin's Coastal Management Program. A third partner, the University of Wisconsin Extension, joined the team to form and support the Southeast Wisconsin Ephemeral Pond Citizen Monitoring Network with over 15 partner organizations. The mapping area and mapping results to date are shown in Figure 28. Results are summarized in *Mapping and Citizen Monitoring of Ephemeral Pond Wetlands in the Coastal Zone of Southeastern Wisconsin*.

Citizen monitors are trained and directed to "potential ephemeral ponds" (PEPs) that have been mapped by WDNR and SEWRPC. Over the past four years 753 of the 8,296 PEPs have been monitored using a simple protocol to assess physical and hydrologic attributes. WDNR staff have used these reports and their own field visits to establish PEP status as "Verified Ephemeral Ponds," "Other Wetland Types," "Not Wetlands" or "Not Yet Determined." A second EPA Wetland Grant was received in January 2010 to complete mapping ephemeral ponds in non-coastal parts of the study area and conduct a formal accuracy assessment for the total pilot mapping area as shown in Figure 28. The results of the accuracy assessment will be analyzed and recommendations will be reported in the final report to US EPA, in December, 2012.

Ephemeral ponds like this one have water in the spring but will be dry during the summer.

Figure 28. Ephemeral Pond Mapping project: A) Pilot Mapping Area and B) Mapping Results to Date



PART D. GROUND WATER MONITORING & ASSESSMENT

Executive Summary of the Annual Report to the Legislature by the Groundwater Coordinating Council

This is the Executive Summary of the annual Report to the Legislature by the Groundwater Coordinating Council (GCC). The report is required by s. 15.347, Wisconsin Statutes and describes the condition and management of the groundwater resource and summarizes the GCC's activities for fiscal year 2009 (FY 09). The full report along with several appendices can be accessed online at http://dnr.wi.gov/org/water/dwg/gcc/rtl/gccreport.htm.

In 1984, the Legislature enacted 1983 Wisconsin Act 410 to improve the management of the state's groundwater. The GCC is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

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. Agency designees are listed on the inside of the front cover. More information about the GCC and its activities can be found on the GCC web pages: (http://dnr.wi.gov/org/water/dwg/gcc/index.htm).

Highlights from each of the Chapters of the Report are summarized below.

Groundwater Coordination

The GCC, its Subcommittees, and member agencies worked together to address groundwater management issues and coordinate groundwater activities in FY 09. Examples include:

The UW Water Resources Institute (WRI) funded and continued to work closely with the GCC Education Subcommittee on a comprehensive groundwater education/outreach project that resulted in fact sheets on nitrate and arsenic in groundwater (http://aqua.wisc.edu/publications/productslist.aspx?CategoryID=38&sel=6), and activities for Groundwater Awareness Week (March 9-15, 2009). The latter included groundwater-related press releases prepared by UW-Stevens Point and WRI, and a public radio talk show with DHS and DNR representatives discussing groundwater issues.

Members of the GCC's Education Subcommittees helped guide the Wisconsin Well Water: Planning Web-Based Resources project (http://www.uwsp.edu/cnr/watersheds/programs_outreach/hwpp.htm). The project's

focus is on developing web-based tools to systematically provide information to Wisconsin's domestic water well users that will aid in individual determinations of drinking water safety. The subcommittee also provided content for the DNR's web page entitled "What's Wrong with My Water?"

Three groundwater workshops for teachers were held in January of 2009 in Mount Horeb, Eau Claire, and West Bend. Staff from the DNR, WGNHS and the Central Wisconsin Groundwater Center at UW - Stevens Point instructed teachers on using a groundwater sand tank model and provided other groundwater teaching aids. Teachers from 24 different schools attended the workshops and received a free model for their school.

The DATCP geographic information system-based well construction report search tool was made available to staff in other state agencies. This innovative tool offers user-friendly access to reports fundamentally important to our understanding of groundwater.

The GCC and the UWS Groundwater Research Advisory Council (GRAC) continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. The FY 10 solicitation for groundwater research and monitoring proposals was released in October 2008. A total of 18 project proposals were received. A comprehensive review process resulted in the selection of 5 new projects for funding for FY 10, all by UWS. The GCC approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The FY 10 groundwater monitoring and research projects are listed by funding agency in Table 2 of the report, including projects that were carried over from FY 09.

Summary of Agency Groundwater Activities

State agencies and the University of Wisconsin System addressed a number of issues related to groundwater protection and management and implementation of Chapter 160, *Wis. Stats.* in FY 09. Several highlights are below.

The Great Lakes Compact - Signed by Governor Doyle in 2008, the Compact requires Wisconsin to have water conservation goals within the Great Lakes Basin. Implementing legislation – 2007 Wisconsin Act 227 – is currently being implemented. In FY 09 the DNR has issued interim approvals to persons who were withdrawing water in the Great Lakes Basin above the threshold permitting level of 100,000 gallons per day as of December 8, 2008. The DNR is also planning to promulgate administrative rules related to the following Compact-related topics: Registration & Reporting; Water Use Permitting; Consumptive Use/Water Loss; Public Participation; Water Conservation & Efficiency; and Water Supply Service Area Planning; and Water Withdrawal Fees.

Nutrient Management Planning - Through its land and water resource management program, DATCP provides funding primarily to counties to assist in the protection of water resources through farmer adoption of nutrient management planning. In calendar year 2008, $2,900,000 was allocated to provide cost-sharing to farmers for the development and implementation of nutrient management plans (NMP) for their cropland. In 2008, Wisconsin attained a record number of cropland acres under NMPs, achieving 1,600,000 acres, a 60% increase over acres reported in 2007.

The Groundwater Protection Act (2003 Act 310) - Chapter NR 820, Wis. Adm. Code, Groundwater Quantity Protection (effective September 1, 2007), created a mechanism for evaluating proposed high capacity wells to determine if there will be a significant environmental impact on springs, trout streams, outstanding and exceptional resource waters. In FY 09 DNR staff made progress updating a high-capacity well inventory and collecting annual pumpage reports. In May 2009 data on this groundwater usage was first compiled and made widely available. These data are establishing important baseline information regarding water use in the state and will be used for a variety of resource management concerns.

Condition of the Groundwater Resource

Major groundwater quality and quantity concerns in Wisconsin include:

Major Groundwater Concerns in Wisconsin:

- Volatile Organic Compounds (VOCs)
- Pesticides
- Nitrates
- Microbial agents
- Radionuclides
- Arsenic
- Groundwater quantity

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.

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%.

Nitrate: Nitrate-nitrogen is the most common contaminant found in Wisconsin's groundwater. Nitrate can enter groundwater and surface water from a variety of sources including farm fields, animal feedlots, septic tanks, and decaying vegetation. 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. This combined dataset from DNR's Groundwater Retrieval Network (GRN) database, the Center for Watershed Science and Education database, and DATCP's groundwater database, included only the most recent nitrate result for each sampled private well. Out of the 48,818 samples, 5686 (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%.

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. In one assessment (Warzecha et.al., 1994), approximately 23% of private well water samples statewide tested positive for total coliform bacteria, an indicator species of other biological agents. Approximately 3% tested positive for *E. coli*, an indicator of water borne disease that originates in the mammalian intestinal tract. 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 becoming 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. (Borchardt 1997, 1999). Another study, conducted in conjunction with the USGS, found that 50% of water samples collected from four La Crosse municipal wells were positive for enteric viruses (Hunt and Borchardt, 2002, Borchardt et al. 2004). More recent and on-going studies have shown a link between viruses found in the municipal wells and wastewater system in Madison (Bradbury, 2007).

Leaking sanitary sewers were shown to be a source of infectious viruses to drinking water wells in subsequent work funded by WDNR and the USGS (Hunt and others, in review). Marshfield Clinic and USGS researchers sampled over 30 unconfined municipal wells in 14 Wisconsin communities. From this survey 8 wells had surface water contributions, 4 had unambiguous waste-water tracers, and 5 were positive for viruses. Follow-up investigation of the shallow groundwater system between 3 of these wells and suspected sanitary sewer sources showed that sampling at any one time may not show concurrent virus and trace presence due to analytical precision and seasonality of the sources in the waste stream. However, given sufficient sampling over time, a good relation between unambiguous waste-water tracers and virus occurrence was identified - locations that were characterized by recurring unambiguous tracer occurrence also were found to have enteric viruses present. Moreover, it was demonstrate that high-capacity pumping can induce viruses to move into a well before they are inactivated during their time in the subsurface.

Microbial contamination of groundwater is not restricted to vulnerable or shallow aquifers. Researchers recently discovered human viruses in the confined aquifer supplying Madison's drinking water. This finding was completely unexpected because it was believed a shale confining layer protected the aquifer from microbial contamination. Additional research on the Madison wells has shown virus transport from leaking sanitary sewers to the wells is very rapid, on the order of weeks to months instead of years. The virus transport and contamination levels were particularly high after extreme rainfall events or rapid snowmelt. From a public health perspective, the lesson learned is that all aquifers are potentially vulnerable to microbial contamination and require a similar level of disinfection for drinking water purposes.

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.

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. The water produced from this aquifer often contains combined radium activities in excess of 5 pCi/L and in some cases in excess of 30 pCi/L. Approximately 35 public water systems exceed the drinking water standard of 15 pCi/L for gross alpha activity (Nelson, personal communication). Federal standards are causing many communities to search for alternative water supplies or treatment options.

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.

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, NR 820, 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 being implemented.

Benefits of Monitoring and Research Projects

The GCC provides consistency and coordination among state agencies in funding groundwater monitoring and research to meet state agency needs. Approximately $15.2 million has been spent by DNR, UWS, DATCP, and Commerce through FY 09 on 369 different projects dealing with groundwater or related topics. While the application of the results is broad, this report describes topic areas where the results of state-funded groundwater research and monitoring projects have been successfully applied to groundwater problems in Wisconsin. These areas include:

- Pharmaceuticals, personal care products, and endocrine disrupting compounds
- The Atrazine Rule

- Groundwater monitoring at solid waste disposal sites
- Arsenic monitoring and research in Northeastern Wisconsin
- Groundwater movement in shallow carbonate rocks
- Developing new tools for groundwater protection
- Prevention and remediation of groundwater contamination
- Detection and monitoring of microbiological contaminants
- Groundwater drawdowns
- Comprehensive planning
- Rain garden design and evaluation
- Methylmercury formed in groundwater

Directions for Future Groundwater Protection

The GCC recommends the following priorities for future groundwater protection and management:

- Evaluate acute and chronic impacts to groundwater from manure management practices.
- Understand and better predict impacts from groundwater withdrawals
- Continue to evaluate and catalog Wisconsin's groundwater resources
- Investigate extent and origins of naturally occurring substances in groundwater
- Evaluate occurrence of recently discovered groundwater contaminants
- Understand the links between land use and groundwater quantity and quality
- Evaluate potential impacts of climate change on Wisconsin's groundwater
- Address groundwater quantity management issues at both statewide and regional levels
- Find solutions to groundwater nonpoint pollution problems
- Meet funding needs for nutrient management practice research to evaluate resource protection effectiveness
- Develop methods to assess and protect against health hazards posed by exposure to 'orphan' contaminants as well as multiple contaminants in a water supply
- Continue to fund groundwater monitoring and research
- Support implementation of a Statewide Groundwater Monitoring Strategy
- Support Implementation of the Great Lakes Compact
- Coordinate and facilitate consistent messages on groundwater related issues
- Promote consistency between the agencies on data management issues
- Ensure access to findings of groundwater research and monitoring projects

PART E. PUBLIC PARTICIPATION

Increased Public Participation in 2009-2010

One of Wisconsin's goals for the 2009-2010 listing cycle was increased opportunity for public participation, and greater transparency about our listing process. To accomplish this, staff provided several opportunities to the public, as shown below.

- A **solicitation for public data** was sent to interested parties on June 9, and publicly submitted data were accepted from June 16 to July 17, 2009. This data solicitation was also publicized via public notice on the WDNR's website. An online data submittal form was developed to streamline data submittal and WDNR review. Eleven entities submitted data for consideration; they are listed on the following web page: http://dnr.wi.gov/org/water/condition/2010_IR/public_data.htm. All public data were required to meet certain quality assurance measures to qualify for use in 303(d) listing decisions.

- WDNR's **Impaired Waters web pages** received extensive developments and enhancements prior to the public comment period. Much more information was provided than in the past. Some of the new features include: Real-time, searchable tables linked to data on the Impaired Waters List; pages featuring background information for each water proposed for listing during this cycle; a link to the methodology used to make listing decisions (WisCALM); and extensive background materials on related programs. An electronic mailbox was set up to encourage on-line comment submittal, and a public survey was developed to collect user feedback on their satisfaction with the new website.

- Once the draft 2010 Impaired Waters list was developed, a **public comment period** was held from December 1, 2009 to January 15, 2010. The public comment period was set for 45 days rather than the required 30 days to account for the holiday season.

- A **public 'webinar'** (a live online presentation) was held on Dec. 15, 2009. Approximately 65 people joined the live webinar, which was also recorded and posted online for future viewing (http://dnr.wi.gov/org/water/condition/webinar.htm). The webinar presentation described the process for Impaired Waters listing and the overall context of Clean Water Act requirements for reporting. A statistical summary of listed waterbodies was presented, and participants were shown how to use WDNR's enhanced website to find specific waterbodies or query information. The webinar was informational only; while participants were able to use a 'chat' feature to submit questions during the webinar, they were instructed to submit formal comments separately.

Public comments were compiled and responded to, as shown in the Integrated Report submittal package to EPA in Attachment I (April 2010). Public comments from approximately 75 citizens or organizations were received. In summary,

- 45 respondents supported the listing of Lake Wisconsin as impaired, attesting to degraded water quality and severe algae blooms significantly impacting lake usage.
- 9 commenters, including the Alliance of Great Lakes, requested evaluation of Great Lakes beaches based on number of days closed and effects of phosphorus loading on nuisance algae at Great Lakes beaches.
- Midwest Environmental Advocates (MEA) submitted a variety of comments primarily relating to Wisconsin's 303(d) listing process.
- Milwaukee Metropolitan Sewerage District (MMSD) submitted primarily questions regarding our 303(d) delisting process in relation to waters in the Milwaukee River Basin.
- The Courte Oreilles Lake Association requested that Musky Bay be included in the 2010 303(d) List.
- Ten respondents submitted comments regarding other individual waterbodies.

Questions about the Impaired Waters List or WDNR's Impaired Waters Program can be submitted electronically to Robert.Masnado@wisconsin.gov or mailed to the Water Evaluation Section, Wisconsin DNR, P.O. Box 7921, WT/2, Madison, WI 53707-7921.

CONCLUSION

Wisconsin has some of the most extraordinary water resources in the nation. In addition to sitting on top of some of the largest quantities of groundwater found throughout the United States, Wisconsin also has over 15,000 lakes and more than 54,000 discrete rivers and streams. WDNR is proud to serve in its role of steward and manager of these unparalleled resources that contribute so much to Wisconsin's identity.

Bass Lake in Marinette County underwent significant restoration efforts and was removed from the Impaired Waters List in 2010.

Significant Progress on Managing Wisconsin's Waters

This 2010 Water Quality Report to Congress represents the cumulative progress in water quality and water resources program work through December 2009. Advancements in study design, monitoring technologies, and data analysis are reviewed regularly by staff and are used whenever resources allow. During this reporting cycle, this has been exemplified by Wisconsin's development of protocols for using satellite data to assess lake condition for a much higher proportion of lake acres in the state than was possible in the past. In recent years, networks with trained volunteers have been strengthened to allow us to increase the number of water bodies for which baseline data are gathered. 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). WDNR hopes to continue to increase the number of waterbodies assessed, and strives to ensure that resources are used as efficiently as possible to do so.

Wisconsin is making great progress in adding several new water quality improvement tools to our program. After many years of hard work, Wisconsin is about to usher in new shoreland zoning requirements that will provide significant protection to surface waters throughout the state. In addition, thermal water quality standards have recently been approved and will be used in the state's WPDES permit program in 2010. Wisconsin is poised to revise both urban and agricultural nonpoint source performance standards – already among the most progressive in the entire nation – to help address the runoff of sediment and nutrients to our waterways. Lastly, Wisconsin will soon be seeking adoption of water quality criteria and implementation rules for the regulation of phosphorus in surface waters – a very important effort that began in the 1980's that has the potential to be inexorably linked to improvements in water quality throughout the state.

Through efforts like these, Wisconsin is taking a very active and progressive approach to assessing and improving water quality. For more information regarding the materials contained in this report, please refer to the WDNR Water Division website for the specific program or geographic area of interest to you.
http://dnr.wi.gov/environmentprotect/water.html