The State of the Sheboygan River Basin

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A report by the Wisconsin Department of Natural Resources in cooperation with the Sheboygan River Basin Land and Water Partners Team and other stakeholders

PUBLIC REVIEW DRAFT

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To: Recipients of *the State of the Sheboygan River Basin* Report

We are pleased to present our Second *State of the Sheboygan River Basin* report. This report improves upon and updates the State of the Basin Report that was published in 1999. It provides an overview of land and water resource quality. It also identifies challenges facing our resources and accomplishments since our 1999 report. It outlines recommended actions the Wisconsin Department of Natural Resources and its many partners can take over the next few years to conserve and restore our natural resources throughout the Sheboygan River Basin.

The report considered other recent natural resource planning documents and reflects an ecosystem approach. This ecosystem approach realizes that environmental, social and economic elements factor into our resource management decision making process. The plan reflects our Departments strategic plan goals of *Making People are Strength, Sustaining Ecosystems, Protecting Health and safety, and Providing for Outdoor Recreation.*

A supplemental technical report is also being updated as part of this process. This supplemental report includes substantial data on our water resources within the Sheboygan Basin. Internet links and phone numbers are provided throughout this report so readers wanting more detail can easily find the information.

This report is a work in progress and we welcome your comments. As objectives are met and projects are completed, we will provide updates on our Sheboygan River Basin Internet page at www.dnr.state.wi.us/org/gmu/Sheboygan/. We look forward to maintaining a relationship with all our partners and the public as we work together to protect, conserve, restore and enhance our natural resources throughout the Sheboygan River Basin.

Sincerely,

Victor C. Pappas
Sheboygan Basin Water Leader

ACKNOWLEDGMENTS

Preparation of *The State of the Sheboygan River Basin* plan has been an effort of the Wisconsin Department of Natural Resources Sheboygan River Land and Water GMU staff with support from the Sheboygan River Basin Land and Water Partners and DNR field and central office staff in the Divisions of Land and Water. Many individuals contributed information, data analysis or review. Their help is much appreciated.

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Executive Summary

The Intent of this State of the Basin Report is to provide a vehicle for identifying natural resource needs, priorities and recommendations for the Sheboygan River Basin. The report reflects the strategic priorities of our agency, our partners and the public for conservation and management of important natural resources in our basin for the next 5-6 years.

The report updates and improves upon the 1999 State of the Environment report for the Sheboygan Basin. It integrates recommendations made in other recent reports, priorities established by the Sheboygan Land and Water Partnership Team, and other Department plans such *as the Fisheries, Wildlife, and Habitat Management Plan for Wisconsin (2001 – 2007)*. The report will also be used to provide direction to Department staff during the development of biennial work plans. It will be a primary tool for assessing our performance and progress on important natural resource priorities in the basin over the next several years.

The report also serves the function of updating our basin watershed tables in accordance with EPA Clean Water Act requirements. The watershed tables will be the main source of information for 305(b) reporting to congress and determining the level of 106 funding DNR receives under the Clean Water Act. Future funding from EPA will be based on the amount of water resources and the conditions of those water resources within each state. A supplemental technical report entitled *Water Resources of the Sheboygan Basin* has been updated with new data and accompanies this document.

BASIN DESCRIPTION

Chapter 1 (page 1) describes the importance that natural resources have played in the growth and development of the cities, towns and villages in the watershed. It also describes many of the unique natural resource features that make up the Sheboygan Basin.

AQUATIC RESOURCES AND CHALLENGES TO WATER QUALITY

Each of the sub-watersheds that make up the Sheboygan Basin is described in detail in Chapter 2 (page 3). In addition, we have included some recent water quality accomplishments and some objectives for the future for each of these sub-watersheds. We have included a section in this chapter describing fisheries of the basin and fish management objectives for the future. A section that describes challenges to surface water and groundwater quality has been included in Chapter 2. The various activities that contribute to sources of pollution and impacts to the natural resources in the basin are described in this part of the report. Some overall surface and groundwater quality recommendations are included.

TERRESTRIAL RESOURCES

Land uses are critically important to the quality of our water resources in the Sheboygan Basin. That is why we have included information on terrestrial resources. Chapter 3 of the report (page 47) describes many of the land resources in the basin including wetlands, forests, recreational, agricultural and grasslands.

PARTNERSHIP

One of the key elements of our Department's strategic plan is *"Making People Are Strength".* Landowners, community organizations, municipalities, conservation clubs, industries, environmental organizations, and local, state and federal agencies must work together to realize our natural resource goals. Chapter 4 (page 66) discusses the Sheboygan Land and Water Partnership Team efforts. It includes a list of broad goals and objectives that the team developed.

STRATEGIC IMPLEMENTATION

Chapter 5 (page **Error! Bookmark not defined.**) summarizes all of the recommendations made throughout the report. They have been reorganized around the four major themes of our Department's strategic plan, which are:

1. Making People Our Strength
2. Sustaining Ecosystems
3. Protecting Public Health and Safety
4. Providing Outdoor Recreation

We hope to translate what the strategic plan means for the Sheboygan Basin by implementing these specific objectives for natural resource improvements over the next several years.

Preface

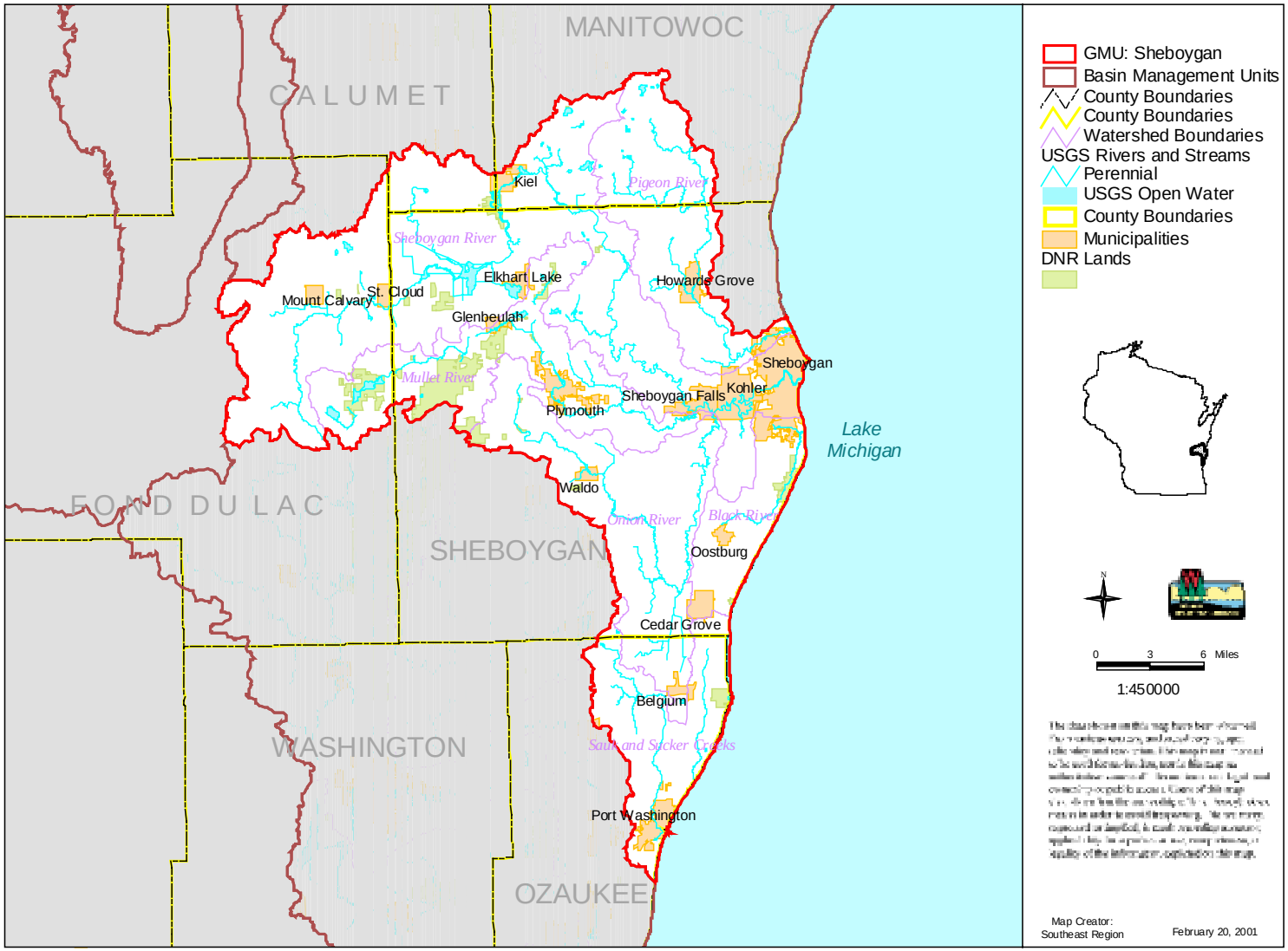
The rivers, lakes, groundwater and lands in the Sheboygan River Basin (Figure 1) sustain a wide range of plant and animal life as well as offer wide range of quality. From the natural and agricultural rural areas to the urban and urbanizing areas, one thing remains constant. Our land and water resources are forever linked. Our activities on the land have an effect not just at the point of origin, but ripple throughout the basin. The quality of our rivers, lakes and groundwater also has influence over what we do on the land.

Today we are challenged with finding ways to balance our use of land and water with our desire to protect, restore and enhance the natural resources in the Sheboygan River Basin. Building and maintaining strong partnerships with shared visions and goals are essential to striking this balance. This Sheboygan River State of the Basin Report provides a general blueprint for managing our resources within a context of shared responsibility.

Specifically, this report

- Provides an overview of the quality of our land and water resources and our relationships with these resources.
- Identifies resource issues and threats that keep the land and water resources from meeting their full potential and actions currently underway to address these issues and threats.
- Outlines specific actions that the Wisconsin Department of Natural Resources and its many partners can put into practice to improve, protect or maintain the quality of the basin's resources for the next 5 or 6 years.
- Provides links and references so those interested in learning more can readily find the information they're seeking.

Figure 1. Sheboygan River Basin Overview



Chapter 1: The Sheboygan River Basin, Past and Present.

PAST

The Sheboygan River Basin has experienced a long and rich natural resource history. Prior to the major influx of settlers from the eastern United States and Europe which began in the basin during the early and middle 18th century, the local native populations were clustered on the bank or shore of practically every major stream and lake. The largest native villages were found along the shores of Lake Michigan (including what is now Kohler-Andrae State Park) and the extensive bluffs overlooking the Sheboygan Marsh (now the Sheboygan Marsh County Park and the State Wildlife Area). Fishing was the chief resource along the lake shore and hunting was the attraction for the native people in the marsh region. Besides hunting and fishing, these and the other native settlements also used the basin resources for limited agriculture. On September 26, 1833, the native people ceded all their lands on the west shore of Lake Michigan to the United States. The birth of Sheboygan County followed on December 7, 1836 when the county area, as it is today, was detached from Brown County. Following land surveys of the mid-1830s, land sales were made by the Federal Government in tracts of not less than 80 acres at a minimum bid price of $1.25 per acre.

The natural resources of the basin area continued to be used by the early settlers in much the same way as by the native people. However, with the advent of road construction (many of which followed well-marked Native American trails such as current highways 23 and 28), the various hardwood and pine forests were cleared for timber use and the land was used for expanding agricultural purposes. In addition to the extensive timber harvest, wheat was the major agricultural crop until the 1880s. Depletion of the soil by this one-crop system and the ravages caused by the chinch-bug pest were generally responsible for a change in land resource use to dairy farming, for which the basin remains famous today.

The local rivers and streams were integral in the development of early manufacturing in the basin. They furnished natural power to numerous saw-mills and flour-mills to process the raw timber and wheat into the products transported out of the area by the growing number of local manufacturers. This led to a rapidly expanding economy and growth in the area particularly at the City of Sheboygan, then a major port on the western shore of Lake Michigan.

This rich natural resource history (from the early settlement of the basin through today) has provided not only an understanding of how important natural resource management is, but how integral the current state of the basin is to our daily lives and to those of future generations.

PRESENT

The Sheboygan River Basin covers about 620 square miles, and is located in portions of five counties, contains (entirely or portions of) six cities, 20 towns, and nine villages and is home to about 130,000 people. The basin contains six watersheds, all named after the major rivers within them (Figure 1, page ix). The basin is water rich and ecologically diverse. Collectively the six watersheds contain about 400 miles of perennial streams, 400 miles of intermittent streams, 35 miles of Lake Michigan shoreline, 21 named lakes and many small lakes and ponds. Wetlands encompass over 45,000 acres, or about 11 percent of the basin land area.

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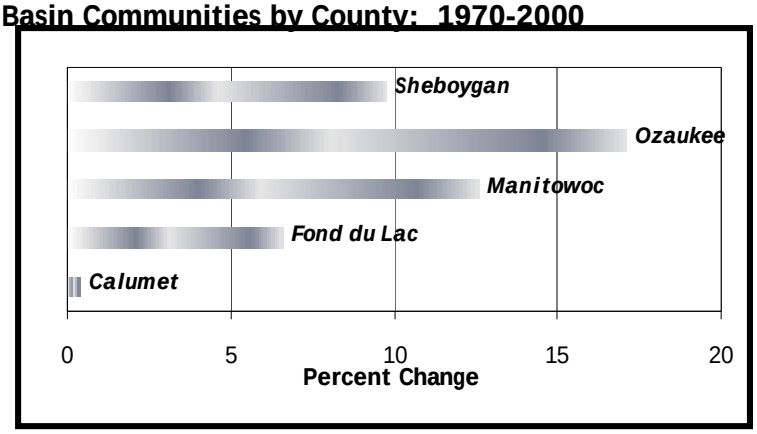
The Natural Heritage Inventory (WDNR, 2000) has documented 10 endangered, 20 threatened and 37 special concern plant and animal species and 24 rare aquatic and terrestrial communities within the basin (Appendix A, page ?). About four percent of the land area of the basin is covered by urban uses, while the remainder is considered rural (WISCLAND land database). The topography of the basin is generally irregular, consisting of low rounded hills to the west interrupted by narrow valleys and many wetlands. A central band of Kettle Moraine landscape divides the basin which grades into irregularly low, flat moraine landscape. The slope of the basin tends toward the east and Lake Michigan, but varies along individual stream reaches from zero to 21 feet per mile.

Population in the basin has grown by about 10 percent since 1970 with Ozaukee County growing the fastest (Figure 2).

Figure 2. Percent Population Change in Sheboygan Basin Communities by County: 1970-2000



Lake Michigan supplies drinking water to about _?_ percent of basin residents. The remainder of the population receives their drinking water from groundwater sources. As people move to the more rural areas of the basin, groundwater quantity and quality issues will become more important.

Recreational opportunities are abundant throughout the basin. The Northern Unit of the Kettle Moraine State Forest and the Sheboygan Marsh State Wildlife area are the two largest state-owned properties in the basin, covering over 20,000 acres.

The next chapters will examine the basin in more detail, including the quality of our water and land resources, issues and resource threats, and objectives for future work.

Chapter 2: Sheboygan River Basin Water Resources

SURFACE WATER

The Sheboygan River Basin encompasses over 600 square miles of land in portions of Sheboygan, Ozaukee, Fond du Lac, Calumet and Manitowoc counties. The basin contains six watersheds, named after the major rivers found in the watershed boundaries. The Mullet River and Onion Rivers meet the Sheboygan River in Sheboygan Falls, before the Sheboygan River enters Lake Michigan. The Pigeon River, Black River and Sauk and Sucker Creeks watersheds drain directly to Lake Michigan. The Sheboygan River Basin has 21 named lakes and five river impoundments greater than 10 acres. The Franklin impoundment, on the Sheboygan River, no longer exists with the dam removal in the spring of 2001.

The topography of the basin ranges from low, flat moraine in the east to a central area of kettle moraine landscape. The western portion consists of abundant wetlands interspersed between the low rounded hills of the basin. Basin elevation varies from 50 feet to 150 feet above lake Michigan. The basin is generally graded to the east with slopes ranging from 0 feet to 21 feet per mile with a seven feet per mile average. Soils of the eastern basin are generally heavy clays that have low permeability and tend to promote runoff of soil and animal wastes. The central moraine area has the associated till or gravely soil with the western soils are generally loamy and light textured.

Land uses in the basin are generally agricultural or rural and include pasture land, cropland and vacant fields. Natural areas, including open water, woodlands, wetlands, park lands and undisturbed non-agricultural lands are the second most dominant land uses in the basin. Urban, residential and transportation uses make up the remainder of land uses. The Sheboygan River Basin contains 15 cities, 20 towns and nine villages. The major urban areas, the cities of Sheboygan and Sheboygan Falls, and the Village of Kohler are located in the east-central portion of the basin.

Runoff from specific and diffuse sources, contaminated sediment, habitat modifications (such as channelization and dams) have degraded water quality throughout the Sheboygan River Basin. Construction site erosion and impervious surfaces (roads, roofs, parking lots) are emerging threats to water quality as the Sheboygan River Basin grows increasingly urban.

Streams and lakes that do not meet water quality standards on a consistent basis make up about 7.5 percent of the total stream miles, and 9 percent of the named lakes in the basin. In response to an U.S. EPA requirement, the State of Wisconsin maintains a list of impaired waters, also known as the 303(d) list. About 30 miles of streams and three lakes are considered sufficiently impaired to be included on this list (Table 1). This listing of waters will enable the WDNR to set priorities for implementing certain water quality management activities for streams not currently meeting water quality standards. ***For more information about the WDNR impaired waters strategy, please see*** www.dnr.state.wi.us/org/water/wm/wqs/303d***.***

Table 1. Sheboygan River Basin Streams and Lakes Included on 303(d) List

Waterbody Name	Watershed	Miles

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		affected
Sheboygan River from mouth to Sheboygan Falls Dam	Sheboygan River	14
Sheboygan River below Franklin downstream to Sheboygan Falls Dam	Sheboygan River	15
Big Elkhart Lake	Sheboygan River	N/A
Crystal Lake	Mullet River	N/A
Pigeon Lake	Pigeon River	N/A

The following sections will give a watershed by watershed perspective of the surface water resources within the Sheboygan River Basin. Each watershed narrative is followed by an overview of actions completed since the 1999 *State of the Environment* report, and a list of objectives future work needed in the watershed. More specific information for each perennial stream and named lakes within the basin is included in the supplemental document, entitled *Water Resources of the Sheboygan River Basin.* A drinking water and groundwater quality section (page 41) with objectives for the future follows the surface water quality sections.

Sauk and Sucker Creeks Watershed

The Sauk and Sucker Creeks Watershed is the southern most watershed in the Sheboygan River Basin. Most of the watershed is located in Ozaukee County, with a small northern portion located in Sheboygan County. Sauk Creek enters Lake Michigan in the City of Port Washington, while Sucker Creek enters the Lake north of the City of Port Washington (Figure 3).

The watershed is primarily agricultural, but urbanization is proceeding rather rapidly. The entire City of Port Washington and portions of the Villages of Cedar Grove, Belgium and Fredonia are located within this watershed.

Water quality is fair to poor in both Sauk and Sucker Creeks. Nonpoint sources of pollution and stream channelization are the primary causes of degraded water and habitat quality throughout the watershed. Construction site erosion and impervious surfaces (such as roads, roofs, and parking lots) are increasingly threatening water quality as urbanization proceeds. Runoff from farm fields and barnyards also contribute to degraded water quality in the watershed. These pollution sources and habitat modifications are contributing to the high concentrations of nutrients and suspended solids and sediment observed in the watershed. Large sediment plumes are frequently observed entering Lake Michigan at the mouths of Sauk and Sucker Creeks during spring melt and heavy rains.

Fish surveys conducted in the headwaters of Sauk Creek in 1999 identified a diverse fish community consisting of twelve forage and four sport fish species. Sauk and Sucker Creeks also support seasonal runs of trout and salmon from Lake Michigan, providing good fishing opportunities for anglers. From 1995 through 1998, the Department of Natural Resources cooperated with local sports clubs, city government and others to improve fish habitat, water quality and streambanks in some downstream portions of Sauk Creek. In stream structures, streambank shaping and erosion control measures were implemented with the objectives of increasing the carrying capacity of Sauk Creek, improving the return of migratory trout and salmon to the creek and increasing fishing opportunities. This project would not have been possible without the help from donations by the Great Lakes Sport Fishing Club of Ozaukee County, cooperation from Wisconsin Electric Power Company, the City of Port Washington and countless volunteers. Repair to structures and additional streambank shaping was done in 1999.

A summary table with general information about the Sauk and Sucker Creeks Watershed follows. For more detailed information about the water resources of this watershed, please refer to the supplemental report entitled *The Surface Water Resources of the Sheboygan River Basin.*

Figure 3. Sauk and Sucker Creeks Watershed.

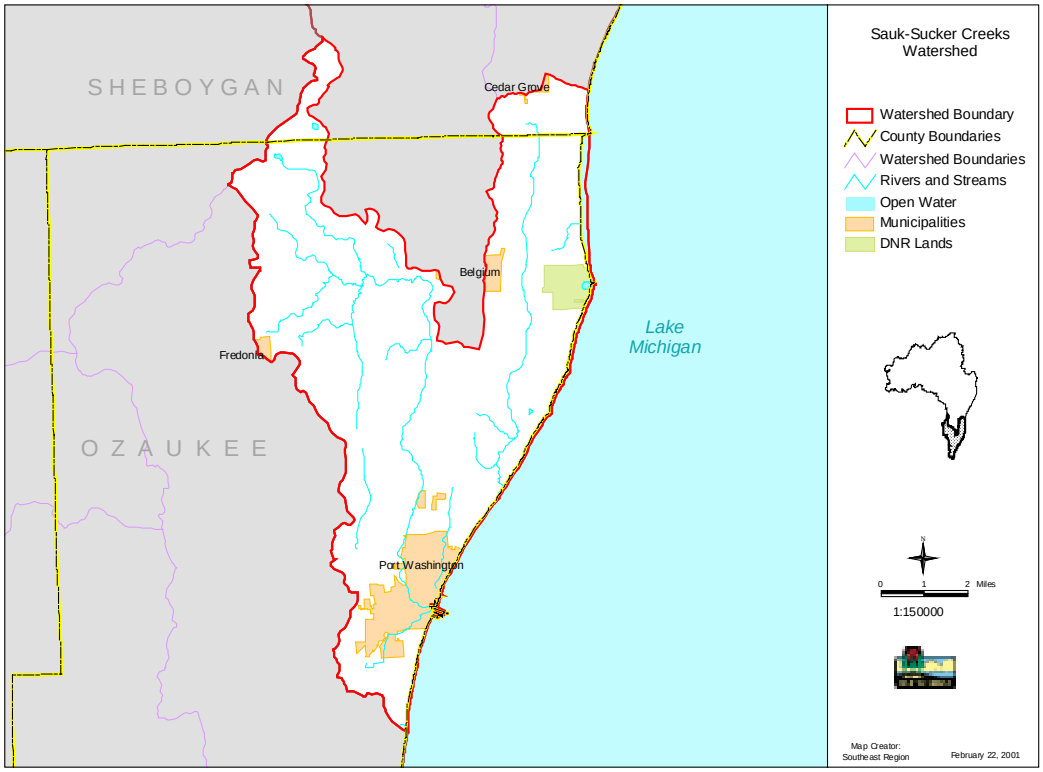

Table 2. Sauk and Sucker Creeks Watershed at a Glance	
Watershed drainage area	58 square miles
Miles of perennial streams	33
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes/ponds on impaired waters list	0
General threats to stream water quality	■ Habitat modification ■ Agricultural and urban runoff ■ Construction site erosion
Number of named lakes	2
Number of dams	
Threats to lake water quality	Not enough information known about the lakes to assess water quality
Number of industrial wastewater treatment facilities	3
Number of municipal wastewater treatment facilities	1

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Recommendations for the Sauk Sucker Creeks Watershed

Completed Actions

Accomplishments in the Sauk & Sucker Creeks Watershed since the 1999 State of the Environment Report are listed below.

- Fish and habitat assessments were conducted on three headwater branches of Sauk Creek; Ludowissi Lake Branch, Holy Cross Branch, and Hickory Grove Branch (unofficial names established by the biologist).
- In cooperation with local sports clubs, city government, and others, WDNR implemented a habitat restoration project in downstream portions of Sauk Creek. A barrier to fish passage was removed and habitat structure was added to the stream.
- Fish and habitat assessments were conducted on Spring Creek in Port Washington.
- Fish and habitat assessments were conducted on the lower reaches of Sucker Creek in the Town of Port Washington.
- Two drain tiles from milk-house wastes draining to Sauk Creek were identified and corrected.
- Sludge deposited in the headwaters of Sauk Creek (Ludowissi Branch) from a drain tile was removed from the stream and the drain tile was flushed and repaired to prevent future releases of organic contaminants.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Sauk and Sucker Creeks Watershed.

- Sauk and Sucker Creeks Watershed should continue to be considered as a high priority for selection of nonpoint source management projects and funding.
- Water quality biologists should continue working with the communities, Ozaukee Land Conservation Department, agricultural community and others to improve the water quality by decreasing sediment runoff, nutrient loads, and stormwater runoff to Sauk & Sucker Creeks.
- The Department should assist and encourage the City of Port Washington to adopt a stormwater management ordinance for water quantity and quality including a snow disposal policy.
- We will continue to work with the City of Port Washington to maintain and enhance fishing opportunities in the Port Washington Harbor.
- The Sheboygan River Basin staff supports and should assist Ozaukee County Land Conservation Department in obtaining stream bank buffers along all of the streams in the county.
- Fisheries and water quality staff should continue to work with external partners on habitat improvement projects on Sauk Creek.
- Water quality biologists should conduct stream assessments on all of the tributaries to Sucker Creek and Sauk Creek.
- The water quality biologists should conduct stream assessments on the tributaries to Lake Michigan within the Sauk & Sucker Creeks Watershed.
- Water quality biologists should conduct water quality assessments on Ludowissi Lake and Grasser Lake.
- The Department should encourage all communities to adopt construction site erosion and stormwater management ordinances.

- Water quality biologists should continue to assist the county in identifying drain tile connections from septic systems and milk-house wastes to surface waters and facilitate the corrections.
- We should coordinate with local agencies to enhance the Self-Help Monitoring Program for lakes in the Sauk & Sucker Creek Watershed.
- Water quality biologists should work with the local schools and interest groups to establish volunteer monitoring in the Sauk and Sucker Creeks Watershed.

Black River Watershed

The entire Black River Watershed is located within Sheboygan County (Figure 4). The southern portion of the City of Sheboygan, most of the village of Cedar Grove and the entire Village of Oostburg are located in the watershed. The watershed encompasses 36 square miles and contains three named streams, the Black River, Barr Creek and Fisherman's Creek and 32 unnamed streams. There are no lakes or impoundments in the watershed.

Land uses in the watershed are mainly rural, characterized as natural lowlands with adjacent agricultural areas. Fisherman's Creek, which flows through the southern portion of the City of Sheboygan is characterized as urban.

Water quality in the watershed is considered poor. Rural and urban runoff, industrial and municipal point sources, channel modifications and construction site erosion all contribute to flashy flows, increased nutrients, bacteria, sedimentation and contaminated sediment.

Fish surveys conducted in 1994, 1999 and 2000 showed that a diverse fish community exists in the Black River with 10 forage fish and eight sport fish species in the lower reaches and fewer species in the upper reaches.

The Black River also supports a limited seasonal run of trout and salmon from Lake Michigan, providing some additional fishing opportunities for anglers.

Purple loosestrife infestations in the wetland areas are severely affecting the natural environment. This plant competes with the native vegetation in the wetland areas. The Jerving Conservancy located near the mouth of the Black River was once a highly valued migratory bird site but is now degraded by purple loosestrife overgrowth.

A summary table with general information about the watershed follows. For more detailed information about the Black River Watershed, please refer to page ? of the supplemental document entitled *The Surface Water Resources of the Sheboygan River Basin.*

Figure 4. Black River Watershed

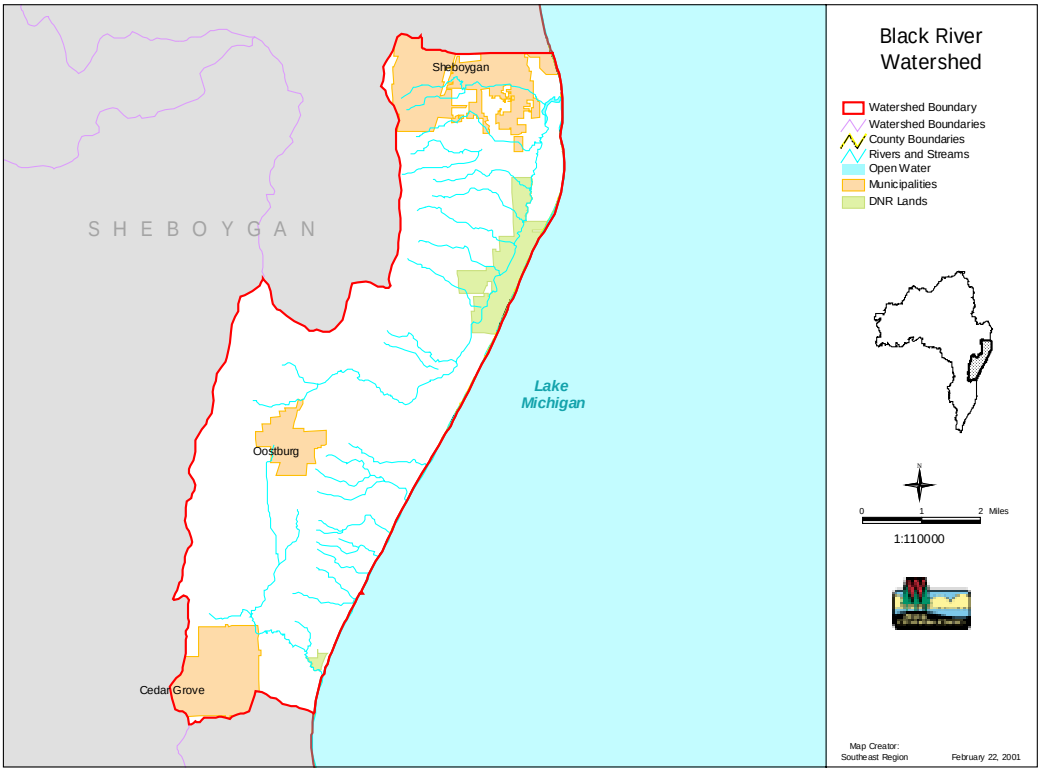

Table 3. Black River Watershed at a Glance	
Watershed drainage area	36 square miles
Miles of perennial streams	15
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams on impaired waters list	0
General threats to stream water quality	■ Habitat modification ■ Agricultural and urban runoff ■ Municipal point sources ■ Construction site erosion
Number of lakes	0
Number of dams/impoundments	0
Number of industrial wastewater treatment facilities	5
Number of municipal wastewater treatment facilities	2

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Recommendations for the Black River Watershed

Completed Actions

Accomplishments in the Black River Watershed since the 1999 State of the Environment Report

- Fish and habitat assessments were conducted on two reaches of the Black River in the Town of Wilson.
- Water quality biologists conducted fish and habitat assessments on two reaches of Barr Creek in the Town of Holland.
- The Department oversaw a sediment quality assessment of an unnamed tributary to Barr Creek in the Town of Holland.
- The DNR assisted a local business in the Village of Cedar Grove by eliminating nonpoint source pollution runoff from its facility to a tributary of Barr Creek.
- Department staff assisted the Village of Cedar Grove in enhancing storm water management practices at a municipal storage site adjacent to Barr Creek.
- Water quality biologists worked with the local schools and interest groups to establish volunteer monitoring in the Black River Watershed.
- A new Naturalist position was established at the Kohler-Andrea State Park that will provide many more opportunities for environmental education and nature experiences for all age groups.
- The DNR and volunteers released beetles and weevils as biological control agents against purple loosestrife in the lower Black River Watershed.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Black River Watershed.

- The water quality biologists should conduct stream assessments on the tributaries to the Black River.
- We should continue working to improve the water quality by decreasing nutrient loads, sediment runoff, and stormwater runoff to Barr Creek and its' tributaries.
- Wetland biologist should evaluate the effectiveness of the biological control agents released in Kohler-Andrae State Park for the control of the exotic plant, purple loosestrife. The evaluation should include the spread of the control agent to determine whether the abundant population of purple loosestrife at the Arthur Jerving Conservancy property is being controlled.
- WDNR biologists should encourage volunteers to assist in raising and releasing biological control agents (beetles and weevils) for purple loosestrife.
- The Black River Watershed continues to be considered a high priority for nonpoint source management projects and funding.
- The Department should continue to assist the Sheboygan County Land Conservation Department staff in obtaining stream bank buffers along all of the streams in the county.
- WDNR should encourage all communities to adopt construction site erosion and stormwater management ordinances and snow disposal policies.
- WDNR should assist the county in identifying drain tile connections from septic systems and milk-house wastes to surface waters and facilitate the corrections.
- Water quality biologists should work with the local schools and interest groups to establish volunteer monitoring in the Black River Watershed.

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Sheboygan River Watershed

The Sheboygan River Watershed is the largest and possibly the most diverse watershed in the basin, covering about 260 square miles. The Sheboygan River originates in east-central Fond du Lac County and flows generally southeastward into the City of Sheboygan where it enters Lake Michigan (Figure 6). The major tributaries to the Sheboygan River are the Onion and Mullet Rivers. Other named warm water tributaries to the Sheboygan River are Otter and Weedens Creeks. Millhome, Schuett and Feldner's Creeks are trout streams located in the Sheboygan River Basin. There are also ten dams in the Watershed: Sheboygan Marsh, Kiel, Rockville, Millhome, Franklin, Johnsonville, Sheboygan Falls, Waelderhaus, Riverbend and Mischo's. The Franklin dam was removed in 2001, restoring this river reach to a free-flowing condition. The positive change in flow, temperature, and oxygen levels will result in habitat suitable for game fish species such as smallmouth bass, northern pike, and rock bass.

Land use in the watershed is primarily agriculture, but the downstream most reaches are entirely urbanized. Water quality is good in the headwaters and fair to poor in the lower reaches. Water and habitat quality are affected by contaminated sediments in the lower 14 miles of the river, agricultural and urban runoff, industrial and municipal wastewater treatment plant discharges, stream channelization, dams, and construction site erosion. These pollution sources lead to contaminated fish and wildlife populations (in the lower 14 miles), high stream turbidity, excess sediment, flashy flows, excess nutrients and nuisance algae, dissolved oxygen fluctuations, and fish migration barriers.

Some municipalities in the Sheboygan River Watershed have been designated to receive a municipal stormwater discharge permit to control contaminated runoff from urban areas. These communities include the Village of Kohler, the Town of Sheboygan and the Town of Wilson. The City of Sheboygan and the City of Sheboygan Falls recently obtained municipal stormwater discharge permits. The stormwater permits require these communities to identify stormwater pollution sources, create plans and implement practices to eliminate or reduce stormwater runoff.

The Sheboygan River Watershed is definitely the most studied watershed in the Sheboygan River Basin. Many researchers have conducted studies to determine the effects of polychlorinated biphenyl (PCB) uptake in fish and wildlife in the lower 14 miles of the Sheboygan River. This section of the river is listed as a Federal Superfund site. The U.S. EPA issued a Record of Decision for the Sheboygan River and Harbor Superfund Site in May 2000 This document presents the remedial action selected U.S. EPA for the Sheboygan River and Harbor site in Sheboygan. ***For more information on the Sheboygan River and Harbor Superfund Site, please see*** http://www.epa.gov/region5/sites***.***

Otter Creek has also been the focus of many studies throughout the years to evaluate the effects of agricultural runoff, and the performance of best management practices installed to reduce the runoff. A State Threatened species, the slippershell mussel, resides in Otter Creek.

While much of the watershed has been studied extensively, the upper reaches of the Sheboygan River had not been assessed since the mid-1980's. In response to this, two headwater sites were sampled in Fond du Lac County for fish and habitat in 1999. A diverse fish community consisting of 12 forage fish species and 4 sport fish species was found.

Volunteer monitoring efforts are a welcome addition and improve public awareness of our resources. Students and teachers in Sheboygan and surrounding communities are learning to become active decision makers through an environmental education project called "Testing the Waters". Through "Testing the Waters" students receive an education in river ecology and responsible citizenship. Students learn to collect water quality data, research land influences affecting the river, and develop measures to protect waterways. In short, "Testing the Waters" introduces students to the basics of stream biology and environmental management.

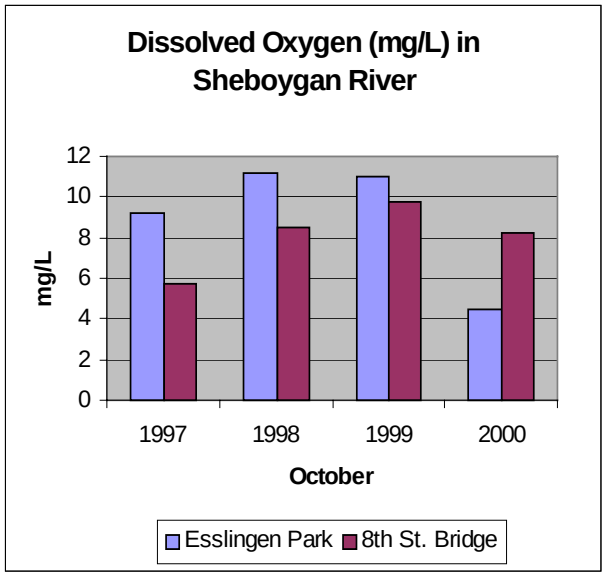
Since 1990, when "Testing the Waters" began, thousands of students in Kenosha, Milwaukee, Ozaukee, Racine, Sheboygan, Washington and Waukesha counties have tested water quality at sites throughout Southeastern Wisconsin. The number of students increases every year as more high schools and middle schools become involved.

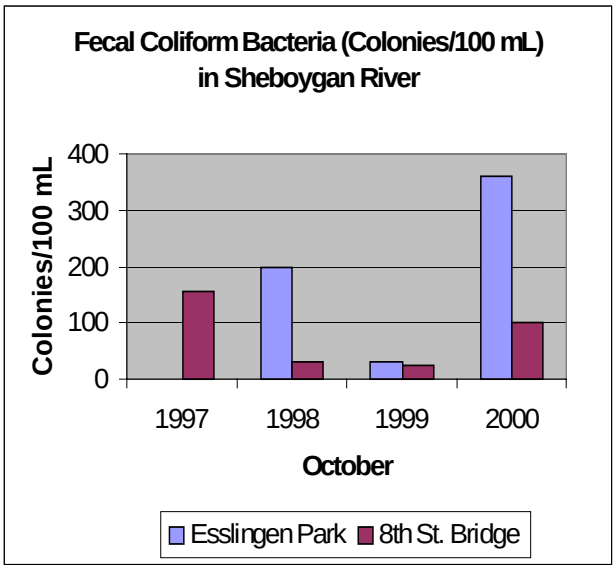
In Sheboygan County, a consortium of middle and high school teachers and students work together to collect water quality data on area rivers. Sample collection and analyses include: dissolved oxygen, fecal coliform bacteria, pH, biochemical oxygen demand (BOD), temperature, total phosphorus, nitrates, turbidity, total solids and benthic macroinvertebrates (water bugs).

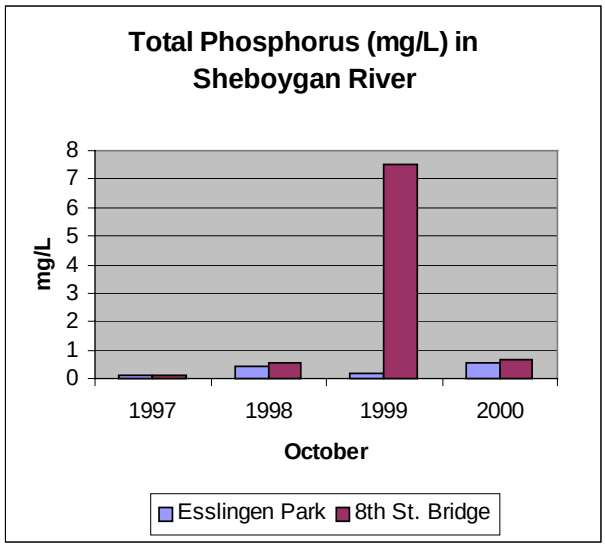
Data are interpreted, reported, and presented at an annual forum. The data the "Testing the Waters" students collect can be a valuable addition to water quality information compiled by the Wisconsin Department of Natural Resources (WDNR) ().

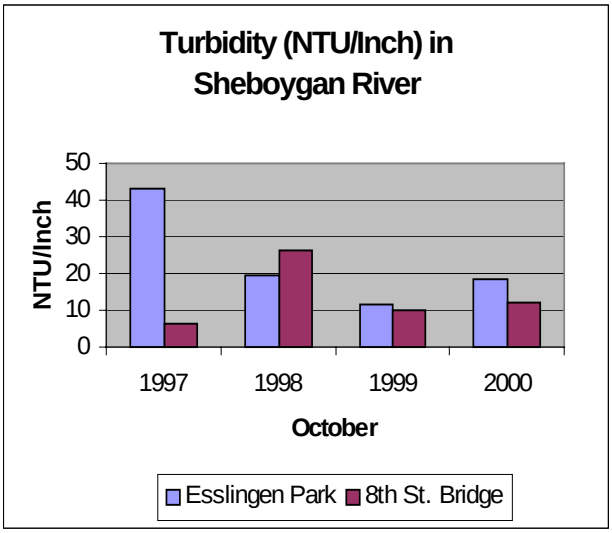
While the group works independently, students and teachers receive assistance and training from state and local groups such as the WDNR, Sheboygan County Land Conservation Department, Elwood H. May Environmental Center and Cardinal Environmental, Inc.

Figure 5. Water Quality Data Summary for Sheboygan River. Data Collected by Testing the Waters Student Participants.









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The Sheboygan River Watershed is home to two large marsh and wildlife areas – Broughton Sheboygan Marsh and Kiel Marsh. The Sheboygan River flows through the Broughton Sheboygan Marsh and Wildlife Area, which lies in northwestern Sheboygan County and includes about 14,000 acres of land and surface water, half of which are publicly owned. The Kiel Marsh Wildlife Area is located in north central Sheboygan County, with portions lying in southwest Manitowoc County and southeast Calumet County along the Sheboygan River. The Kiel Marsh Wildlife Area encompasses over 2,000 acres of land and water, 800 acres of public land managed by WDNR. Both wildlife areas are ecologically diverse; comprised of cedar and tamarack swamps, lowland hardwoods, and large areas of marsh and open water. Both of these wetland areas are attractive to anglers, hunters, and nature observers alike, for all seasons.

A summary table with general information about the Sheboygan River Watershed follows. For more detailed information regarding these studies and others, please refer to the supplemental document, *The Surface Water Resources of the Sheboygan River Basin*.

Figure 6. Sheboygan River Watershed

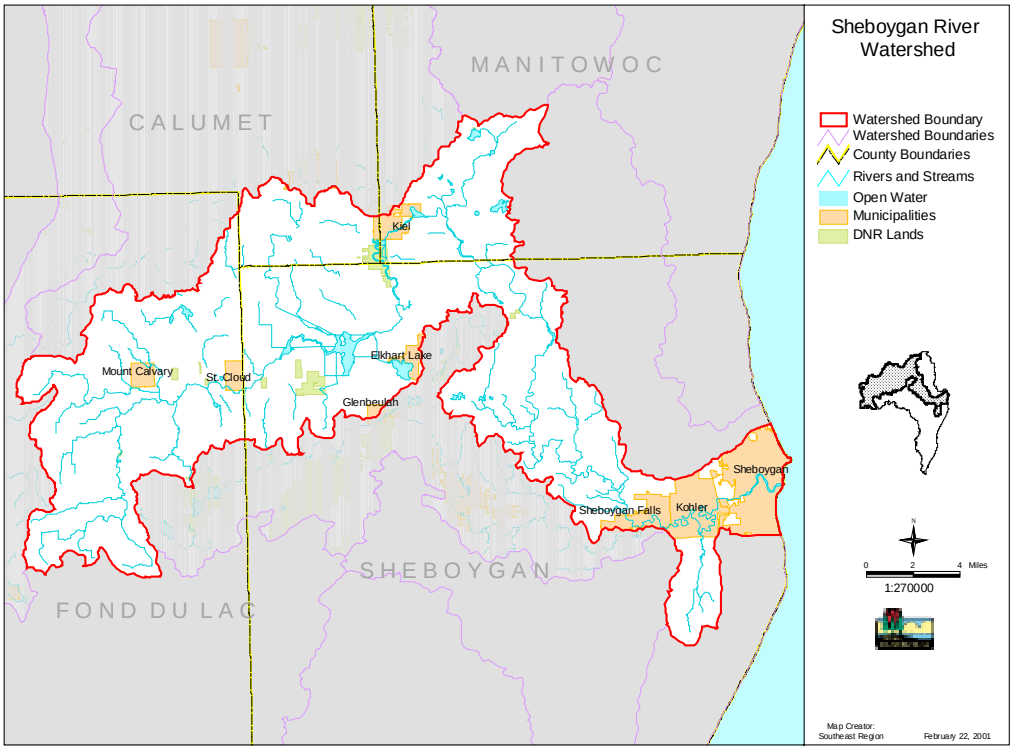

Table 4. Sheboygan River Watershed at a Glance	
Watershed drainage area	260 square miles
Miles of perennial streams	173
Miles of streams listed as outstanding or exceptional resource waters	4.12
Miles of streams/# lakes on impaired waters list	29/1 lake
General threats to stream water quality	■ Contaminated sediment ■ Habitat modification ■ Urban and agricultural runoff ■ Industrial and municipal point sources ■ Construction site erosion ■ Dams
Number of named lakes	15
Number of dams	10
Threats to lake water quality	■ Exotic species ■ Agricultural runoff ■ Shoreline development
Number of industrial wastewater treatment facilities	26
Number of municipal wastewater treatment facilities	4

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Recommendations for the Sheboygan River Watershed

Completed Actions

Accomplishments in the Sheboygan River Watershed since the 1999 State of the Environment Report

- A significant step towards cleaning up the PCBs in the Sheboygan River occurred in May 2000 when the U.S. EPA signed a Record of Decision (ROD) for a remediation plan for the Sheboygan River Superfund site.
- Sheboygan and Sheboygan Falls have obtained stormwater permits.
- Water quality monitoring was conducted in Big Elkhart Lake during 1999 and 2000, and fish were assessed in 2000. Little Elkhart Lake had water chemistry data collected in 2000.
- Fish community assessments were conducted in Sheboygan Marsh in 2000.
- Water quality data were obtained from Crystal Lake as part of the Trend Monitoring project in 1999 and 2000.
- Water quality data were obtained from the Sheboygan River at Esslingen Park quarterly in 1999 and 2000 as part of the Trend Monitoring project for streams.
- Sediment quality data were collected from the Franklin Impoundment, and Johnsonville Impoundment.
- Water Quality biologist continue to evaluate the distribution of zebra mussels in the Sheboygan River downstream of Big Elkhart Lake and any reports of infestations in other surface waters.
- The Department breached the Franklin Dam in 2000 and is planning to remove the dam in 2001.
- Fish and habitat assessments were conducted in the upper watershed on the South and North Branches of the Sheboygan River and an unnamed headwater tributary to the Sheboygan River.
- Three wetland restorations were completed in 1999, one of which was an 8 acre wetland on state land within the Sheboygan Marsh.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Sheboygan River Watershed.

- The Department continues to work with the U.S. EPA, NOAA, USFWS, and the principle responsible parties to effect sediment clean-up activities in the Sheboygan River Area of Concern/Superfund Site.
- DNR Sheboygan River Superfund review staff support a sediment transport model in the lower Sheboygan River and inner harbor to evaluate the potential to scour contaminated sediment under various stream flows.
- Water Resources managers should continue to assess the bioavailability of contaminants in the Sheboygan River Area Of Concern (AOC).
- Wildlife biologists should continue to collect waterfowl, small mammals, turtles, and swallows, for tissue analyses to determine toxic contaminant levels and health effects associated with the Sheboygan River Superfund Site.
- Fisheries and wildlife biologists should complete a feasibility study and master plan for the Kiel Marsh area.

- Wildlife, fish, and water quality managers should continue to work with the Sheboygan County Planning and Resource Department staff and others to update the Sheboygan Marsh area Master Plan as it nears completion.
- Wildlife biologist should continue to restore wetlands on state lands in the Sheboygan Marsh.
- Water quality biologists should continue to assist the Sheboygan County Land Conservation Department staff in obtaining stream bank buffers along all of the streams in the watershed.
- We should encourage all communities to adopt construction site erosion and stormwater management ordinances including snow disposal policies.
- Water quality, fisheries, and wildlife biologists should encourage lakeshore owners to maintain and/or establish riparian buffers.
- Fisheries and Water Resources biologists should conduct water quality and comprehensive fish surveys on Little Elkhart Lake and Gerbers Lakes.
- The Department should continue to conduct water quality and fisheries assessments on Crystal Lake as part of the Trend Monitoring project.
- Water quality biologists should continue to conduct water quality assessments on the Sheboygan River at Esslingen Park as part of the Trend Monitoring project for streams.
- Fish and aquatic biologists should conduct water and sediment quality and fish surveys on the Sheboygan River impoundments.
- The Department in cooperation with Trout Unlimited and the River Alliance will complete the Franklin Dam removal and restoration of the Sheboygan River in the former impoundment.
- Water quality and fish biologists should conduct water quality and aquatic life surveys associated with the Franklin Dam Removal project and other dam removals if the opportunity arises.
- Water quality biologist should evaluate the distribution of zebra mussels in the Sheboygan River downstream of Big Elkhart Lake and the impacts to native mussels in the lake and river.
- Department biologists should collect and analyze fish for PCBs, pesticides, and mercury throughout the watershed.
- The water quality biologists should encourage volunteers to start a Self-Help monitoring program on Little Elkhart Lake, Gerber Lakes, Wilke Lake, Shoe Lake, Graf Lake, Praeder Lake, Giltners Lake, Sy Lake, Little Sy Lake, Paulys Lake, and Bullet Lake.
- The water resources engineer should determine the status of the dams in the watershed.
- Water quality biologists should evaluate the need for a point source assessment since Lakeland College now discharges to the Sheboygan River.
- The Department should continue to work with the City of Sheboygan to maintain and enhance fishing opportunities in the Sheboygan Harbor and river front.

Onion River Watershed

The Onion River Watershed covers 98 square miles (Figure 7). The Onion River flows southerly for about half its length before turning northward, entering the Sheboygan River in Rochester Park in the City of Sheboygan Falls. Belgium Creek is the only major tributary to the Onion River. There are two dams on the Onion River, which form the Waldo and Hingham impoundments.

Land use in the watershed is primarily agricultural. The entire Village of Waldo, most of the Village of Belgium, and small portions of the Village of Cedar Grove and the City of Sheboygan Falls comprise the urban areas of the watershed.

Water quality in the Onion River Watershed ranges from excellent to good in the headwater areas to fair to poor in the lower sections. Sources of pollution degrading stream water quality are primarily agricultural with some urban runoff, and point source discharges. Excessive sedimentation and channelization limit stream habitat quality. Heavy metal and polycyclic aromatic hydrocarbon (PAHs) contamination is found in the sediments in the East Branch of Belgium Creek. Impoundment of headwater areas for fish hatcheries negatively impacts water quality, trout and other aquatic life.

The Onion River Watershed was one of the very first watersheds targeted under the Nonpoint Source Water Pollution Abatement (Priority Watershed) Program. A follow up report found that the watershed continues to be affected by nonpoint pollution sources. The upstream reaches (above the Village of Waldo) continue to exhibit excellent to good water quality, while the downstream reaches continue to be heavily affected by agricultural runoff.

The headwaters of the Onion River are a trout stream downstream to the top of the pool formed by the Waldo dam. The headwaters, including Ben Nutt Creek and Mill Creek, have been adversely impacted by private fish ponds on major spring sources. WDNR recently purchased property in the headwaters of Ben Nutt Creek upstream of County Highway ZZ in the Town of Plymouth. This was the site of an old fish farm and the stream had been diverted into a pond and then impounded. This cold water reach is being restored and is expected to provide important spawning and rearing habitat for brook trout.

A summary table with general information about the Onion River Watershed follows. For more detailed information about the watershed, please refer to the supplemental document entitled *The Surface Water Resources of Sheboygan River Basin*.

Figure 7. Onion River Watershed

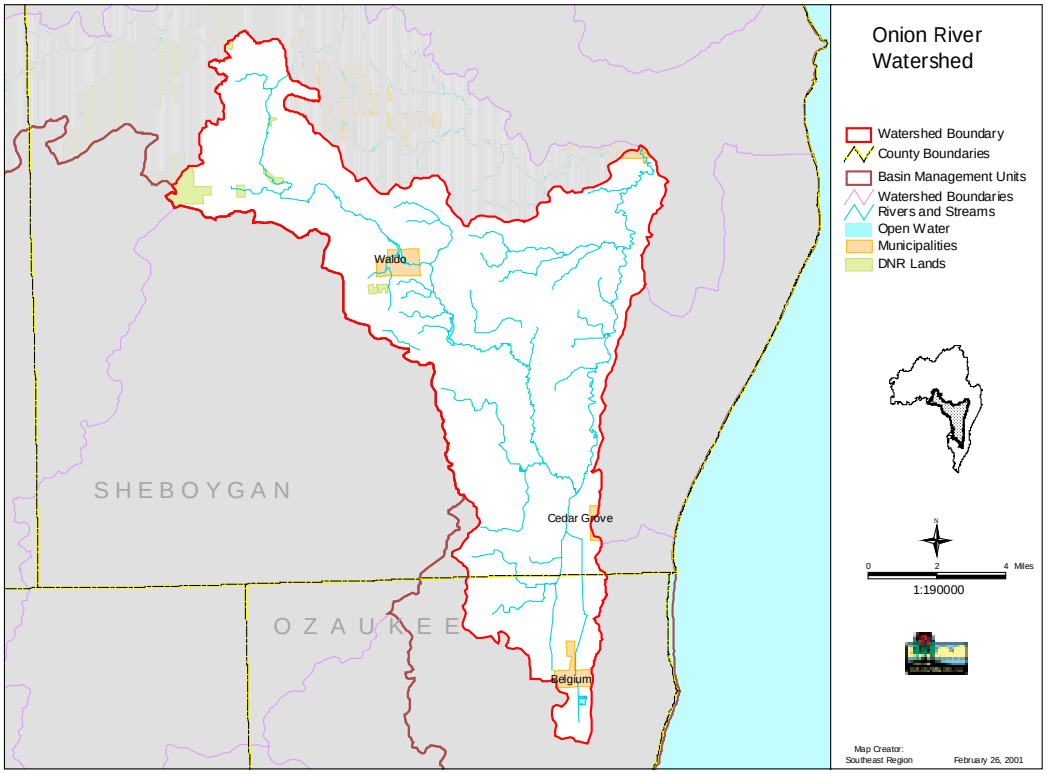

Table 5. Onion River Watershed at a Glance	
Watershed drainage area	98 square miles
Miles of perennial streams	71
Miles of streams listed as outstanding or exceptional resource waters	4.5
Miles of streams on impaired waters list	0
General threats to stream water quality	■ Agricultural and urban runoff ■ Habitat modification ■ Municipal and industrial point sources ■ Contaminated sediment
Number of named lakes	0
Number of dams	2
Number of industrial wastewater treatment facilities	3
Number of municipal wastewater treatment facilities	5

Recommendations for the Onion River Watershed

Completed Actions

Accomplishments in the Onion River Watershed since the 1999 State of the Environment Report

- State acquisition of a property in the headwaters of the Onion River called the Kamrath parcel was finalized. This parcel contains significant springs that contribute flow to the trout stream.
- Cold water stream restoration projects are underway at the Kamrath, Silver Springs, Bohnhoff and Drewry properties. These projects should have a significant beneficial efect to trout waters.
- Approximately two miles of trout stream are being restored as result of the Kamrath Project.
- Fish and habitat surveys were done on four headwater branches of the Onion River.
- A mussel survey was conducted at a fisheries channel restoration project in the headwater area.
- Fish, mussel, macroinvertebrate and habitat surveys were conducted in the lower reaches of the Onion River within the Pinehurst Golf Course area, which is currently under construction.
- Sediment quality was assessed in the Hingham Impoundment.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Onion River Watershed.

- DNR wildlife biologists and U.S. Fish and Wildlife Service personnel should continue the restoration of wetlands along Belgium Creek in conjunction with the Conservation Reserve Program.
- Water Resources biologists should determine the source and extent of contaminated sediment in the East Branch of Belgium Creek and Onion River.
- We should assist the Sheboygan County Land Conservation Department staff in obtaining stream bank buffers along all of the waterways in the county.
- The Department should continue land acquisition within the Onion River Stream Bank Protection Area as part of the Stewardship Program.
- We should encourage all communities in this watershed to adopt construction site erosion and stormwater management ordinances and establish snow disposal policies.
- The water quality and fish biologists should assess the impacts of the fish hatcheries in the headwaters Mill Creek.
- The fisheries biologist will continue to implement stream habitat improvements on the upper reaches of the Onion River as opportunities arise. Much of this work is dependent on the acquisition of additional stream frontage and cooperation with partner groups such as Trout Unlimited and the River Alliance.
- Resource managers will continue fishery and habitat surveys of the upper Onion River during the life of this plan. WDNR will continue to partner with Trout Unlimited, River Alliance and others towards restoration and monitoring improvements in water quality, habitat and aquatic life.
- Surveys of the warmwater reaches of the river will be needed as well to assess the impacts of dams and obtain pre-dam removal data should the opportunity arise.

- Water quality and fish biologists should conduct a water quality and fish survey on Hingham Millpond.
- Water quality biologist should conduct a stream assessment on the Lima Tributary to the Onion River.

Mullet River Watershed

The Mullet River Watershed drains about 98 square miles in Fond du Lac and Sheboygan Counties (Figure 8). The Mullet River originates at the outlet of Mullet Lake in Fond du Lac County and runs generally east before joining the Sheboygan River in the City of Sheboygan Falls. The two named tributaries to the Mullet River are La Budde Creek and Jackson Creek. The watershed contains nearly 2 miles of Class I trout water, 10 miles of Class II trout water and nearly 35 miles of streams supporting a warm water sport fish community.

Land use in the watershed is primarily agricultural. The City of Plymouth is the major urban area in the watershed. About half of the land area of the Village of Glenbeulah rests in the watershed, as well as small portions of the Village of Elkhart Lake and the City of Sheboygan Falls. Water quality ranges from good to fair in the watershed, and is affected by agricultural and urban runoff, point source discharges in the urban areas, stream channelization and dams.

The effects of dams and their associated impacts on stream water quality are well documented, especially in the Mullet River Watershed. A number of these dams are located in the city of Plymouth.

The Wisconsin State Historical Society, in conjunction with the Kohler Foundation has reconstructed the historic Herrling Dam and sawmill in Greenbush at the Wade House Historic Site. Although the project is historically accurate, it was completed in a manner that does not actually impound the Mullet River, because of concerns about the effects on water quality. A pond has been built adjacent to the river from which the mill would be operated. Some flow from the Mullet River is diverted in to the pond that runs the sawmill. Extensive water quality monitoring is being conducted for the evaluation of biological, physical, and chemical conditions in the Mullet River during project construction and after. This includes long-term assessments of the endangered mussel population present in the Mullet River. The project is innovative because it blends historic operation and public interpretation of a 19th century sawmill with 21st century environmental protection. The sawmill is now operating. ***For more information, please see*** www.shsw.wisc.edu/sites/wade/sawmill.htm***.***

A summary table with general information about the watershed follows. For more detailed information about the Mullet River Watershed, please refer to the supplemental document entitled *The Surface Water Resources of Sheboygan River Basin*.

Figure 8. Mullet River Watershed.

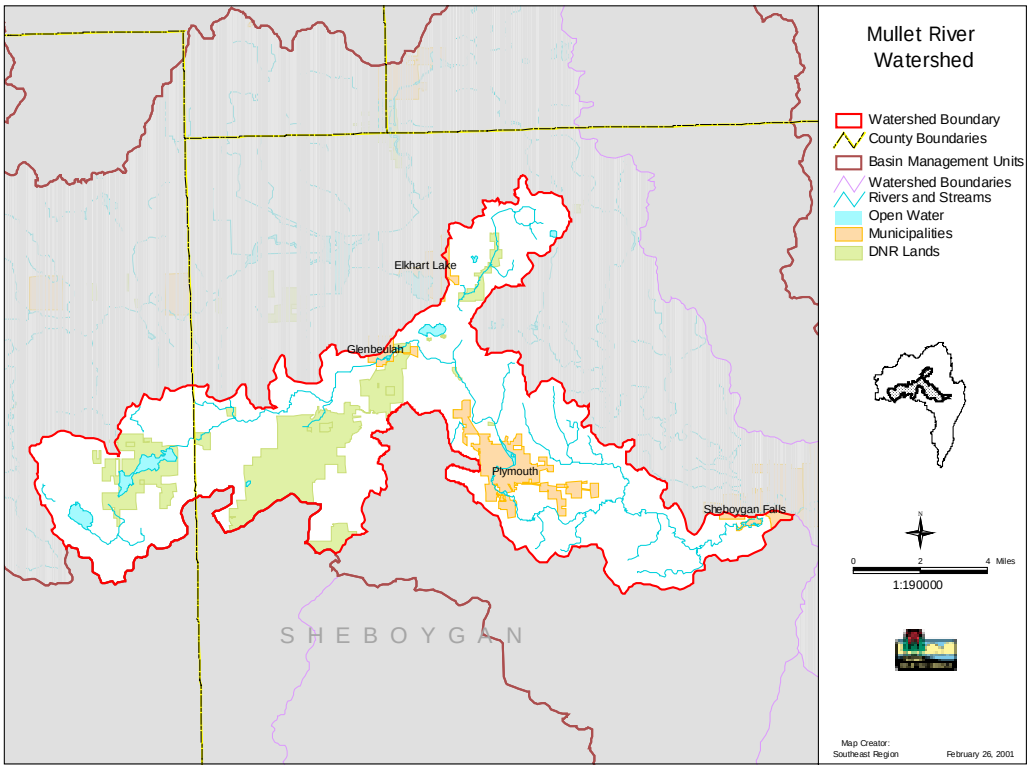

Table 6. The Mullet River Watershed at a Glance	
Watershed drainage area	88 square miles
Miles of perennial streams	63
Miles of streams listed as outstanding or exceptional resource waters	1.8
Miles of streams/# lakes on impaired waters list	0/1 lake
General threats to stream water quality	■ Agricultural and urban runoff ■ Habitat modification ■ Municipal and industrial point sources
Number of named lakes	2
Number of dams	5
Threats to lake water quality	■ Shoreline developmentf ■ Exotic species ■ Winter fish kills
Number of industrial wastewater treatment facilities	5
Number of municipal wastewater treatment facilities	2

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Recommendations for the Mullet River Watershed

Completed Actions

Accomplishments in the Mullet River Watershed since the 1999 State of the Environment Report

- Sediment quality surveys were conducted in the Plymouth Impoundment and Meyer Impoundment.
- A water quality assessment to evaluate the potential impacts to the Mullet River from the groundwater discharge by the Northern Kettle Moraine Utility Commission was completed and found no evidence of impact.
- Fish and habitat assessments were conducted at the Mullet River upstream and downstream of the Camp Evelyn Impoundment upstream of CTH CJ.
- Fish and habitat assessments were conducted on a tributary to the Mullet River upstream of Sumac Road.
- The Department continues to work with the State Historical Society on their project to restore a sawmill on the Mullet River at the Old Wade House State Park. Endangered mussels were relocated from the project area and monitoring of the water quality, fisheries and mussel community continues.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Mullet River Watershed.

- Water quality biologists should conduct a stream assessment on Jackson Creek.
- Water quality biologists should continue to evaluate the monitoring conducted by the State Historical Society for the Old Wade House Project on the Mullet River.
- Endangered Resources, Fish Biologists, and Water Resources Biologists should continue to monitor the water quality and biological communities in the Mullet River for potential impacts associated with the Old Wade House Project.
- Water resources biologists should conduct sediment quality assessments in the New Paris impoundment and Camp Evelyn Impoundment.
- The water quality and fish biologists should conduct a survey of water quality water temperature and aquatic life in the coldwater section of the Mullet River to determine the factors that limit the river from reaching its full potential as a coldwater resource. Based on this information, habitat restoration will be done as needed, and as opportunities arise.
- The Mullet River Watershed continues to be considered a high priority for selection of nonpoint source management projects and funding.
- We should assist the Sheboygan County Land Conservation Department staff in obtaining stream bank buffers along all of the streams in the county.
- The Department should encourage all communities to adopt construction site erosion and stormwater management ordinances and establish snow disposal policies.
- We should encourage removal of dams on the Mullet River and conduct water quality and fisheries monitoring at these sites as dam removal opportunities arise.
- Water resources and fish biologists should assess the fish community of the Meyer Impoundment.
- The Department should continue to work with the City of Plymouth to address safety and water quality issues associated with the Plymouth Millpond and its dam.

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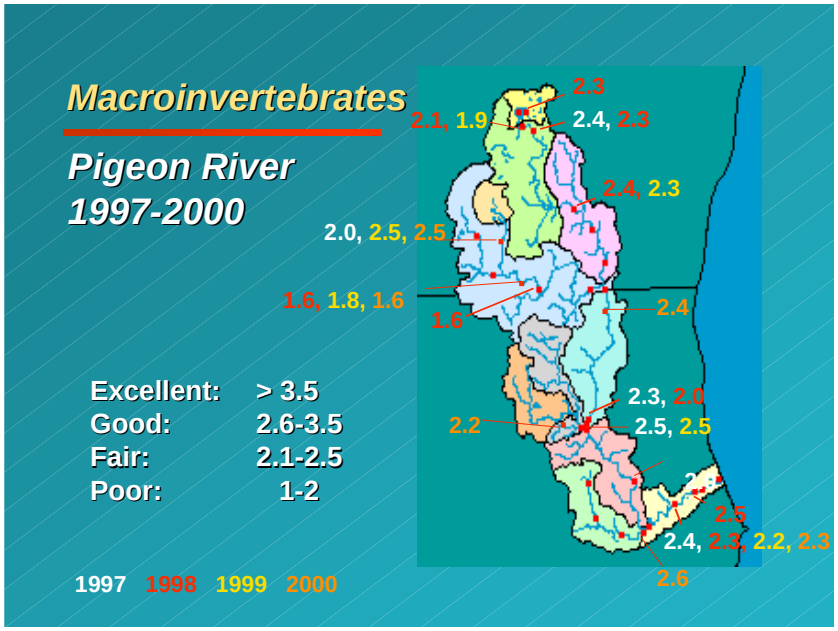
Pigeon River Watershed

The Pigeon River Watershed is the northernmost watershed in the Sheboygan River Basin (Figure 9). Nearly half of the 79 square mile drainage area is located in Manitowoc County, while the other half is located in the northern portions of Sheboygan County. The Pigeon River originates from an outlet of Pigeon Lake in Manitowoc County. Many small tributaries converge on this outlet to form the larger Pigeon River. The river flows generally south and east to its confluence with Lake Michigan in the City of Sheboygan. Tributaries to the Pigeon River include the Meeme River, Fisher Creek, Grandma Creek and nine unnamed tributaries. There are four named lakes in the watershed (Pigeon, Horseshoe, Spring and Jetzers) and many small, unnamed lakes.

Land use in the watershed is primarily agricultural, but urbanization is proceeding. The Village of Howards Grove is completely contained in the watershed. Portions of the Village of Kohler and the City of Sheboygan also fall within the watershed. Water quality in the watershed is considered good in the headwaters area, and fair to poor in the lower reaches. High turbidity, nuisance algae and vegetative growth, low dissolved oxygen, high fecal coliform bacteria counts, and sedimentation all contribute to the poor water quality conditions in the watershed. Factors causing these effects include agricultural and urban runoff, construction site erosion, stream channelization and point source discharges.

Figure 9. Macroinvertebrate Rating Scores on Pigeon River Watershed Streams. *Data Collected by Volunteers*.



Volunteer monitoring in the watershed is flourishing, and sets the Pigeon River watershed apart from the other Sheboygan Basin watersheds. Area students are participating in the Testing the Waters Program, and young and old alike make up a team of water quality monitors as part of the Water Action Volunteers (WAV) program. Volunteers have monitored streams throughout the watershed since 1997. The macroinvertebrate rating scores recorded by WAV volunteers from 1997 through 2000 are shown at left (Figure 8). These data benefit the WDNR by enabling more extensive and ongoing coverage of the waters in this watershed than what could otherwise be accomplished. If you would like to become a volunteer monitor, or are just interested in more information about the Water Action Volunteers Program, please visit http://clean-water.uwex.edu/wav/, or call (608) 264-8948.

A summary table with general information about the watershed follows. For more detailed information about the Pigeon River Watershed, please refer to page ? of the supplemental document entitled *The Surface Water Resources of Sheboygan River Basin*.

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Figure 10. Pigeon River Watershed.

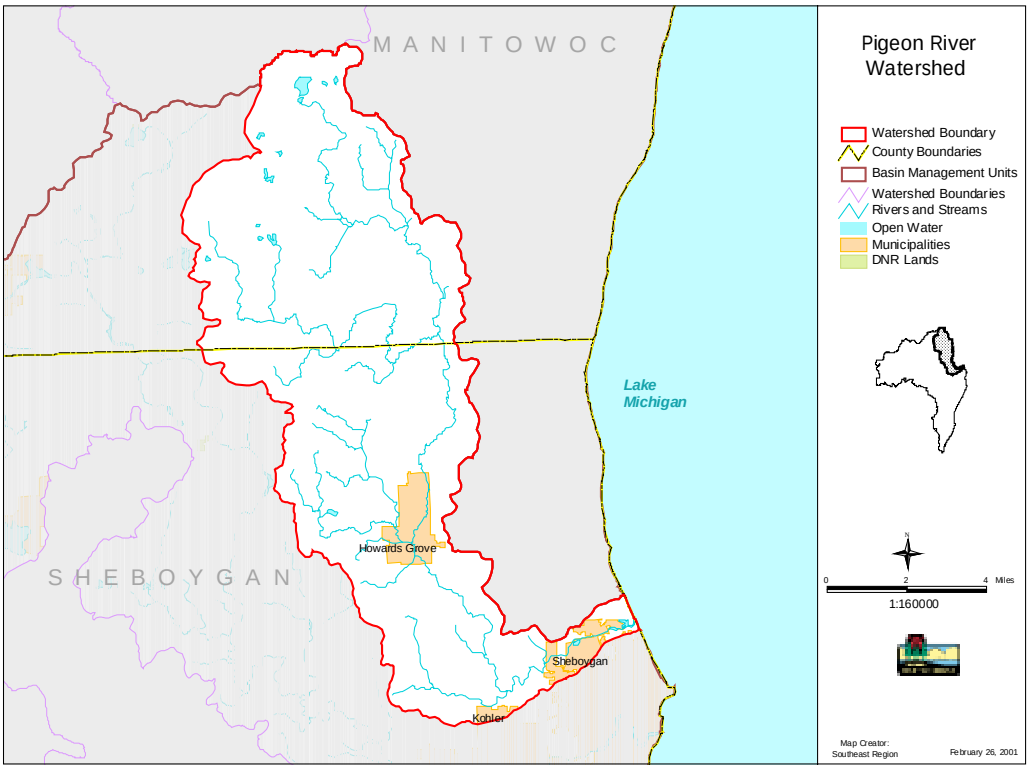

Table 7. Pigeon River Watershed At A Glance	
Watershed drainage area	79 square miles
Miles of perennial streams	76
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams/# lake on impaired waters list	0 streams, 1 lake
General threats to stream water quality	▪ Agricultural and urban runoff ▪ Habitat modification ▪ Construction site erosion ▪ Municipal point sources
Number of named lakes	6
Number of dams	1
Threats to lake water quality	▪ Agricultural runoff ▪ Shoreline development
Number of industrial wastewater treatment facilities	
Number of municipal wastewater treatment facilities	3

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Pigeon River Watershed Recommendations

Completed Actions

Recommendations accomplished since the 1999 State of the Environment Report are listed below.

- Water quality biologists conducted an Alum treatment in June 2000, on Jetzers Lake to isolate nutrients from the water column and bottom sediment.
- WDNR biologists completed stream bank stabilization measures for the Pigeon River in Howards Grove.
- Water quality biologists collected biological and habitat data from the Pigeon River at the stream bank stabilization project site in Howards Grove and at the Maywood Nature Center in 2000 as part of the Baseline Monitoring project for wadable streams.
- The Pigeon River Water Action Volunteers have been monitoring water temperature, turbidity, and macroinvertebrates at over a dozen sites since 1997.
- Wildlife biologists restored 6 acres of wetlands in the Pigeon River Watershed in 1999.

Objectives for the Future

Following is a list of actions recommended by WDNR staff for monitoring and management in the Pigeon River Watershed.

- Water quality biologists should continue to work with the Pigeon River Water Action Volunteers in conducting water quality monitoring throughout the Pigeon River Watershed.
- The Department should continue to assist in the implementation of the Pigeon River Nonpoint Source Control Plan.
- We should assist the Sheboygan and Manitowoc Counties Land Conservation Departments staff in obtaining stream bank buffers along all of the streams in the counties.
- The Department should encourage all communities to adopt construction site erosion and stormwater management ordinances including snow disposal policies.
- Water quality biologists should conduct Signs Of Success monitoring when best management practices get implemented as part of the Priority Watershed project.
- WDNR should conduct a stream assessment of the unnamed tributary to Fisher Creek now that the Lakeland College no longer discharges to the stream.
- WDNR biologist should conduct a follow-up survey to evaluate the effectiveness of the alum treatment on Jetzers Lake.

SHEBOYGAN RIVER BASIN FISHERIES RESOURCES

The fisheries resources of the Sheboygan Basin are as varied in quality as the lakes and streams in which they reside. The streams and lakes with the poorest habitat also have corresponding poor fisheries, while the higher quality waters contain healthier and more diverse fisheries resources.

While some streams have the ability to sustain some trout populations, very few of the cold water stream miles are able to support trout at the highest, self-sustaining level (Class I). The class I streams in the Sheboygan Basin include reaches of Dotyville Creek, LaBudde Creek and Schuett Creek. Other cold water streams without trout populations have been identified by fisheries staff as capable of supporting cold water sport fish species. Stocking occurs in some of these Class II and Class III streams including Ben Nutt, Jackson, LaBudde and Melius Creeks, Glenbeulah Springs, and the Mullet and Onion Rivers.

Table 8. Classification of Trout Streams in the Sheboygan River Basin.

Trout Stream Classification	I	II	III
Ben Nutt Creek		X	
Dotyville Creek	X		
Feldners Creek		X	
Glenbeulah Springs		X	
Jackson Creek		X	
LaBudde Creek	X	X	
Melius Creek		X	
Mill Creek		X	
Mullet River		X	
Onion River		X	
Schuett Creek	X		

Table 9. Coldwater Species Stocked in the Sheboygan River Basin in Recent Years.

Species	Brook	Brown	Rainbow
Ben Nutt Creek			X
Glenbeulah Springs	X		
Jackson Creek	X		
LaBudde Creek	X		
Melius Creek		X	
Mullet River	X	X	X
Onion River			X
Harrington Beach Quarry			X
Sheboygan Quarry			X

Some of the tributary streams to Lake Michigan (Sauk Creek, Sheboygan River, Pigeon River) have spring and fall runs of stocked steelhead and salmon. It is not uncommon to see heavy fishing pressure during fall and spring along these tributary streams for coho and chinook

salmon, brown trout and steelhead. Fishing opportunities also exist in the rivers and harbors for northern pike, smallmouth bass and yellow perch. During 2000, the DNR creel survey estimated that 26,192 angler hours were spent fishing from Sheboygan and Ozaukee County piers for a harvest of 1,547 trout and salmon. From the shoreline, anglers spent 33,258 hours to harvest 4,968 trout and salmon. The lower reaches of the streams supported another 11,887 angler hours for a harvest of 801 trout and salmon. In addition, Port Washington and Sheboygan harbors support a strong boat fishery for trout and salmon, including 47 licensed charter captains and many private vessels. Commercial fishers base out of the two ports, targeting chubs and whitefish.

Table 10. Lake Michigan Trout and Salmon Stocking Quotas for the Sheboygan River Basin.

Species	Brook	Brown	Chinook	Coho	Rainbow
Pigeon River	8,100	19,360			6,500
Sauk Creek	8,100		61,200	20,000	6,500
Sheboygan River			122,400	68,540	25,200
Port Washington Harbor	8,200	87,500	61,200	48,540	
Sheboygan Harbor	8,210	68,140			20,000

Sucker and smelt dip-netting has diminished over recent years. Lower harvests of smelt and cultural changes may have fostered the current decline.

Warmwater streams throughout the basin have the potential for supporting warmwater sport fisheries like smallmouth bass, with the low-flow reaches functioning as rearing habitat for sport fish and forage production.

The lakes in the Sheboygan Basin have good quality sport fisheries. Largemouth and smallmouth bass, walleye, northern pike, muskellunge and panfish populations are present in many lakes with good to excellent quality and quantity. Several lakes must rely on stocking of at least one species to maintain a viable sport fishery. Big Elkhart, Crystal, and Wolf Lakes have each been stocked with walleye fingerlings in recent years.

An extensive list of the fisheries resources for the Sheboygan Basin can be found in the supplemental technical report entitled *Water Resources of the Sheboygan Basin.*

Challenges to Fisheries Quality

Degraded habitat and surface water quality are the primary factors keeping the streams and lakes in the Sheboygan Basin from meeting their full fisheries potential. Lakes in the basin are nearly fully developed with year-round homes and businesses. With extensive development along lakes and streams comes habitat degradation. Natural shorelines are necessary for maintaining healthy fish populations. However, maintaining natural shorelines is often at odds with the wants of landowners. Landowners often require piers and boat docks, swimming areas, lawns and patios. Trees and brush are cut for viewing and to reduce mosquitoes. Natural shorelines are replaced by boulder riprap and seawalls, which eliminate the gradual transition zone in the interface between land and water. Sand or pea gravel blankets replace the cobble, muck and aquatic plants needed for fish spawning and maintaining food chain integrity. Removing all submerged and emergent woody debris and

aquatic plants from the near shore areas allows wave action to further erode the shoreline, creating a need for engineered shoreline "protection". Nearshore boat traffic causes destruction of emergent and submerged plants and disrupts fish spawning, especially bass and sunfish species

Streamside development often removes shoreline trees; shrubs and long grasses needed to keep streams cool. Streams were historically, and in some cases still are, ditched, straightened or relocated to accommodate agriculture or development. Parts of streams are enclosed in culverts and used as drainage ditches for stormwater that can no longer infiltrate due to increases in impermeable surfaces. Loss of the buffering capability of healthy shoreline vegetation leads to erosion of the streambanks which, along with construction site erosion, leads to excessive stream siltation. All of these events work together to limit the capacity of streams to support diverse fisheries populations.

FISHERIES OBJECTIVES FOR THE SHEBOYGAN BASIN

Cold Water Habitat

- Continue to implement stream habitat improvements on the upper reaches of the Onion and Mullet Rivers to increase natural reproduction of trout. Much of this work is dependent on the acquisition of additional stream frontage and cooperation with partner groups such as Trout Unlimited and the River Alliance.
- Continue fishery and habitat surveys of the upper Onion River during the life of this plan. WDNR will continue to partner with Trout Unlimited, River Alliance and others towards restoration and monitoring improvements in water quality, habitat and aquatic life.
- Continue land acquisition within the Onion River Stream Bank Protection Area as part of the Stewardship Program.
- Survey water temperature and aquatic life in the coldwater section of the Mullet River to determine the factors that limit the river from reaching its full potential as a coldwater resource. Based on this information, habitat restoration will be proposed as needed, and as opportunities arise.
- Assess the impacts of the fish hatcheries in the headwaters Mill Creek.

Lake Michigan Habitat

- Conduct sturgeon assessment in the Sheboygan River to identify remnant populations and available habitat
- Continue research and management to reverse decline in yellow perch population, including on-going fish assessments by the Lake Michigan Fisheries Unit for yellow perch young-of-the-year.
- Conduct acoustical forage assessment off the Sheboygan Shore to assess the available forage in Lake Michigan in cooperation with USGS.
- Conduct lake trout and lake wide fish assessment at the midlake refuge to assess the lake trout population.
- Continue research to enhance near-shore fishery, including on-going year study of new strains of rainbow trout by the Lake Michigan Fisheries Unit.
- Evaluate environmental impacts associated with solid piers and rock groin structures in Lake Michigan.

Warm Water Habitat

- Maintain warmwater fisheries in area lakes. Conduct water quality and comprehensive fish surveys on:
  - Little Elkhart Lake
  - Gerbers Lake
  - Hingham Millpond
- Continue to conduct water quality and fisheries assessments on Crystal Lake as part of the Trend Monitoring project.
- Increase the smallmouth bass population in the Sheboygan River, particularly above Johnsonville; pursue habitat improvement projects, where feasible.
- Assess the fisheries resources in the former Franklin Dam Impoundment and pursue habitat improvement for smallmouth bass and other species.
- Decrease carp populations in the Mullet River.
- Identify the presence of exotic species on land and in water, limit their spread and work towards eradicating them.

Resource Integration

Fish managers work with a broad range of public and private individuals and programs to provide habitat creation and restoration, population and harvest estimates, and stocking programs. Although traditional fish management is very important for basin fisheries, good water quality and habitat conditions are critical factors for a quality fishery. The Department of Natural Resources manages fishery resources from an integrated ecosystem approach. Our wastewater engineers monitor discharges from point sources with fisheries in mind. The regional sludge specialist insures that buffers are in place between streams and spreading sites. Our water regulation staff guide development proposals on our waterways through statutory protections and assist the counties and municipalities with shoreland standards that protect lakes and streams. Water quality biologists evaluate physical and chemical trends in streams and rivers, work to eliminate sources of poor water quality, evaluate contamination issues, and work with fish managers and our partners towards improvements in water quality and habitat. Working together, sharing information, pooling resources, and enlisting broad support from a range of customers are all important reasons why an integrated approach works for fisheries management.

CHALLENGES TO SURFACE WATER QUALITY

Surface and groundwater resource quality in the Sheboygan River Basin is mostly affected by the way we use the land. As population increases and rural lands are converted for homes and business, pollution sources to surface and groundwater increase while habitat and water quality degrades. Streams and lakes with degraded water quality tend to have high populations of a few tolerant species like common carp that are capable of adapting to extremes. In contrast, stable systems generally have a higher diversity of species of all tolerance levels. Exceptions to this include cold water streams and some lakes which, if unaffected by pollution and habitat destruction, have a low diversity of intolerant species.

Pollutants to surface waters come from a single point of origin (point sources), or through many different, or diffuse areas (nonpoint sources). Point sources of pollution are usually associated with industrial discharges or municipal wastewater treatment plants, while nonpoint sources of pollution are associated with materials running off the land and into surface waters. Stormwater is considered both a point and nonpoint source of pollution. Areas with curbs and gutters generally have storm sewer systems that keep the water from pooling on streets, parking lots, rooftops and other areas. Rainfall that runs off of many different areas is often collected in a storm sewer system and ultimately discharged at a single point to a stream or lake. In many areas buildings, parking lots, farm fields and pastures come very close to the waters edge which can negatively affect water quality and habitat for wildlife.

One pollutant that is common in both point and nonpoint sources is phosphorus. Excess phosphorus in freshwater systems causes a chain reaction of events that stresses the whole ecosystem. The nutrient causes plants and algae to multiply. In some areas where shading is limited, these plants can multiply to levels which cause extreme shifts in dissolved oxygen content in the water column. During the day the plants, without shade, multiply and produce oxygen which can supersaturate the water column. In the evening these same plants respire and use the oxygen, along with the other living organisms. Because of their sheer biomass, the plants use a lot of oxygen at night, and cause the concentration in the water to drop to very low levels. The large changes in dissolved oxygen concentrations are detrimental to fish and other species that require a more stable oxygen supply.

The following sections will describe the major sources of pollutants to surface water quality in the basin, followed by actions that should be taken to eliminate or minimize the effects.

Industrial and Municipal Point Sources of Pollution

Within the Sheboygan River Basin there are 252 industrial point sources, and 15 municipal point sources of pollutants to surface and groundwater resources. Industrial point sources are designated as either specific or general. Specific permits are issued to industries that have discharge requirements unique to their site. Of the total number of industrial dischargers, those with specific permits account for less than five percent. Over 60 percent of the industrial point sources are from industrial stormwater sites and construction sites which are discussed in the stormwater section (beginning on page 35).

General permits are given to industries for discharges that can be broadly categorized and regulated with standard conditions such as non-contact cooling water. This is not water

mixed into materials to process a particular product, but rather water that is used to cool machinery. Non-contact cooling water accounts for 15 percent of the discharge permits in the basin. Wastewater discharged under these general permits has characteristics of the municipal water supplies, which often contains phosphorus (orthophosphate or polyphosphate) added by the water utility which prevents lead and copper from leaching into drinking water supplies. Phosphorus is also used to keep iron in solution so it does not deposit on plumbing fixtures. As a result, many single pass cooling water discharges have become new sources of phosphorus to surface waters. The total amount of phosphorus entering streams from non-contact cooling water discharges has not been calculated for rivers in the basin, so the extent of these inputs compared to nonpoint sources of phosphorus is not known.

Nonpoint Sources of Pollution

Most nonpoint sources of pollution to surface waters can be designated as either rural or urban in origin. Some sources, such as eroding streambanks and construction site erosion are found in both urban and rural areas. In rural areas nitrogen, phosphorus, bacteria and soil are the major nonpoint pollutants. These pollutants as well as metals and other man-made compounds, are found in urban runoff. Three of the six watersheds forming the Sheboygan River Basin have participated in the Priority Watersheds Program. Specific information about rural and urban nonpoint pollution sources in each of the watersheds can be found in the Priority Watershed Plans (WDNR, 19??, ??need citations for these plans.). The other three watersheds are ranked high for nonpoint source impacts to surface waters. The following sections will highlight the major sources of runoff pollution and the environmental consequences of these pollutants in rural and urban areas.

Rural

Rural nonpoint sources are often, but not always associated with agricultural operations. Barnyards, feedlots, farm fields and direct livestock access to surface waters are the major agricultural sources of runoff to basin surface and groundwater resources and wetlands. Eroding farm fields, streambanks and construction sites also contribute soil and associated pollutants to surface waters and wetlands.

Barnyards and livestock feeding and pasture areas carry significant amounts of nutrients, solids and bacteria to surface waters. Excess nutrients, like phosphorus and nitrogen in surface waters, can lead to excessive plant growth which in turn leads to extreme fluctuations in dissolved oxygen concentrations. Widely fluctuating dissolved oxygen concentrations are detrimental to sensitive fish and other aquatic species that depend on a consistent level of water quality. Streams exhibiting these fluctuations support tolerant fish species such as common carp, yellow bullhead and fathead minnows which are less sensitive to extremes in oxygen concentrations.

Soil erosion from adjacent farm fields, streambanks and construction sites add to the sediment load in streams. This soil settles to the bottom of streams and often covers the rocky and gravely areas needed for many invertebrate and fish species to survive. Only the hardiest species are able to thrive in streams with sediment covering the bottom.

Livestock manure is a cause of high bacteria, nutrient and solids concentrations in water bodies adjacent to agricultural lands. Manure is delivered to streams by direct access of livestock to streams, feedlot runoff, and inadequate manure management. Failing septic

systems can also increase bacteria concentrations in streams. Most small farms have enough land on which to properly spread manure. For those that do not, manure storage is an option that landowners can exercise. Farms containing at least 1000 animal units (one animal unit equals a 1000 pound steer) are considered concentrated animal feeding operations (CAFOs) and must receive a permit from the WDNR for meeting specific manure management standards. ***For more information on manure management and WDNR regulations, please contact the Southeast Region Animal Waste Specialist at (414) 263-8625.***

There are approximately 300 sites with over 4500 acres of agricultural land approved for the spreading of municipal biosolids and industrial waste within the Sheboygan River Watershed. All land application is strictly regulated under Federal (USEPA Chapter 40, Part 503 Code of Federal Regulations) and State (Wisconsin Administrative Code, Chapter 110, 204, 214 and 113) regulations. The management practice requirements in these codes establish site restrictions and limit application rates on approved agricultural land in the basin. We will continue to use these requirements to establish strict discharge limitations, monitoring requirements and operating standards for all land treatment systems to protect public safety and maintain the physical, chemical and biological integrity of the soil, air, surface water and ground water of the Sheboygan River Basin.

The WDNR Regional Sludge Coordinator will continue to work closely with Federal, State, Town and County officials, landowners, County land Conservation Staff, and other partners to provide information and address safety and water quality issues that may arise from the landspreading of biosolids. We will work closely with land owners and the Sheboygan County Land Conservation Department to insure critical buffers are established between wells, streams, lakes, ponds, wetlands or channelized waterways. We will continue to conduct onsite assessments of all land treatment systems to determine and evaluate their effect on environmental systems.

We are in the process of developing a full feature geographic information system to analyze land application relationships to basin water quality. We will be able to perform environmental evaluations and identify critical areas where land treatment systems may or may not be beneficial to the basin. The system will allow us to share this information with out customers and partners in a graphic format that is useful and easy to understand. ***For more information on land application of biosolids, please contact the Southeast Region Sludge Coordinator at (414) 229-0860.***

Urban

The Sheboygan River Basin is urbanizing quickly in some areas and, therefore, is affected greatly by urban runoff. Unlike rural areas where much of the land allows some rainwater to seep into the ground, urban areas have a higher percentage of hard surfaces impermeable to water. So, when rain falls or snows melt, the water washes pollutants off parking lots, streets, construction sites, storage yards, lawns and golf courses. In order to keep this runoff from flooding streets and yards, storm sewers and roadside ditches carry these untreated pollutants through storm sewers directly to rivers and lakes.

The pollutants found in urban stormwater are different than in rural runoff. Sediment runoff is a major concern in urban areas, but the particles making up sediment contain more than soil and nutrients. Although soil is the largest component of urban sediment, it also contains metal from cars, trucks and rooftops, particles from vehicle exhaust, pieces of pavement, and fallout from chimneys and industrial smokestacks, which make it more toxic.

Construction Sites. Most of the sediment load to streams in urban areas comes from active construction sites (USGS, 2000; UWEX, 1997). Based on research in Dane County, Wisconsin, the sediment yield from construction sites with no erosion controls in place is about 15 tons per acre per year (Roa, 2000). The WDNR has the authority to oversee construction activity on sites greater than five acres in size, while the Wisconsin Department of Commerce regulates construction activities on smaller lots. As of July 1, 2000, there were 34 active WDNR permitted construction sites in the Sheboygan River Basin. The total land disturbance permitted was 1,083 acres with an average land disturbance of 32 acres per construction site (range of five to 250 acres). Residential construction accounted for 41 percent of the active WDNR permits, with commercial (12%), other (recreational, institutional, governmental-23%), industrial (6%), and utility (18%) rounding out the list. If permit requirements are followed at these construction sites, the sediment yield can be reduced by 80 percent (Wood, 2000).

Based on inspection of permitted construction sites by WDNR staff, it is unlikely that the permitted construction sites in the Sheboygan River Basin are achieving a sediment yield reduction of 80 percent. Similar to experiences reported by other states (Brown and Caraco, 2000), WDNR staff find erosion control problems at most construction sites. Typical problems include failure to develop appropriate plans, failure to implement plans, and failure to maintain erosion controls. A particular problem is the common practice of stripping topsoil from the entire construction site which leaves large areas of exposed subsoil susceptible to erosion. Better timing of construction activities throughout a site will reduce the potential for erosion. ***For more information on stormwater and construction site programs in the Sheboygan Basin, please contact the Municipal Stormwater Management Coordinator at (414) 263-8586. See the U.S. EPA web site (www.epa.gov/ost/stormwater) for stormwater management practices and their effectiveness in removing pollutants.***

Industrial Stormwater Permitting. Some industries are required to comply with stormwater permit rules. The types of industries required to receive industrial stormwater permits include many heavy manufacturers, light manufacturers, transportation facilities and mining, oil and gas operations. In the Sheboygan River Basin over 100 facilities are permitted under the industrial stormwater permitting program. Facilities receiving permits are required to identify best management practices for their facility to prevent contamination of stormwater. The facilities are also required to maintain records of inspections to verify these practices are in place and working. ***For more information on industrial stormwater permits in the Sheboygan River Basin, please contact the Wastewater Management Specialist at (414) 229-0836.***

Contaminated Sediments

Contaminated sediments are a concern in urban and industrial areas of the Sheboygan River Basin. Many pollutants cling to sediment particles and eventually settle on river and lake bottoms, forming sediment deposits. These deposits serve as a sink for a variety of pollutants, allowing them to collect at elevated levels. When sediment is disturbed through biological, hydrological or human activity, these toxicants can return to the water column and be taken up by fish and other organisms. Some pollutants no longer in use, such as polychlorinated biphenyls (PCBs), can remain in sediments for long periods of time. Over time, fish and other organisms exposed to PCBs accumulate these substances in their bodies, often at extremely elevated levels. ***For information about fish consumption advisories, please see the publication, Important Health Information For People Eating Fish From***

Wisconsin Waters, which is published annually by the Wisconsin Division of Health and the WDNR, or visit the WNDR Fish Consumption Web site at www.dnr.state.wi.us/org/water/fhp/fish/advisories.

Stream and Shoreline Modification

Stream and shoreline modifications are common occurrences throughout the Sheboygan River Basin. Small headwaters streams were ditched to facilitate drainage for agriculture or to supply water for irrigation. Land was often cleared right up to the streambanks to obtain forest products and to maximize the amount of land in agricultural production. Floodplain development and increases in impervious surfaces in urban areas have led to stream channel deepening, straightening and concrete lining to move stormwater off the land and downstream more swiftly. Dams built to perform specific purposes also have noticeable effects of stream ecosystems. This section will briefly touch on the loss of stream corridor habitat, channel modifications and their effects.

Floodplain Development

Flooding is a natural occurrence in all stream and river ecosystems. The once common practice of floodplain development and resultant loss of wetlands and flood fringe areas decreases the natural function of the floodplain to store floodwaters. It also puts property and lives in danger. The floods of 1997 & 1998 in Southern Wisconsin have increased attention for finding solutions to the problems associated with flooding.

In some cases, small watersheds can be rapidly developed and resultant changes to the floodplain do not come to light until flooding occurs. This was the case with a neighborhood in Sheboygan along Fisherman's Creek. Homes were built along Camelot Boulevard prior to the existence of a good floodplain study that mapped the exact location of the regulatory floodplain. Rapid development in the headwaters of this creek also increased floodplain elevations downstream. As a result of flooding incidents, the City of Sheboygan with the assistance of DNR staff mapped the floodplain. The new study showed that a number of these previously constructed homes were located within the regulatory floodplain of Fisherman's Creek. In the mid-1980's, the City of Sheboygan constructed a levee and relocated a stretch of Fisherman's Creek to prevent further inundation of these homes. In addition, the City insured that stormwater detention ponds were constructed for any new development in the headwaters of this creek. Although the levee was designed to withstand the 100 year flood event with some freeboard, the magnitude of the flooding in August, 1998 far exceeded the capacity of the levee to protect these homes. As a result of these floods and severe property damage, the City of Sheboygan received grants to purchase flood prone homes along Camelot Boulevard near Fisherman's Creek and restore the floodplain. This procedure removes regularly flood-damaged properties from the floodplain reducing both risks to human life and potential for future economic burden.

Floodplain mapping is continuously changing. As new survey data is collected and new models are performed, floodplain mapping will improve throughout the basin. By working in partnership with the County and Local Community Zoning Staff, we will be able to identify areas where inaccurate or in adequate mapping exists and strive to have the best possible floodplain information available.

Dams

The rivers, ponds and some wetlands in the Sheboygan River Basin contain about 48 dams of varying size and function (see Appendix ?). Some of these dams are small, privately owned structures. Others are old milldams that no longer operate water-powered machinery as they once did in our past history.

The Department has a safety program established to inspect large dams. Over the next 5-6 years, we anticipate that about 10 –12 of these large dams in the basin will be inspected to insure they are safe and can reasonably withstand the impacts of flooding.

Regardless of size, dams can have profound effects on stream ecosystems. Dams can change free flowing streams into bodies of water more resembling ponds or lakes (called impoundments). Because streams and rivers carry sediment and nutrients from runoff and natural processes, these impoundments tend to act as sinks that slowly fill in with sediment and become shallow. The water in these shallow ponds increase water temperature, and place demands upon the dissolved oxygen available in the water for fish and other aquatic life. Dams and their impoundments displace many of the native species that thrive in a flowing environment. Dam structures prevent or slow migration of fish and other aquatic life within the stream ecosystem thereby having effects throughout the food chains of stream or rivers.

Streams rely on periodic high flows to move sediment. Dams can dampen that effect. Instead of being suspended in the water column and depositing at river bends, sediments get backed up behind dams and cover the gravel areas many species rely on for reproduction and habitat. A dam on a cold water stream can allow for the water upstream on the dam to warm, which can have a negative effect on species sensitive to temperature fluctuations.

The WDNR does not normally pursue removal of dams if it is maintained in good condition. However, it is our experience that removal of dams can often have a beneficial impact on rivers and streams. Our agency recognizes that many dams continue to provide cultural, economic, historical and recreational values to landowners and some members of the public. The Department will continue to address abandoned or unsafe dams in order to ensure preservation of life, health and property. Where possible, DNR and partners will continue to look for opportunities to remove dams that no longer serve a purpose or are unsafe or abandoned.

Stream Corridor Modification

The corridor area adjacent to a stream is a very important part of the stream ecosystem that benefit water quality and wildlife. Prior to intensive development, most of the streams in the Sheboygan River Basin were lined with trees such as ash, willow, river birch and black walnut. As forests were cleared, agriculture and urban development along rivers soon took the place of the natural wildlife corridors adjacent to the rivers. Water quality also declined as the streams lost the benefit of shading and soil retention that the vegetation along streams provided.

Trees, shrubs and grasses provide shade to keep the water cool, stabilize streambanks, filter runoff, and attract insects that wildlife feed on and create resting and nesting areas. Trees that fall into the water provide cover for fish and basking areas for snakes and turtles.

The corridor adjacent to streams also provides important travel routes for many wildlife species. Without these continuous wildlife "highways" habitat becomes fragmented and wildlife populations often decline.

The Natural Resources Conservation Service (NRCS), the WDNR, the US Fish and Wildlife Service and many others have recognized the importance of restoring stream corridors to benefit aquatic and terrestrial life and water quality. These agencies have programs to assist landowners willing to protect and restore stream corridors. ***For more information please see*** www.nrcs.usda.gov/ ***or call your local WDNR office.***

General Surface Water Recommendations

Following is a list of actions recommended by WDNR staff for monitoring and management throughout the Sheboygan River Basin.

- Support county Land Conservation Departments and work with riparian owners to establish buffers along all waterways to reduce nutrient and sediment loadings.
- Work with communities in establishing construction site erosion and stormwater runoff management ordinances and snow disposal policies.
- Protect and restore wetlands throughout the Sheboygan River Basin.
- Improve angling, hunting, and nature enthusiast opportunities in the Sheboygan River Basin.
- Improve canoe access along our rivers.
- Assist the counties in identifying drain tile connections from septic systems and milk-house wastes to surface waters and facilitate the corrections needed to improve water quality.
- Identify the presence of exotic species on land and in water, limit their spread and work towards eradicating them.
- Encourage and support lake and river volunteer monitoring groups in the Sheboygan River Basin.
- Establish reference sites for water quality and sediment quality in the basin.
- The Sheboygan River Basin resource managers (e.g. Fisheries, Wildlife, Water Resources, Water Management Specialists, Groundwater, Remediation and Restoration) will continue to work with their colleagues in adjoining counties and Regions for our shared resources.
- The water quality biologists should conduct mussel surveys throughout the river basin.
- The water quality biologists should conduct periodic reviews on all streams in the Sheboygan River Basin listed in NR 104.
- Support and encourage enrollment by private landowners in the federal farm programs, especially the Conservation Reserve Program and Wetland Reserve Program.
- Improve public access for nature recreation along Lake Michigan in the Sheboygan River Basin.
- Continue to work with local communities to plan development projects that are environmentally friendly.
- Evaluate environmental impacts associated with solid piers and rock groin structures in Lake Michigan.
- Reduce inputs of persistent toxic substances to Lake Michigan from the Sheboygan River.
- Improve sediment quality so that, if dredging is necessary, disposal is not restricted because of contaminants.
- Reduce inputs of nutrients suspended solids (i.e. soil) from tributaries to Lake Michigan.

- Limit the spread of zebra mussels and other exotic species present in Lake Michigan from spreading to inland waters.
- Creel surveys in Sheboygan County to assess the salmon and trout populations in Lake Michigan and the Sheboygan River.
- Sturgeon assessment in the Sheboygan River to identify remnant populations and available habitat
- Fish assessments by the Lake Michigan Fisheries Unit for yellow perch young-of-the-year.
- Acoustical forage assessment off the Sheboygan Shore to assess the available forage in Lake Michigan. This is a cooperative effort with USGS.
- Lake trout and lake wide fish assessment at the midlake refuge to assess the lake trout population.

GROUNDWATER RESOURCES

Thirty-six miles of Lake Michigan coastline form the Eastern Shore of the Sheboygan River Basin, with more than 122,530 residents of cities along this coastline relying upon water drawn from Lake Michigan to supply their drinking water. More than 63,000 residents across the basin obtain their drinking water from groundwater wells.

The City of Sheboygan has drawn drinking water from Lake Michigan for residents since 1887; the City of Port Washington began providing lake water to residents in 1948. Each City treats the water before distribution and employs trained operators to monitor the process and respond to changes inherent to the lake source. The treated water is routinely monitored and consistently meets federal and state drinking water requirements. The Villages of Sheboygan Falls and Kohler also provide treated lake water to many of their residents through the Sheboygan municipal system.

Groundwater is in widespread use throughout the Sheboygan River Basin. Eleven municipalities and thousands of rural residents, businesses and industries within the Basin rely upon groundwater as their primary water source of potable water. ?? public groundwater supply systems are maintained in the Basin. Municipally owned systems employ trained operators who monitor and maintain the systems; all community systems within the State will use trained operators by 2002.

Both surface and groundwater public water supply systems sample their water in compliance with state and federal Safe Drinking Water Act laws. WDNR Drinking and Groundwater staff in the Basin inspect public drinking water systems on a routine cycle and guide the response to system monitoring results. Staff also provide guidance and training to well drillers and pump installers to ensure that all drinking water wells meet required construction standards; these codes are designed to protect the health of those who use the well; to protect the groundwater; and to protect those who use water from connected aquifers.

Wisconsin residents recognized the importance of protecting groundwater early on. In 1936, the state legislature passed the first well construction code in the nation. Today, the resource is protected through:

- updated construction codes
- well drillers and pump installers licensing & annual continuing education
- vulnerability assessments underway for all public systems
- monitoring requirements for all systems that serve > 25 people per day

In combination, these tools work to insure that public water supply systems meet safe drinking water standards throughout the state. To learn more about drinking & groundwater, access:
http://www.dnr.state.wi.us/org/water/dwg/index.htm

Several natural and man-made factors interact to influence groundwater quality in the Sheboygan Basin. Important factors include:

Geology	Lithology (rock/mineral characteristics)
Aquifer Depth	Soil Type
Land Use	Surface Water Quality

The geology of the Sheboygan Basin reflects the region's glacial history. Glacial maps indicate that surface geology and soil types in the Basin generally align parallel to the lateral moraines of the Lake Michigan Lobe advance.

Within the Basin, groundwater is generally drawn from one or more of three main formations: Unconsolidated Glacial Drift (sand & gravel aquifer), Silurian Dolomite (Niagaran aquifer), and Cambrian Sandstone (sandstone aquifer).

Unconsolidated Glacial Drift (sand & gravel aquifer)

The sand and gravel aquifer is composed of Pleistocene glacial drift, which varies substantially in thickness and continuity. The unconsolidated sand and gravel aquifer is generally the shallowest water bearing unit in the Sheboygan Basin and is therefore susceptible to climatic changes and to the vertical migration of organic contaminants. Predominant soils in the eastern half of the basin have a loamy surface layer and a loamy or clayey subsoil and substratum formed under forest vegetation. These soils consist of fine textured silts and clays with low infiltration rates; the soils are susceptible to runoff but less vulnerable to groundwater contamination. Water yields from sand and gravel wells completed in the eastern side of the Basin can be inconsistent. Higher yield rates are noted in the western side of the Basin, which has more sandy loam soils with more rapid percolation rates; these conditions also result in greater susceptibility to aquifer contamination. A survey of well logs identify sand and gravel well completion in the Basin that range from 28 feet (ft.) below land surface (BLS) to 220 ft. BLS.

Silurian Dolomite (Niagaran aquifer)

The Silurian Dolomite sedimentary formation is the primary aquifer for residential, municipal and industrial use in the Sheboygan River Basin. In Sheboygan County, the Silurian Dolomite formation dips to the east-southeast away from the igneous and metamorphic core of the Canadian Shield, which is located to the west and north of Sheboygan County. Sheboygan County has the greatest recorded thickness of "Niagaran Formation" (719 ft.) in the State of Wisconsin (Weidman and Schultz, 1915). Pleistocene era glacial deposits truncate the Dolomite. In addition, the thickness of the formation decreases to the west due to truncation caused by pre-glacial erosion of the exposed dolomite on the flanks of the uplifted Canadian Shield.

Where truncated, the glacial sands, gravels and tills that overlie weathered, fractured dolomite are often hydraulically connected; the units act as one aquifer. The degree of pre-glacial weathering, the vertical fractures and the primary porosity of the dolomite units establish the permeability and well yields in the Niagaran Aquifer. Ozaukee County residents experience lower well yield where this secondary porosity is absent; a conforming Devonian Rock formation overlies the Silurian Dolomite. In much of Sheboygan County, the Devonian

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Formations were stripped away by erosion prior to deposition of the Pleistocene "sand and gravel aquifer". Construction logs identify wells completed in the Niagaran aquifer range from 57 ft. BLS to 740 ft. BLS. Within the Basin; well logs identify the top of the dolomite formation ranging from 13 ft. BLS in the Town of Sheboygan (Sheboygan County), to 201 ft. BLS in Meeme Township (Manitowoc County).

Cambrian Sandstone (Sandstone Aquifer)

Cambrian rocks overly the Pre-Cambrian Crystalline rocks throughout Sheboygan and Manitowoc Counties. The Cambrian Sandstone Aquifer is comprised of the following units: the Mount Simon, Eau Claire, Galesville, Franconia Sandstones, and the Trempealeau Formation. The sandstone Aquifer has not commonly been used for domestic water supplies in the Sheboygan Basin due to the availability of sufficient water yields in more shallow formations. Increased demand, improved technology and contamination of upper aquifers and localized factors have driven extensive access to the sandstone aquifer in neighboring Basins.

Water Use

2,879 wells were constructed in the Sheboygan River Basin between 1988 and 2000, completed well depths ranged from 28-914 feet, with an average depth of 170 feet. Groundwater systems able to produce more than 70 gallons per minute (gpm) are considered high capacity systems; construction of wells within these systems requires WDNR approval. State law requires that the Department evaluate potential impacts of the proposed system to existing municipal systems. Ninety-nine high-capacity wells currently hold active approvals in the Sheboygan River Basin.

Table 11. High Capacity Wells in the Sheboygan River Basin

Use	Number of Wells	Average Pumpage gpd
Commercial	29	2,542,000
Industry	26	2,066,000
Irrigation	16	493,000
Residential/Municipal	31	6,531,000
Schools	11	114,000

Land Use

Surface and groundwater are interconnected elements of the hydrologic cycle. Contaminants are additions that restrict one or more uses of the water. Contaminants may be natural or man-made and may be added, compounded, mixed, filtered, diluted, or broken-down at any or several points along the cycle from recharge to discharge. Man-made contaminants can originate on the land surface or subsurface through many routes including:

- chemical storage
- animal feedlots
- use and spillage of fertilizers
- septic tanks and drain fields
- Mines
- sewage lagoons
- Graveyards
- road salt use and storage
- accidental spills
- leaking from underground storage tanks
- leaking from underground pipelines and sewers
- waste disposal in excavations
- sumps and dry wells
- improperly abandoned wells

Many man-made products have been formulated to persist. As spills or residuals enter surface or groundwater they and their breakdown products can also disperse, impede, or combine with other compounds downstream to impact human and non-human users of the water for unknown stretches of time.

Table 12. Potential Groundwater Issues Based Upon Land Use in the Sheboygan Basin

Watershed	Score*	Comments
Sauk & Sucker Creeks	74.00	Land use in the watershed is 70% agriculture.
Black River	64.39	Land use in the Watershed is 58% agriculture, one confined animal feeding operation (equivalent of 1000 animal units).
Sheboygan River	64.34	Land use is 60% agriculture, one confined animal feeding operation (equivalent of 1000 animal units).
Onion River	71.05	Land use is 70% agriculture.
Mullet River	67.14	Land use is 63% agriculture. Of 9 wells sampled for nitrate, 22% exceeded the groundwater enforcement standard, 44% exceeded groundwater preventative action limit.
Pigeon River	59.55	Land use is 56% agriculture, one confined animal feeding operation (equivalent of 1000 animal units).

**Score based upon land coverage and groundwater sample analytical results nitrate and pesticides in WDNR GRN database. * Very few private well samples have been collected and analyzed for nitrates and pesticides in the Sheboygan Basin. This means that the high scores are based on land cover and not groundwater data. Score of 30 or greater is considered high for groundwater contamination potential.*

GROUNDWATER QUALITY OBJECTIVES

Recent Actions

- WDNR, UW-Extension, the City of Plymouth and residents living near the City of Plymouth Landfill in the Town of Greenbush worked together to characterize the source of contaminants identified in local well water. Contaminated wells were replaced and groundwater monitoring will continue to determine any long-term impacts.
- Basin Communities including Belgium, Kiel, St. Cloud and the Town of Sheboygan have enacted wellhead protection plans for some or all of their drinking water wells.
- Drinking & Groundwater staff participated in evaluation of potential impacts regarding removal of the Franklin Dam in the Town of Herman. They also monitored impacts to surrounding wells following breach of the dam, and worked with the Franklin Volunteer Fire Department to authorize the high capacity well that replaced the millpond as source water for fire fighting.
- Workshops developed with the Wisconsin Water Well Association and statewide WDNR Drinking & Groundwater staff were presented throughout the state to provide technical training & program updates and to enable a forum for exchanging information between regulators and the well drillers and pump installers.
- WDNR began implementation of a source water protection initiative that begins to identify area sources with the potential to impact public drinking water wells.

Priority Objectives for the Future

Targeted development, urbanization and an increasing population are a primary concern for government and residents throughout the Sheboygan Basin. To sustain viable and enduring neighborhoods, groundwater source protection will need to be a primary component of all comprehensive plans initiated or updated by inland communities within the basin. In addition, as neither surface nor groundwater tends to respect political boundaries; source protection, distribution, stormwater and waste stream management will enviably cross jurisdictions. Planning, management and use strategies will need to be comprehensive, collaborative and inclusive. Approaching these shared responsibilities as sustaining members of the Basin-wide ecosystem will be the challenge for the next decade.

Key Priorities to Continue

- Continue to provide technical assistance and education to system owners and patrons regarding:
    1. Drinking water contaminants have been detected that present an acute potential health risk.
    2. Hazards such as floods may have overtopped wells or tanker spills of compounds that may seep into aquifers tapped by area drinking water wells.
- Support individual water supply system's in monitoring their drinking water by providing technical assistance in sample collection, responding to water sample results, and continuing to issue boil water/disinfection advisories as appropriate to enforce SDWA requirements.
- Continue work with the community, including UW-Extension, Public Health Departments, professional and environmental organizations to comprehensively address local needs for information, education, and technical assistance to support the public's ability to

knowledgeably participate in making decisions regarding their drinking water & groundwater.

- Continue special investigations as necessary to identify and appropriately respond to contaminant plumes, potential repercussions from the pumping of high capacity well systems, dam removal, farm or industry land-use applications and other unanticipated drinking water or groundwater issues impacting the community.
- Continue work in source water protection, including identification of potential contaminant sources with the potential to impact public drinking water wells

Chapter 3. Land Resources of the Sheboygan River Basin

The previous chapter discussed the different resources and issues related to surface and groundwater quality. It should be apparent from that discussion that land use plays an important role in water quality and habitat protection and degradation. This chapter will focus on the land resources within the Sheboygan River Basin.

WETLANDS

Wetlands are a critical link between our land and water resources. Until very recently, wetlands were considered a sort of wasted land, with little to no value unless altered by draining or filling. Wetlands are very important not just for the plants and animals they sustain, but are also beneficial to humans. In brief, wetlands…

- help protect and enhance water quality by keeping pollutants from reaching lakes, rivers, streams and groundwater;
- help reduce flood damage by storing runoff from rains and snow melt;
- protect shorelines from erosion damage caused by waves and currents;
- enhance our quality of life, property values and tourism by providing beautiful open spaces that support many plant and animal species.

Wetlands Before Settlement

It is difficult to determine exactly how many acres of wetlands were in the Sheboygan River Basin prior to European settlement. The statewide estimate of wetland acreage at the time of the surveys was approximately 5 million 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. Some surveys were done in winter when wetlands were covered under ice and snow. The surveys were conducted by walking the section lines of the Public Land Survey System (PLSS). As a result, wetlands surveyed along these lines were mapped more accurately than those in the interior. Soil scientists estimate that Wisconsin actually had twice the acreage of wetlands (10 million acres) than originally estimated in the surveys. This was done much more accurately by classifying wet soils (somewhat poorly, poorly and very poorly drained) as wetlands. In the Sheboygan River Basin, the original surveyors estimated wetlands covered about 35,500 acres or nine percent of the land area (Figure 10). We know this estimate is not accurate, since many wetlands that we find in large masses today, and many found along river corridors were not included in the original surveys.

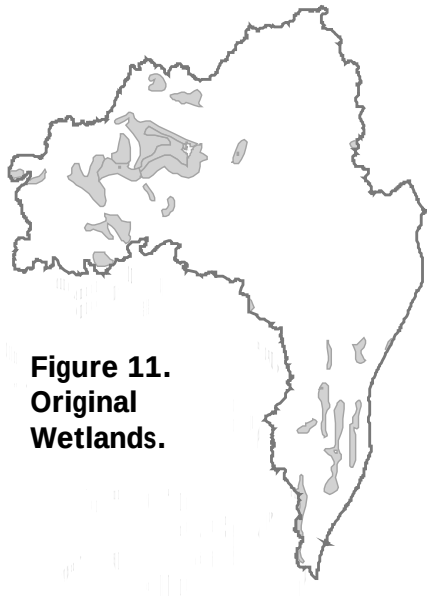


Figure 11. Original Wetlands.

Wetlands Today

Today, using more modern techniques, we have a pretty good idea of the acreage of remaining wetlands in the Sheboygan River Basin. Data from the Wisconsin Wetland Inventory indicate that the Sheboygan River Basin currently contains more than 45,000 acres of wetlands (Figure 11). Note that wetlands are the most abundant in the western watersheds, and are least abundant in the urbanized areas. The largest protected wetland complexes remaining in the basin are located in the Sheboygan Marsh and Kiel Marsh State Wildlife Areas.

Wetlands of the Sheboygan River Basin

Wetlands provide many benefits for humans, but are also very important ecologically. For this report we classified wetlands in the Sheboygan River Basin by general type: Coniferous swamp, hardwood swamp/floodplain forest, marsh, shrub swamp and wet meadow. This section will describe the plant and animal characteristics attributed to each category.

Coniferous swamp

These are usually white cedar or tamarack wetlands that are often associated with lowland hardwoods. The soils may be under water in spring and saturated for most of the growing season. Tamarack is the dominant tree species in acid soils while white cedar is more common where soils are alkaline. While common in the north, this type of wetland is quite rare in the southern half of the state. Conifer swamps are the least abundant type of wetland (3036 acres) in the Sheboygan River Basin (Table 9). Bog plants such as tamarack, pitcher plant and leatherleaf can be found in conifer swamps, as well as the rare lady slipper orchid, jack in the pulpit and sedge.

Birds found in coniferous swamps include saw-whet owl, cedar waxwing, hermit thrush, northern water thrush, veery, and many species of sparrows and warblers. Mammals that use these swamps include white-tailed deer, red fox, coyote, and various small mammals.

Table 13. Sheboygan River Basin Wetland Vegetation Summary

Wetland Type	Wetland Acreage by Watershed/% of Total Watershed Area					
	Sheboygan	Pigeon	Mullet	Onion	Black	Sauk-Sucker
Coniferous Swamp	2691/1.6	54/0.1	249/0.4	21/0.03	8/0.04	13/0.03
Hardwood Swamp/ Floodplain Forest	12370/7.4	2047/4.0	3280/5.8	3596/5.7	1480/6.5	806/2.2
Marsh	1957/1.2	154/0.3	974/1.7	165/0.3	72/0.3	41/0.1
Shrub Swamp	5383/3.2	368/0.7	827/1.5	377/0.6	379/1.7	146/0.4
Wet Meadow	4992/3.0	416/0.9	963/1.7	906/1.4	318/1.4	415/1.1
Totals	**27393/16.5**	**3039/6.0**	**6293/11.1**	**5065/8.0**	**2257/9.9**	**1421/3.8**

Hardwood Swamp/Floodplain Forest

These wetlands are the most abundant of all wetlands within the basin (23,579 acres). Most of the wetlands closely associated with river corridors are of this type. Floodplain forests generally occur in river valleys while hardwood swamps are commonly found on old lake

basins or oxbows. Both wetland types are important for storing floodwaters. Hardwood swamps have standing water in spring and saturated soils or ponded water for much of the growing season. Floodplain forests are inundated during flood events and receive silt as the waters recede. Soils during most of the growing season are usually well drained. Trees found in hardwood swamps include black ash, red maple, silver maple, yellow birch and elm. These wetlands also have a shrub layer and ground cover with species including dogwoods, alder, skunk cabbage, marsh marigold, and sedges, ferns, grasses and forbs similar to wet meadows. Common trees in floodplain forests include silver maple, green ash, cottonwood, elm, black willow and box elder. Because of frequent flooding, these wetlands generally lack a shrub layer. Typical ground cover in floodplain forests is stinging nettle and jewelweed.

Both wetland types are important for supporting diverse communities of amphibians and reptiles. Temporary ponds are created during spring floods, providing important breeding grounds for amphibians. Amphibian and reptile species commonly found in these wetlands include American toads, eastern gray tree frogs, spring peepers, wood frogs, blue-spotted salamanders, central newt, redbacked salamanders, painted turtles, snapping turtles, eastern garter snakes, northern ringneck snakes, northern water snakes and red-bellied snakes.

Rare bird species such as the cerulean warbler, acadian flycatcher and prothonotary warbler and cerulean warbler can be found in floodplain forests. Other bird species associated with both wetland types include belted kingfisher, green heron, spotted sandpiper, wood duck, mallard duck, flicker, pileated woodpecker, hooded mergansers and barred owls.

The stream and river corridors created by hardwood swamps and floodplain forests often provide valuable cover and transportation routes for white-tailed deer, muskrat, mink and raccoons.

Marshes

At about 3400 acres, marshes are one of the least abundant wetland types in the basin. Plants such as cattails, sedges and arrowhead growing in permanent to seasonal shallow standing water characterize marshes. These wetlands store floodwater, protect shorelines from erosion and improve water quality by filtering out pollutants.

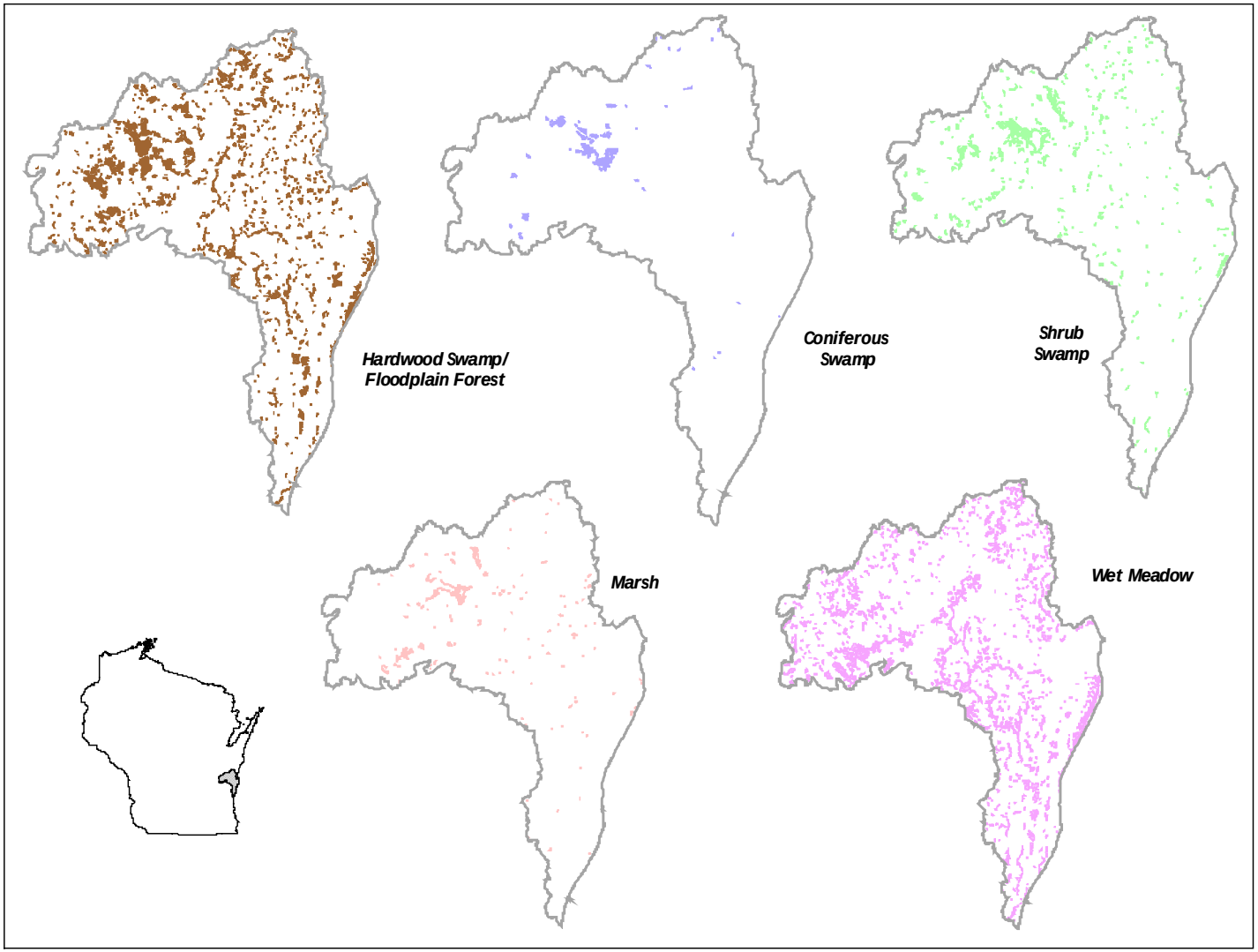
This wetland type is the most productive for water birds and furbearers, and also provides important spawning and nursery habitat for northern pike. Species commonly found breeding and feeding in marshes include various ducks, rails, songbirds and herons. Upland wildlife like pheasants and rabbits uses marshes as winter habitat.

Shrub swamp

Woody vegetation like small willows, red osier and silky dogwoods are dominant in the 7,480 acres of shrub swamps found in the basin. These wetlands occur on saturated or seasonally flooded muck soils and on the mineral soils of floodplains. Drainage and fire suppression my cause wet meadows to become shrub swamps.

These wetlands provide year-round habitat for grouse, woodcock, songbirds and small mammals, and winter habitat for upland game such as pheasants, white-tailed deer and rabbits.

Figure 12. Sheboygan River Basin Wetland Vegetation



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Wet Meadows

This wetland type encompasses over 8,000 acres of land within the basin. Wet meadows, with their dense vegetation are often located between upland areas and waterways, thereby serving an important water quality function by keeping soils and associated nutrients from entering lakes and rivers. Standing water is only found in marshes during periods of heavy rain. Unless greatly disturbed, wet meadows lack woody vegetation. Instead, grasses, sedges, goldenrod, asters, and marsh milkweed dominate them. Wet meadows provide habitat for wildlife such as sandhill cranes, pheasants, and small mammals that are important food sources for coyote, fox, mink and hawks.

Challenges to Wetlands

Lands that were perpetually or seasonally wet were historically considered useless unless filled for development or drained for agricultural purposes. It wasn't until relatively recently federal and state decision makers recognized the need to provide some protection for wetlands.

The first attempt on a federal level to stem the loss of wetlands was Section 404 of the 1972 Clean Water Act. This section was enacted to regulate the discharge of dredge and fill material into surface waters and wetlands. These regulations, administered by the Army Corps of Engineers (ACOE) may have slightly slowed the rate of wetland loss in the state, but it wasn't until 1991 when Wisconsin adopted state wetland water quality standards that the rate of wetland destruction was really slowed. A recent U.S. Supreme Court decision limiting the ability of the U.S. Army Corps of Engineers to regulate wetland fill and dredging in certain wetland types may have significant impacts over the fate of many wetlands within the state of Wisconsin. The U.S. ACOE and the WDNR are currently studying the decision and potential scope of impact. ***For more information on recent developments, please see*** www.dnr.state.wi.us/org/water/fhp/wetlands/index.htm**.**

Some wetland loss statistics compiled for time frames before and after statewide control of wetland loss are presented below.

Statewide Wetland Losses

The WDNR examined ACOE permit decisions from 1982 through August 1991 (the year statewide wetland water quality regulations were adopted). During this time period, WDNR estimated that nearly 13,000 wetland acres (1440 acres/year) statewide were legally filled. Note that this estimate does not include illegal wetland filling, wetland drainage, and it is likely that some ACOE wetland permit decisions were overlooked.

Following adoption of statewide wetland water quality standards in 1991 which enabled WDNR in many cases to restrict or modify ACOE permit decisions, permitted wetland losses statewide decreased by 460% for the time frame August 1991-April 1998. Statewide about 2,000 wetland acres (312 acres/year) were legally filled. Again, these numbers are considered estimates that do not include illegal wetland filling, wetland drainage and pre-authorized or overlooked ACOE permit decisions.

Sheboygan River Basin Wetland Losses

A review of WDNR permits issued for wetland projects within the Sheboygan River Basin showed that about 20 acres were legally altered between 1991 and 1999. These numbers may

not be a complete representation of the extent of wetlands affected in the basin because of jurisdictional restrictions, illegal wetland filling and other unauthorized activities.

Some Consequences of Wetland Losses

Earlier we discussed the important ecological benefits of different wetland types. Because of these important functions, it's easy for many to see why it's important to restore and protect wetlands. Wetlands are also beneficial for stabilizing water levels in lakes and rivers, and for protecting water quality.

While it is now commonly agreed that the water dynamics of the Great Lakes drainage basin have been altered by urban development and agriculture, scientists have not agreed on the role wetland destruction has played in this regard (Hey and Wickencamp, 1996).

Hey and Wickencamp analyzed nine watersheds tributary to Lake Michigan in southeastern Wisconsin to better understand the relationships between wetlands, water quantity and water quality.

The analysis concluded that watersheds with low percentages of wetlands tended to have higher percentages of impervious surfaces, leading to increased runoff to surface waters. Conversely, watersheds with higher wetland percentages had more water infiltration (less runoff to surface waters). Watersheds with fewer wetlands also showed decreased base flows and higher peak flows.

What this indicates is that higher percentages of wetlands within a watershed are beneficial for keeping stream flows stable compared to watersheds with lower wetland percentages. However, the beneficial effects of wetlands on the stream flow characteristics studied tended to level off above the 10 percent mark. Therefore, increasing wetlands within a watershed would stabilize stream flows, and reduce the risk of flooding by providing storage. Increased storage capacity is also beneficial for water quality by increasing detention time, thereby allowing pollutants to settle out of the water column.

In the Sheboygan River Basin, watershed wetland acres as a percent of land area range from four percent to about 16 percent (Table 9). The least urbanized watersheds have the highest percentages of wetlands. As the basin becomes more developed, wetland acreage substantially decreases. In the northwestern watersheds, the wetlands are distributed throughout the watershed, while those in the more populated areas are more sporadically distributed (Figure 11).

Opportunities for Wetland Restoration and Protection

While some of the discussion presented above regarding wetland losses may sound rather grim, more opportunities than ever before are available for landowners to restore and protect wetlands. In fact, estimates for the Sheboygan River Basin from 1990-1999 show that over 200 acres of wetlands have been restored or protected through various state and federal programs. Please note that these numbers are estimates and don't include all wetland restorations individual landowners, nature centers or foundations have accomplished. Following are brief descriptions of some wetland restoration and protection activities accomplished in the Sheboygan River Basin or the entire WDNR Southeast Region, followed by recommendations for future actions.

Wetland Restorations

WDNR Wildlife Management staff have restored over 160 acres of wetlands within the basin between 1990 and 1999 with the goal of providing high quality habitat for wildlife. Most of these wetland restoration activities are conducted in cooperation with the U.S. Fish & Wildlife Service, private landowners, and conservation organizations such as Ducks Unlimited. The WDNR and partners have been actively involved in meeting the goals and objectives of the North American Waterfowl Management Plan (NAWMP), which identifies habitat loss and degradation as major factors limiting waterfowl populations in North America. The Sheboygan River Basin is included in the Southeast Focus Area of the NAWMP, which is considered a high priority area. ***For more information on restoring wetlands for wildlife in the Sheboygan River Basin, please contact the WDNR Private Lands Wildlife Biologist at (920) 892-8756.***

The Natural Resources Conservation Service (NRCS) offers landowners resources to restore and protect wetlands. The Wetland Reserve Program (WRP) allows landowners the opportunity to receive cost share payments for restoring wetlands on their property. From 1992-1999 over 100 acres of wetlands have been restored in the basin through WRP. The Conservation Reserve Program (CRP) allows the NRCS to enter into contracts with farmers to remove cropped wetlands and highly erodible cropland from production for 10 year periods. Because the landowners do not enter into perpetual easements, acreage figures of enrolled land will vary from year to year. ***For more information on the WRP and CRP programs, please visit the NRCS web site at www.nrcs.usda.gov, or call your county NRCS agent.***

The Wisconsin Department of Transportation is required to compensate for unavoidable wetland loss from transportation projects through wetland mitigation. From 1991 through 1999 over 170 acres of wetland were lost to road projects in WDNR's eight county Southeast Region. To compensate for this loss, the DOT restored over 250 acres of wetlands in the region.

Wetland Protection

Even though the decline of wetlands has slowed as we realize their many benefits and implement protection programs, a comprehensive approach to wetland protection and restoration is needed. In a recent publication, *Reversing the Loss: A Strategy for Protecting & Restoring Wetlands in Wisconsin* (WDNR, 2000) the WDNR Wetland Team outlines a strategy for protecting Wisconsin's remaining wetlands over the long term. The overall strategy recommends that the WDNR:

- strengthen relationships with property owners, nonprofit conservation organizations and local governments,
- manage wetlands to protect diversity of species, wildlife health and ecological integrity,
- streamline our regulatory approach for permits and restoration activities in wetlands, and
- develop and use modern technology to map, monitor, protect and manage wetlands.

The goals and actions identified in the strategy give WDNR and its many partners a solid foundation from which to work together to protect and restore wetlands throughout the Milwaukee River Basin and the state. ***For more information on this strategy and what you can do to protect and restore wetlands, please see:***
www.dnr.state.wi.us/org/water/fhp/wetlands/reversing.pdf.

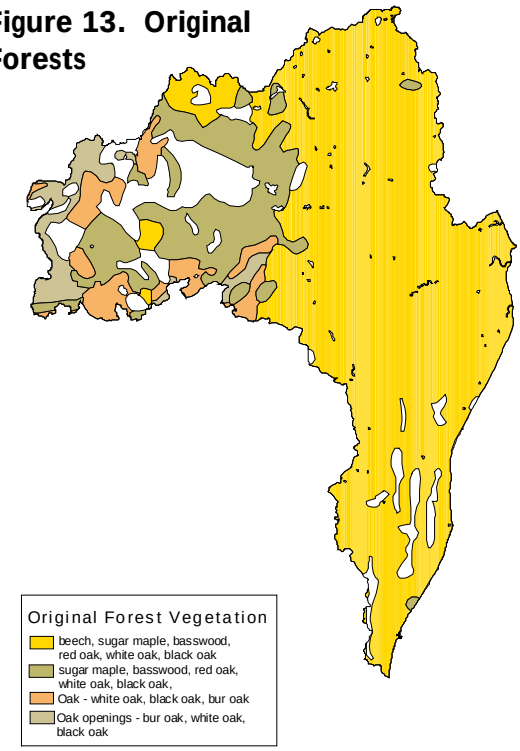
FORESTS

When discussing forests, some think of large unbroken expanses of land with many species of trees with a wide variety of plants and animals. Others may think of pines planted in neat rows, while others may consider the woodlot in their neighborhood a forest. Whether found in rural areas, suburbs or cities, forests in the Sheboygan River Basin come in all shapes and sizes.

Forests Before Settlement

The major forest types originally found in the Sheboygan River Basin are characterized as southern forests. This forest type is characterized by the absence of conifers, dominance of oak species, and presence of other tree species (shagbark hickory, black walnut, box elder) not normally found in the northern forests (WDNR, 1995). These forests once dominated the presettlement landscape of the basin, covering about 90 percent (over 350,000 acres) of the land area (Figure 12). The forests supported many types of animals such as bison, elk, cougar, white-tailed deer, black bear, bobcat, mink, otter, beaver, muskrat and a rich diversity of birds. By the early 1920s, most of the forests in the basin were logged for lumber, and other products and converted to agricultural land.

Figure 13. Original Forests



The tension zone transects the center of the basin, therefore the northern portion and the woodlots

Forests Today

Today only about 12 percent of the Sheboygan River Basin, or 47,000 acres is considered forested, with the largest tracts confined to the northwestern reaches of the basin. Most of the forested land is privately owned. Because of the influences of agriculture and development in the basin, the southern forests of today are characterized by their fragmentation. Remnants of original forest vegetation in the basin are found in small patches with the exception of the Northern Unit of the Kettle Moraine State Forest. The Northern Unit of the Kettle Moraine State Forest contains a wide variety of forest cover types including northern hardwoods, upland and lowland conifer plantations and wooded wetlands like floodplain forests and southern hardwood swamp forests.

Northern Hardwoods

The northern hardwoods cover type is also known as southern mesic forest. This forest type is considered a very stable terminal forest. Once sugar maple, ash, basswood and beech are established in the canopy they persist because of their ability to reproduce seedlings in the shade. Closed canopy mesic forests are highly resistant to fire because of the high moisture content of the litter in winter and spring, and rapid decomposition and high internal humidity

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in summer. The understory of this forest type is rather sparse so it supports few game species. White tailed deer use these forests as travel routes between feeding and resting areas. Birds found here include songbirds like redstart, scarlet tanager and cerulean warbler as well as winter foraging species like black-capped chickadee, nuthatch, brown creeper, woodpeckers and wild turkey. Red-tailed hawks and great-horned owls can be found near the forest's edge. Mammals found in the forest interior include gray squirrels, flying squirrels and woodland deer mice with chipmunks and woodchucks expected near the edge. Populations of squirrels and chipmunks are lower than in other forest types because of the lack of nut-producing tree and shrub species. This forest community is threatened by fragmentation, stand isolation and outright destruction. These disturbances allow exotic species to invade, further threatening this cover type.

Aspen

The aspen dominated cover type is preferred by a variety of wildlife species. Young aspen provide brood rearing habitat for woodcock and ruffed grouse, and succulent summer foods for white-tailed deer. Because of the lack of ground cover mid age stands of aspen, male ruffed grouse can be found drumming for mates here. Wildlife value the winter buds produced by 15 to 25 year old trees.

Conifer Plantations

Upland conifer plantations that were planted, and lowland conifer stands which are natural to portions of the basin, provide some cover and nesting habitat for wildlife. Young stands provide the best cover with many lower branches. Most conifers lose their cover value for wildlife with age, with the exception of Norway spruce which retain their lower branches. Wildlife found here include mourning doves, sharp-shinned and Cooper's hawks, red squirrels and cottontail rabbits. Wild turkeys, wintering birds and migratory songbirds use this type for cover during inclement weather. Wild turkeys, wintering birds and migratory songbirds use this type for cover during inclement weather. Wild turkeys prefer white pine plantations near open water for winter roosting habitat, while white-tailed deer find cover during cold weather in dense conifer plantations.

Wooded Wetlands

The water resources and relatively open canopy make floodplain forests an extremely diverse habitat for many species. The flooding regime benefits amphibians by creating temporary breeding ponds, while the abundance of large, woody debris provides cover for amphibians and their prey . Hardwood swamps also provide important habitat for many species including white-tailed deer, cottontail rabbits, raccoons, white-footed mice and shrews. Birds such as ruffed grouse, woodcock, white-breasted nuthatches, downy, hairy and pileated woodpeckers and red-shouldered hawks use hardwood swamps and floodplain forests for food and cover. Please see the discussion of hardwood swamps and floodplain forests (page 48) for more information.

Remnant Forest Communities

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) recently published the findings of a technical advisory committee that identified high quality natural areas and critical species habitats in their seven county planning area (SEWRPC, 1997). Ozaukee County is the only County within the Sheboygan River Basin included in this report. The main purpose of this effort was to identify areas of significant resource value (natural areas), and provide recommendations for protecting and managing these areas. Natural areas are defined by

SEWRPC as "tracts of land or water which were so little modified by human activity, or which have sufficiently recovered from the effects of such activity, that they contain intact native plant and animal communities believed to be representative of the pre-European settlement landscape". Many of the areas identified in the report are remnant forests.

Within the Ozaukee County portion of the Sheboygan River Basin over 850 acres of forested lands were found to possess natural resource features of such quality to merit natural areas designation. These parcels were designated a classification of NA-1, NA-2 or NA-3.

NA-1 parcels are the highest quality areas of statewide or greater significance. They represent nearly complete and virtually undisturbed plant and animal communities resembling presettlement vegetation. NA-2 sites are classified as having countywide or regional significance. These areas have some apparent human disturbance, but generally have somewhat complete native biotic communities. Sites classified as NA-3 have obviously been altered by human activities, but still maintain good wildlife habitat and may contain small pockets of plants that no longer exist in adjacent areas. These sites are considered of local significance.

No parcels within the basin were identified as NA-1, while one parcel was classified as NA-2 and seven classified as NA-3 (Table 10). Most of the parcels are privately owned. ***For more detailed information on the natural areas within the SEWRPC planning area, please see SEWRPC Planning Report No. 42. "A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin."***

Urban Forests

The urban forest is all of the trees and other vegetation in and around a city, village or development. Traditionally it has meant tree-lined streets, but it is important to remember that this forest is a complex network of green space extending beyond property lines and involving many different landowners. An urban forest also includes home and corporate landscapes, schoolyards, parks, cemeteries, vacant lots, riparian corridors, utility rights-of-way, adjacent woodlots and anywhere else trees can grow in and around a community. Shrubs, flowers, vines, ground covers, grass and a variety of wild plants and animals are also part of the urban forest. Streets, sidewalks, buildings, utilities, soil, typography and, most importantly, *people* are an integral part of the urban forest.

The urban forest is, in fact, an ecosystem. To maintain the quality of the environment and the quality of life for the vast majority of Wisconsin residents, the urban forest must be managed. Six communities and other unique participants within the Sheboygan River Basin are taking advantage of the WDNR Urban Forestry Program. ***For urban forestry assistance in the Sheboygan River Basin, please contact the Urban Forester at (262) 670-3405.***

Table 14. Forested Natural Areas Within the Ozaukee County Portion of the Sheboygan River Basin.

Area Name	Class Code	Size (acres)	Description and comments
Harrington Beach Lacrustine Forest	NA-2	178	Moderate to good quality mature second growth northern wet-mesic forest, located just west of the shoreline beach ridge. Dominant trees include green and black ashes, basswood and white cedar. This is a regionally rare community type, heavily used by migratory birds.
Cedar Heights Gorge	NA-3	9	Disturbed, narrow, steep-sided gorge leading to Lake Michigan. Almost complete dominance by white cedar.
Lions Den Gorge	NA-3	20	Deep ravine on Lake Michigan shore. Dominated by white cedar and hardwoods, with a relatively good-quality herb layer, including a few northern relicts.
Ulao Lowland Forest	NA-3	347	A large lowland hardwoods area, dominated by red and silver maples and black ash. Adversely affected by changing water levels, selective cutting and Dutch elm disease which have opened the canopy. Marshy stands occur throughout.
Cedar Grove Swamp	NA-3	177	Extensive second-growth forest on ditched lacustrine flats with clayey soils. Dominated by red and silver maple, black ash, yellow birch, American elm, and swamp white oak. Repeatedly logged and encroached on by agriculture and ditching.
Belgium Swamp-North	NA-3	150	An extensive, but young, lacustrine forest 2.5 miles from Lake Michigan, with American elm, black ash, and red and silver maples. Disease, logging, and windthrow have opened the canopy, permitting a brushy understory to develop.
Belgium Swamp-South	NA-3	148	Low, flat, wet forested area of black ash and silver and red maples, with some yellpw birch and basswood. Old windfalls and dead standing trees are common. There is a history of disturbance, resulting in a very open and brushy appearance.

Source: SEWRPC (1997)

Forest Management, Restoration and Protection Opportunities

Many opportunities are available to private landowners, municipalities and non-profit organizations for managing, restoring and protecting Wisconsin's Forests. Below is just a sampling of some programs available, along with some specific objectives for forest management within the Sheboygan River Basin.

Wisconsin's Forest Tax Laws

Wisconsin used to have property tax policy that required landowners with forests to pay higher taxes on their lands. This often was a financial burden for many property owners who over cut their lumber to pay for their taxes. This resulted in over harvesting of timber, and prompted the state legislature to enact laws to promote timber growing. Forest cover types enrolled with the forest tax law programs include northern hardwoods, central hardwoods, bottomland hardwoods, swamp hardwoods, oak, white ash, aspen, red pine, white pine, white spruce, fir/spruce, herbaceous vegetation, upland brush, lowland brush, dogwood and

willow. For more detailed information, please see: www.dnr.state.wi.us/org/land/forestry/ftax, or contact your local WDNR forester.

Conservation Reserve Program

The Conservation Reserve Program (CRP) provides financial incentives to landowners to voluntarily establish and maintain vegetative cover on lands that need protection from erosion, to act as windbreaks, or in places where vegetation can improve water quality or provide food and habitat for wildlife. This is a federally funded cost-share program, administered by the Natural Resources Conservation Service (NRCS).

Wisconsin Forest Landowner Grant Program

This program provides cost-share assistance to landowners for managing their woodlots. Landowners must have an approved management plan before applying for funding. Practices often approved include tree planting, vegetative control, timber stand improvement, soil and water protection, wetland protection, restoration and enhancement, stream and stream bank protection, wildlife habitat creation or improvement and protection of rare natural communities and species.

Stewardship Program

Some of the most popular ways to protect high quality forest areas are through easement and acquisition. Wisconsin's Stewardship Program is a competitive program available to non-profit entities and local governments to acquire property for resource protection. ***For more information on the Stewardship Program, please see:***
http://www.dnr.state.wi.us/org/caer/cfa/lr/stewardship/stewardship.html

WDNR Urban Forestry Assistance

Cities, villages, towns, counties, tribal governments and nonprofit organizations are eligible to participate in this 50/50 matching grant program, which emphasizes developing or expanding management capacity for long-term urban forestry programs at the local level. Projects have included initiating volunteer tree boards, conducting tree inventories, developing management plans, organizing tree workshops, training for personnel ad youth, and tree planting projects.

National Arbor Day Foundation Programs

The Tree City USA program, sponsored by the National Arbor Day Foundation is another important urban forestry program within the basin. This program recognizes towns, cities and villages across America that effectively manages their public tree resources. It also encourages them to implement a community tree management program based on four Tree City USSA standards. These standards include developing a tree board or having a forestry department; developing a tree ordinance; budgeting at least two dollars per capita for a forestry program and celebrating Arbor Day and reading a proclamation. A community must meet each of these standards every year to qualify for the program.

AGRICULTURAL LANDS AND GRASSLANDS

Agriculture

Agriculture continues to play a very important role in shaping the landscape of the Sheboygan River Basin. Together, lands in agriculture and grasslands account for about 72 percent of the basin land cover. As urban development proceeds further into the countryside, farmland decreases. Need to do something similar with Manitowoc County and Fond du Lac.

Table 15. Number of Farms, Land in Farming and Farm Size for the Four Major Counties in the Sheboygan River Basin.

	FOND DU LAC			OZAUKEE			MANITOWOC			SHEBOYGAN		
	1987	1997	%	1987	1997	%	1987	1997	%	1987	1997	%
NO. of FARMS	132	83	-37	483	427	-12	1529	1227	-20	1213	968	-20
LAND IN FARMS (ACRES)	8763*	6334	-38	85201	39930	-22	276805	244864	-12	209508	182460	-15
AVERAGE FARM SIZE (ACRES)	90*	76	-16	176	164	-7	181	200	10	173	188	9

Farms don't only provide us with most of our dairy, meat, grain and vegetables, but also play an important role in water quality and wildlife management. Many landowners are taking steps to decrease these effects while maintaining their ability to earn a living off their land.

Landowners in the Sheboygan River watershed have been participating in the Nonpoint Source Water Pollution Abatement, or Priority Watersheds Program. The program is a joint effort of the Department of Natural Resources (WDNR), Department of Agriculture, Trade and Consumer Protection (DATCP), the University of Wisconsin Extension (UWEX), counties (usually through their Land Conservation Departments), municipalities, and lake districts with assistance from a variety of federal, state and local agencies. Since the program started in the watershed in 1990over 50 percent of the rural landowners have been personally visited several times by county, federal or state staff. Annual or semi-annual efforts are made to communicate with agricultural producers.

Through this program cost-share grant funding assistance is available to rural landowners at up to 70 percent to employ *best management practices* (BMPs) to control nonpoint sources of pollution to area waterways in high priority watersheds. All of the Sheboygan River Basin watersheds are high ranking watersheds for nonpoint sources. The following accomplishments have occurred in the basin since 1990.

Upland erosion and sediment transport has been reduced by 25-35 percent throughout the basin. Watersheds with more cash crops continue to have higher erosion rates than those primarily in dairy. Agricultural market conditions have an effect on the erosion and sediment transport to surface waters. For instance, with a decline in dairy prices, many landowners convert fields that were once planted with hay and grains (low erosion rates) to a more profitable rotation of continuous corn and soybeans. Each spring and fall the fields that had been cash cropped have exposed soil that is more prone to erosion.

Phosphorus runoff from barnyards has been reduced by 55 percent. This is due to improved barnyard runoff management systems and the declining animal based agriculture in the basin. Many of the smaller livestock operations have gone out of business due to poor financial returns. Those that remain are better managed or are the larger total confinement operations with manure storage capabilities.

Critical acres spread with manure have been reduced by 45 percent. This pertains to winter manure spreading, and manure spreading on steeply sloped fields at any time, where the manure is more prone to running off into surface waters. More than 40 percent of the livestock operations in the basin continue to do some sort of "daily haul." Some of the largest livestock operations in the basin must winter spread at times due to undersized manure storage structures. Earthen (clay) manure storage facilities are common in this watershed due to clayey top and sub-soils.

Grasslands

Wisconsin was once covered with over 2 million acres of prairie. Only one percent of the native prairie remains. Also gone are many wildlife species associated with prairies. We have seen a drastic decline in most grassland bird species. Changes in agricultural practices and rural land-use has resulted in the elimination of grassland habitat and destroyed many nests and chicks. By converting former croplands into grassland, we can bring back some grassland wildlife.

Grassland bird species such as pheasants, bobolinks, meadowlarks, dickcissels and upland sandpipers need undisturbed grasslands for nesting and raising broods. Many waterfowl species such as blue-winged teal and mallards nest in grasslands that are located near wetlands. Besides being valuable for wildlife, grasslands improve water quality by trapping sediment that would flow into wetlands, lakes and rivers.

By restoring native prairie, we can improve the grassland habitat in the basin, which will provide a home for many wildlife species and provide water quality benefits. Since 1995 over 1200 acres of grassland have been restored or established within Fond du Lac, Manitowoc, Ozaukee and Sheboygan Counties.

RECREATIONAL LANDS IN THE SHEBOYGAN RIVER BASIN

Lands owned by the state, county, and municipal governments within the Sheboygan River Basin provide year round opportunities for wildlife watching, hiking, fishing, hunting (excluded in some areas), bicycling, golf, horseback riding, snowmobiling, skiing, camping, picnicking and water sports (Table 12). Provided for all ages and all seasons, these diverse outdoor recreational opportunities attract numerous visitors throughout the year and provide local residents with a quality of life separate from fast-paced urban influences.

State facilities such as the Kettle Moraine State Forest, Kohler-Andrae State Parks, Harrington Beach State Park, various state wildlife areas (Sheboygan Marsh, Kiel Marsh, Mullet Creek, and La Budde Creek), and the Ice Age National Scenic Trail, provide both satisfying and unique recreational experiences. Table 12 provides contact information for the major state facilities within the Sheboygan River Basin.

Table 16. Major State-Owned and Managed Lands in the Sheboygan River Basin.

Property Name	Size (Acres)	Contact Information
Kettle Moraine State Forest – Northern Unit	14,800	(262) 626-2116
Sheboygan Marsh State Wildlife Area	6,349	No contact station. Cal (414) 263-8500 for more information
Kohler Andrae State Parks	1,000	(920) 451-4080
Harrington Beach State Park	636	(262) 285-3015
Kiel Marsh State Wildlife Area		(920) 892-8756
Nichols Creek State Wildlife Area		(920) 892-8756
Wade House Historic Site	236	(920) 526-3271

For more information about these and other Wisconsin State Parks and Forests, please visit the State Parks and Forests web site at www.dnr.state.wi.us/org/land/parks/specific.

County and city owned parks provide recreational opportunities in both rural and urban settings. These parks offer many outdoor activities like camping, golf, nature trails, sports playing fields, cross-country skiing, sledding, play equipment and picnicking. Many parks adjacent to lakes offer boat launches, swimming beaches and fishing opportunities. For more information about what the various county and city owned parks have to offer, please contact them directly using the information in Table 13.

Table 17. Contact Information For County Parks.

County Department	Phone Number/Internet Address
Calumet County Parks Department	(920) 439-1008 http://www.co.calumet.wi.us/
Fond du Lac County Parks Department	(920) 929-3135
Manitowoc County Parks Department	www.co.manitowoc.wi.us
Ozaukee County Park Commission	(262) 284-8258 http://www.co.ozaukee.wi.us/parks.html
Sheboygan County Parks Department	http://www.co.sheboygan.wi.us/
Additional Sheboygan Area Recreation Information	http://access-sheboygan.com/recreation

The 2000+ miles of recreational trails within the Southeast Region provide for a myriad of opportunities. These trails owned by state, county, local governments and non-profit organizations meander through many state forests, parks, wildlife and natural areas to provide scenic wildlife viewing, biking, horseback riding and nature hunting opportunities. In the winter months these trails also provide opportunities like cross-country skiing, snowshoeing, and snowmobiling. The Sheboygan River Basin contains a portion of the 1,000 mile long Ice Age Trail. This trail is known for its distinctive glacial features and unique recreational opportunities. Approximately 20 miles of the Ice Age Trail currently exist in the basin, all within the Northern Unit of the Kettle Moraine State Forest.

Shore fishing opportunities are abundant throughout the Sheboygan River Basin. Inland lakes including Gerber and Jetzers provide handicap accessible fishing piers. Many of the local parks along major rivers provide wadable and shore fishing opportunities. The Sheboygan Quarry is stocked seasonally with rainbow trout for urban and youth fishing opportunities. The tributaries to Lake Michigan also enjoy seasonal runs of Lake Michigan trout and salmon. ***For more information about fishing opportunities in the Sheboygan River Basin, please contact the WDNR Fisheries Manager at (920) 892-8756.***

Many of the inland lakes in the Sheboygan River Basin have public launch facilities (Table 14). In addition, there are several Lake Michigan public launch sites located within the cities of Port Washington and Sheboygan. A public canoe launch for the Sheboygan River is maintained by Sheboygan County along the Old Plank Trail. Canoeing is also very popular at the Sheboygan Marsh.

Table 14 is a summary of the boat access sites on lakes in the Sheboygan River Basin.

Table 18. Boat Access Sites on Sheboygan River Basin Lakes and Ponds.

Waterway	Lake Size (acres)	Operating Authority	Launch Fee	Handicapped Access	Boat access type	Ramp type	# of ramps	# of vehicle/ trailer parking spaces	Directions
Beechwood Lake	11	Village of Beechwood	No	Fishing pier	Boat ramp	Gravel	1	3	CTH A just north of CTH S in Beechwood. Accessible fishing pier available.
Big Elkhart Lake	286	Sheboygan County	No	Yes	Boat ramp	Concrete planks	2	22	CTH C, north on CTH P for 2 miles. Watch for sign. No powerboats on Sundays from 2nd Sunday in June to the to 2nd Sunday in Sept.
Big & Little Gerber Lakes	22	Sheboygan County	No	Yes	Boat ramp	Concrete planks	1	12 (approx.) gravel lot	STH 57, west on Gerber Lake Rd. for 3/4 mile. Electric motors only. Accessible fishing pier available.
Butler Lake	7	DNR	State Park Sticker	No	Boat ramp	Gravel	1	5	In No. Kettle Moraine State Forest. From CTH V, west on Butler Lake Rd. for 1/2 mile. North end of lake. Electric motors only.
Cascade Mill Pond	7	Village of Cascade	No	No	Roadside	Dirt/gravel	0	0	From STH 28, north on CTH NN to small park and launch site.
Cedar Lake	142	Manitowoc County			Boat ramp				
Crooked Lake	91	DNR	No	Yes	Boat ramp	Concrete planks	1	10	From CTH 28, west on CTH SS for 5.5 miles to site. Look for sign.
Crystal Lake	152	Sheboygan County	No	Yes	Boat ramp	Concrete	1	19	From CTH C to east on Birch Tree Rd. SW side lake. No powerboats on Sundays from the 2nd Sunday in June to the 2nd Sunday in September.
Glenbeulah Millpond	7	Village of Glenbeulah	No	No	Roadside	Blacktop	0	0	From Main Street in Glenbeulah, south on Garden Street to site.
Jetzers Lake	15	Sheboygan County		Yes	Boat ramp	Concrete	1	5	From STH 32, west on CTH A for 2.25 miles to launch site. Electric motors only. Accessible fishing pier available.
Lake Ellen	121	DNR	No	Yes	Boat ramp	Concrete planks	1	6	From STH 28, south on Ellen View Rd. to site.
Lake Seven	27	DNR	No	Yes	Boat ramp	Concrete planks	1	5	From CTH SS, south on Maple Tree Rd., for ¼ mile. Watch for sign. Electric motors only.
Little Elkhart Lake	54	Sheboygan County	No	Yes	Boat ramp	Concrete planks	1	7	From STH 67, north to Schwaller Dr. to launch site. No powerboats on Sundays from 2nd Sunday in June to the 2nd Sunday in September.
Pigeon Lake	86				Boat ramp				

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Waterway	Lake Size (acres)	Operating Authority	Launch Fee	Handicapped Access	Boat access type	Ramp type	# of ramps	# of vehicle/ trailer parking spaces	Directions
Random Lake	209	Village of Random Lake	No	Yes	Boat ramp	Sand & Gravel	2	20	From STH 57, west on CTH K to east on Russell Dr. Launch in village park.
Rockville Flowage	110	Manitowoc County			Boat ramp				
Sheboygan Marsh	675	Sheboygan County	No	Yes	Boat ramp	Concrete	2	40 (approx.) gravel lot	Located in Broughton Sheboygan Marsh Park. Park entrance at the int. of CTH P and CTH SR.
Shoe Lake	9	Manitowoc County			Boat ramp				
Wilke Lake	95	Manitowoc County			Boat ramp				
Wolf Lake	76	Fond du Lac County			Boat ramp				

OBJECTIVES FOR RECREATIONAL LANDS IN THE SHEBOYGAN RIVER BASIN

- The State should continue to acquire recreational lands within the Sheboygan River Basin in accordance with project acquisition goals, where feasible.
- The WDNR should continue to work with local municipalities and conservation clubs or groups on acquisition and development of public lands or access through established programs such as the State Stewardship Program.
- The WDNR should work with counties and municipalities to evaluate the adequacy of public launch sites on inland lakes and Lake Michigan and prioritize needs for existing sites or the needs for additional sites.
- Where feasible, work with others to establish additional canoe/kayak launch sites on major rivers within the Sheboygan River Basin.
- Explore opportunities to expand the urban and youth fishing program in the Sheboygan River Basin.

Chapter 4. Sheboygan River Basin Partnerships

SHEBOYGAN RIVER BASIN LAND AND WATER PARTNERS

The Department of Natural Resources reorganized land and water resource programs around geographic features (river basins) to improve natural resources management. A central theme of the reorganization has been to encourage enhanced community cooperation and citizen involvement through partnerships. This emphasis led to the formation of the Sheboygan River Basin Land and Water Partner Team (Partner Team).

The Partner Team was formed in 1998 to give citizens, environmental and conservation groups, businesses and local governments the ability to directly participate in setting priorities for work conducted throughout the Sheboygan River Basin. Table 14 (page 67) lists the partner team representation, and Table 15 (page 69) lists the WDNR Land and Water staff for the Sheboygan River Basin. Through a group process the Partner Team defined the following Sheboygan River Basin Goal and Objective as their partnership philosophy.

Sheboygan River Basin Goal

"To protect, restore and improve the Natural Resources of the Sheboygan River Basin through a cooperative effort of Federal, State and Private entities"

Sheboygan River Basin Objective

"The Sheboygan partners will help set joint priorities for the geographic management unit and will define the roles of various partners in addressing the priorities"

Table 19. Sheboygan River Basin Land and Water Partners Representation.

❖ City of Sheboygan	❖ Sheboygan Farm Bureau
❖ Maywood Environmental Park	❖ Tecumseh Products Company
❖ Sheboygan County Conservation Association	❖ Wisconsin Woodlands Association
❖ Alpha Terra Science	❖ Wisconsin Conservation Congress
❖ Kohler Company	❖ Earth Tech, Inc
❖ UW-Extension	❖ Wisconsin Department of Natural Resources
❖ Sheboygan County Planning	❖ Sierra Club
❖ Representative Landowners	❖ Sheboygan County Land Conservation Department
❖ Natural Resources Conservation Service	

Land and Water Resource Issues and Priorities

The Sheboygan River Basin Land & Water Partners have substantially improved communication between stakeholders on a number of important conservation issues in the basin. Every meeting starts with an issues and opportunities discussion that has been extremely valuable relative to sharing information between partners. The Team utilizes sub-working groups to focus partnership team efforts. These working groups include:

Publicity & Public Relations Work Group: Work efforts are directed at increasing the awareness of the partnership team and shared priorities. This team has helped in the development of the partner team web page and other tools for publicity. Currently, the team is working on a survey of conservation projects being conducted by environmental groups and municipalities in the basin. This work group will be creating a map of conservation projects in the basin which will be widely distributed to public locations for display.

Grant Resources Work Group: This team is focusing on available grants and has made progress on a process to manage grant resources.

Riparian Buffers & Wetland Resources Work Group: A number of partners have programs that focus resources on the establishment of riparian buffers and wetland resources. This work group has made some progress in a collaborative approach that brings local, state and federal resources and efforts together.

Sheboygan Marsh Strategic Master Plan Work Group: The partnership team has provided support to this very important master plan process.

Dam Work Group: This group is working on a basin wide strategy for dams including increased communication and education for dam owners and the public.

Environmental Corridors & Smart Growth Work Group: This is a new working group that will be evaluating partnership team roles relating to municipal comprehensive planning and use of newly acquired environmental corridor GIS data.

The Partnership Team recently reorganized a three year old list of issues to focus priorities with clearer goals and objectives. These priorities are listed below in Table 15.

Table 20. Priorities Identified by the Sheboygan River Basin Land and Water Partners.

1. Promote Sound Land Use in the Sheboygan Basin

- Conserve the character of rural areas in the basin including natural areas, prime agricultural lands, and environmental corridors
- Encourage compatible land uses adjacent to public lands
- Encourage re-development of brownfields, abandoned and derelict properties in urban areas
- Support & encourage Comprehensive Land Use Planning ("Smart Growth") in the basin
- Promote measures designed to improve air quality (i.e. mass transit, multi-modal transportation options, ozone action)

2. Conserve and Restore Riparian Areas in the Sheboygan Basin

- Combine public & private efforts to restore riparian stream buffers for water quality and wildlife
- Conserve and restore wetland functions and values in the basin
- Conserve and enhance sensitive habitat areas in lakes
- Restore environmental integrity & recreation values in the lower Sheboygan River
- Remove dams and restore free flowing waterways, where feasible

3. Acquire Sufficient Public Lands and Manage for Multiple Uses

- Complete the Sheboygan Marsh Master Plan
- Promote public land acquisitions that protect natural areas and provide recreational opportunities
- Connect the northern & southern units of the Kettle Moraine State Forest

4. Improve Water Quality

- Encourage best management practices in agricultural areas
- Promote stormwater management measures that prevent non-point pollution in rural & urban areas
- Support measures that prevent the pollution associated with the use of bio-solids
- Protect groundwater resources in the basin

5. Educate Citizens on the Importance of Natural Resources in the Basin

- Improve public outreach for education of land & water issues in the basin
- Provide land development information related to wise use of resources

Table 21. Sheboygan River Basin Land and Water Staff.

Water Team Staff	Land Team Staff
Vic Pappas, Water Team Leader (414) 229-0862	Frank Trcka, Regional Land Leader (414) 263-8615
Rhonda Volz, Water Sub-team Leader (414) 229-0868	Larry Baer, Forester (920) 892-8756
Ken Denow, Sludge Specialist (414) 229-0860	Dale Katsma, Wildlife Biologist (920) 892-8756
John Masterson, Water Resources Biologist (414) 229-0845	Steve Klock, Wildlife Technician (920) 892-8756
Steve Galarneau, Water Resources Biologist (414) 229-0859	Missy Sparrow, Wildlife Biologist (920) 892-8756
John Nelson, Fisheries Biologist (920) 892-8756	Bob Hanson, Wildlife Technician (920) 892-8756
Rick Knapp, Fisheries Technician (920) 892-8756	
Jerry Collins, Small Public Wells Specialist (414) 229-0825)	
Brent Binder, Floodplain/Dam Safety Engineer (414) 229-0861	
Wastewater Engineer (Vacant) (414) 229-0836	
Kathi Kramasz, Water Regulation & Zoning (920) 892-8756	
Petwara Toyingtrakoon, Public Drinking Water Engineer(414) 229-0824	
Kevin Shurilla, Private Wells Specialist (414) 229-0830	
Liz Spaeth-Werner, Source Water Assessment Program-Drinking Water (414) 229-0828	

- Note: A new service center for Department Staff will be opening in the City of Plymouth in 2002. Telephone numbers will likely change at that time.

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Chapter 5: Strategic Implementation Recommendations Summary

This document has described the issues and challenges, past and present, facing the water and land resources in the Sheboygan River Basin. We recognize the effects our actions have on the environment, and many groups and individuals are taking action. This chapter summarizes the high priority issues and actions that the Wisconsin Department of Natural Resources and partners have identified to monitor, manage, restore and protect the basin'' resources for the present and the future. The following represent priority issues and actions identified for the next five years. These actions are described under the goals and objectives of the WDNR Strategic Plan, which provides a context for carrying out the mission of the Department of Natural Resources.

MISSION AND GOALS

The Wisconsin Department of Natural Resources (WDNR) operates with a broad mission for managing natural resources of the state (see box, below right). The WDNR recently completed a strategic plan guided by this mission. The four main goals outlined below provide a blueprint for WDNR staff and partners to cooperatively carry out this mission. *The State of the Southeast Fox River Basin Report* provides a framework for managing our resources within a context of shared responsibility.

WDNR Mission Statement

To protect and enhance our natural resources:
our air, land and water;
our wildlife, fish and forests
and the ecosystems that sustain all life.
To provide a healthy, sustainable environment
and a full range of outdoor opportunities.
To ensure the right of all people
to use and enjoy these resources
in their work and leisure.
To work with people
to understand each other's views
and to carry out the public will.
And in this partnership
consider the future
and generations to follow.

I. Making People Our Strength

We must promote people, organizations and officials working together to provide Wisconsin with healthy, sustainable ecosystems. In partnership with all publics it is imperative we find innovative ways to set priorities, to accomplish tasks and to evaluate successes to keep Wisconsin in the forefront of environmental quality and science-based management.

II. Sustaining Ecosystems

We must work to ensure the state's ecosystems become and remain balanced and diverse. Sound decisions that reflect long-term considerations of healthy environments and a sustainable economy will help us protect, manage and use these ecosystems in a balanced way.

III. Protecting Public Health and Safety

We must work to ensure our lands, surface waters, groundwater and air are safe for humans and other living things that depend upon them and that people are protected by the laws governing natural resources in their livelihoods and recreation.

IV. Providing Outdoor Recreation
We must provide citizens and visitors with opportunities and access to areas in which they can enjoy a full range of nature-based outdoor recreations.

For the complete text of the WDNR Strategic Plan, please visit us on the web at www.dnr.state.wi.us/aboutdnr/plans.

MAKING PEOPLE OUR STRENGTH

From the DNR Mission Statement:

To work with people
to understand each other's view
and to carry out the public will.
And in this partnership
consider the future
and generations to follow.

The Goal

People, organizations and officials work together to provide Wisconsin with healthy, sustainable ecosystems. In partnership with all publics we find innovative ways to set priorities, accomplish tasks and evaluate successes to keep Wisconsin in the forefront of environmental quality and science-based management.

Strategic Objectives:

- Continue work with the U.S. EPA, NOAA, USFWS, and the principle responsible parties to effect sediment clean-up activities in the Sheboygan River Area of Concern/Superfund Site.
- Continue work with the Sheboygan County Planning and Resource Department staff and other stakeholders to update the Sheboygan Marsh area Master Plan as it nears completion.
- Prioritize support and assistance to County Land Conservation efforts in the basin to establish critical buffers along streams throughout the basin to protect stream integrity.
- Continue to work with the City of Plymouth to address safety and water quality issues associated with the Plymouth Millpond and its dam.
- Assist and encourage Basin communities to implement effective construction site erosion and stormwater management ordinances, with snow disposal provisions, to enhance water quality, stabilize flows and enhance public safety.
- Continue work with Sheboygan County to identify drain tiles from septic systems and milk-house wastes that discharge directly to basin streams; facilitate needed corrections.
- Connect volunteers with opportunity to assist in raising and releasing beetle and weevil species used in controlling the spread of the detrimental exotic plant, Purple Loosestrife.
- Encourage riparian landowners to maintain and/or establish riparian buffers.
- Continue support work with the Pigeon River Water Action Volunteers in conducting water quality monitoring throughout the Pigeon River Watershed.
- Coordinate with and support local partners in initiating and/or enhancing the Self-Help Monitoring Program for Basin lakes including: Little Elkhart Lake, Praeder Lake, Gerber Lakes, Giltners Lake, Wilke Lake, Sy Lake, Shoe Lake, Little Sy Lake, Graf Lake, Bullet Lake, and Paulys Lake.

- Coordinate with and support local schools and interest groups in establishing volunteer monitoring in the Sauk Sucker and Black River Watersheds.
- Continue workshop development and presentations with Professional Associations and statewide staff to provide technical updates, discussion, and assistance for/with well installers, pump installers and regulators.
- Continue work with community, including UW-Extension, Public Health Departments, professional and environmental organizations, to comprehensively address local needs for information, education, technical assistance and to support the public's ability to knowledgeably participate in making decisions regarding their natural environment.
- Continue to work with individuals and local communities to plan projects with an environmental awareness.
- Continue to work with local zoning staff to ensure proper floodplain management and work toward reducing the number of at risk structures.
- Assist local officials with the transition to the new Lake Michigan Floodplain model that accounts for wave run-up along the shoreline.

II SUSTAINING ECOSYSTEMS

From Our Mission Statement:

To protect and enhance our natural resources:
our air, land and water;
our wildlife, fish and forests
and the ecosystems that sustain all life.
To provide a healthy, sustainable environment

The Goal

The state's ecosystems are balanced and diverse. They are protected, managed and used through sound decisions that reflect long-term considerations for a healthy environment and a sustainable economy.

Strategic Objectives

Lake Michigan Habitat

- Conduct sturgeon assessment in the Sheboygan River to identify remnant populations and available habitat
- Conduct Fish assessments by the Lake Michigan Fisheries Unit for yellow perch young-of-the-year.
- Conduct acoustical forage assessment off the Sheboygan Shore to assess the available forage in Lake Michigan in cooperation with USGS.
- Conduct lake trout and lake wide fish assessment at the midlake refuge to assess the lake trout population.
- Evaluate environmental impacts associated with solid piers and rock groin structures in Lake Michigan.
- Form partnerships with agencies, environmental groups and citizens that wish to work on Great Lakes issues such as beach monitoring, coastal wetlands, enhancements, erosion and floodplain mapping.

Cold Water Habitat

- Continue to implement stream habitat improvements on the upper reaches of the Onion River as opportunities arise. Much of this work is dependent on the acquisition of additional stream frontage and cooperation with partner groups such as Trout Unlimited and the River Alliance. Complete initiated projects including habitat restoration at Kamrath Springs, Silver Spring and the Bonhoff projects.
- Continue fishery and habitat surveys of the upper Onion River during the life of this plan. WDNR will continue to partner with Trout Unlimited, River Alliance and others towards restoration and monitoring improvements in water quality, habitat and aquatic life.
- Continue land acquisition within the Onion River Stream Bank Protection Area as part of the Stewardship Program.
- Survey water temperature and aquatic life in the coldwater section of the Mullet River to determine the factors that limit the river from reaching its full potential as a coldwater resource. Based on this information, habitat restoration will be proposed as needed, and as opportunities arise.
- Scrutinize proposed private pond projects that require Chapter 30 permits and assist in the protection of the public interest in these cold water resources.
- Assess the impacts of the fish hatcheries in the headwaters Mill Creek.

Warm Water Habitat

- Continue restoration of wetlands on state lands in the Sheboygan Marsh.
- Continue the restoration of wetlands along Belgium Creek in conjunction with the Conservation Reserve Program with U.S. Fish and Wildlife Service personnel.
- Complete a feasibility study and master plan for the Kiel Marsh area.
- Continue cooperative work on habitat improvements to Sauk Creek.
- Conduct surveys of the warm water reaches of the Onion River to assess the impacts of dams and obtain pre-dam removal data as opportunities arise.
- Continue work to improve water quality be decreasing nutrient loads, sediment runoff and stormwater runoff to Barr Creek and its tributaries.
- Conduct water quality assessments on:
  - Ludowissi Lake in the Sauk Sucker Watershed
  - Grasser Lake in the Sauk Sucker Watershed
- Conduct water quality and comprehensive fish surveys on:
  - Little Elkhart Lake
  - Gerbers Lake
  - Hingham Millpond
- Continue to conduct water quality and fisheries assessments on Crystal Lake as part of the Trend Monitoring project.
- Assess Smallmouth Bass populations on the main stem of the Sheboygan River and provide additional habitat where feasible, especially in the former Franklin Dam impoundment.
- Continue to conduct water quality assessments on the Sheboygan River at Esslingen Park as part of the Trend Monitoring project for streams
- Conduct stream assessments that include water chemistry and habitat attribute evaluations on all tributaries to:
  - Sauk Creek
  - Sucker Creek
  - Lake Michigan within the Sauk Sucker Watershed
  - Black River
  - Lima Tributary to the Onion River

- Jackson Creek
- Evaluate the effectiveness of biological control agents released in Kohler-Andrae State Park to restrain expansion of the exotic plant, Purple Loosestrife and the control agent at the Arthur Jerving Conservancy property.
- Identify the presence of exotic species on land and in water, limit their spread and work towards eradicating them.
- Conduct a stream assessment of the unnamed tributary to Fisher Creek now that the Lakeland College no longer discharges to the stream.

Nonpoint Pollution

- Promote and assist in local efforts to install effective riparian buffers along all streams within the basin to minimize unnecessary entry of sediments and nutrients to basin lakes and streams. Critical partners include:
  - Sheboygan County Land Conservation Department
  - Ozaukee County Land Conservation Department
  - Manitowoc County Land Conservation Department
  - FonduLac County Land Conservation Department
  - Natural Resources Conservation Service (NRCS)
- Prioritize support for the following watershed selection of nonpoint source management projects and funding:
  - Mullet River
  - Black River
- Survey Jetzer's Lake to evaluate the effectiveness of the alum treatment.
- Conduct "Signs of Success" monitoring when best management practices get implemented as part of the Priority Watershed project.

Impoundments

- Complete the Franklin Dam removal and restoration of the Sheboygan River in the former impoundment in cooperation with Trout Unlimited and the River Alliance.
- Assess the fish community of the Meyer Impoundment.
- Conduct sediment quality assessments in the New Paris impoundment and Camp Evelyn Impoundment.
- Continue to evaluate the monitoring conducted by the State Historical Society for the Old Wade House project on the Mullet River.
- Continue to monitor the water quality and biological communities in the Mullet River for potential impacts associated with the Old Wade House Project.
- Conduct water quality and aquatic life surveys associated with the Franklin Dam Removal project and other dam removals as the opportunities arise.
- Encourage removal of dams on the Mullet River and conduct water quality and fisheries monitoring at these sites as dam removal opportunities arise.
- Conduct water and sediment quality and fish surveys on the Sheboygan River impoundments.

Contamination

- Continue to support development of a sediment transport model in the lower Sheboygan River and inner harbor to evaluate the potential to scour contaminated sediment under various stream flows.

- Continue assessment of the bioavailability of contaminants in the Sheboygan River Area of Concern (AOC).
- Determine the source and extent of contaminated sediment in the East Branch of Belgium Creek and Onion River.
- Reduce inputs of persistent toxic substances to Lake Michigan from the Sheboygan River.
- Improve sediment quality so that, if dredging is necessary, disposal is not restricted because of contaminants.

Land Use

- Work to develop a Sheboygan County version of the *Natural Areas and Critical Species Habitat Plan* similar to the one written by the Southeast Wisconsin Regional Planning Commission for Ozaukee County.
- Work in partnership with municipalities and townships that are developing new comprehensive plans in accordance with the new "Smart Growth" initiatives. Provide the best natural resource information available to enhance community awareness of local environmental assets and encourage consideration of these factors in development of community plans.
- Work with Sheboygan County Airport staff and Wisconsin Department of Transportation Bureau of Aeronautics on preventing wetland loss and the use of mitigation where wetland loss is critically unavoidable in the expansion of the Sheboygan County Airport.

III. PROTECTING PUBLIC HEALTH AND SAFETY

From Our Mission:

To provide a healthy, sustainable environment
and a full range of outdoor opportunities.
To ensure the right of all people
to use and enjoy these resources
in their work and leisure.

The Goal

Our lands, surface waters, groundwater and air are safe for humans and other living things that depend upon them. People are protected by natural resources laws in their livelihoods and recreation.

Strategic Objectives

- Provide technical assistance to owners, operators and patrons of drinking water supply systems. Continue to issue boil water/disinfection advisories as appropriate; enforce SDWA requirements.
- Continue collection of waterfowl, small mammals, turtles, and swallows, for tissue analyses to determine toxic contaminant levels and health effects associated with the Sheboygan River Superfund Site.
- Collect and analyze fish for PCBs, pesticides, and mercury throughout the watershed.
- Assess the general status of all dams in the watershed based on size, date of last inspection, and estimated hazard rating. Then, address specific concerns of individual dams that posses a relatively higher risk. Eventually bringing all of the dams in the watershed into compliance with the dam safety program.
- Continue to improve floodplain mapping through the use of new technology, more detailed data and new or additional studies.

- Continue special investigations as necessary to assist in the identification & appropriate response to contaminant plumes, potential repercussions to pumping by high capacity well systems, dam removal, farm or industry land-use applications and other unanticipated drinking or groundwater issues impacting the community.
- Continue work in source water protection, including identification of potential contaminant sources with the potential to impact public drinking water wells.
- Maintain cycle of water supply system inspections to insure routine maintenance of sanitary conditions and provide opportunity for updates and technical discussions with system owners and operators.
- Work with building inspectors and other municipal officials to identify new or abandoned public wells.
- Assist in the development of a protocol for monitoring and responding to bacteria levels along Lake Michigan beaches in the basin.

IV. PROVIDING OUTDOOR RECREATION

From Our Mission:

To provide a healthy, sustainable environment
and a full range of outdoor opportunities.
To ensure the right of all people
to use and enjoy these resources
in their work and leisure

The Goal

Our citizens and visitors enjoy outdoor recreation and have access to a full range of nature-based outdoor recreational opportunities.

Strategic Objectives:

- Improve canoe access along our rivers.
- Support and encourage enrollment by private landowners in the federal farm programs, especially the Conservation Reserve Program and Wetland Reserve Program.
- Improve public access for nature recreation along Lake Michigan in the Sheboygan River Basin.
- Continue work with the City of Sheboygan to maintain and enhance fishing opportunities in the Sheboygan Harbor and riverfront.
- Continue work with the City of Port Washington to maintain and enhance fishing opportunities in the Port Washington Harbor.
- Conduct creel surveys in Sheboygan County to assess the salmon and trout populations in Lake Michigan and the Sheboygan River.
- Improve angling, hunting, and nature enthusiast opportunities in the Sheboygan River Basin.
- Work to ensure safe and adequately marked portage routes exist at all dams along the Sheboygan River.

References

Will insert upon completion of report for public review

Appendix A

Table 22. Endangered, Threatened, Special Concern Species and Rare Communities in the Sheboygan River Basin.

Common Name	Type	Status
PIPING PLOVER	BIRD	endangered
BARN OWL	BIRD	endangered
STRIPED SHINER	FISH	endangered
COOPER'S MILKVETCH	PLANT	endangered
SMALL SKULLCAP	PLANT	endangered
EARLY ANEMONE	PLANT	endangered
PRAIRIE WHITE-FRINGED ORCHID	PLANT	endangered
PURPLE FALSE OATS	PLANT	endangered
PRAIRIE DUNEWORT	PLANT	endangered
QUEEN SNAKE	SNAKE	endangered
NORTHERN RIBBON SNAKE	SNAKE	endangered
LAKE--HARD BOG	COMMUNITY	rare
LAKE--SOFT BOG	COMMUNITY	rare
LAKE--SHALLOW, HARD, DRAINAGE	COMMUNITY	rare
LAKE--SHALLOW, HARD, SEEPAGE	COMMUNITY	rare
SPRING POND	COMMUNITY	rare
FLOODPLAIN FOREST	COMMUNITY	rare
NORTHERN WET-MESIC FOREST	COMMUNITY	rare
NORTHERN WET FOREST	COMMUNITY	rare
HARDWOOD SWAMP	COMMUNITY	rare
EMERGENT AQUATIC	COMMUNITY	rare
NORTHERN SEDGE MEADOW	COMMUNITY	rare
SOUTHERN SEDGE MEADOW	COMMUNITY	rare
INTERDUNAL WETLAND	COMMUNITY	rare
SHRUB-CARR	COMMUNITY	rare
ALDER THICKET	COMMUNITY	rare
BOG RELICT	COMMUNITY	rare
SPRINGS AND SPRING RUNS, HARD	COMMUNITY	rare
STREAM--FAST, HARD, COLD	COMMUNITY	rare
SOUTHERN DRY-MESIC FOREST	COMMUNITY	rare
SOUTHERN MESIC FOREST	COMMUNITY	rare
NORTHERN DRY-MESIC FOREST	COMMUNITY	rare
NORTHERN MESIC FOREST	COMMUNITY	rare
GREAT LAKES BEACH	COMMUNITY	rare
LAKE DUNE	COMMUNITY	rare

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Common Name	Type	Status
BLACK-CROWNED NIGHT-HERON	BIRD	special concern
NORTHERN GOSHAWK	BIRD	special concern
UPLAND SANDPIPER	BIRD	special concern
AMERICAN EEL	FISH	special concern
LAKE HERRING	FISH	special concern
BANDED KILLIFISH	FISH	special concern
LEAST DARTER	FISH	special concern
PHYLLIRA TIGER MOTH	MOTH	special concern
FRAGRANT SUMAC	PLANT	special concern
DRAGON WORMWOOD	PLANT	special concern
AMERICAN GROMWELL	PLANT	special concern
MARBLESEED	PLANT	special concern
AMERICAN SEA-ROCKET	PLANT	special concern
CUCKOOFLOWER	PLANT	special concern
CUCKOOFLOWER	PLANT	special concern
SEASIDE SPURGE	PLANT	special concern
YELLOW EVENING PRIMROSE	PLANT	special concern
ONE-FLOWERED BROOMRAPE	PLANT	special concern
WAXLEAF MEADOWRUE	PLANT	special concern
HAIRY BEARDTONGUE	PLANT	special concern
LONG-SPUR VIOLET	PLANT	special concern
GREEN ARROW-ARUM	PLANT	special concern
RICHARDSON SEDGE	PLANT	special concern
MANY-HEADED SEDGE	PLANT	special concern
COMMON BOG ARROW-GRASS	PLANT	special concern
SLENDER BOG ARROW-GRASS	PLANT	special concern
INDIAN CUCUMBER-ROOT	PLANT	special concern
SWAMP-PINK	PLANT	special concern
SMALL YELLOW LADY'S-SLIPPER	PLANT	special concern
SHOWY LADY'S-SLIPPER	PLANT	special concern
WHITE ADDER'S-MOUTH	PLANT	special concern
LEAFY WHITE ORCHIS	PLANT	special concern
HOOKER ORCHIS	PLANT	special concern
LARGE ROUNDLEAF ORCHID	PLANT	special concern
SLIM-STEM SMALL-REEDGRASS	PLANT	special concern
VARIEGATED HORSETAIL	PLANT	special concern
OVAL VALLONIA	SNAIL	special concern
RED-SHOULDERED HAWK	BIRD	threatened
ACADIAN FLYCATCHER	BIRD	threatened
CERULEAN WARBLER	BIRD	threatened

Common Name	Type	Status
HOODED WARBLER	BIRD	threatened
SLIPPERSHELL MUSSEL	MUSSEL	threatened
ELLIPSE	MUSSEL	threatened
FORKED ASTER	PLANT	threatened
DUNE THISTLE	PLANT	threatened
STICKY GOLDENROD	PLANT	threatened
YELLOW GENTIAN	PLANT	threatened
CLUSTERED BROOMRAPE	PLANT	threatened
SEASIDE CROWFOOT	PLANT	threatened
MARSH VALERIAN	PLANT	threatened
SNOW TRILLIUM	PLANT	threatened
ROUND-LEAVED ORCHIS	PLANT	threatened
RAM'S-HEAD LADY'S-SLIPPER	PLANT	threatened
SAND REED-GRASS	PLANT	threatened
THICKSPIKE	PLANT	threatened
CHERRYSTONE DROP	SNAIL	threatened
BLANDING'S TURTLE	TURTLE	threatened