

The State of the Wolf Basin

PUBL WT 664 2001



Photo: Loon Lake, Shawano County. E.J. Judziewicz, WDNR Bureau of Endangered Resources

A report by the
Wisconsin Department of Natural
Resources in cooperation with the Wolf
Basin partnership team and stakeholders



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State of the Wolf River Basin Report

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August 25, 2001

To: Residents and User of the Natural Resources within the Wolf River Basin

Wisconsin Department of Natural Resources staff and the Wolf River Basin Partnership are very pleased to present the first *Wolf River Basin State of the Basin Report*. The primary purpose of this report is to provide direction to Department staff, the Partnership, other agencies and citizens for managing and protecting the Wolf Basin's valuable natural resources. It should be clearly understood that this document is only a small part of managing our natural resources. We clearly recognize that other governmental units such as Federal agencies, other state agencies, each respective county and township, municipality, other natural resource and environmental groups and private citizens all have a role in preserving and protecting the basin's natural resources. One of the most important challenges we will have, as the Wolf Basin Team Leaders and Partnership leaders will be to integrate these other plans and work collaboratively with others. It is clearly recognized that we all have interests in preserving and protecting our natural resources and need to work cooperatively together.

It is widely recognized that the Wolf Basin is a wonderful place to live and play. Within the basin there are many miles of crystal clear trout streams, numerous forested lands, thousands of lakes and the Wolf River itself. Within the past twenty years significant changes have impacted the basin's landscape. As such, our natural resources have and will continue to come under increasing pressures and stresses. Several important developments have and will continue to drive this pressure. These include new highway projects, Highway 10 & 29, that will provide increased accessibility by residents and rural landowners. The idea of living in rural Wisconsin and working in a city is continuing to impact small basin cities and the landscape. These impacts of these changes and others will need to be considered in the future management of natural resources. The partnership understands this pressure and has reflected this concern in its direction and actions.

We would like to pay tribute to the members of the Wolf Basin Partnership. This partnership is made up of dedicated natural resources professionals, governmental and industrial officials, representatives from environmental and outdoor sporting organizations and private concerned citizens. These partners have contributed to managing the basin resources in ways they never envisioned. These people have identified issues and priorities for which will guide Department efforts for the next six years as noted in this report. Also, within the partnership, these members are working collaboratively together; to get separate projects completed without direct Department intervention and/or participation. In addition, these partners intend to move forward by working of specific project with workgroups. The partnership also acknowledges and accepts the challenge of educating the public on these important issues.

We would also like to acknowledge the importance and partnership of other organizations within and outside the basin. Many of these organizations are formed for the express purpose of promoting, protecting, preserving and managing natural resources. Their contributions of time, financial donations, property, equipment and support on issues are very much appreciated. We need to continue to nurture this cooperative atmosphere which will allow for greater effectiveness, efficiency and achievements.

Finally, we need to foster an attitude that it's all of our natural resources. We need to all work together to preserve and protect our precious natural resources for future generations.

Sincerely,

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Wolf Basin Water Team Leader

Jean Romback-Bartels
Wolf Basin Land Team Leader

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ACKNOWLEDGMENTS

Preparation of the Wolf River Basin Plan has been an effort of the Wisconsin Department of Natural Resources with support from its partnership group and DNR field and central office staff in the Divisions of Land, Water and Forestry. Many individuals contributed information, data analysis or review. Their help is much appreciated.

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Abbreviations Used in the State of the Basin Report:

DATCP	Wisconsin Dept. of Agriculture, Trade & Consumer Protection
DNR	Wisconsin Department of Natural Resources
NRCS	Natural Resources Conservation Service
LCD	County Land Conservation Department
UW-Extension	University of Wisconsin-Extension
USDA	United States Department of Agriculture
USGS	United States Geological Service

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<http://www.dnr.state.wi.us/org/gmu/wolf/index.htm>

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Picture Below: Wolf River, Oxbow Rapids, Langlade Co. June 3, 2000. E.J. Judziewicz. WDNR Bureau of Endnagered Resourches



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Executive Summary

This State of the Wolf River Basin Report identifies the status of resources in the basin and articulates DNR and partner goals and objectives to maintain, restore and protect ecosystem health. This integrated resource plan serves as an update to the Wolf River Basin Water Quality Management Plan and lists objectives for the areas of fish, wildlife and habitat to implement the state Fish and Wildlife Strategic Implementation Plan within the basin.

Basin Setting

The water-rich Wolf Basin covers a large area, draining over 3600 square miles and portions of eleven counties in the northeast portion of the state. The basin is primarily located in the Northeast Hills and Northeast Plains Ecological Landscapes with small portions in the Central Sand Hills, Southeast Glacial Plains, and North Central Forest (see map). The variable topography of the Northeast Hills are covered with extensive hardwood forests, while the Northeast Plains are characterized by gently rolling to flat topography with sandy soils and primarily oak and pine forests. Also present are hemlock, northern white cedar swamp, and hardwood conifer swamp. Numerous wetlands exist, particularly those associated with the Wolf River floodplain. Agricultural activities are more prevalent in the southern portion of the basin, while development along lakes and riverways is occurring throughout the basin.

Various stretches of the Wolf River, the basin's largest water resource, are considered outstanding or exceptional resource waters (ORW/ERW). This waterbody drains to the Winnebago Lake System and the rapidly growing Fox Valley area. Numerous lakes and impoundments, many of which are human-made from low-head dams on streams, serve as focal points for fishery and wildlife habitat as well as recreation.

Challenges

The scenic beauty of the Wolf Basin and its proximity to rapidly developing areas such as Green Bay and the Fox Valley make enhance its susceptibility to habitat loss and pollution from urban runoff. Likewise, the basin's agricultural sector results in runoff of excess nutrients and sediment. Additional challenges to ecosystem managers include the introduction of exotic species such as garlic mustard, purple loosestrife, gypsy moths, zebra mussels, and others that disrupt the delicate balance of both uplands and lowlands. Shawano Lake is an excellent example of an unbalanced ecosystem, with annual bird die-offs related to the presence of an exotic trematode or flatworm.

Priorities

Priorities for action have been identified by both the Department and its partnership team. The partnership team has identified four main priorities or issues of concern along with a series of recommendations. These issues and objectives/recommendations are identified on page 10. The four priority areas are:



Water Pollution



Loss of Shoreline Habitat



Hunting, Fishing, Trapping and Recreational Uses



Need for an Inventory of Basin Resources

The DNR Wolf Basin Team shares these concerns and has identified its own top priorities as well:



Preservation and protection of wetlands



Preventing the introduction and reducing the spread of invasive exotic species



Pressures from development



Land use and 'Smart Growth'

Public Review Comments and Response

A public informational open house for the draft of the State of the Wolf Basin Report was held June 26th, 2001 from 4:00 pm to 7:00 pm at the Clintonville Community Center located at 30 South Main Street, Clintonville, WI. Comments on the plan were received until July 11th, 2001 by the Department of Natural Resources. Below are key comments and responses from that process.

1. Crandon Mine Proposal - It goes against public opinion and the public should start a trust fund to buy the Crandon Mine
Please see: <http://www.dnr.state.wi.us/org/es/science/mining/>
2. The Mukwa Marsh - this should be a major project of the Wolf Basin's and should be enclosed in the Wolf River Bottomlands Project
3. Grant money for private land management for landowners
4. Boating Regulations on the Wolf River - erosion and safety concerns **This subject will be considered by the Wolf Basin Partnership.**
5. Invasive Species - What? Where? Management Techniques? **This subject will be considered by the Wolf Basin Partnership.**
6. List of Resources for people to attain (contact representatives) for grant money etc. **Please see page x-xi**
7. County Plans should be referenced in the report **Please see references**
8. Mercury contaminants in Sturgeon <http://www.dnr.state.wi.us/org/water/fhp/fish/>
9. Air photos of the river system from Army Core of Engineers
10. Keep the Fox Locks closed; there is a system of boatlifts to take a boat from point A to point B without the transfer of water. Wash/chlorinate and flush boat's system. **Please see:**
<http://www.dnr.state.wi.us/org/water/wm/lowerfox/>
11. Dam removal, where are they and where is the River Alliance at on this issue.
<http://www.wisconsinrivers.org/>
12. Tax break for people living on the water to demote selling off their land.
13. Land use maps for each watershed.
14. Priority Watersheds - The new proposal is to spread pollution funds- bank protection moneys around. Concentrate on an area like the Lower Little Wolf River where many landowners participate. **Please see pages 30-34**
15. Concern with DNR administrative decision to split the Wolf Basin. It is widely known that whatever happens in the north will impact the south.
16. More action on issues such as fragmentation of land, cold water systems loss to dams and housing.

Wolf Basin Partnership

The Wolf River partnership first began in March of 1998. From that meeting the partners identified that their four highest natural resource concerns for the basin were:

- **Water Pollution**
- **Shoreline Loss of Habitat**
- **Hunting/Fishing/Trapping and Recreational Use**
- **Inventory of Resources (to regulate all 3)**

The process then involved developing subteams (listed below), drafting a partnership agreement, developing a partnership philosophy and identifying resource priorities under the 4 major categories through a survey of each workgroup.

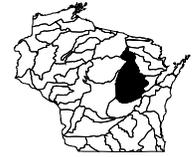
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Haze Diemel Shadows on the Wolf W7644 County F Shiocton, WI 54170 (715) 752-3344	Len & Judy Pubanz N6725 Balsam Row Shawano, WI 54166 (715) 526-34226
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Bush Brothers & Co. 401 W North Water Suite 200 P.O. Box 541 New London, WI 54961 (920) 986-3816	Fox/ Wolf 2000 P.O. Box 1861 Appleton, WI 54913 (920) 738-7025
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Wolf Basin Partnership



Partnership Agreement

The Wolf Basin Partnership is a broad group of citizens and agency representatives who have gathered together in the spirit of Partnership to benefit the environment of the Wolf River Basin.

The Mission of the Wolf Basin Partnership is to cooperatively prioritize and implement strategies, which protect, enhance and preserve the cultural and natural resources of the Wolf River Basin.

MEMBERSHIP

The Wolf Basin Partnership will strive to maintain a diverse membership including, but not limited to representatives from the following groups:

Tribes
Citizens
County government
Farming/Agriculture
Education

County Natural Resources Agencies

State Natural Resources Agencies
Conservation Groups
Federal Natural Resources Agencies
Recreational/Sportsman's groups
Industry/Business
Local Governments

Members understand, agree with and respect the Partnership's Mission and operating philosophy.

Regular meeting attendance is a key responsibility of all members. Full partnership meetings will be held twice a year, workgroup meetings are held as needed, usually monthly.

STRUCTURE

The Wolf Basin Partnership is comprised of a group of members, a steering/executive committee, and workgroups. Workgroups are staffed by partnership members and additional volunteers, and focus their energies on addressing specific issues or topics.

WHAT DO WE DO?

The Wolf Basin Partnership follows its Mission by relying on the dedication of its membership and workgroups.

☞ The Wolf Basin Partnership is self-directed and is accountable to itself.

☞ The Wolf Basin Partnership sets goals for addressing issues within the Basin and establishes workgroups to address these issues. Currently,

- The Loss of Habitat/Land Use Workgroup is addressing shoreland development issues by focusing on a targeted information and education program.
- The Pollution Workgroup is exploring point and non-point pollution issues and their impacts to the Wolf River Basin. This group also supports the concept of watershed management for planning and implementation activities.
- The Recreation/Hunting/Fishing Workgroup explored recreation issues and recommended an inventory and prioritization of Wolf Basin lands be conducted.

☞ The Wolf Basin Partnership is not funded by or supported by one entity alone – it is a Partnership which will look for funding and partnership opportunities to carry out its Mission. To date, the Wolf Basin Partnership has received 2 grants.

COMMUNICATION

Web site (<http://clean-water.uwex.edu/foxwolf/>) and mail will be used to ensure that all members and outside entities are informed about the activities of the Wolf Basin Partnership.

Wolf Basin Partnership Operating Philosophy
The Wolf Basin Partnership operating philosophy is based on 3 principles:
Diverse and active Partnership members
Clear Structure/Organization

*Communication***I. Partnership Members**Member Selection:

When selecting members for the Wolf Basin Partnership, both the size and diversity of the existing group will be evaluated. Potential members will be selected upon recommendation by current members and asked to make the commitment by the steering/executive committee.

People (not currently a member) interested in participating should make the request of the partnership and are invited to attend a meeting(s) to learn more about the Partnership and its goals and for the Partnership to learn more about them.

If membership is at a suitable capacity, interested people may be asked to serve in other capacities, such as workgroups, at-large or on an as-needed basis.

Responsibilities:

It is the responsibility of the members to attend and participate in all Partnership meetings and workgroup meetings as applicable. If a member cannot make a meeting date, it is requested that they provide advance notification to someone else on the group.

Partners that represent an organization are requested to send a proxy if the designated representative cannot attend.

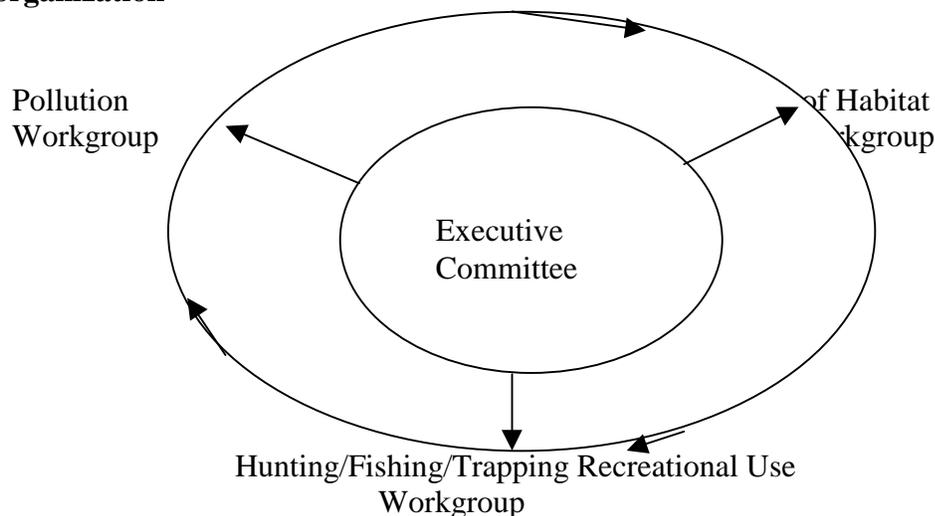
Frequent absences will be addressed by the steering/executive committee who may ask that the member reconfirm their commitment to the Partnership or step down to a different role so that someone with the time can be on the Partnership.

Decision-Making:

In the spirit of Partnership, decisions will be made by Partnership members using consensus.

Subcommittees or workgroups will act on their own accord and make smaller decisions in order to make progress and accomplish their goals. The workgroups will make recommendations to the Partnership on larger projects or issues for discussion and approval.

II. Structure/organization



Wolf Basin Partnership:

The function of the whole partnership is to prioritize and work on projects, issues and strategies, provide expertise and set goals and policies.

Steering Committee: The steering committee should only “start up”: the Partnership and work out procedural details. The steering committee will remain active for a year until an executive committee is selected and takes over.

Executive Committee: The executive committee will consist of a minimum of 8 diverse members from the Partnership including a liaison from each workgroup. Co-chairs will be self-selected from the executive committee. Co-chairs shall serve to lead the executive committee for 2 years, and shall be replaced alternately to maintain continuity and energy. There is no term limit for executive committee members.

Responsibilities of the executive committee are:

- Build Partnership capacity, including both human and fiscal resources, to accomplish the goals of the Partnership
- Call and chair Partnership meetings, coordinate workgroups; keep the Partnership moving forward
- Build fiscal capacity by finding appropriate grants and sponsors to accomplish workgroup goals and projects
- Maintain contact with workgroups to be aware of needs, issues and barriers
- Promote and maintain a diverse membership with the Partnership and the Executive Committee

Workgroups

Formed as needed as issues come up that need to be addressed more closely. Workgroups will meet as often as needed to get the work done.

Interested members from Partnership shall be on the workgroups, and other subject matter experts as needed.

Workgroups will be responsible for reporting back to the full Partnership at annual meetings and to provide a representative to the executive/steering committee.

Meetings

Frequency:

- Full Partnership will meet no less than 2 times per year and will accomplish the following in the two meetings:
 - Serve as a “check-in” point for all members
 - Reports/updates from workgroups
 - Have an educational/informational component
 - Review priorities and goals
 - Do strategic planning
 - Address policy concerns
 - Do work planning for upcoming year
 - Create or re-assign workgroups as needed
 - Provide an opportunity for Partners to discuss issues / concerns with each other during an informal setting and form new partnerships.
- Workgroups will meet as needed, approximately monthly
- Executive committee will meet as needed (approximately 4-6 times per year)
- Steering committee will meet as needed until duties are completed and executive committee takes over

Where: Meeting locations will vary depending on need.

Groundrules: from the Wolf Partnership Binder

- Start and end on time
- Respect each other’s ideas
- One person talks at a time
- Check your title at the door
- Complete all assignments
- 100 mile rule (meeting location)
- Everyone participates
- Decisions by consensus
- No side conversations

III. Communication

Communication is important to the Partnership. The Partnership will do its best to maintain communication with its members and external entities. To this end:

- Agenda – an agenda will be developed prior to each meeting with input from the previous meeting and partnership members. Agendas will be distributed with meeting notices, and may also be posted on the web site.
- Minutes – A scribe will be appointed at each meeting to take minutes. Minutes will be forwarded (electronically if possible) to UWEX Basin Educator for posting on web site. Minutes will be forwarded to DNR for distribution. Minutes will be completed not more than 10 days after each meeting.
- Mail lists will be maintained and updated by DNR Team Leaders and provided regularly to members
- Web site will be maintained by UWEX Basin Educator. Digital files of minutes, major documents, etc., will be posted on the web site. General information provided by Basin Partnership will also be posted on the site, and links to other partnership websites will be maintained as appropriate.
- The Partnership will do its best to send meeting notices no later than (30) days prior to the meeting.

Partnership List of Issues for 2000

Results are in order from most votes to least votes. Subheadings of a,b,c, indicate an equal number of votes for those issues.

Habitat Development- (Loss of Habitat)

1. Land use planning and implementation (due to new roads coming in and cities sprawling out).
2. Loss of habitat near shore area; shoreline restoration.
3. Need to be able to identify priority areas within the Basin.
4. Conduct a strong riparian owner education effort to show them the importance of proper land and shore management.
5. Look at "sustainability" of development issues within the Basin.
6. Create sustainability benchmarks and a group to monitor them.
7. Offer constructive criticism to DNR on its citizen participation process related to water and land decision making. Make Wolf River Basin a model for expanded citizen participation in DNR decision making.
8. Benefits of wetlands related to water quality. Should do an educational project to heighten awareness of their benefits.
9. Government should protect riparian area via regulation (what can/cannot people do?).
10. Have Wolf Basin Partnership endorse land acquisition in Basin (whether by DNR or other groups)
11. Develop a "water school" for community leaders in Basin.
12. Research and comment upon general permit program for Winnebago Pool pilot water permitting (piers, wharves, seawall replacement and pile clusters), per WI AB755 of 1997.
13. Address water levels, controls on White Lake in Weyauwega.
14. Fox Locks- keep them closed (because of exotic species concerns)

Hunting, Fishing, Trapping/Recreational Use Workgroup

1. Need to be able to identify priority areas within Basin.
2.
 - a.) Level of recreational use in our waterways - how do we manage?
 - b.) Look at "sustainability" of development issues within the Basin.
Create sustainability benchmarks and a group to monitor them.
 - c.) Dam removal issues
-Unclear- what are the issues? Which dams? And what are the management goals?
-Fish migration obstructions and cold water river or system degeneration.
3. Take a position on Crandon Mine
-OR Review implications of Ladysmith leakage for Crandon Mine and forward "findings of fact" to regulators and decision-makers, but without taking a political position.
-Get educated on the Crandon Mine Project (then make a decision if possible).
4. Offer constructive criticism to DNR on its citizen participation process related to water and land decision making. Make Wolf River Basin a model for expanded citizen participation in DNR decision making.
5.
 - a.) Recruit more hunting and fishing members to workgroup and get going.
Failing this, the workgroup should be discontinued or a new mission chosen.
 - b.) Have Wolf Basin Partnership endorse land acquisition in Basin (whether by DNR or other groups).
 - c.) Develop a "water school" for community leaders in Basin.
 - d.) Address Mukwa area and Hwy. X construction for walleye spawning and for public access on Wolf River.
 - e.) The exotic weed Eurasian Milfoil is spreading throughout the waterways of our state. Promote and support action that will help prevent this spread in the Wolf Basin.
6.
 - a.) Research and comment upon general permit program for Winnebago Pool pilot water permitting (piers, wharves, seawall replacement and pile clusters), per WI AB755 of 1997.

- b.) Watershed losses in Basin impact on base flows (better water management and uses- it is not an inexhaustible resource).
- 7. Clarify the trespassing law to the people in words all can understand- such as the public does not have the right of way along banks of streams of rivers. All land belongs to private ownership unless it is marked public land or is in forest crop, farm deer damage or other program making it open to the public.
- 8.
 - a.) Have a discussion on Bald Eagles and their removal from the endangered Species List.
 - b.) Trumpeter Swan awareness to improve identification by hunters (this is a DNR job).
 - c.) Address water levels, controls on White Lake in Weyauwega.
 - d.) Protect wood turtle (Clemy sp.) in riparian systems (Endangered species that needs clean water-good indicator species).
 - e.) Fox Locks- keep them closed (because of exotic species concerns).

Pollution Workgroup

- 1.
 - a.) Look into Large farm operations (CAFOs-Concentrated Animal Feeding Operations) potentially entering the basin. And comment on any proposal...and comment on overall impact and regulatory stance of Wisconsin State government.
 - b.) Take a position on Crandon Mine
 - OR Review implications of Ladysmith leakage for Crandon Mine and forward "findings of fact" to regulators and decision-makers, but without taking a political position.
 - Get educated on the Crandon Mine Project (then make a decision if possible).
 - c.) Offer constructive criticism to DNR on its citizen participation process related to water and land decision making. Make Wolf River Basin a model for expanded citizen participation in DNR decision making.
- 2. Benefits of wetlands related to water quality. Should do an educational project to heighten awareness of their benefits.
- 3. Conduct a study to determine seasonal and spatial variation in water quality and sources of pollution across the Basin, (part of TMDL development).
- 4.
 - a.) Have Wolf Basin Partnership endorse land acquisition in Basin (whether by DNR or other groups).
 - b.) Develop a "water school" for community leaders in Basin.
- 5.
 - a.) Examine federal and state regulations of cranberry operations for Wolf Basin prior to future establishment of industry.
 - b.) The goal of resource management by watershed is in danger of being lost to management by county due to changes in the non-point program.
- 6. Implement pollutant trading pilot and document effects on discharges, education piece; market based incentives for pollution control. Unclear-what is Partnership's role?
- 7.
 - a.) Protect wood turtle (Clemy sp.) in riparian systems (Endangered species that need clean water-good indicator species).
 - b.) Fox Locks-keep them closes (because of exotic species concerns).

Inventory (GIS) Workgroup

- 1. Need to be able to identify priority areas within Basin.
- 2. Improve accessibility of land use information to people (i.e. the web).
Use this to leverage a greater citizen participation in land and water management decisions.
- 3. Need to do resource inventory and resource management plan.

Steering/Executive Committee

- 1. Increase education efforts to private landowners on good stewardship of their property. Sound forestry, wildlife management practices. Ownership has some responsibility with it for good stewardship to occur (similar to the shoreline work done this year- just more efforts upland).
- 2. Need to be able to identify priority areas within Basin.
- 3. Review outdoor recreation facilities in Bain- do we need more open space/parks/non-hunting area for outdoor recreation such as hiking, horseback riding, mountain biking?

4. Create classification for rivers and accompanying ordinances and regulations. This would parallel the lakes classification program and would hopefully utilize state grant money from that program.
5. Offer constructive criticism to DNR on its citizen participation process related to water and land decision making. Make Wolf River Basin a model for expanded citizen participation in DNR decision making.
6. Fragmentation of land; leave large tracts large.
7. a.) Need to do resource inventory and resource management plan.
b.) [Prepare a] State of the Basin report and [clarify] GMU responsibility for integrated ecosystem management.
8. Recruit more hunting and fishing members to workgroup and get going.
Failing this, the workgroup should be discontinued or a new mission chosen.
9. a.) Need to educate people on the benefits of Ecosystem Services.
b.) Increase the diversity of user groups in the partnership.

Wolf Basin Overview

The Wolf River Basin covers an area of 3671 square miles and includes all or portions of eleven counties; Waushara, Outagamie, Waupaca, Marathon, Portage, Shawano, Menominee, Langlade, Oneida, Winnebago and Forest (see Map, pg. xvi). The Wolf River originates with a discharge from Pine Lake located in Forest County. The river flows south for about 203 miles until it reaches Lake Poygan. At that point it becomes part of the Winnebago Lake system. Waters from the Winnebago system then flow into the Lower Fox River where they eventually reach the Bay of Green Bay.

The Wolf Basin's general topography can be characterized by rolling hills, plain meadows, lush and forested wetlands, numerous lakes and small tributaries. Vegetation consists primarily of hardwood forests mixed with large amounts of hemlock, northern white-cedar swamp, and hardwood-conifer swamp. Many of the small creeks and rivers are sustained by draining numerous wetlands between rocky hills. As one travels from north to south they will observe that the terrain changes from hilly wooded, forest regions to flatter areas with an increase in farming activity. As one travels from the east-side of the basin to the west, you will observe clay soils become more sandy and see the effect of the glacier by seeing more pot hole lakes.

Development within the basin is predominately along the Wolf River or its major tributaries. Communities like Shawano, Clintonville, New London, Waupaca, Weyauwega and more were developed primarily because of being located on waterways that were used by the logging industry by our forefathers (see map page vxii). The basin's communities have an important link to their industrial bases. This industrial base is relatively modest compared to other communities located in the Fox Valley, Green Bay and Wausau areas. This "lack of large industry" is one of the factors that have allowed the landscape to remain basically a rural area. This "climate" is changing as many other people are finding the Wolf Basin as an attractive place to live and work.

Uncontrolled development is one of the most important issues that face the residents and governmental bodies within this basin. With the reconstruction of Highways 29 and 10 to four lanes, east/west travel has been greatly improved. This new highway system is allowing people to live in the basin and commute to their places of employment in the Fox Valley, Green Bay and Wausau areas. This system also works in reverse as this allows people to more easily access recreational opportunities and use the basin's natural resources. One other important aspect of this mobility is it is driving the price of lands to increase significantly. Further, this is creating a situation where it is becoming an economical impossibility to keep large tracts of land whole. In the past generations, we saw families or organizations keep their farms or land holdings within the family/group or they chose to sell it as one parcel. Today, there is considerable economic pressure to sub-divide large tracts of land into smaller more affordable areas. As such, we are seeing an increase in rural housing development, which in turn leads to new environmental and natural resource stresses. Examples of these situations include but are not limited to: more wells drawing more groundwater; more septic tanks or other systems discharging into the basin's aquifers; more roofs and driveways that reduce surface areas for absorption which in turn reduces groundwater recharge and increases runoff to waterways; land fragmentation and its effects on plant and animals as well as creating other sociological and governmental situations. This increased mobility of people is creating new pressures on the basin's environment and natural resources.

The Wolf River is the basin's largest watercourse. This large river serves as the basin's main artery by discharging its waters into the Winnebago Lake system. Within the Wolf system all other rivers, streams and their tributaries eventually flow into the Wolf River. Some of the larger rivers within the basin include the Waupaca/Tomorrow, Red, Little Wolf, and Embarrass. Many of these feeder streams are classified as Class 1 trout streams.

Within the basin are numerous lakes and impoundments. Many of these impoundments were man-made as the area's history was strongly linked to logging. During the early logging times, numerous rivers were dammed so their waters could be used as log transportation and energy generation. Many of these dams still exist today. Even today, many of these impoundments have remained as important community based resources as they include important fishery and wildlife areas and recreational and economic

opportunities. One only has to look at several communities and you will see the impact of their dams. Several important dams that come to mind are the Balsam Roe and Shawano Dams on the Wolf River. Others include dams at Clintonville on the Pigeon River, Weyauwega on the Waupaca River, and there are many more. One also needs to think about the challenges remaining with these dams. Today, we have concerns on these waters with the negative effects related to stormwater, point sources discharges and non-point runoff on the basin's water quality. These new situations will each create a new watershed and community based challenge.

The basin's natural lakes have their own kind of challenge. That challenge being an era of over development and over use. We are seeing lakefront "cottages" that were built in the 1930's, 40's and 50's being demolished and being replaced with year-round homes. This situation is not unique to the Wolf Basin as it is occurring in many other portions of the state. Basin lakes are succumbing to the impacts of year round use in both the water quality and habitat loss. People were once content to have a path to the lake. Today, many shoreland owners clear their frontage of all vegetation. The natural vegetation is replaced with virtually sterile expansive lawns. This "clear-cut" frontage approach removes the natural transition zone between the aquatic and terrestrial habitat. Loss of these zones significantly eliminates the habitat needed by fish and animals to live and reproduce. This loss also has an effect on shoreland erosion, which adds to water quality concerns. After the damage has been done and the effects are noted, people then decide to install riprap or seawalls in order to try and protect their shoreline. These alternatives are far inferior to Mother Nature's original shoreland protection plan. This pressure is expanding to the basin's rivers and streams. One could add river bottomlands and wetlands to this scenario as they too are under pressure to be developed.

We are seeing second and third tier homes being built around some of the basin's lakes. As such, sanitary sewer systems are needed to avoid groundwater contamination from septic tanks. We are also seeing an increase in portable docking facilities for these surrounding property owners as they demand access to the water. As one would expect, we see major boat traffic and personal watercraft congestion and accidents increase as they crowd these popular lakes, especially on holiday weekends. At some point, we have concerns about user safety and resource damage.

There is also another issue that needs to be clearly identified. The Wolf Basin is being threatened by invasive exotic species. There is growing concern about purple loosestrife, gypsy moths, zebra mussels, Eurasian water milfoil, garlic mustard in uplands, and others. We are seeing a situation in Shawano Lake where there is an annual fall water bird die off. This die off is linked to an exotic trematode (flatworm) parasite, which is ingested by the duck during its life cycle. There is a fear that this situation can be easily spread during migration. These species need to be continually monitored and if possible action needs to be taken to control their spread.

The Wolf Basin is a very large area with many diverse and plentiful natural resources. Current uses of the land includes; farming, forest products, residential areas within municipal & rural settings, municipal and industrial based discharges, publicly owned lands, lands held in trust by Native American Tribes, recreational opportunities and it is the home of many unique species of plants and animal as well as migratory species of fish and wildlife. This Wolf Basin is truly a special place with special and needs

Within the basin live many people and their respective communities. Some of these people clearly care about the basin they live in and it's natural resources. By their joining and supporting efforts numerous natural resource based organizations exist. There are numerous local organizations which include, but not limited to the following; Wisconsin Wildlife Federation, Walleyes for Tomorrow, Sturgeon for Tomorrow, Wisconsin Whitetails, Wolf River Preservation Association, Shadows on the Wolf, Fox/Wolf 2000, and several state and national chapters of Ducks Unlimited, Trout Unlimited, and various other Lake and County Organizations. The basin is also the home of several Native American Tribes. These tribes include the Menominee Nation, the Ho-Chunk Nation, Stockbridge-Munsee band of Mohicans, Sakaogon (Mole Lake), and Potawatomi Tribes. Almost the entire 233,384-acre Menominee Indian Reservation is located within the basin.

The Wolf Basin Partnership is made up of representatives from several of the aforementioned organizations and Native American Tribes. This Partnership has identified their main priorities and/or issue of concern:

- **Water Pollution**
- **Loss of Habitat of the Shoreline**
- **Hunting/Fishing/Trapping and Recreational Use**
- **Inventory of Basin Resources**

The Wolf Basin Teams share these concerns as well, and has some of their own. The team's top priorities are listed below and their other concerns are listed on the following pages.

- **Preservation and protection of wetlands**
- **Exotic species**
- **Pressures from development**
- **Land use and Smart Growth**

Townships of the Wolf River Basin Map

Municipalities of the Wolf River Basin Map

Land Cover of the Wolf River Basin Map

Watershed Priorities and Recommendations

Internal Priorities

1. Encourage and promote the formation of lake and river management organizations.
2. Encourage and promote comprehensive management planning and implementation of management recommendations to protect, enhance, and restore water quality and habitat of the water resources in the basin.
3. Conduct baseline lake and river monitoring in the basin and other special monitoring projects as needed to assess the condition of the water resources.
4. Educate riparian residents about waterfront owner stewardship, the value and protection of shoreline habitat and native aquatic plant species.
5. Educate residents and users of the water resources in the basin about preventing the spread of nuisance exotic species that threatened native species and habitat.
6. Encourage lake associations and individuals to participate in self-help volunteer lake-monitoring program.
7. Note the nonpoint source priorities for the basin identified in Table 1: Nonpoint Source Rankings.

Geographic Focus: Pine and Willow Creek Watershed

The Pine River and Willow Creek Priority Watershed (see map) is a current priority watershed project focusing on protection, as well as restoration. This watershed was singled out for specific recommendations due to its importance to the Wolf River Basin. Waters of the Pine River and Willow Creek Watershed are in relatively good condition. Most efforts should be focused on preserving the current environmental quality through protection of habitat (e.g. easements or fee acquisition), implementation of best management practices (e.g. bank stabilization, erosion control, buffer strips) and education. However, restoration of degraded waters should also be given high priority. Based on surveys, the following streams should be given the highest priority for future intensive mitigation efforts (listed in order of priority):

1. Carpenter Creek (Carpenter Creek Subwatershed)
2. Humphreys Creek (Middle Pine River Subwatershed)
3. Cedar Springs Creek (Cedar Springs Subwatershed)
4. Bruce Creek (Bruce Creek Subwatershed)

These streams and watersheds can be considered the most degraded areas within the Pine River and Willow Creek watershed. Dramatic changes in water quality and fisheries can be realized in each of these streams if mitigation efforts are concentrated on these subwatersheds. Interdisciplinary involvement by fisheries, water resources, wetlands experts, and hydrologists will be needed to formulate an effective mitigation plan for each of these streams/subwatersheds. Other streams also have degraded areas and will be addressed in more detail in the "Subwatershed Recommendations". These areas can be addressed with minor restoration efforts or implementation of Best Management Practices.

Subwatershed Recommendations:

Upper Pine

1. Continue current fee title land acquisition and easement work in the Upper Pine River. The uppermost headwaters of the Pine River were not included in the project area for purchasing land or easements. We recommend this area be included in the Stewardship Streambank Protection Program.
2. Best management practices may include: livestock fencing to maintain riparian vegetation and streambank stability, additional buffers to intercept cropland runoff, and trout habitat improvement.
3. Spawning habitat is excellent in this stream. Trout habitat improvement projects should concentrate on increasing adult cover in the Upper Pine River above Wild Rose and the Davis Creek.

4. The very headwater reaches of the Upper Pine River above Wild Rose have been negatively impacted by channelization, dredging and filling of springs. Future mitigation projects should be directed for this portion of the subwatershed to restore stream channel, springs, and remove spoils from wetland or springs.
5. Future DNR fish management activities may include: trout habitat improvement, eradication of brown trout and restoration of native brook trout population, and spring pond dredging on newly acquired DNR land.
6. The Upper Pine River just above Wild Rose would make an excellent educational area for demonstrating trout habitat improvement techniques and various BMPs. The DNR has several acres of public land adjoining the Village of Wild Rose that could be used to develop a trail or demonstration area.

Middle Pine

The Humphreys Creek is the most degraded stream in this subwatershed. Several ditches are located at the headwater reaches of this stream and contribute sediment and increased water temperatures. Minor restoration efforts would be needed to see a dramatic affect on water quality and fisheries in this stream. Mitigation activities may include but are not limited to: restoration of wetlands by breaking drainage tiles and backfilling ditches; restoration of channel meanders; utilizing bank covers, half logs, or other in-stream devices to improve trout habitat; and construction of sediment traps. Easements and fee title acquisition should be pursued along this stream to protect un-impacted areas.

This stream would be an excellent candidate for a demonstration site. Several mitigation techniques could be used to demonstrate improvements in water quality and fisheries. The results of these efforts could be compared to the Kaminski Creek and/or Davis Creek, which have excellent water quality and fisheries. Improvements in this subwatershed could serve as a model for future projects in the entire Pine River and Willow Creek Basin. High priority should be given to this watershed for demonstration funding and general wetland mitigation and habitat improvement funding.

1. The upper Humphreys Creek should be given high priority for wetland restoration and stream habitat improvement. The entire stream length should be mapped and problem areas identified. A mitigation plan for this watershed should be developed with interdisciplinary involvement from DNR and county staff.
2. The Kaminski and/or Davis Creeks (both high quality streams with IBI scores ≥ 80) should serve as control streams to monitor changes in water quality and fisheries in the Humphreys Creek. A water quality and fishery objective for the Humphreys Creek would be to obtain IBI scores of at least 80 or better.
3. Trout habitat improvement projects should be focused on the Main Pine River to increase adult cover.
4. To better evaluate BMPs, IBI and habitat surveys should be repeated for 1997 with (1) additional station in the Kaminski Creek, Davis Creek, and Humphreys Creek. Surveys should be scheduled in 4-5 year rotations to monitor long-term changes in the watershed.

Carpenter Creek

Over the past few decades, the Carpenter Creek has experienced major environmental perturbations from agricultural activities throughout its watershed. The Little Silver Creek, for the most part, has remained in fairly good condition with most problems caused by beaver activity and minor agricultural impacts. Comparisons of these two streams may demonstrate how poor land practices can affect water quality and fisheries. Our results suggest that agricultural activities such as wetland drainage and channel straightening have had a negative impact on the coldwater fish communities and water quality of Carpenter Creek. Increased water temperatures and sedimentation appear to have the greatest negative affect. Priority Watershed efforts should be given the highest priority for this stream and its watershed. Restoration of wetlands should be focused along critical hydrologic areas. In addition, sediment traps should be placed in strategic areas to remove excessive sediments. Stream bank protection easements and/or land acquisition projects should be established for this stream. Trout habitat enhancement projects should be initiated only after significant improvements are made to water quality.

1. A comprehensive inventory of all ditches and farmed wetlands should be completed for this watershed and specific problem areas should be identified. A comprehensive mitigation plan should be developed with interdisciplinary involvement from DNR and county staff.
2. A section of the Little Silver Creek along CTH E and H has been channelized and severely degraded because of a road construction project. The channel in this section of stream should be moved away from the road and redesigned to incorporate meanders and trout cover.
3. The main Pine River should be included in stream bank easement or land acquisition projects.
4. In 1995, a large amount of sediment was released into the Pine River from the Saxeville dam. This large slug of sand is slowly moving downstream and filling in valuable trout habitat. A Sediment traps) should be placed 1-3 miles downstream of Saxeville to capture this material.
5. The Saxeville dam is a trout migration barrier to upstream spawning and over summer habitat. It also has, a thermal impact on the stream by warming downstream receiving waters. Dam removal should be a future option.
6. The Little Silver Creek (good water quality with IBI scores of 60) should serve as a control stream to monitor improvements in the Carpenter Creek. A water quality and fisheries objective for the Carpenter Creek should be to improve IBI scores to at least 60 or greater.
7. In order to better evaluate BMPs, IBI and habitat surveys should be repeated for 1997 with (1) additional station in the Carpenter Creek and (2) additional stations in the Little Silver Creek. Surveys should also be scheduled in 4-5 year rotations to monitor long-term changes within the watershed.

Lower Pine

1. The lower main Pine River should be included in DNR stream bank easement or land acquisition projects.
2. Identify areas for future trout habitat improvement work.

Upper Willow

1. Implementation of streambank stabilization, trout habitat improvement devices, and riparian buffers.
2. Continuation of current DNR land acquisition and streambank easement work.
3. Continuation of beaver control to maintain high quality trout habitat.
4. Trout habitat improvement projects to restore habitat in beaver damaged areas.

Middle Willow

1. Implementation of streambank stabilization, trout habitat improvement devices, and other BMPs in degraded areas,
2. Continuation of "wild trout" stocking and evaluation in lower (downstream of blackhawk Ave) portions of the Willow Creek.
3. Continuation of current DNR land acquisition and stream bank easement work. Areas without land acquisition projects should be strongly considered for Stewardship Streambank Protection Program.
4. Continuation of DNR trout habitat development projects (e.g. brushing, construction and maintenance of overhead bank covers) on DNR public lands.

Mount Morris

1. Porters Creek should be given high priority for the Stewardship Streambank Protection Program. This creek is an important source of water for Mt. Morris Lakes and Willow Creek. Currently, it possesses above average water quality and fishery.
2. Several areas in the Rattlesnake Creek were damaged by the Mt. Morris dam break in 1995. Stream bank stabilization, trout habitat improvement, and sediment traps should be planned for this part of the watershed.
3. Implementation of other BMPs where needed.

Bruce Creek

Our results suggest that agricultural activities such as wetland drainage and channel straightening have had a negative impact on the coldwater fish communities and water quality of Bruce Creek. Increased water temperatures and sedimentation appear to have the greatest negative affect. Priority Watershed efforts should be given the highest priority for this stream and its watershed. Restoration of wetlands should be focused along critical hydrologic areas. In addition, sediment traps should be placed in strategic areas to remove excessive sediments. Stream bank protection easements and/or land acquisition projects should be established for this stream. Trout habitat enhancement projects should be initiated only after significant improvements are made to water quality.

1. Bruce Creek should be given high priority for wetland restoration and stream habitat improvement. The entire stream length should be mapped and problem areas identified. A mitigation plan for this watershed should be developed with interdisciplinary involvement from DNR and county staff.
2. A water quality and fishery objective for the Bruce Creek would be to obtain IBI scores of at least 60 or better.
3. Trout habitat improvement projects should be focused on the Bruce Creek to increase spawning areas and adult cover.
4. Surveys should also be scheduled in 4-5 year rotations to monitor long-term changes within the stream/watershed.
5. High number of ditches entering the stream at the Walejko and Eagan properties. Work with these landowners to design and construct retention basins to minimize sediment and warm water entering the Bruce Creek.

Cedar Springs Creek

Our results suggest that agricultural activity such as wetland drainage, channel straightening, and poor have had a negative impact on the coldwater fish communities and water quality of lower portions of Cedar Springs Creek. Increased water temperatures, low dissolved oxygen and sedimentation appear to have the greatest negative affect. Priority Watershed efforts should be given the highest priority for this stream and its watershed. Restoration of wetlands, construction of sediment traps, and stream bank protection easements and/or land acquisition projects should be planned for this stream. Trout habitat enhancement projects should be initiated only after significant improvements are made to water quality. The headwater portions of this stream are in excellent condition. Brook trout populations thrive and water quality appears to be very good. Past DNR land acquisition in this area of the watershed has preserved its integrity and should be continued.

1. Conduct a comprehensive inventory of all drainage ditches and farmed wetlands within the watershed.
2. A comprehensive mitigation plan should be developed with interdisciplinary involvement from DNR and county staff.
3. Restore wetlands, sediment traps and trout habitat improvement.
4. Any portion of this watershed that is not included in a land acquisition program should be recommended for Stewardship Streambank Protection Program.
5. The 1996 fishery appraisal succeeded in identifying a problem within this watershed but more information should be collected to better evaluate BMPs. IBI and habitat surveys should be repeated for 1997 with (3) additional stations. Surveys should also be scheduled in 4-5 year rotations to monitor longterm changes within the watershed.
1. The upper Cedar Springs Creek should be used as a control to monitor water quality and fisheries changes. A water quality and fisheries objective for the lower Cedar Springs Creek should be to improve IBI scores to at least 60 or greater.

Nonpoint Source Rankings

The following nonpoint source rankings for the Wolf River basin were derived from stream, lake, and groundwater data, and data on land use patterns and changes and how those changes affect water resource quality. The table below will be used in calculations for the DNR's Targeted Runoff Implementation Management (TriM) Program recipients. These areas should also be noted for high priority work by counties in their land and water plans.

Table 1. Nonpoint Rankings

Watershed Name	Watershed Number	Streams	Lakes	Ground-water	Comments
Arrowhead and Daggets Creek	WR01	High	Insufficient Data	Low	Current Priority Watershed
Pine River and Willow Creek	WR02	High	Insufficient Data	Medium	Current Priority Watershed
Walla Walla and Alder Creek	WR03	High	High	Low	
Lower Wolf River	WR04	Low	Not Ranked	Not Ranked	
Waupaca River	WR05	Medium	Not Ranked	High	Current Priority Watershed
Lower Little Wolf River	WR06	Medium	Insufficient Data	High	Bear Lake Ranked High (Current PWS)
Upper Little Wolf River	WR07	Medium	Not Ranked	High	
South Branch Little Wolf River	WR08	Low	High	High	
North Branch and Main Stem Embarrass River	WR09	High	High	Medium	
Pigeon River	WR10	Medium	High	Medium	Pigeon Lake Ranked High
Middle and South Branch Embarrass River	WR11	Low	Not Ranked	High	
Wolf/New London and Bear Creek	WR12	Medium	Medium	Low	Bear Creek Ranked High Small-Scale
Shioc River	WR13	High	Not Ranked	Not Ranked	
Middle Wolf	WR14	High	Low	Medium	
Shawano Lake	WR15	Not Ranked	High	Not Ranked	Shawano Lake Ranked High
Red River	WR16	Low	Not Ranked	Not Ranked	
West Branch Wolf	WR17	Not Ranked	Not Ranked	Not Ranked	
Wolf/Langlade and Evergreen	WR18	Not Ranked	Not Ranked	Not Ranked	
Lily River	WR19	Not Ranked	Not Ranked	Not Ranked	
Upper Wolf Post Lake	WR20	Not Ranked	Not Ranked	Not Ranked	

Land Priorities and Recommendations

The Wolf Basin Land Team includes a variety of functional areas related to management of terrestrial resources. Functional areas within the Land Team include Wildlife Management, Forestry, Parks and Recreation, and Facilities and Lands.

Land Priorities and Recommendations:

- ❖ Maintain Department properties.
- ❖ Manage outdoor recreation areas to provide our citizens and visitors with the highest quality state parks, forests, trails, educational experiences, resources stewardship and services in their pursuit of a full range of nature based outdoor recreational opportunities.
- ❖ Implement *Deer Management for 2000 and Beyond* recommendations and aggressive harvest management strategies to lower deer populations in most areas of the state.
- ❖ Protect all types of aquatic and terrestrial communities and other significant natural features native to the state for educational and research, and to secure the long term protection of the state's biological diversity in line with the Department's Land Legacy Study.
- ❖ Utilize *Stewardship 2000* land acquisition funding to purchase additional land for state properties.
- ❖ Follow guidance from Land Legacy Study to develop master plans and feasibility studies in the basin.
- ❖ Continue to screen proposed management actions for impacts on state and federally listed species. Ensure all projects comply with the National Environmental protection Act, the Wisconsin Environmental Protection Act, and the State and Tribal Historic Preservation Acts.
- ❖ Implement the Karner Blue Habitat Conservation Plan.
- ❖ Assist research on wildlife species, wildlife health issues, and the use of wildlife resources.
- ❖ Manage lands for multiple use according to the property master plan, which may include outdoor recreation, aesthetics, native biological diversity, terrestrial and aquatic wildlife, soil and water protection, and sustainable growth of forest products.
- ❖ Maintain viable populations of rare species and assure the sustainability of native aquatic and terrestrial species and natural communities through leadership and involvement in research, management, recovery and monitoring efforts.
- ❖ Continue activities associated with the collection, management, interpretation, and use and sharing of the Natural Heritage Inventory (NHI) data. NHI data plays a significant role in decision-making, including the Department's ecosystem management decision model.
- ❖ Continue development and maintenance of a broad-based constituency that will encourage stronger political and financial support for Land Division issues.
- ❖ Assist partners and private landowners with wetland and grassland restoration efforts in the basin.
- ❖ Plan and develop activities, special events, and publications to interpret the natural and cultural environment of the basin.
- ❖ Provide information to the public about Division programs and opportunities.
- ❖ Assess the wildlife and endangered resources impacts of dams or hydro facilities in the basin in cooperation with the Water Division.
- ❖ Respond to requests for assistance from local governments undertaking comprehensive planning by providing and interpreting natural resource and outdoor recreation information.

Wolf Basin State Parks

Hartman Creek State Park

Hartman Creek State Park is a 1,417-acre property located 6 miles west of Waupaca in Waupaca County. Hartman Creek is an all season park, providing facilities for camping, picnicking, environmental interpretation, swimming, boating, hiking, horseback riding, biking, fishing, skiing, and snowmobiling.

Development consists of a 101 unit family campground, a 5 unit group campground, and 600 lineal ft. of swimming beach. It also has 14 miles of hiking trail, 7 miles of equestrian trails, 4 miles of off-road bike

trails, 11 miles of cross country ski trails, 4 miles of snowmobile trails, 3 miles of National Ice Age Scenic Trail, and 10 acres of picnic area. Park buildings include a park entrance and visitor station, a shop storage building, an enclosed heated shelter building, an open shelter, a restored Norwegian log cabin and 2 shower buildings.

Year round attendance at the park is over 240,000 and yearly revenue totals for the park is over \$215,000. A recent poll from the Milwaukee State Journal ranked Hartman Creek State Park in the top five state parks in Wisconsin for camping, wildlife viewing, and recreational opportunities. The park is within 45 minutes of the Fox Cities, 60 minutes from Green Bay, 2.5 hours from Milwaukee and Madison.

Wolf River Wildlife Areas and Natural Areas

Navarino Wildlife Area

Navarino Wildlife Area is located in southern Shawano and northeast Waupaca Counties in the Townships of Navarino, Lessor, Waukechon, Hartland, and Matteson. It is approximately seven miles south of Shawano. Approximately 15,000 acres are state owned. The wildlife area is comprised of sandy uplands and ridges with marshy depressions. Open fields, swamp conifer, lowland shrub, bog, bottomland hardwoods, pine plantations, and aspen/oak forests make up the habitat types on this property. The West Branch of the Shioe River and Wolf River run through the property.

Navarino Wildlife Area began with the purchase of 557 acres in 1953 by the Wisconsin Conservation Department. Local conservation groups were leaders in urging the state to develop a wildlife area prior to the first acquisition. Navarino was well known for its prairie grouse, deer, squirrel, rabbit, ruffed grouse, pheasant, and duck populations. The area was approved as an upland wildlife management area and in the 1960's it was thought to have potential as a satellite area for the Horicon goose flock. Pheasants were favored and stocked through 1967. The first dike was constructed in 1962. Since then, fourteen other dikes have been constructed totaling over 1,400 acres of water which can be manipulated using water control structures. Fields have been converted to grassland habitat composed of prairie species which are periodically burned. Other fields are sharecropped to provide additional wildlife food and viewing opportunities. Forest management and timber sales are utilized to maximize the timber values for wildlife through a variety of cutting methods including clearcuts, selective cuts, thinnings, etc. In 1986, the Navarino Nature Center was formed and began leasing 20 acres on Navarino Wildlife Area.

The Navarino Nature Center and the leased acreage allows for a variety of recreational opportunities. The leased area is equipped with a picnic area, picnic shelter, amphitheater, rustic restrooms, pump well, parking lot, and cabin to accommodate program participants. A new education center is currently under construction. Self-guided nature trails have been developed for visitors also. Cross-country skiing, hiking, berry picking, and hunting are popular activities. There is a 1,000-acre refuge, which is closed to hunting during the waterfowl season. The site is also a Watchable Wildlife Viewing Area. A county snowmobile trail runs through the northern part of the wildlife area. The county grooms the cross-country ski trail. A boat landing is located on Hwy 156. Canoes can be launched at the end of River Road.

Deer Creek Wildlife Area

Deer Creek Wildlife Area is located in northeast Waupaca and northwest Outagamie Counties in the Townships of Deer Creek and Matteson. It is approximately five miles west of Leeman and ten miles east of Clintonville. Approximately 1,500 acres are state owned. The wildlife area is comprised of rolling uplands of fine sand which surround a central peat bog. The ridges are dune complexes from the fringes of glacial lakes. Open fields, swamp conifer, lowland shrub, bog, pine plantations, and aspen/oak forests make up the habitat types on this property. The property has good access, with two parking lots on the north and south and a walk-in access on the west side

Deer Creek Wildlife Area began with the purchase of 440 acres from Outagamie County in 1942. Additional land was acquired by the Wisconsin Conservation Department from 1957-65. During the 1950's and early 1960's, other lands were leased for public hunting within and around the property.

These lands were stocked with pheasants for public hunting at that time. Six miles of ditches are remnants of the Deer Creek Drainage District active from 1913-23. The property drains to the Embarrass River, which is 2 miles west. The Wolf River lies 3 miles to the east of the wildlife area.

As late as 1957, a small flock of prairie chickens and sharp-tailed grouse were present on the area. Since state ownership, vegetative succession has resulted in management aimed at more forest dependent species. White-tailed deer, ruffed grouse, cottontail rabbit, and snowshoe hare take advantage of the aspen tree species present. The main ditch draining the area was fitted with a water control structure in 1971, which flooded approximately 120 acres of land improving habitat for waterfowl. An 80-acre "heath" with many bog species is located in the southeast portion of the wildlife area. Some prairie plant species have been planted in the open areas. A five-mile cross-country ski trail was constructed in 1974 but has not been maintained due to a lack of funds. A snowmobile trail passes across the north portion of the property. Two osprey platforms were placed in the flowage in 1992.

The Department of Natural Resources currently manages the property for forest and wetland wildlife. Through forest management the aspen/oak tree stands and pine plantations are maintained, to maximize benefits to many wildlife species. Aspen and oak require a lot of light to grow. Clearcutting while reserving many oaks and den trees allows a quick regeneration of these two species on the property with the increase of sunlight. Prescribed burning and reestablishment of prairie on the north end of the property are occurring. A bluebird trail is maintained around the openings throughout the property.

Maine Wildlife Area

Maine Wildlife Area is located in northcentral Outagamie County in the Township of Maine. It is approximately seven miles north of Shiocton. Approximately 750 acres are state owned. The wildlife area is comprised of bog marsh and aspen/oak ridges on fine sand. The ridges are dune complexes from glacial lake margins. A large tamarack bog and spruce fringe is in the center of the property. The private lands surrounding the property are largely agricultural. The Wolf River flows one mile to the east. Currently, there is one parking lot and access on Moes Road, but several logging roads follow the ridge tops. Access to the north half of the property requires a long trek through the central bog and is easier in winter when it is frozen.

Acquisition began in 1942 with the purchase of some tax delinquent land by the Wisconsin Conservation Department. The only major development project was the digging of a level ditch, which connects several dug ponds. The Department of Natural Resources currently manages the property for forest and wetland wildlife. Forest management maintains the aspen/oak stands, which are designed to maximize wildlife benefits. Furbearer trapping, deer, and grouse hunting are the only major current uses.

Mack Wildlife Area

Mack Wildlife Area is located in northcentral Outagamie County in the Township of Bovina. It is approximately two miles northeast of Shiocton. Approximately 1,830 acres are state owned (1350 DNR & 480 DOT). The topography is flat since this area was once glacial lakebed. The soils are rich, but a high water table limits the types of vegetation that are present. The wildlife area is comprised of marsh, aspen, swamp hardwoods, old fields, and lowland brush. An active railroad bisects the south part of the property. Two parking lots are maintained along Herman Road and one along Van Patten Road, formerly Bischoff Road. State Highway 54 separates the DNR portion from the DOT owned area.

The Wisconsin Conservation Department purchased the entire property as a single unit in 1943. In the 1950's, share cropping was conducted on a portion of the property for pheasants. Approximately 3 miles of trail were constructed through the forested portion. Both of these practices were abandoned, as drainage was inadequate. At various times, short level ditches or potholes were created primarily for wildlife watering holes. In 1991 the DOT purchased the 480 acres to the north of the highway to mitigate wetland losses due to highway construction. In 1993 dike construction encompassing over 460 acres was completed. The DNR will begin managing water levels and vegetation on this area in the spring of 2000.

The Department of Natural Resources currently manages the property for forest and wetland wildlife. Forest management practices maintain the aspen which is designed to maximize wildlife habitat for species such as grouse. Alder and dogwood are abundant in scattered clones. Management to increase these species for woodcock are undertaken when possible. Management of the DOT wetlands currently consists of burning, mowing, and water level manipulation. Disking areas for shorebird use is also being considered. The area is a designated watchable wildlife area. The Van Patten Road parking lot contains a viewing mound. Over 7 miles of dike allow easy access to the majority of the impounded wetlands. An interpretive kiosk and platform are planned in the near future in cooperation with Outagamie County UW-Extension.

Outagamie Wildlife Area

Outagamie Wildlife Area is located in northwest Outagamie County in the Townships of Maine and Bovina. It is approximately four miles north of Shiocton. Approximately 1,000 acres are state owned. The wildlife area is comprised of bottomland forest, impounded marsh, and aspen forests. The entire property is located in the Wolf River floodplain, limiting improvements. Soils are rich floodplain soils. Currently there are three parking lots serving the largest land sections, two located on Hwy M and the other on Hwy 187. The Wolf River bisects the property allowing excellent access by boat.

In 1940, a 412-acre parcel in the core of the property was leased from Outagamie County by the Wisconsin Conservation Department for a 20-year period to use as public hunting grounds. The lease did not permit any management of the land and with strong local support from sportsmen's clubs, this property was purchased in 1958. Additional acreage was purchased later from adjacent landowners which tied into a state fishery area known as Spoehr's Marsh. In 1960 a dike was constructed to create a 145-acre flowage. Other short dikes and plugs on old oxbows created another 40 acres of flowage area. Five water control structures and water transfer ditches connect the various flowages. In the early 1960's, a diesel pump was installed on the Wolf River to permit flooding the flowages during dry periods. It was replaced in 1969 by an electric lift pump, which was in service until 1989. There is a 50-acre waterfowl refuge in the main flowage. Wild rice is the dominant vegetation in the southern half of the flowage. Approximately 50 acres of upland have been converted to prairie grasses along Hwy 187 on the east side of the wildlife area. Three osprey platforms were erected and one is occupied annually.

The Department of Natural Resources currently manages the property for forest and wetland wildlife. Forest management maintains the aspen and bottomland hardwood species, which are designed to maximize wildlife benefits. Dikes are currently being upgraded on the impoundment. Willow is mowed to maintain water flow through the spawning marsh. A heron rookery is monitored yearly. Prescribed burning and mowing are conducted on the prairie grasses. Duck hunting and birdwatching are the two most popular uses of the property.

Wolf River Bottoms Wildlife Area-K&S Unit

Wolf River Bottoms Wildlife Area is located in northwest Outagamie County in the Townships of Deer Creek and Maine. It is approximately four miles north of Shiocton. Approximately 2,500 acres are state owned. The wildlife area is comprised of sandy, forested ridges, multiple impoundments, spruce plantation, swamp hardwood, wetland and grassland habitat. Approximately 1800 acres are impounded, 200 acres in upland timber, 100 acres in grassland, and the remaining in wetland habitat. Two-thirds of the property is within the Wolf River fringe floodplain limiting improvements which can be made. Currently two parking lots serve the property. These are located on Hwy M and the end of Balsam Road. Soils are moderate in richness.

The property was purchased in 1991. The property was an active game farm called Maine Creek Farm established in 1954. It is totally surrounded by a fence, which has had little maintenance in a decade. Trophy deer and waterfowl management were emphasized by the previous owners. Peat harvesting, Christmas tree production, and aquaculture were other uses that were explored and abandoned. Since the purchase of the property, recovery of the vegetation from overpopulation of deer has been accentuated. Four osprey platforms were erected with one being active.

The Department of Natural Resources currently manages the property for forest and wetland wildlife. Forest management maintains the aspen/oak tree species, which are designed to maximize wildlife benefits. Dikes are currently being upgraded on the impoundments. Aspen and oak are sun-loving species that require disturbance about every 50 years to regenerate. Historically fire, disease, and windthrow were important in regenerating these forests. Currently, clearcutting with uncut residual oak and den trees is the preferred method to mimic these natural disturbances. Prescribed burning and shearing have been used in the recent past to regenerate and expand the acreage of alder, the favorite habitat for the American woodcock. Over 20 miles of dike and in excess of 40 water control structures are on the property. These dikes not only impound water, but also provide excellent access to the property. The northeast flowages had two high capacity wells that were upgraded in hopes of raising warmwater fish species for stocking Wisconsin waters in the future. Major uses of the property are deer and duck hunting, bird watching, and trapping.

Wolf River Bottoms Wildlife Area-LaSage Unit

The Wolf River Bottoms Wildlife Area - LaSage Unit is located in west central Outagamie County in the Township of Ellington. It is approximately one mile northwest of Stephenville and four miles southwest of Shiocton. Approximately 500 acres are state owned. The wildlife area is comprised of aspen forest, bottomland hardwoods along the Wolf River, impounded marshes and agricultural fields. The property is entirely situated in the Wolf River floodplain limiting the scope of improvements. These floodplain soils are rich in nutrients and organic matter. Currently one parking lot is on Hwy S serves the property and a road to the buildings is utilized by the tenant conservation group. The Wolf River runs along the entire eastern boundary of the property, allowing excellent access by boat.

The property was purchased in 1998 by the Department of Natural Resources as a statewide habitat project. There are 4 buildings on the property. The main lodge and approximately 20 acres are leased to Whitetails Unlimited-Fox Valley Chapter for educational purposes. There are 4 miles of dyke which enclose at least 100 acres of flowage with numerous water control structures and artesian wells. A ditch was dug to allow waterflow from Hortonville Bog. This property was previously owned by a private individual and was used as a hunting and vacation retreat. A historic "Indian crossing" in the Wolf River is located on the northern portion of the property.

The Department of Natural Resources currently manages the property for forest and wetland wildlife. Forest management maintains the tree and vegetation species, which are designed to maximize wildlife benefits. Sturgeon and walleye spawning sites are assessed and enhanced if possible. Cropland is converted to nesting cover and maintained through prescribed burning. The dikes and flowage are currently managed for wetland wildlife. Shorefishing, birdwatching, and hunting are the most common uses by the public.

Mukwa Wildlife Area

Mukwa Wildlife Area is located in southeast Waupaca County, just west of New London. Approximately 1,300 acres are state owned. The wildlife area is comprised for the most part of bottomland hardwoods, lowland brush, and old oxbows of the Wolf River. The Mukwa Bottomland Forest State Natural Area lies within the boundary of Mukwa Wildlife Area and consists of 160 acres.

The Mukwa Wildlife Area was a leased public hunting ground from 1948 to 1964. As a result of local interest, it was approved for acquisition by the Wisconsin Conservation Commission in 1964. The intent was to develop a waterfowl area by using an extensive impoundment system. Due to various social and economic factors this development option was abandoned.

Since being in state ownership, hay mowing has been used to reduce the encroachment of woody vegetation and dugout ponds for waterfowl habitat improvement have been constructed. Up until 1977, several hundred state game farm reared pheasants were annually released. The stocking of state-reared pheasants was discontinued due to a lack of suitable habitat and trespass issues with adjacent landowners.

The Department of Natural Resources currently manages the property for the bottomland hardwoods habitat, which is slowly disappearing on private lands, primarily due to the construction of homes and cottages. A variety of management techniques are used to improve bottomland hardwoods habitat and enhance recreational use of available resources, with an emphasis on waterfowl, ruffed grouse, and woodcock. Management techniques that are used include, controlling water levels and selective timber management. Two ditches have been blocked, which provides better waterfowl habitat, as well as funnels water through a walleye spawning marsh. The wildlife area is seasonally flooded as two miles of the Wolf River and 1/2 mile of the Little Wolf River bisect the property.

Mukwa Bottomland Forest State Natural Area

The natural area is located in southwest portion of the property, where the bottomland forest type is preserved. Mukwa is a typical southern bottomland forest in the floodplain of the Wolf River. Although dominated by silver maple and swamp white oak, small numbers of American elm persist. The trees vary in size from saplings to an occasional tree more than 30 inches in diameter. Areas with smaller trees appear quite natural with no evidence of past logging or grazing. The topography is uneven, having been dissected by many old channels and fluctuating water levels.

Hortonville Bog State Natural Area

Hortonville Bog State Natural Area is located in westcentral Outagamie County in the Township of Liberty. It is approximately 4.5 miles north of Hortonville. Approximately 640 acres are state owned. This property is surrounded by private landowners and the Department of Natural Resources has an easement on adjacent lands in order to access the property. The site has been identified as one of the best bogs in the southern two-thirds of Wisconsin. The property was purchased in 1987 with the objectives of preservation and protection of this land so that natural processes are allowed to occur. The Department of Natural Resources currently manages the property so that natural processes are allowed to occur. Annual inspections occur to control purple loosestrife, which has been found within a 1/2 mile of the property. Hunting is permitted on the property, but public access is limited. Other uses of the property include guided nature study trips and research study.

Shakey Lake State Natural Area

Shaky Lake State Natural Area is located in southwest Outagamie County in the township of Dale southwest of Hortonville. Approximately 220 acres are in state ownership. The site contains a hard water seepage lake surrounded by northern sedge meadow and northern wet forest. Some marsh hay was cut in the past. The surrounding woods have been logged, both heavily and selectively. Sporadic fires have swept the sedge meadows. The site was designated a state natural area in April 1983.

The Department of Natural Resources currently manages the property so that natural processes are allowed to occur. Management practices are done in order to protect the unique marl-bottomed lake resource. Beavers have caused much damage to the area by damming the outlet and raising the water level in the lake. This causes the mat of vegetation to pull up from the bottom, and also kills the surrounding trees. Trappers are encouraged to remove beavers from the natural area. Purple loosestrife is pulled and removed from the sedge meadow annually. Controlling purple loosestrife is essential in maintaining natural communities on this property.

Wolf River Wildlife Area

Wolf River Wildlife Area is located in northwest Winnebago County in the Town of Wolf River. Approximately 1,800 acres are owned, managed, or leased by the state. The Wolf River Wildlife Area is a wetlands area associated with the confluence of the Wolf and Rat Rivers. The Deltox Marsh segment was once a wire grass (sedge) marsh that was important to a local rug industry, but now has converted to a canary grass marsh with scattered stands of willow. The Metzsig Marsh segment consists of a lowland brush and grass complex (shrub carr) with cattail in the wetter sites. Stands of soft maple and brush occupy the narrow ridges along the river channel and in old oxbows. A 180 acre closed area exists in the

Metzig Marsh. There is also a series of man-made potholes and level ditches for waterfowl use. The wetlands are protected from erosion by the installation of 7,300 feet of rock rip-rap.

The Deltox Marsh has recently undergone a major facelift, with the installation of a 3,300 foot dike and water control structure. This allows the management of the water level within the impoundment. Efforts are being made to convert canary grass to a more desirable mixture of native wetland plants. Uplands areas are managed for waterfowl nesting habitat.

Rat River Wildlife Area

Rat River Wildlife Area is located in northcentral Winnebago County, 2 miles north of Winchester. Approximately 4,000 acres are state owned and managed. The property was established in 1963 as a Fisheries Management Area, and was changed to a Wildlife Management Area in 1978 with an emphasis on preservation to prevent private development. Historically, the area was comprised of sedge meadows and marshes. The sedges were cut annually and used for making "wire grass" rugs and packing material. At some point in time, the marshlands were converted to or invaded by reed canary grass, an aggressive exotic species from Europe. The sedges virtually disappeared from the natural landscape, and along with them, valuable wildlife habitat was lost. Today, much of the property is dominated by canary grass, and the wetter areas support a dense population of cattails. The Rat River runs east to west through the long, narrow property, and eventually flows into the Wolf River. Some lowland forest types are found on the property, as well as a few upland fields.

Past management has included pothole blasting for waterfowl, marsh hay cutting to set back brush, planting upland fields to dense nesting cover, herbicide application to cattails to create vegetative diversity, and limited prescribed burning to maintain upland fields. The marsh hay harvesting has been stepped up recently in an effort to convert the canary grass fields back to the original sedges and other native species. There are limited opportunities for creating impoundments due to the size and varying shape of the property. Second generation Iowa strain pheasants have been experimentally stocked on the Rat River Wildlife Area in Winnebago County. Hens and roosters were stocked over a three year period. Crowing counts in this area were conducted prior to, and during the release years. These counts will be compared with counts taken in years following stocking to evaluate the viability of this "wilder" strain of birds. Efforts have been focused to improve wetland and upland nesting habitat in the stocking area.

Fisheries Areas

Over the years, the Fisheries Program has purchased several marshes along the Wolf River to manage them for walleye spawning and to protect the wetlands from development. To compliment these purchases, Fisheries has also developed a Cooperative Walleye Spawning Marsh Agreement for areas under private ownership. This agreement allows the state to enter into a partnership with landowners to manage wetlands for walleye spawning. This may be as simple as posting the marsh as a "No Entry Zone" in spring, mowing brush to keep the marsh in grass and sedge or the project may be as complicated as dike and bank modification or installation of water control structures, culverts or bridges.

Geographic Focus: Lower Wolf River Bottomlands Master Planning Project

In September 1999, the Department initiated a master planning effort state properties along the Lower Wolf River from the Shawano Dam down to Lake Poygan. Included in this effort are various wildlife, fishery, and natural areas (i.e. Navarino, Deer Creek, Maine, Wolf River Bottoms - K&S Unit and LaSage Unit, Outagamie, Mack, Mukwa, Wolf River and Rat River Wildlife Areas; Hortonville Bog and Shaky Lake Natural Areas; Wolf River Fishery Area and other remnant fishery areas). A master plan will identify how the properties will be used, managed, and developed for the next 15 years. The Lower Wolf River Bottomlands planning process is expected to be completed in the summer of 2002.

Deer Management

The number of deer in the Wolf River Basin varies widely from the predominately agricultural areas to the wooded recreational lands. The established over-winter goals vary from 15–30 deer/square mile,

although recent over-winter estimates have been well above established goals and has triggered several years of Zone T antlerless only deer seasons. Several Deer Management Units are found within the Basin: (43, 44, 47, 48, 62A, 62B, 63A, 63B, 65B, and 66 and small portions of 38, 39, 46, 51B, 65A). The high over-winter goals in much of the basin (>25 deer/square mile) has resulted in extremely high agricultural deer damage, damage to forest regeneration and high deer/vehicle accidents. The Department has attempted to *alleviate* these problems with liberal hunting seasons with unlimited antlerless deer permits and with Agricultural Deer Damage Shooting Permits.

Deer Management for 2000 and Beyond (Deer 2000), a cooperative project between the Department of Natural Resources, the Conservation Congress and the public, has identified a couple of the Deer Management Units in the Basin for an over-winter goal reduction. These changes should help alleviate the problems associated with high deer numbers.

Turkey Management

There are primarily 4 Wild Turkey Management Zones in the Wolf River Basin (units 22, 23, 35 and 41). The Spring 2000 harvest was 2842, 2589, 213, and 55, respectively. Turkeys are extremely abundant and increasing in the western half of the Wolf River Basin, but the population is smaller in the eastern half. This variation with the turkey population is due primarily to the differences in habitat. The western half of the watershed consists of oak forests, pine plantations, prairies, open fields, and/or farm fields, all interspersed with high quality streams and other smaller water sources. The eastern half has less oak woodlands and savannas and more open agricultural land.

The work focuses mostly on State Wildlife Areas or State Fisheries Areas to restore diverse prairies and create beneficial oak savannas and forests with the help of the National Wild Turkey Federation and Turkey Stamp Funds. With the increase in the turkey population, turkey hunting is also increasing. Youth Turkey Hunts have been rapidly growing in popularity and are excellent tools to educate young hunter education graduates.

Threatened and Endangered Species in the Wolf River Basin:

The Wolf River Basin is home to many of Wisconsin's threatened and endangered species. The Wisconsin Natural Heritage Inventory documents endangered, threatened, and special concern species for the entire state. Endangered species are those species whose continued existence in the state are in jeopardy. Threatened species are those species that appear likely, within the foreseeable future, to become endangered. Special Concern species are those for which some problem of abundance or distribution are suspected but not yet proven. Major problems for the at risk species within the basin include habitat loss, habitat fragmentation, and pollution.

Department staff is responsible for a variety of actions designed to help populations of "at risk" species within the basin. Property acquisition is a valuable tool that allows staff to permanently protect critical habitat. Biologists acquire land as Natural Areas and Wildlife Areas throughout the Basin. Habitat restoration, modification, and maintenance are other tools used to provide the elements needed by threatened and endangered species. Practices such as prairie and wetland restoration, prescribed burning, water level management, and invasive species control are combined with knowledge about species' life history to guarantee that their needs are being met. Surveys are conducted in conjunction with these activities to monitor the effects of habitat management and to identify areas that stand to benefit most.

Natural Communities of the Wolf River Basin

Occurrences of the natural communities listed below have been documented recently in the Wolf River basin. Natural communities are not provided designations for federal or state protection status (NA = not applicable).

Table 2: Natural Communities of the Wolf River Basin

Common Name	Last obs Year	State Status	Federal Status
alder thicket	1999	NA	NA
bedrock glade	1982	NA	NA
calcareous fen	1978	NA	NA
coastal plain marsh	1978	NA	NA
dry cliff	1982	NA	NA
emergent aquatic	1999	NA	NA
emergent aquatic - wild rice	1999	NA	NA
floodplain forest	1999	NA	NA
hardwood swamp	1999	NA	NA
lake--deep, hard, drainage	1986	NA	NA
lake--deep, hard, seepage	1987	NA	NA
lake--deep, soft, drainage	1982	NA	NA
lake--deep, soft, seepage	1982	NA	NA
lake--deep, very soft, seepage	1982	NA	NA
lake--hard bog	1981	NA	NA
lake--oxbow	1978	NA	NA
lake--shallow, hard, drainage	1982	NA	NA
lake--shallow, hard, seepage	1988	NA	NA
lake--shallow, soft, drainage	1981	NA	NA
lake--shallow, soft, seepage	1983	NA	NA
lake--soft bog	1981	NA	NA
lake--unique	1982	NA	NA
mesic floodplain terrace	1999	NA	NA
moist cliff	1982	NA	NA
northern dry forest	1982	NA	NA
northern dry-mesic forest	1999	NA	NA
northern mesic forest	1999	NA	NA
northern sedge meadow	1999	NA	NA
northern wet forest	1983	NA	NA
northern wet-mesic forest	1999	NA	NA
oak barrens	1992	NA	NA
open bog	1999	NA	NA
pine barrens	1982	NA	NA
sand prairie	1999	NA	NA
shrub-carr	1999	NA	NA
southern dry forest	1979	NA	NA
southern dry-mesic forest	1999	NA	NA
southern hardwood swamp	1999	NA	NA
southern mesic forest	1999	NA	NA
southern sedge meadow	1999	NA	NA
spring pond	1982	NA	NA
springs and spring runs, hard	1983	NA	NA
springs and spring runs, soft	1981	NA	NA
stream--fast, hard, cold	1983	NA	NA
stream--fast, hard, warm	1982	NA	NA
stream--slow, hard, cold	1982	NA	NA
stream--slow, hard, warm	1982	NA	NA
tamarack fen	1991	NA	NA
tamarack swamp	1999	NA	NA

Common Name	Last obs Year	State Status	Federal Status
wet prairie	1984	NA	NA
wet-mesic prairie	1991	NA	NA

Rare Vascular Plants of the Wolf River Basin

The Wisconsin Natural Heritage Inventory lists 57 rare plant species in the Wolf River Basin. Listed below, these include 8 WI Endangered species, 11 WI Threatened species, and 38 Special Concern species. There are two federally listed plants, prairie white-fringed orchid and Fassett’s locoweed. Fassett’s locoweed is a critically imperiled variety of a globally secure species (G5T1), whereas prairie white-fringed orchid is a globally imperiled (G2) species. Three Wolf River plant species are considered rare or local through their range (G3, G3G4), and the remaining 52 tracked plant species are considered globally secure (G4, G5).

The majority of plants on this list are associated with wetlands and lake margins. Twenty-nine of these rare plant species grow in wetlands, 7 of them grow in upland forests, and 7 of them grow in lakes and streams. Several species grow in prairies and savannas.

The vicinity of the proposed Crandon Mine holds a large proportion of the documented rare plant occurrences in the Wolf River Basin. At least 19 of the 57 rare plant *species* in the Wolf River Basin are found around Crandon. An even larger proportion of rare plant *sites* is concentrated there. This reflects the intensive botanical efforts made in that area over the last 40 years, and especially in the last 6 years. Some of the rare plant sites around Crandon are on property owned by the mining company, but a great number more are on adjacent County and National Forest land.

Botanists have also paid special attention to land controlled by the Chequamegon – Nicolet National Forest in the last 20 years. Our database shows 10 rare species in the Wolf River Basin portion of the forest. In particular, the wetlands surrounding Kohlhoff Lakes boast 4 rare species. These wetlands are partly owned by private individuals.

The Wolf River Basin portion of Menominee County has supported populations of at least 11 rare species from a wide variety of vegetative communities. Unfortunately, many of those plants grew in the vicinity of Legend Lake, which is now owned by a large number of individuals, and has been developed for lake front recreation. Menominee County seems to be especially important for *Medeola virginiana*, which suffers intensive deer herbivory in most other parts of its WI range.

Plant Summaries

Each of the 57 rare plant species documented in the Wolf River Basin are listed and described below. The descriptions are listed in alphabetical order according to scientific name (written in italics) and include each species’ geographic distribution, legal status in Wisconsin, and management considerations. The state and federal protection status listed in the table below and the element ranks listed with each species paragraph are defined in the section Natural Heritage Working List (see page 35).

The dates when the species were last observed vary greatly across the list. Recently observed plant populations are more likely to be extant than those that were reported many decades ago. Nonetheless, old records often represent persisting populations that simply haven’t received recent botanical attention. Recent inventory efforts have been concentrated in limited areas of the Wolf River Basin, with a focus on public land in the southeastern portion of the basin.

Table 3: Rare Plant Species of the Wolf River Basin

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status
climbing fumitory	<i>Adlumia fungosa</i>	1963	SC	

Table 3: Rare Plant Species of the Wolf River Basin

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status
round-leaved orchis	<i>Amerorchis rotundifolia</i>	1998	THR	
Deam's rockcress	<i>Arabis missouriensis var deamii</i>	1965	SC	
swamp-pink	<i>Arethusa bulbosa</i>	1995	SC	
dwarf milkweed	<i>Asclepias ovalifolia</i>	1995	THR	
purple milkweed	<i>Asclepias purpurascens</i>	1984	END	
yellow screwstem	<i>Bartonia virginica</i>	1916	SC	
little goblin moonwort	<i>Botrychium mormo</i>	1996	END	
blunt-lobe grape-fern	<i>Botrychium oneidense</i>	1994	SC	
fairy slipper	<i>Calypso bulbosa</i>	1994	THR	
cuckooflower	<i>Cardamine pratensis</i>	1999	SC	
Assiniboine sedge	<i>Carex assiniboinensis</i>	1994	SC	
handsome sedge	<i>Carex formosa</i>	1999	THR	
northern bog sedge	<i>Carex gynocrates</i>	1995	SC	
many-headed sedge	<i>Carex sychnocephala</i>	1959	SC	
sparse-flowered sedge	<i>Carex tenuiflora</i>	1995	SC	
sheathed sedge	<i>Carex vaginata</i>	1994	SC	
prickly hornwort	<i>Ceratophyllum echinatum</i>	1982	SC	
ram's-head lady's-slipper	<i>Cypripedium arietinum</i>	1931	THR	
small white lady's-slipper	<i>Cypripedium candidum</i>	1992	THR	
small yellow lady's-slipper	<i>Cypripedium parviflorum</i>	1890	SC	
showy lady's-slipper	<i>Cypripedium reginae</i>	1988	SC	
longstem water-wort	<i>Elatine triandra</i>	1994	SC	
capitate spikerush	<i>Eleocharis olivacea</i>	1977	SC	
squarestem spikerush	<i>Eleocharis quadrangulata</i>		END	
few-flower spikerush	<i>Eleocharis quinqueflora</i>	1977	SC	
Robbins spikerush	<i>Eleocharis robbinsii</i>	1982	SC	
marsh willow-herb	<i>Epilobium palustre</i>	1994	SC	
marsh horsetail	<i>Equisetum palustre</i>	1994	SC	
variegated horsetail	<i>Equisetum variegatum</i>	1994	SC	
wild licorice	<i>Glycyrrhiza lepidota</i>	1915	SC	
Vasey rush	<i>Juncus vaseyi</i>	1916	SC	
American shore-grass	<i>Littorella americana</i>	1931	SC	
Indian cucumber-root	<i>Medeola virginiana</i>	1999	SC	
rock stitchwort	<i>Minuartia dawsonensis</i>	1965	SC	
brittle prickly-pear	<i>Opuntia fragilis</i>	1986	THR	
Fassett's locoweed	<i>Oxytropis campestris var chartacea</i>	1989	END	LT
pale beardtongue	<i>Penstemon pallidus</i>	1965	SC	
leafy white orchis	<i>Platanthera dilatata</i>	1995	SC	
pale green orchid	<i>Platanthera flava var herbiola</i>	1970	THR	
Hooker orchis	<i>Platanthera hookeri</i>	1916	SC	
prairie white-fringed orchid	<i>Platanthera leucophaea</i>	1993	END	LT
large roundleaf orchid	<i>Platanthera orbiculata</i>	1931	SC	
algae-like pondweed	<i>Potamogeton confervoides</i>	1994	THR	
long-beaked baldrush	<i>Psilocarya scirpoides</i>	1978	THR	
small yellow water crowfoot	<i>Ranunculus gmelinii</i>	1994	END	

Table 3: Rare Plant Species of the Wolf River Basin

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status
northern black currant	<i>Ribes hudsonianum</i>	1998	SC	
Torrey's bulrush	<i>Scirpus torreyi</i>	1994	SC	
waxleaf meadowrue	<i>Thalictrum revolutum</i>	1971	SC	
common bog arrow-grass	<i>Triglochin maritimum</i>	1995	SC	
purple bladderwort	<i>Utricularia purpurea</i>	1982	SC	
northeastern bladderwort	<i>Utricularia resupinata</i>	1994	SC	
dwarf huckleberry	<i>Vaccinium cespitosum</i>	1994	END	
mountain cranberry	<i>Vaccinium vitis-idaea ssp minus</i>	1994	END	
marsh valerian	<i>Valeriana sitchensis ssp uliginosa</i>	1997	THR	
northern wild-raisin	<i>Viburnum cassinoides</i>	1973	SC	
long-spur violet	<i>Viola rostrata</i>	1979	SC	

Protection Categories: END=endangered; THR=threatened; SC=special concern

* located within the Lower Wolf River Bottomlands Master Plan Inventory Area

Rare Animals of the Wolf River Basin

The Wisconsin Natural Heritage Inventory lists 143 rare animals in the Wolf River Basin. These include 8 WI Endangered species, 17 WI Threatened species, and 118 Special Concern species. Only one animal, a land snail (*Catinella gelida*) is considered imperiled globally (G2), although another 12 Wolf River basin species are considered rare or local throughout their range (G3). The remaining rare species are considered secure (G4-G5) or global status is unknown. From the perspective of the state of Wisconsin, 18 species from the basin are critically imperiled (S1), 60 species are imperiled (S2), 56 species are rare or uncommon (S3). The remaining 9 species are either secure (S4), of unknown status (SU) or extirpated (SX).

Aquatic habitats are considered critical for 53 percent of the rare species found in the basin. Other important habitats for rare species in the basin are wetlands, harboring 17 percent of the taxa, northern forests with 14 percent, pine/oak barrens with 9 percent, southern forests with 7 percent, grasslands with 6 percent and oak savanna with 2 percent.

As a result of inventory work conducted in the 1999 field season and subsequent literature review, a number of invertebrates were added to the NHI Working List. Most of these were aquatic insects.

Inventory coverage in the basin has been uneven in terms of species or species groups covered, chronology and geography. For example, as with rare vascular plants, an enormous amount of survey work was conducted in the vicinity of the proposed Crandon mine, but comparable work has not been basin-wide. The Lower Wolf River and several major tributaries have been systematically sampled for mussels, fish and aquatic insects, but other portions of the basin and other aquatic habitats have not. The efforts of the NHI in the 1999 field season were concentrated in the lower Wolf River Basin and on state properties. The upshot is that care need to be taken in generalizing about distribution patterns of rare species in the basin (as well as the state).

With consideration of the above, some patterns of rare species occurrences do seem apparent. Several species like the bald eagle, osprey, northern goshawk, etc. are largely confined to the continuously forested northern part of the basin. Many species are strongly associated with the Wolf River corridor. Many of these are restricted to the northern or southern portions of the basin.

Animal Summaries

This appendix lists each of the rare animal species known to occur within the Wolf River basin and provides information on conservation status and species management. For each of the animals, the state and federal protection status is listed in the table below and the element rank (denoting its rarity in Wisconsin and throughout its range) is listed with each species paragraph. The status and ranking codes are defined on the first pages of the Wisconsin Natural Heritage Working List (see Appendix L).

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status	Group Name
a tiger beetle	<i>Cicindela patruela patruela</i>	unknown	SC/N		beetle
a riffle beetle	<i>Stenelmis antennalis</i>	1999	SC/N		beetle^
northern goshawk	<i>Accipiter gentilis</i>	1998	SC/M		bird
yellow-billed cuckoo	<i>Coccyzus americanus</i>	1984	SC/M		bird
cerulean warbler	<i>Dendroica cerulea</i>	1984	THR		bird
spruce grouse	<i>Falcapennis canadensis</i>	1989	THR		bird
red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	1984	SC/M		bird
gray jay	<i>Perisoreus canadensis</i>	1994	SC/M		bird
black-backed woodpecker	<i>Picoides arcticus</i>	1994	SC/M		bird
prothonotary warbler	<i>Protonotaria citrea</i>	1985	SC/M		bird
great gray owl	<i>Strix nebulosa</i>	1995	SC/M		bird
barn owl	<i>Tyto alba</i>	1981	END		bird
american bittern	<i>Botaurus lentiginosus</i>	1994	SC/M		bird^
red-shouldered hawk	<i>Buteo lineatus</i>	1994	THR		bird^
black tern	<i>Chlidonias niger</i>	1984	SC/M		bird^
northern harrier	<i>Circus cyaneus</i>	1994	SC/M		bird^
yellow rail	<i>Coturnicops noveboracensis</i>	1994	THR		bird^
bald eagle	<i>Haliaeetus leucocephalus</i>	1992	SC/FL	(PS)	bird^
yellow-crowned night-heron	<i>Nyctanassa violacea</i>	1984	THR		bird^
osprey	<i>Pandion haliaetus</i>	1992	THR		bird^
forster's tern	<i>Sterna forsteri</i>	1997	END		bird^
henry's elfin	<i>Callophrys henrici</i>	1990	SC/N		butterfly
gorgone checker spot	<i>Chlosyne gorgone</i>	1991	SC/N		butterfly
columbine dusky wing	<i>Erynnis lucilius</i>	1991	SC/N		butterfly
persius dusky wing	<i>Erynnis persius</i>	1994	SC/N		butterfly
northern blue butterfly	<i>Lycaeides idas nabokovi</i>	1994	END		butterfly
karner blue butterfly	<i>Lycaeides melissa samuelis</i>	1998	SC/N	LE	butterfly
jutta arctic	<i>Oeneis jutta</i>	1995	SC/N		butterfly
tawny crescent spot	<i>Phyciodes batesii</i>	1994	SC/N		butterfly
greenish blue	<i>Plebejus saepiolus</i>	1994	SC/N		butterfly
broad-winged skipper	<i>Poanes viator</i>	1991	SC/N		butterfly
smokey eyed brown	<i>Satyrodes eurydice fumosa</i>	1994	SC/N		butterfly
bog fritillary	<i>Boloria eunomia</i>	1995	SC/N		butterfly^
two-spotted skipper	<i>Euphyes bimacula</i>	1989	SC/N		butterfly^
dion skipper	<i>Euphyes dion</i>	1999	SC/N		butterfly^
dorcas copper	<i>Lycaena dorcas</i>	1995	SC/N		butterfly^
bog copper	<i>Lycaena epixanthe</i>	1995	SC/N		butterfly^
west virginia white	<i>Pieris virginianensis</i>	1995	SC/N		butterfly^
mulberry wing	<i>Poanes massasoit</i>	1991	SC/N		butterfly^
little glassy wing	<i>Pompeius verna</i>	1991	SC/N		butterfly^
black-tipped darner	<i>Aeshna tuberculifera</i>	1985	SC/N		dragonfly^

Table 4: Rare Animal Species of the Wolf River Basin

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status	Group Name
green-striped darner	<i>Aeshna verticalis</i>	1985	SC/N		dragonfly^
river bluet	<i>Enallagma anna</i>	1986	SC/N		dragonfly^
plains clubtail	<i>Gomphurus externus</i>	1999	SC/N		dragonfly^
splendid clubtail	<i>Gomphurus lineatifrons</i>	1991	SC/N		dragonfly^
skillet clubtail	<i>Gomphurus ventricosus</i>	1999	SC/N		dragonfly^
green-faced clubtail	<i>Gomphus viridifrons</i>	1999	SC/N		dragonfly^
dark rubyspot	<i>Hetaerina titia</i>	1999	SC/N		dragonfly^
elfin skimmer	<i>Nannothemis bella</i>	1990	SC/N		dragonfly^
stygian shadowfly	<i>Neurocordulia yamaskanensis</i>	1999	SC/N		dragonfly^
pygmy snaketail	<i>Ophiogomphus howei</i>	1999	THR		dragonfly^
least clubtail	<i>Stylogomphus albistylus</i>	1989	SC/N		dragonfly^
elusive clubtail	<i>Stylurus notatus</i>	1999	SC/N		dragonfly^
zebra clubtail	<i>Stylurus scudderi</i>	1999	SC/N		dragonfly^
lake sturgeon	<i>Acipenser fulvescens</i>	1996	SC/H		fish^
pirate perch	<i>Aphredoderus sayanus</i>	1970	SC/N		fish^
creek chubsucker	<i>Erimyzon oblongus</i>	unknown			fish^
lake chubsucker	<i>Erimyzon sucetta</i>	1981	SC/N		fish^
western sand darter	<i>Etheostoma clarum</i>	1994	SC/N		fish^
least darter	<i>Etheostoma microperca</i>	1979	SC/N		fish^
banded killifish	<i>Fundulus diaphanus</i>	1995	SC/N		fish^
longear sunfish	<i>Lepomis megalotis</i>	1979	THR		fish^
striped shiner	<i>Luxilus chrysocephalus</i>	unknown	END		fish^
redfin shiner	<i>Lythrurus umbratilis</i>	1979	THR		fish^
river redhorse	<i>Moxostoma carinatum</i>	1982	THR		fish^
greater redhorse	<i>Moxostoma valenciennesi</i>	1994	THR		fish^
pugnose shiner	<i>Notropis anogenus</i>	1979	THR		fish^
weed shiner	<i>Notropis texanus</i>	1995	SC/N		fish^
pugnose minnow	<i>Opsopoeodus emiliae</i>	1981	SC/N		fish^
blanchard's cricket frog	<i>Acris crepitans blanchardi</i>	1983	END		frog^
bullfrog	<i>Rana catesbeiana</i>	1986	SC/H		frog^
northern marbled locust	<i>Spharagemon marmorata</i>	1999	SC/N		grasshopper
ash-brown grasshopper	<i>Trachyrhachys kiowa</i>	1999	SC/N		grasshopper
seaside grasshopper	<i>Trimerotropis maritima</i>	1998	SC/N		grasshopper
western slender glass lizard	<i>Ophisaurus attenuatus</i>	1989	END		lizard
prairie vole	<i>Microtus ochrogaster</i>	1898	SC/N		mammal
woodland jumping mouse	<i>Napaeozapus insignis</i>	1995	SC/N		mammal
western harvest mouse	<i>Reithrodontomys megalotis</i>	1976	SC/N		mammal
franklin's ground squirrel	<i>Spermophilus franklinii</i>	1990	SC/N		mammal
arctic shrew	<i>Sorex arcticus</i>	1999	SC/N		mammal^
pygmy shrew	<i>Sorex hoyi</i>	1995	SC/N		mammal^
water shrew	<i>Sorex palustris</i>	1995	SC/N		mammal^
a small minnow mayfly	<i>Paracloeodes minutus</i>	1992	SC/N		mayfly^
a primitive minnow mayfly	<i>Parameletus chelifer</i>	1993	SC/N		mayfly^
an ephemerid mayfly	<i>Pentagenia vittigera</i>	1992	SC/N		mayfly^
a heptageniid mayfly	<i>Pseudiron centralis</i>	1999	SC/N		mayfly^
buck moth	<i>Hemileuca nevadensis</i>	1974	SC/N		moth
phlox moth	<i>Schinia indiana</i>	1992	END		moth
elktoe	<i>Alasmidonta marginata</i>	1995	SC/H		mussel^

Table 4: Rare Animal Species of the Wolf River Basin

Common Name	Scientific Name	Lastobs Year	State Status	Federal Status	Group Name
slippershell mussel	<i>Alasmidonta viridis</i>	1991	THR		mussel^
snuffbox	<i>Epioblasma triquetra</i>	1995	END		mussel^
round pigtoe	<i>Pleurobema sintoxia</i>	1997	SC/H		mussel^
salamander mussel	<i>Simpsonaias ambigua</i>	1991	THR		mussel^
buckhorn	<i>Tritogonia verrucosa</i>	1995	THR		mussel^
four-toed salamander	<i>Hemidactylium scutatum</i>	1994	SC		salamander^
a land snail	<i>Catinella gelida</i>	1997	SC/N		snail
appalachian pillar	<i>Cionella morseana</i>	1997			snail
sculpted glyph	<i>Glyphyalinia rhoadsi</i>	1997	SC/N		snail
northern ringneck snake	<i>Diadophis punctatus edwardsii</i>	1995	SC/N		snake
wood turtle	<i>Clemmys insculpta</i>	1989	THR		turtle^
blanding's turtle	<i>Emydoidea blandingii</i>	1999	THR		turtle^

Protection Categories: END=endangered; THR=threatened; SC=special concern

Wisconsin Natural Heritage Working List

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. Most of the species and natural communities on the list are actively tracked and we encourage data submissions on these species. This list is meant to be dynamic--it is constantly changing as new information regarding the biological status of species becomes available. The Natural Heritage Program welcomes your input on any aspect of this list. Wisconsin's extirpated species list is at the end. **Changes from the previous list (01/98) are bolded.**

Key

ELCODE: Unique 10 digit code for each element (plant, animal, or natural community).

Scientific Name: Scientific name used by the Wisconsin Natural Heritage Inventory Program.

Common Name: Standard, contrived, or agreed upon common names.

Global Rank: Global element rank. Refer to the Rank Definition Sheet.

State Rank: State element rank. Refer to the Rank Definition Sheet.

US Status: Federal protection status designated by the Office of Endangered Species, U.S. Fish and Wildlife Service indicating the biological status of a species in the United States. LE = listed endangered; LT = listed threatened; LELT = listed endangered in part of its range, threatened in another part; PE = proposed endangered; PT = proposed threatened; PEPT = proposed endangered in part of its range threatened in another; E(S/A), T(S/A) = Treat as endangered (E) or threatened (T) due to similarity of appearance.

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern.

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The level of protection currently follows: SC/P = fully protected; SC/N = no laws regulating use, possession, or harvesting; SC/H= take regulated by establishment of open closed seasons; SC/FL = federally protected as endangered or threatened, but not so designated by WDNR; SC/M = fully protected by federal and state laws under the Migratory Bird Act.

Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Global & State Element Rank Definitions**Global Element Ranks:**

- G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
- G4 = Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.
- GU = Possibly in peril range-wide, but their status is uncertain. More information is needed.
- GX = Believed to be extinct throughout its range (e.g. Passenger pigeon) with virtually no likelihood that it will be rediscovered.
- G? = Not ranked.

Species with a questionable taxonomic assignment are given a "Q" after the global rank.

Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

State Element Ranks

- S1 = Critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2 = Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
- S3 = Rare or uncommon in Wisconsin (21 to 100 occurrences).
- S4 = Apparently secure in Wisconsin, with many occurrences.
- S5 = Demonstrably secure in Wisconsin and essentially ineradicable under present conditions.
- SA = Accidental (occurring only once or a few times) or casual (occurring more regularly although not every year); a few of these species (typically long-distance migrants such as some birds and butterflies) may have even bred on one or more of the occasions when they were recorded.
- SE = An exotic established in the state; may be native elsewhere in North America.
- SH = Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years, and suspected to be still extant. Naturally, an element would become SH without

such a 20-year delay if the only known occurrence were DESTROYED OR IF IT HAD BEEN EXTENSIVELY AND UNSUCCESSFULLY LOOKED FOR.

- SN = REGULARLY OCCURRING, USUALLY MIGRATORY AND TYPICALLY NONBREEDING SPECIES FOR WHICH NO SIGNIFICANT OR EFFECTIVE HABITAT CONSERVATION MEASURES CAN BE TAKEN IN WISCONSIN. THIS CATEGORY INCLUDES MIGRATORY BIRDS AND BATS WHICH DO NOT BREED IN WISCONSIN BUT PASS THROUGH TWICE A YEAR OR MAY REMAIN IN THE WINTER (OR, IN A FEW CASES, THE SUMMER) AND CERTAIN LEPIDOPTERA WHICH REGULARLY MIGRATE TO WISCONSIN WHERE THEY REPRODUCE, BUT THEN COMPLETELY DIE OUT EVERY YEAR WITH NO RETURN MIGRATION. SPECIES IN THIS CATEGORY ARE SO WIDELY AND UNRELIABLY DISTRIBUTED DURING MIGRATION OR IN WINTER THAT NO SMALL SET OF SITES COULD BE SET ASIDE WITH THE HOPE OF SIGNIFICANTLY FURTHERING THEIR CONSERVATION.
- SZ = NOT OF SIGNIFICANT CONSERVATION CONCERN IN WISCONSIN, INVARIABLY BECAUSE THERE ARE NO DEFINABLE OCCURRENCES IN THE STATE, ALTHOUGH THE TAXON IS NATIVE AND APPEARS REGULARLY IN THE STATE. AN SZ RANK WILL GENERALLY BE USED FOR LONG-DISTANCE MIGRANTS WHOSE OCCURRENCE DURING THEIR MIGRATIONS ARE TOO IRREGULAR (IN TERMS OF REPEATED VISITATION TO THE SAME LOCATIONS), TRANSITORY, AND DISPERSED TO BE RELIABLY IDENTIFIED, MAPPED, AND PROTECTED. TYPICALLY, THE SZ RANK APPLIES TO A NONBREEDING POPULATION.
- SR = REPORTED FROM WISCONSIN, BUT WITHOUT PERSUASIVE DOCUMENTATION WHICH WOULD PROVIDE A BASIS FOR EITHER ACCEPTING OR REJECTING THE REPORT. SOME OF THESE ARE VERY RECENT DISCOVERIES FOR WHICH THE PROGRAM HASN'T YET RECEIVED FIRST-HAND INFORMATION. OTHERS ARE OLD, OBSCURE REPORTS THAT ARE HARD TO DISMISS BECAUSE THE HABITAT IS NOW DESTROYED.
- SRF = REPORTED FALSELY (IN ERROR) FROM WISCONSIN BUT THIS ERROR IS PERSISTING IN THE LITERATURE.
- SU = POSSIBLY IN PERIL IN THE STATE, BUT THEIR STATUS IS UNCERTAIN. MORE INFORMATION IS NEEDED.
- SX = APPARENTLY EXTIRPATED FROM THE STATE.

State Ranking Of Long-Distance Migrant Animals:

RANKING LONG-DISTANCE AERIAL MIGRANT ANIMALS PRESENTS SPECIAL PROBLEMS RELATING TO THE FACT THAT THEIR NONBREEDING STATUS (RANK) MAY BE QUITE DIFFERENT FROM THEIR BREEDING STATUS, IF ANY, IN WISCONSIN. IN OTHER WORDS, THE CONSERVATION NEEDS OF THESE TAXA MAY VARY BETWEEN SEASONS. IN ORDER TO PRESENT A LESS AMBIGUOUS PICTURE OF A MIGRANT'S STATUS, IT IS NECESSARY TO SPECIFY WHETHER THE RANK REFERS TO THE BREEDING (B) OR NONBREEDING (N) STATUS OF THE TAXON IN QUESTION [E.G. S2B, S5N].

Karner Blue Butterfly Habitat Conservation Plan

The Karner Blue Butterfly (*Lycaeides melissa samuelis*) is a federally-listed endangered species. Wisconsin supports the largest widespread Karner Blue butterfly populations in the world. This species has been extirpated from much of its historic range; thus, the status of the species in Wisconsin is critical to its continued survival. The species occurs in Adams, Green Lake, Marquette, and Waushara counties (and other counties) and is known to exist at many sites in the southern portion of the Wolf River Basin. Karner Blue butterflies are found in close association with wild lupine (*Lupine perennis*), the only known host plant for their larvae. Natural habitats that Karner Blue butterflies occupy include sandy pine and oak barrens, pine prairies, oak savannas, and some lake shore dunes.

Current Karner Blue butterfly habitat in Wisconsin and the Wolf River Basin includes abandoned agricultural fields, mowed utility and road rights-of-way, managed forest land and barrens, and a State Park. Potential habitat at the specific site level can only occur where conditions exist to support wild lupine. This butterfly species specializes on wild lupine and other food plants that are found primarily on early successional habitats that are dependent on ecosystem disturbance. Thus, suitable habitat can be a shifting and increasingly smaller fraction of a greater landscape mosaic that results in local species extinction events that are frequently inevitable. Therefore, the availability – or absence – of suitable habitat mosaics plays a key role in the long-term survival of this species.

In 1999, The U.S. Fish & Wildlife Service participated as a partner in the Wisconsin Statewide Karner Blue Butterfly Habitat Conservation Plan (HCP). The HCP was developed by DNR and other state partners including utilities, county forests, industrial forest companies, trade organizations, and Wisconsin state agencies. DNR administers the federal incidental take permit aspects of the HCP. The HCP is an innovative approach designed to move regulated communities (partners) beyond compliance and into efforts to proactively apply conservation measures on the land while engaging in normal land management activities. Over time, additional entities, such as town and county highway departments who manage lupine sites along roadsides, will be added as participating partners in the HCP. New HCP partners, interested individuals and experts, and interested organizations will be sought and nurtured in the southern Wolf River Basin to assist in moving forward the conservation of Karner Blue butterflies and their habitat.

The HCP utilizes two approaches to land management by partners:

- 1) Management with consideration for Karner Blue butterflies such that long term goal on these lands is that the butterfly habitat gains equal or exceed losses occurring through natural succession or otherwise.
- 2) Management to feature, protect or enhance Karner Blue butterflies which has the same goal on lands as above plus measures are taken to promote viable Karner Blue butterfly populations despite potential economic costs.

These management strategies are also applied by DNR, a participating partner, in managing state lands in the Wolf River Basin. Wolf River Basin state lands listed in the HCP for such management includes Hartman Creek State Park. Prairie and savanna restoration activities underway on several of these areas will expand lupine-containing habitat for this butterfly.

Wildlife Management Accomplishments

Below are Wildlife Management work that has occurred in the Wolf Basin between July 1999 and June 30, 2000.

Table 5: Wildlife Management Accomplishments - FY00: 7/1/99 - 6/30/00

HABITAT MAINTENANCE(Public Land: DNR, County, Federal, etc)	Known or Estimated	
Survey & Control Purple Loosestrife	75	acres treated
Total Wetland Habitat (ponds, impoundments, etc.)	4400	acres
Operated and Maintained	23	wetlands
Grasslands Maintained (DNC, burning, Sharecropping)	510	acres
Woodlands (forest habitats), Brushland Maintained	18,000	acres
Timber Harvested	75	acres
Water Control Structures Replaced	3	structures
Forest Openings Maintained	20	openings
Firebreaks Maintained	2	miles
HABITAT DEVELOPMENT Public Land: county, federal, etc.)	DNR	
Wetlands Established or Restored	0	acres
Dikes Established	0	miles
Forest Openings Established	0	acres
Grasslands Established or Restored	0	acres
Woodlands (forest habitats), Brushland Developed	6	acres
Wild Rice Established	0	acres
Firebreaks Constructed	6	miles
FARM BILL IMPLEMENTATION (Separate from other priv.lands)		
Grasslands Established	172	acres
	14	sites
Wetlands Restored	3	acres
	1	sites
Oak Savanna Established	0	acres
FACILITY DEVELOPMENT (Public land: DNR only)		
DNR Buildings Constructed	0	buildings
Parking Lots and/or Access Sites Constructed	3	lots/sites
Fences Constructed	0	Miles
Trails Constructed	0	miles
Roads Constructed	0	miles
Disabled Facilities Developed	2	facilities
Other Facilities Developed	1	other facilities
ADMINISTER DOC PMG/STOCK PHEASANTS		
DOC's Provided	4325	pheasants

Pheasants Released	3882	pheasants
Genetically Wild Pheasants Released	0	pheasants
Properties Stocked	1	properties
DOC Cooperators	6	cooperators
PUBLIC HUNTING GROUND		
Public Hunting Ground Leases	0	acres
		leases
WILDLIFE POPULATION MANAGEMENT		
	Known or	Estimated
Trumpeter Swans Presently in Area	0	swans
Canada Geese Translocated	0	geese
Urban Wildlife Inquiries, Contacts(not nuisance or damage)	40	contacts
Prairie Chickens Managed/Maintained	0	Prairie chickens
Turkeys Trapped, Released	0	
WILDLIFE DAMAGE & NUISANCE CONTROL		
Wildlife Damage Complaints (A crops and livestock)	30	complaints
Wildlife Nuisance Complaints (other than damage)	75	complaints
WILDLIFE EDUCATION PROGRAM		
Outdoor Skills Program	13	programs
	250	participants
Project Wild Workshops	0	workshops
Wildlife Interpretation Programs	10	presentations
(tours and presentations to an group)	200	participants
Total Media Contacts	40	contacts
	20	interviews
	16	articles
Special Events	18	days attended
Fairs	0	days attended
Other Wildlife-Related Events	2	days attended
Farm Progress Days	0	days attended
Total # of Information Requests	100	requests
PRIVATE LANDS MANAGEMENT		
	Known or	Estimated
Wildlife: Nonpoint.Cooperation	3	contacts
FERC	0	sites evaluated
Roadside Habitat Management	0	miles
Dodge Count Private Lands Management		
(acres managed and evaluated)	0	acres
Wetlands Restored	3	acres
	6	wetlands
HRA Landowner Contacts	0	contacts
Wildlife: MFL Cooperation	3	plans reviewed
Technical Assistance to Landowners	25	contacts
Technical Assistance to Outside Agencies	20	contacts
Grasslands Restored	10	acres
Food Patches Developed	10	acres
Project Respect	0	acres
Nesting Structures	0	nest structures
LICENSE/PERMIT APPLICATIONS		
Collectors	0	reviewed
Game Farm	4	reviewed
	3	issued
Shooting Preserve	0	reviewed
Stocking	3	reviewed
	3	issued

Dog Training	13	reviewed
	12	issued
Dog Trialing	0	reviewed
Rehabilitator	0	reviewed
Falconry	0	reviewed
Wildlife Exhibit	0	reviewed
Others: Fur	1	reviewed
	1	issued
Nuisance Permits	10	reviewed
	10	Issued
SURVEYS	Known or Estimated	
Wildlife Surveys Completed	35	surveys
Species: (list) ruffed grouse, bear, mammal, Karner's, brood, deer, heron, frog, red-shouldered hawk, rail, winter track, turtle, beetle, dragonfly, aquatic inverts, butterfly, waterfowl, woodcock, mourning dove, sturgeon		
MISC. & ADMINISTRATIVE SERVICES		
Liaison to Outside Agencies & Conservation Groups	20	meetings attended
	100	contacts
Setting Quotas, Establishing Rules/Regulations	10	public meetings attended
Master Planning/Feasibility Stud	15	meetings attended
Wildlife Disease Work:		
Shawano Lake	15	days
Eagles	3	
Swans	8	
Deer	3	
Hawks & Owls	10	
Crane	2	2
Cormorant	1	
Porcupine	1	

Forest Priorities and Recommendations

Wolf Basin Landscape Ecosystems

The Wolf River Basin is primarily in the Northeast Hills and Northeast Plains Ecological Landscapes with small portions in the Central Sand Hills, Southeast Glacial Plains, and North Central Forest (see map). In pre-settlement times, the basin was diverse and included floodplain forest, extensive wetland and swamp forest complexes, mesic (tallgrass) prairie, oak savanna, jack pine-scrub oak barren, maple-beech forest, red and white pine forest, and extensive hemlock hardwood/northern hardwood forest in the north. The plant communities throughout the basin formed a complex mosaic, resulting from complicated drainage patterns and landforms created by glacial deposits, edaphic factors, and recurrent natural disturbances such as windstorms, wildfires, floods, droughts, and insect infestations.

Historic Communities

Only in the northern-most part of the basin (Forest and Langlade counties, and to a lesser extent the Menominee Reservation) did a single community type prevail (sugar maple-hemlock-beech). The central and southern parts of the basin contained marshes, sedge meadows, swamp conifers (white cedar, black spruce and tamarack), lowland hardwoods (willow, soft maple, ash, elm and cottonwood), maple and beech forests, hemlock-hardwood forests, pine forests (white and red pine) and jack pine-scrub oak barrens. The pine-oak barrens were confined to small areas of sandy outwash located on the present day Menominee Reservation, and an area in central Shawano County, around Shawano Lake and to the Clover Leaf Lakes area, and Navarino Wildlife Area. The lowland hardwood, marsh and sedge communities present before settlement were largely concentrated along the Wolf River on its lower-most reaches, below present-day Shawano south to Lake Poygan. The southwest corner of the basin (Waupaca, Portage, and Waushara Counties) also includes oak forest (red, black, and white oak) and scattered areas of oak opening and prairie (Finley, 1976).

Avian Use

Due to its location, many common local resident and neo-tropical migrant songbirds can be found in the Wolf River Basin. Many transient species utilize the basin during annual fall and spring migrations, while others migrate specifically to the basin for winter or breeding habitat. The basin has a unique mixture of open grassland/agricultural habitat, and contiguous wooded habitat along the river corridors. In addition, the basin is near the north/south tension zone of Wisconsin, which provides an interesting mix of habitat and the songbirds associated with northern and southern Wisconsin.

Forest Program

There is a very active forest management program on state lands in the Wolf River basin, especially in the upper portion. Aspen, oak, and hardwood regeneration are managed perpetually through the use of timber sales that vary in size.

Geographic Focus: Wolf River Bottomlands - Sustainable Forestry

The forest resource of the Lower Wolf River Bottomland properties serves a vital roll in supporting a healthy environment that provides habitat for a wide variety of wildlife and fish, recreational opportunities, clean water, and timber to help support the local economy. Considering all the state properties in the Lower Wolf River Bottomlands, over 30,000 acres, nearly 50% is in some type of forest cover. The remaining land cover is marsh, lowland brush, open water, upland grass, or actively farmed.

A forest type is an association of trees with similar growth characteristics that require same soil, nutrient and moisture conditions to sustain growth. The largest forest type represented on the properties is aspen, with nearly twice as much acreage than any of the other forest types found on the properties. Swamp hardwoods and bottomland hardwoods follow as the next most common forest type. Although only comprising about 3% of the forest cover type; oak serves a vitally important role in supporting deer, ruffed grouse, turkeys, squirrels, etc.

Forestry has played an important role in the past in managing these state properties through carefully planned timber harvests designed to maintain or enhance certain forest cover types desired by wildlife. In addition, these timber harvests also provide an income to the state and a raw timber resource to support the local and state economy

General Forestry Priorities:

- ❖ Find and suppress forest fires.
- ❖ Be prepared to immediately coordinate and conduct fire suppression activities.
- ❖ Provide general forest management information to private landowners.
- ❖ Administer Forest Tax Law programs.
- ❖ Advise landowners about tree and shrub planting projects.
- ❖ Provide assistance to landowners with Wisconsin Forest Landowner Grant Program.
- ❖ Continue educational activities such as landowner workshops and school programs.
- ❖ Work with other partners to control the spread of Gypsy Moth.
- ❖ Work with Land Division staff to promote healthy sustainable forests on state owned and managed properties.

Fisheries & Habitat Priorities and Recommendations

Department & Partner Recommendations

1. Promote one or more fish or habitat related success story(s) about a major project in the Wolf Basin. Provide information to the local press on a regular basis.
2. Look to increase the available opportunities to promote basin fishery and habitat projects. Provide information to fish oriented sports groups by speaking about basin projects or work activities at their meetings. Provide information about sport fish including muskellunge, walleye, bass, catfish, sturgeon and trout to inform anglers about the status and management of their fisheries
3. Work with partners to research the status of Wolf River Flathead and Channel Catfish. If necessary, work with the partners to develop effective regulations designed to preserve and protect these species.
4. Work with partners to better protect and enhance the basin's trout streams. Plan and implement trout stream habitat projects throughout the basin.
5. Work with partners to continue to provide adequate protection for all species of fish. We need to focus on walleye, Northern Pike, bass and sturgeon spawning sites. This activity may include securing agreements for the preservation and protection of existing spawning sites. Continue to monitor the Wolf River area for new sites and take appropriate action to preserve and protect these sites.
6. Provide information to the public regarding invasive exotic aquatic species of plants, fish and mussels. Monitor inland lakes and rivers for these species.
7. Promote fishing as a fun recreational sport to young people.

Department Goals & Objectives

1. Continue to Implement the monitoring strategy in the Wolf Basin and developing bio-criteria, habitat indices and supporting databases for aquatic systems.
2. Identify and protect critical habitat in Wolf Basin through the basin planning and monitoring processes and by working with concert with local citizens and partners.
3. Identify and investigate the causes of aquatic, terrestrial and wetland habitat loss. Take appropriate action(s), if warranted.
4. Collaborate and provide assistance local units of government to protect basin waters, aquatic and terrestrial habitat and shoreline habitats. This may result in the Department directly implementing the enforcement of state statutes and rules. Utilize enforcement mechanisms for habitat restoration.

Warm and Cold Water Lakes, Streams & Habitat Activities

1. Prevent any further loss of habitat including water quality or quantity in cold water streams through regulatory, watershed management, and land acquisition programs. Work with partners to conduct these activities.
2. Conduct intensive trout habitat restoration projects as funding allows. Also, maintain past habitat development projects while also protecting and enhancing habitat for non-game, threatened or endangered species.
3. Keep high priority trout streams free of beaver dams consistent with the beaver control policy.
4. Restore naturally reproducing native brook trout and the associated native cold water community in basin stream as funding and support allow.
5. Conduct monitoring for invasive exotic species of fish, mussel, aquatic insect and aquatic plant communities.
6. Evaluate and report the impact of harvest and regulations on sport fish in lakes, rivers and stream populations.
7. Identify critical habitat sites in each basin plan for stream bank protection or in-stream habitat restoration to enhance sport fisheries in the basin.
8. Identify and protect critical spawning, reproductive, and nursery habitat in basin lakes, rivers and streams.
9. Monitor contaminant levels in fish by implementing the baseline monitoring strategy for lakes, rivers and streams. Also, monitor contaminants in fish and substrate to support the Statewide Fish Advisory.
10. Develop criteria to identify and recommendations protect existing self-sustained fisheries. Utilize fish stocking, where applicable
11. Continue to research, implement and evaluate current and new habitat restoration techniques on basin projects.

Wetland Protection Activities

1. Identify and prioritize wetlands in need of protection, restoration and enhancement in the basin plans.
2. Protect wetlands with exceptionally high value through acquisition, easements, incentives and other innovative strategies. Collaborate with partners, other governmental units and owners of wetlands.
3. Restore degraded wetland areas on public and private lands to re-establish function and value. Preserve and protect endangered species of plants and animals and in certain areas enhance migratory waterfowl habitat.

Geographic Focus: Lower Wolf River Bottomlands Fisheries Resources

The properties that make up the lower Wolf River Bottomlands are parts of a rich and diverse tapestry that runs from Shawano to Lake Poygan. Its weave includes open marshes, areas of lowland hardwoods, uplands and a labyrinth of old river channels, oxbows and bayous. The thread that binds this landscape fabric together is the historic Wolf River. Walleye, sturgeon, northern pike and white bass swim its currents while adjacent marshes and bayous are home to a myriad of other species. This thread of relatively unspoiled river is the lifeblood of this regions rich bounty. One of the most important aspects of the Wolf River Bottomlands is its significance in providing critical spawning habitat for walleye and sturgeon, two of the most popular species in the Winnebago system.

Walleye migrate out of Lake Winnebago and travel upstream on the Wolf as far as 90 miles to historic "spawning marshes" where they lay their eggs and then return to the lakes downstream. These spawning marshes are unique areas with distinctive characteristics unique to walleye in the Winnebago system. Well defined inlets and outlets provide oxygenated water flows while grasses and sedges provide a silt-free spawning substrate -both essential for successful egg incubation and hatching. The flows also carry the newly hatched fry to the river before the marshes begin to dry up. Over time, the effectiveness of these marshes has diminished from both natural succession and man-made changes in these bottomlands.

Over the years, DNR fisheries management has purchased several of the marshes along the Wolf to manage them for walleye spawning and protect them from development. To compliment that, they have also developed a Cooperative Walleye Spawning Marsh Agreement for areas under private ownership. This agreement allows the state to enter into a partnership with the landowner and manage the marsh for walleye spawning. This may be as simple as posting the marsh as a "No Entry Zone" in spring, mowing brush to keep the marsh in grass and sedge or complicated projects like dike or bank modification, or even the installation of water control structures, culverts or bridges.

Our lake sturgeon population, the largest self-sustaining one in North America, is also dependent on critical spawning areas on the Wolf River. Traditional spawning areas were natural in-stream riffles and rocky areas along the banks. Natural changes in the rivers path along with increased shoreline development-caused more and more sediment to be transported downstream, covering some of these areas with silt. Owners of shoreline property changed the waterfront to suit their desires. The addition of rock rip rap to protect shorelines from erosion has had the unanticipated benefit of providing additional spawning areas for these prehistoric fish.

In addition to work done by state personnel and private landowners, several sport and conservation clubs have stepped forward and taken a "hands on" role in restoring and enhancing walleye and sturgeon spawning habitat on the Wolf River. Among these groups are Walleyes for Tomorrow, Shadows on the Wolf, the Otter Street Fishing Club and Sturgeon for Tomorrow. These organizations have donated money, time, and services on numerous projects up and down the Wolf River, restoring thousands of acres of walleye spawning marshes and dozens of sturgeon spawning sites.

Drinking Water & Groundwater Priorities and Recommendations

Groundwater is the source of potable water for all residents within the Wolf River Basin. Water can be obtained from an upper sand and gravel aquifer, the Cambrian sandstone or the upper weathered parts of the underlying Precambrian granite. Some private wells in the SE portion of the basin obtain water from the Prairie du Chien dolomites. In parts of the basin the bedrock aquifer contains elevated levels of radon and uranium which could force communities to seek other shallower aquifers. These sandstone and gravel aquifers are likely to be very thin which can lead to interactions between the groundwater withdrawals and surface water flows or wetlands. In addition, the sand and gravel aquifer system is extremely vulnerable to contamination related to land use. High levels of nitrate and bacteria have caused wells to be closed in Mattoon to be abandoned. In addition, elevated nitrates in the Village of Bowler's municipal well are of increasing concern. Some wells in the eastern part of the Wolf River Basin may have arsenic levels that exceed the MCL.

Groundwater Contamination Potential

Each watershed within the Wolf River Basin was ranked based on land coverage and groundwater sample analytical results in the DNR's GRN database. The table below lists each watershed score and gives a short description of the land cover and groundwater sample analytical data that determined the score. A score of 20 or more is considered medium. At 30 or greater, the score is considered high for groundwater contamination potential. The Wolf Basin has very little urban land cover so the amount of agricultural land and presence of nitrate or pesticides in groundwater determine the score. There are three permitted Confined Animal Feeding Operations in the basin.

Abbreviations include:

1. ES: Groundwater enforcement standard as per NR 140 Wis. Adm. Code. For nitrate the groundwater ES is 10 ppm.
2. PAL: Groundwater Preventive Action Limit as per NR 140 Wis. Adm. Code. For nitrate the groundwater ES is 2 ppm.
3. CAFO: Confined Animal Feeding Operation which consists of the equivalent of 1000 animal units.

Table 6: Scores for Groundwater Contamination Potential

Watershed Name	Score	Comments
Arrowhead and Daggets Creek	83.06	Of the 151 wells sampled, 16% had nitrate levels greater than the ES and 42% had nitrate levels greater than the PAL. Pesticides were detected in 93 wells. The land cover is 68% agricultural. There is one CAFO in the watershed.
Pine River and Willow Creek	49.31	Sample analytical data showed nitrate levels greater than the ES in 12% of the wells and greater than the PAL in 64% for 42 wells sampled. Pesticides were detected in 32 wells. 34 % of the land cover is agricultural.
Walla Walla and Alder Creek	39.05	Agriculture makes up 38% of the land cover
Lower Wolf River	55.77	Forty-two percent of the land cover is agricultural. Of 16 well samples, 18% exceeded the ES and 62.5 exceeded the PAL
Waupaca River	53.83	Thirty-four percent of the land cover is agricultural. Of 140 well samples analyzed for nitrate within the watershed, 55% exceeded the PAL and 27% exceeded the ES for nitrate. Pesticides were detected in 144 wells.
Lower Little Wolf	44.82	Agriculture makes up 44% of the land cover
Upper Little Wolf	42.7	Twenty-four percent of the land cover is in agriculture. Sample analytical results from 57 wells show 22% exceed the ES and 61 % exceed the PAL.
South Branch Little Wolf River	31.2	Pesticides were detected in 36 wells in the watershed. Land cover is 27% agriculture.
North Branch and Main Stem Embarrass River	50.38	Pesticides were detected in 32 wells within the watershed. Land cover is 47% agriculture.
Pigeon River	48.21	Agriculture makes up 45% of the watershed. There is 1CAFO located in the watershed
Middle and South Branch Embarrass River	25.6	Twenty-five percent of the land cover is agriculture.
Wolf/New London and bear Creek	69.5	Sixty-eight percent of the land cover is agriculture.
Shioc River	71.27	Seventy percent of the land cover is agriculture. There is one CAFO in the watershed.
Middle Wolf	44.3	Forty-three percent of the watershed is agriculture
Shawano Lake	48.37	Thirty-two percent of this small watershed is agricultural land cover. Of 12 samples analyzed for nitrate, 25% exceeded the ES.
Red River	22.22	Twenty-two percent of the land cover is agriculture.
West Branch Wolf River	7.7	Seven percent of the watershed is agriculture. Seventy-three percent is forest.
Wolf/Langlade and Evergreen	6.51	Seven percent of the watershed is agriculture. Seventy-eight percent is forest.
Lily River	3.15	Seventy percent of the land cover is forest.
Upper Wolf Post Lake	2.92	Land cover is 59% forest, 24% wetland and only 2 % agriculture

Department and Partner Recommendations

1. Encourage and educate well owners to insure that unused wells are properly abandoned.
2. Encourage and assist farmers with nutrient and pest management planning especially adjacent to municipal supply wells.
3. Assist communities with Water system planning, Wellhead protection planning and Source Water Protection planning.

4. Assist DNR and county health departments with problem assessment monitoring.
5. Promote water conservation within the basin by encouraging well owners and operators to find and fix leaking distribution pipes as soon as possible.

Department Goals and Objectives

1. Protect groundwater recharge areas and groundwater quality.
2. Use land use planning to protect public health and water supply wells.
3. Identify and assess the extent of groundwater contamination problems.
4. Conserve groundwater use where practicable to reduce declining groundwater levels and protect groundwater flow to lakes, streams and wetlands.

Summary of the Counties in the Wolf Basin

Menominee County

Menominee County is located in northeastern Wisconsin, about forty miles northwest of the City of Green Bay. It sits on the northern border of the East Central region, and is bordered on the south and west by Shawano County. With 4,655 residents, it is, by far, the smallest county in the region. It is also the newest. Menominee County is the only county in the state created after 1901. Menominee County was authorized in 1959 and created in 1961 (Long, 1997). Development within the county is concentrated in the incorporated communities of Neopit and Keshena. County and tribal offices are both located in Keshena. Menominee County's boundaries are coterminous with the Menominee Reservation and the Town of Menominee. Reservation trust lands and the county's non-trust lands form a checkerboard effect.

Population Trends

Between 1950 and 1990, Menominee County grew faster than the state, but slower than the region. Between 1950 and 1990, Menominee grew by an average annual rate of 1.17 percent, compared to the region and state, which grew at 1.20 percent and 1.06 percent, respectively. The county lost population during the 1950's, but has experienced steady population growth since 1960. Menominee County experience its greatest population growth in the 1970's, while the region experienced its faster rate of growth in the 1960's, and the state in the 1950's.

In the 1990's, Menominee's average annual rate of growth increased to 2.19 percent, while average annual growth rates for the region and state declined to 1.11 percent and 0.87 percent, respectively. Between 1990 and 1999, Menominee County's population increased from 3,890 to 4,655.

While net migration significantly influences Menominee's total rate of growth, most of Menominee County's growth can be attributed to natural increase. Menominee's natural rate of increase is considerably higher than the natural increase rates for the region and the state. Between 1970 and 1990, natural increase rates for Menominee County have fluctuated between 14.04 percent and 24.16 percent, compared to the region and the state, which have seen their rate of natural increase fluctuate between 6.53 percent and 3.75 percent and 6.64 percent and 4.43 percent, respectively.

Table 7: Menominee County Population by Age, 1990 to 2020

Age Group	1990	1995	2000	2005	2010	2015	2020
0-4	489	568	617	680	769	847	918
5-19	1,224	1,290	1,479	1,552	1,713	1,883	2,108

20-64	1,849	1,928	2,203	2,456	2,661	2,909	3,101
65+	328	361	445	489	539	603	704
Total	3,890	4,147	4,743	5,177	5,682	6,242	6,832

Reference:

1. Population Characteristics; of the East Central Region, 2000.

Outagamie County

Outagamie County is one of the three counties that comprise the Appleton-Neenah-Oshkosh MSA. It is located on the east side of the East Central region. Outagamie County is bordered by Shawano County on the north, Calumet and Winnebago Counties on the south and Waupaca County on the west. With an estimated 1999 population of 157,994, Outagamie County is the largest county in the region.

Outagamie County contains 32 local units of government, including four cities, eight villages and 20 towns. The City of Appleton, which lies partially in the adjoining counties of Calumet and Winnebago, is the county's largest community and county seat. With a combined population of 69,911 residents, Appleton is easily the largest community in the East Central region. The City of Kaukauna, with 12,773 residents, is the only other incorporate community in Outagamie County over 10,000. The Town of Grand Chute, with 18,351 residents, is the second largest community in the county.

Population Trends

Over the past fifty years, Outagamie County has grown faster than the region and the state. Between 1950 and 1990, Outagamie County grew by an average annual rate of 1.80 percent, compared to the region and state which grew at 1.20 percent and 1.06 percent, respectively. Outagamie County and the state experienced their highest rate of growth during the 1950's, while the region's greatest population growth occurred during the 1960's.

Between 1990 and 1999, Outagamie County grew by an annual average rate of 1.38 percent, compared to 1.11 percent for the region and 0.87 percent for the state. By 1999, Outagamie County had an estimated population of 157,994, a 12.44 percent increase since 1990. Outagamie County's higher rate of growth was due to higher natural increase rates.

Between 1970 and 1999, the rate of natural increase for Outagamie County fluctuated between 10.16 percent and 6.90 percent. During the same time period, natural increase rates for the region fluctuated between 6.53 percent and 3.75 percent, while natural increase rates for the state fluctuated between 6.64 percent and 4.43 percent.

At the county level, net migration rates have not been a significant growth factor since 1950. Since 1950, net migration rates for Outagamie County have exceeded one percent in only two decades, the 1970s and the 1990s. In the 1970's, Outagamie County experienced -2.74 percent net out-migration. In the 1990's Outagamie County experienced 5.54 percent net in-migration.

During the 1990's, unincorporated communities within the county grew faster than incorporated communities. Collectively, towns grew by 24.88 percent between 1990 and 1999. Growth rates for individual towns varied from 94.85 percent in the Town Buchanan to 0.97 percent in the Town of Deer Creek. Towns with the highest rate of growth tended to be urbanizing towns bordering the Fox Cities. Grand Chute, which borders the City of Appleton, gained 3,861 new residents in the 1990's, adding more residents than any other community in the county.

Villages collectively grew by 10.96 percent between 1990 and 1999. Growth rates for individual villages ranged from 19.66 percent in the Village of Hortonville to -3.54 percent in the Village of Nichols. Nichols was the only community in Outagamie County, which lost population during the 1990's.

In the 1990's, cities, on average, grew by 4.86 percent. Growth rates among cities varied from 16.89 percent in the city of Seymour to 3.80 percent for the Outagamie portion of the City of Appleton.

Table 8: Outagamie County Population by Age, 1990 to 2020

Age Group	1990	1995	2000	2005	2010	2015	2020
0-4	11,483	10,577	10,100	9,541	9,673	10,205	10,309
5-19	32,461	35,604	36,755	34,981	32,229	31,087	30,903
20-64	80,955	86,847	94,822	100,404	104,644	106,160	103,465
65+	15,611	17,019	19,333	19,484	21,562	23,988	29,406
Total	140,510	150,048	160,011	164,410	168,107	171,440	174,083

Reference:

1. Population Characteristics; of the East Central Region, 2000.

Shawano County

Shawano County is located in the northwest corner of the East Central region. It is bordered on the north and east by Menominee County, and on the south by Outagamie and Waupaca Counties. Shawano County contains 38 local units of government, including 2 cities, 11 villages and 25 towns.

The City of Shawano, with 8,091 residents in 1999, is the largest community in the county and the county seat. Among the eleven villages, Bonduel and Wittenberg each have over 1,000 residents, and Birnamwood, Gresham and Tigerton have populations in excess of 500. Although mostly rural, a few towns located in the Greater Shawano/Shawano Lake are support populations of more than 1,500 residents.

Population Trends

Since 1950, Shawano County's growth rate has not kept pace with either the region or the state. Between 1950 and 1990, Shawano County grew at an average annual rate of 0.35 percent, compared to 1.20 percent for the region and 10.6 percent for the state. The state experienced its highest population growth rate during the 1950's. Shawano County experienced a population loss during this time period, due, in part, to the formation of Menominee County. The county's greatest population increase occurred in the 1970's, and the region's occurred during the 1960's.

Between 1990 and 1999, Shawano county grew by an average annual rate of 0.57 percent, compared to 1.11 percent for the region and 0.87 percent for the state. By 1999, Shawano County had an estimated population of 39,066, a 5.14 percent increase since 1990.

Slower growth in Shawano County can be attributed mostly to lower rates of natural increase. The rate of natural increase in Shawano County has remained well below the rate of natural increase for the region and the state since 1970. In the 1990's, Shawano county rate of natural increase was negative.

Incorporated communities grew at a faster rate than unincorporated communities. Between 1990 and 1999, cities collectively grew by 6.61 percent. Most of that growth occurred in the City of Shawano. The

City of Marion, which lies primarily in Waupaca County, first expanded into Shawano County in 1996. By 1999, and estimated 9 residents lived in the Shawano portion of the City of Marion.

Villages collectively grew by 5.06 percent during the 1990's. Growth rates for individual villages ranged from 14.70 percent in Bowler to -0.49 percent in Tigerton. Tigerton and Eland were the only two villages to lose population during this time period. Pulaski, which lies primarily in Brown County, had an estimated 11 residents living in the Shawano portion of the village in 1999.

Towns grew collectively by 4.68 percent during this time period. Growth rates for individual towns varied from 12.34 percent in the Town of Birnamwood to -4.39 percent in the Town of Germania. Four towns lost population during the 1990's, Germania, Herman, Maple Grove, and Waukechon.

Table 9: Shawano County Population by Age, 1990 to 2020

Age Group	1990	1995	2000	2005	2010	2015	2020
0-4	2,615	2,553	2,375	2,240	2,185	2,093	1,968
5-19	8,208	8,309	8,431	7,926	7,374	6,894	6,593
20-64	19,662	20,064	21,420	22,021	22,185	22,003	21,304
65+	6,672	6,889	7,060	7,031	7,274	7,699	8,342
Total	37,157	37,815	39,286	39,218	39,018	38,689	38,206

Reference:

1. Population Characteristics; of the East Central Region, 2000.

Waupaca County

Waupaca County is located on the west side of the East Central region. It is bordered by Shawano County on the north, Outagamie County on the east, and Waushara and Winnebago Counties on the south. With an estimated 50,125 residents in 1999, it is the most populous rural county in the region.

Waupaca County contains 34 local units of government, including six cities, six villages and 22 towns. New London, which lies partially in adjoining Outagamie County, is the largest community in the county. In 1999, the Waupaca portion of the City of New London had 5,620 residents. The City of Waupaca, which is the county seat, had 5,393 residents. The remaining cities in the county ranged in size from 4,609 residents in Clintonville to 1,293 residents in the Waupaca County portion of Marion. Iola with 1,315 residents, and Fremont with 770 residents, are the only two villages with populations greater than 500. The towns of Farmington and Dayton, in the popular Chain O' Lakes area southwest of Waupaca, and the towns of Mukwa and Royalton, adjacent to the City of New London, are the most populous towns in Waupaca County.

Population Trends

Over the past fifty years, Waupaca has grown at a slower rate than the region or the state. Between 1950 and 1990, Waupaca County grew at an average annual rate of 0.35 percent, compared to 1.20 percent for the region and 1.06 percent for the state. Waupaca County experienced its highest rate of growth during the 1970's. The region's greatest population increase occurred during the 1960's, and the state's during the 1950's.

Between 1990 and 1999, Waupaca County grew by an average annual rate of 0.97 percent, compared to 1.11 percent for the region and 0.87 percent for the state. By 1999, Waupaca County had 50,125 residents, and 8.72 percent increase since 1990.

The slower rate of growth in Waupaca County can be attributed to lower rates of natural increase. Since 1970, Waupaca County has had higher net migration rates than the region and the state, but much lower rates of natural increase. Between 1970 and 1999, natural increase rates for Waupaca County have fluctuated between 2.11 percent to -0.13 percent. Natural increase rates for the region and state have fluctuated between 6.53 percent and 3.75 percent and 6.64 percent and 4.43 percent, respectively. Net migration rates in Waupaca County varied between 11.26 percent and 6.84 percent during this time period, while net migration rates for the region and state varied between 6.28 percent and -2.68 percent.

Between 1990 and 1999, every community in Waupaca County experienced growth. Unincorporated communities grew faster than incorporated communities. Collectively, towns grew by 10.62 percent during this time period. Growth rates among individual towns ranged from 17.69 percent in the Town of Lind to 1.41 percent in the Town of Wyoming.

Collectively, villages grew by 8.57 percent. The Villages of Fremont and Iola had the highest rates of growth, 14.56 percent and 11.11 percent, respectively. Growth rates for individual villages ranged from 14.56 percent in the Village of Fremont to 0.65 percent in the Village of Embarrass.

Cities experienced the slowest overall growth between 1990 and 1999. Collectively, cities grew by 6.26 percent during this time period. Growth rates for individual cities ranged from 12.15 percent in the City of Manawa to 3 percent in the City of Weyauwega.

Table 10: Waupaca County Population by Age, 1990 to 2020

Age Group	1990	1995	2000	2005	2010	2015	2020
0-4	3,212	3,366	3,180	3,074	3,002	2,845	2,647
5-19	10,295	10,770	10,886	10,310	9,783	9,226	8,825
20-64	24,444	26,169	28,267	29,396	29,738	29,307	28,024
65+	8,153	8,122	8,257	8,299	8,643	9,515	10,756
Total	46,104	48,428	50,589	51,079	51,165	50,893	50,253

Reference:

1. Population Characteristics; of the East Central Region, 2000.

Waushara County

Waushara County lies on the western border of the East Central region. It is bordered on the north by Waupaca County, on the east by Winnebago County and on the south by Marquette and Green Lake Counties. Waushara County contains 26 local units of government, two cities, six villages and eighteen towns.

The City of Wautoma, with 2,001 residents, is the county's largest community, retail hub and county seat. Only a small portion of the City of Berlin lies within Waushara County. Redgranite is the only village in the county that supports a population greater than 1,000. Rural development is concentrated in those towns with significant lakeshore frontage.

Population Trends

Between 1950 and 1990, Waushara County grew at a slower rate than either the region or the state. During this time period, Waushara County grew by an average annual rate of 0.98 percent, compared to 1.20 percent for the region and 1.06 percent for the state. Waushara County experienced its highest rate of

growth during the 1970's, while the region's greatest population increase occurred during the 1960's and the state's during the 1950's.

Between 1990 and 1999, Waushara County had a higher growth rate than either the region or state. In the 1990's, Waushara's population increased at an average annual rate of 1.56 percent, compared to 1.11 percent for the region and 0.87 percent for the state. By 1999, Waushara County had a population of 21,113, an 8.91 percent increase.

Population growth in Waushara County has been heavily influenced by net migration rates. Since 1970, the rate of natural increase in Waushara County has fluctuated between 2.40 percent and 0.22 percent, while net migration rates have fluctuated between 23.76 percent and 2.23 percent. Consequently, natural increase has played a small role in changes in growth patterns for the county.

During the 1990's, cities, on average, experienced a higher rate of growth than villages and towns. Between 1990 and 1999, cities collectively grew by 12.48 percent. The Waushara County portion of Berlin grew by 20.90 percent, while Wautoma grew by 12.16 percent.

Villages, on average, experienced the slowest rate of growth during the 1990's. Villages collectively grew by 4.26 percent. Growth for individual villages ranged from 6.79 percent in the Village of Lohrville to 2.48 percent in the Village of Redgranite.

During the 1990's, Waushara County towns grew, on average by 9.70 percent. Growth for individual towns ranged from a high of 14.99 percent in the Towns of Hancock and Mount Morris to a low of -2.31 percent in the Town of Oasis. The Town of Oasis was the only community in Waushara County to lose population during this time period.

Table 11: Waushara County Population by Age, 1990 to 2020

Age Group	1990	1995	2000	2005	2010	2015	2020
0-4	1,239	1,195	1,136	1,166	1,158	1,058	986
5-19	3,960	4,124	4,086	3,948	3,674	3,483	3,351
20-64	10,426	10,801	11,812	12,780	12,885	12,419	11,659
65+	3,760	3,973	4,292	4,652	4,877	5,486	6,114
Total	19,386	20,093	21,326	22,546	22,593	22,473	22,110

Reference:

1. Population Characteristics; of the East Central Region, 2000.

Watersheds of the Wolf River Basin Map

Watersheds of the Wolf Basin

WR01 ARROWHEAD AND DAGGETS CREEK WATERSHED

The Arrowhead River and Daggets Creek Watershed covers approximately 135 square miles in Winnebago, Waupaca and Outagamie counties. A small part of the watershed, about 1 percent, is located in Waupaca County. An endangered species of fish, the striped shiner (*Notropis chrysocephalus*) has been found in the watershed. The creek chubsucker (*Erimyzon oblongus*), a species now believed to be extirpated in Wisconsin, was previously reported. This species is a candidate for federal endangered species listing.

Polluted runoff problems are widespread. The *Winnebago Comprehensive Management Plan* rated an 8.2 mile priority strip along the Arrowhead River as high priority for nonpoint source pollution abatement activities, and the *Lower Green Bay Remedial Action Plan* identified this watershed as one of 11 contributing significant amounts of pollution to the Lake Winnebago system. A study by the Northeast Wisconsin Waters for Tomorrow showed that this watershed was one of the largest contributors of total suspended solids to the Lake Winnebago system (NEWWT, 1994). Major problems in this watershed include dissolved oxygen standard violations and critical levels of soil loss.

The watershed was selected as a priority watershed project in 1990 and a priority watershed plan was completed in 1992 (WDNR, 1993). The plan was prepared cooperatively by the WDNR, the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP), the Outagamie County Land Conservation Department, and the Winnebago County Land and Water Conservation Department, with assistance from the University of Wisconsin-Extension and the USDA Natural Resources Conservation Service (NRCS). The priority watershed plan is considered an amendment to this plan.

The *Nonpoint Source Control Plan for the Arrowhead River, Rat River and Daggets Creek Priority Watershed Project* (WDNR, 1993) describes in detail the water resources in the watershed. The plan outlines polluted runoff problems, establishes water quality goals and objectives, and identifies management practices to achieve those goals and objectives. The project will expire at the end of the year 2004.

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WR01 Public Wells Map

WR01 Wastewater Map

WINNECONNE WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	0 (average)	nd- 1	NO
BARIUM (ppm)	2	.130 (average)	.110- .150	NO
COPPER (ppm)	AL=1. 3	.3500	.3500	NO
FLUORIDE (ppm)	4	.3 (average)	.2- .3	NO
LEAD (ppb)	AL=15	2.10	2.10	NO
SODIUM (ppm)	n/a	6.65 (average)	6.60- 6.70	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	17.7 (average)	16.0- 21.0	YES
GROSS BETA PARTICLE ACTIVITY (pCi/l)	n/a	3.8 (average)	3.4- 4.1	NO
RADIUM, (226 + 228) (pCi/l)	5	1.5	1.5	NO

Synthetic Organic Contaminants including Pesticides & Herbicides

Contaminant (units)	MCL	Level Found	Range	Violation
DI(2-ETHYLHEXYL) PHTHALATE (ppb)	6	.3 (average)	nd- .6	NO

Health effects for any contaminants with MCL violations

Contaminant	Health Effects
GROSS ALPHA, EXCL. R & U	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.

WR01 Lakes Tables

WR01 Streams Tables

PINE RIVER AND WILLOW CREEK WATERSHED (WR02)

The Pine River and Willow Creek watershed is the southernmost watershed of the Wolf River Basin and is located in Waupaca, Waushara and Winnebago counties. This watershed covers 286 square miles. This watershed drains directly to Lake Poygan, and the surface water drainage from the majority of this watershed is filtered by the Poygan Marsh Wildlife Area.

Those portions of the watershed within Winnebago County are located in the Lower Fox River Designated Planning Area. Refer to Fox Valley Water Quality Planning Agency (FVWQPA) planning documents for additional information.

Pine River and Willow Creek are clear, hardwater streams that drain the center two-thirds of Waushara County. Substantial critical animal waste problems affect the eastern half of this watershed. Soil erosion, at rates above 2 tons per acre per year, combined with local animal waste delivery and in-stream erosion have accelerated the deterioration of trophic status of millponds on the Pine River and Willow Creek.

This watershed ranked "high" as a priority for streams and "medium" as a priority for groundwater under the Nonpoint Source Priority Watershed selection process. Insufficient data on lakes in this watershed prevented their inclusion in this round of priority watershed rankings.

The Pine River Willow Creek Watershed was selected as a priority watershed in 1995, and will expire at the end of the year 2009. The priority watershed plan was prepared cooperatively by the WDNR, the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP), the Waushara County Land Conservation Department, the Winnebago Land and Water Conservation Department, with assistance from the University of Wisconsin-Extension, and the USDA Natural Resources Conservation Service (NRCS). The priority watershed plan is considered an amendment to this plan.

The soils, geology and other physical resources of this watershed's western half indicate the area is highly susceptible to groundwater contamination from poor land use practices (WDNR and WGNHS, 1987). A data search revealed no runoff-related groundwater contamination problems.

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WR02 Public Wells Map

WR02 Wastewater Map

WR02 Trout Streams Map

REDGRANITE WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	2 (average)	nd- 5	NO
BARIUM (ppm)	2	.032 (average)	.029- .035	NO
BERYLLIUM TOTAL (ppb)	4	.03 (average)	.02- .03	NO
COPPER (ppm)	AL=1.3	.1620	.1620	NO
FLUORIDE (ppm)	4	.5 (average)	.3- .7	NO
LEAD (ppb)	AL=15	13.10	13.10	NO
MERCURY (ppb)	2	.3 (average)	.2- .4	NO
NITRATE (N03-N) (ppm)	10	.01 (average)	.01- .02	NO
SODIUM (ppm)	n/a	6.37 (average)	4.07- 8.66	NO
THALLIUM TOTAL (ppb)	2	.3 (average)	nd- .6	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.1	1.1	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.30	.00 .30	NO
SULFATE (ppm)	n/a	12.20	12.20	NO

WR02 Lakes Tables

WR02 Streams Tables

WALLA WALLA AND ALDER CREEK WATERSHED (WR03)

The Walla Walla and Alder Creek Watershed (locally known as Walla Walla Creek Watershed) lies in portions of Waupaca, Waushara and Winnebago Counties on the northwest shore of Lake Poygan.

Those portions of the watershed within Winnebago County are in the Lower Fox River Designated Planning Area. Refer to the discussion in the Fox Valley Water Quality Planning Agency (FVWQPA) planning documents for additional information.

The *Winnebago Comprehensive Management Plan* rated this watershed a high priority due to critical animal waste problems and soil loss. The data search for the Wolf River Basin Plan indicates polluted runoff problems with excess vegetation and habitat deterioration. Approximately 20 percent of the watershed (in the western part) is highly susceptible to groundwater contamination (WDNR and WGNHS, 1987).

The 97 square-mile watershed is ranked number one in the Waupaca County Animal Waste Management Plan for concerns over both surface and groundwater. A substantial number of medium to high priority barnyard/feedlot operations exist in the Waushara County portion, with many of these draining directly into Lake Poygan via man-made ditches. In the Winnebago County portion, three barnyard/feedlot operations were ranked as critical polluted runoff pollution hazards, one was ranked as high priority; three as medium priority. Average soil erosion rates are 3.1 tons per acre per year in Waupaca County, 3.5 tons per acre per year in Waushara County, and 2.0-3.0 tons per acre per year in Winnebago County. This watershed drains directly to Lake Poygan and is likely to affect lake water quality during storms.

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WR03 Public Wells Map

WR03 Wastewater Map

WR03 Trout Streams Map

WR03 Lakes Tables

WR03 Streams Tables

LOWER WOLF RIVER WATERSHED (WR04)

The Lower Wolf River watershed is 120 square miles and covers parts of Outagamie, Waupaca and Winnebago Counties. This includes a portion of the mainstem Wolf River from the junction with the Embarrass River to the mouth of the Waupaca River, including the lower portion to the Weyauwega millpond. The mainstem Wolf River flows within the watershed for about 19 miles and contains a diverse warm water sport fishery. Wetlands adjacent to the river provide excellent spawning grounds for these fish.

Those portions of the watershed within Winnebago and Outagamie counties are in the Lower Fox River Designated Planning Area. Refer to the Fox Valley Water Quality Planning Agency (FVWQPA) planning documents for additional information.

References

1. WDNR. 1989. Oshkosh Area: Fisheries Management Files.
2. WDNR. 1995. Lake Michigan District: Water Quality Management Files.
5. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County, Wisconsin DNR.

WR04 Public Wells Map

WR04 Wastewater Map

NEW LONDON WATERWORKS for 1999**Microbiological Contaminants**

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	1		NO

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	1 (average)	nd- 5	NO
BARIUM (ppm)	2	.031 (average)	.014- .061	NO
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	.2400	.2400	NO
FLUORIDE (ppm)	4	1.0 (average)	.7- 1.7	NO
LEAD (ppb)	AL=15	8.10	8.10	NO
NICKEL (ppb)	100	.9400 (average)	.7800- 1.2000	NO
NITRATE (NO3-N) (ppm)	10	.76 (average)	nd- 1.80	NO
NITRITE (NO2-N) (ppm)	1	.010 (average)	nd- .019	NO
SODIUM (ppm)	n/a	10.41 (average)	1.20- 22.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	3.6	2.2 3.6	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMOFORM (ppb)	n/a	.03 (average)	nd- .18	NO
CHLOROFORM (ppb)	n/a	.02 (average)	nd- .17	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.03 (average)	nd- .19	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
1,1,1-TRICHLOROETHANE (ppb)	200	.0 (average)	nd- .3	NO
P-DICHLOROBENZENE (ppb)	75	.1 (average)	nd- .2	NO
TETRACHLOROETHYLENE (ppb)	5	.1 (average)	nd- .7	NO
TTHM (ppb)	100	.1 (average)	nd- .4	NO

WR04 Lakes Tables

WR04 Streams Tables

WAUPACA RIVER WATERSHED (WR05)

The Waupaca River watershed is 292 square miles and lies almost entirely in Portage and Waupaca counties. A small part of its southwestern portion is in Waushara County. The river's name changes as it flows from Portage County to Waupaca County: In Portage County it is called the Tomorrow River. In Waupaca County, it is the Waupaca River; which in its entirety runs approximately 63 miles. The Waupaca River's major tributary, the Crystal River, ties into the system from the south and is included within the planning area and is classified as Class II trout waters. The Crystal River is the outlet to the Chain O' Lakes (Long Lake) which is a very prominent recreational and residential area consisting of 22 interconnected lakes. These lakes comprise approximately 725 acres and is considered as part of the Tomorrow/Waupaca River Priority Watershed Project. Recent changes to the Waupaca County Shoreland Ordinance should improve this resource, from a development standpoint, in the future.

The Waupaca River Watershed was selected as a priority watershed project in 1993 and will expire at the end of the year 2007. A priority watershed plan was prepared cooperatively by WDNR, DATCP, NRCS, University of Wisconsin Extension, Portage County Land Conservation Department, Waupaca County Land and Water Conservation Department, and Waushara County Land Conservation Department.

The *Winnebago Comprehensive Management Plan* rated this watershed a medium priority due to critical local surface water problems from animal waste. The highest concentrations of livestock in Portage County occur at Amherst on the Tomorrow River. The greatest overall water quality threat in the watershed is excess nutrients (nitrates) entering groundwater. Sources of nitrate include livestock manure and agricultural fertilizers. Nitrate infiltrates into the groundwater due to the high permeability. Sandy soils pose a risk to vulnerable residents (those under 6 months old) if furnishing drinking water supplies. The data search for the Wolf River Basin Plan indicates polluted runoff problems with some habitat degradation and potential impacts from irrigation. The value of these streams (used for irrigation) as a trout fishery and the potential for polluted runoff problems make protective measures the key to good water quality in the future.

The soils, geology and other physical resources of the western 95 percent of this watershed indicate that this area is highly susceptible to groundwater contamination due to poor land use practices (WDNR and WGNHS, 1987). A data search revealed groundwater samples with contamination, mainly pesticides, in this area.

References

1. WDNR. 1989. Wisconsin Rapids Area: Fisheries Management Files.
2. WDNR. 1989. Oshkosh Area: Fisheries Management Files.
3. WDNR. 1989. Winnebago Comprehensive Management Plan. Oshkosh, Wisconsin.
4. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
6. Stoll, Richard. DNR LMD, District Hydrogeologist. 1990. Personal communication, Wisconsin DNR, Green Bay.
7. WDNR. 1995. Lake Michigan District: Water Quality Management Files.
8. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR- Research Monoma.
9. WDNR. 1980. Wisconsin Trout Streams. PUB1.6-3600(80).
10. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.

13. Gansberg, Mary. 1994. Surface Water Quality Appraisal of the Waupaca County Portion of the Tomorrow/Waupaca River Priority Watershed. Wisconsin DNR, Green Bay.

14. Klosiewski, Jim. 1994. Tomorrow/Waupaca River Priority Watershed Surface Water Resources Appraisal Report. Wisconsin DNR, Rhinelander.

15. Waupaca/ Chain O' Lakes SSA Plan

WR05 Public Wells Map

WR05 Wastewater Map

WR05 Trout Streams Map

AMHERST WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.063 (average)	.025- .100	NO
COPPER (ppm)	AL=1.3	.3920	.3920	NO
FLUORIDE (ppm)	4	.4 (average)	.2- .6	NO
LEAD (ppb)	AL=15	3.00	3.00	NO
NITRATE (N03-N) (ppm)	10	4.79 (average)	.68- 8.90	NO
NITRITE (N02-N) (ppm)	1	.020 (average)	nd- .039	NO
SODIUM (ppm)	n/a	5.30 (average)	4.90- 5.70	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	2.8	2.8	NO

WAUPACA WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.026 (average)	.016- .031	NO
BERYLLIUM TOTAL (ppb)	4	.04 (average)	nd- .22	NO
CADMIUM (ppb)	5	.1 (average)	nd- .4	NO
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	.7500	.7500	NO
FLUORIDE (ppm)	4	.9 (average)	.1- 1.4	NO
LEAD (ppb)	AL=15	4.40	4.40	NO
NICKEL (ppb)	100	.3280 (average)	nd- .8300	NO
NITRATE (N03-N) (ppm)	10	3.90 (average)	1.30- 9.30	NO
NITRITE (N02-N) (ppm)	1	.004 (average)	.003- .006	NO
SODIUM (ppm)	n/a	12.80 (average)	2.70- 23.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.7	1.7	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.03 (average)	nd- .16	NO
SULFATE (ppm)	n/a	16.80 (average)	12.00- 20.00	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
1,1,1-TRICHLOROETHANE (ppb)	200	.2 (average)	nd- 1.0	NO
TETRACHLOROETHYLENE (ppb)	5	1.9 (average)	nd- 3.3	NO
TTHM (ppb)	100	.0 (average)	nd- .2	NO

WEYAUWEGA WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.020 (average)	.018- .021	NO
CHROMIUM (ppb)	100	1 (average)	nd- 2	NO
COPPER (ppm)	AL=1.3	.0420	.0420	NO
FLUORIDE (ppm)	4	.9 (average)	.1- 1.1	NO
LEAD (ppb)	AL=15	7.80	7.80	NO
NICKEL (ppb)	100	25.3000 (average)	2.9000- 44.0000	NO
NITRATE (N03-N) (ppm)	10	1.97 (average)	1.40- 2.30	NO
SODIUM (ppm)	n/a	4.53 (average)	4.00- 5.20	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.9	1.9	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.16 (average)	nd- .47	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	.2 (average)	nd- .5	NO

WR05 Lakes Tables

WR05 Streams Tables

LOWER LITTLE WOLF RIVER WATERSHED (WR06)

The Lower Little Wolf River watershed is 152 square miles and lies in central Waupaca County. Approximately 27 miles of the Little Wolf River are in this watershed, from the confluence of the South Branch Little Wolf River (WR08) to the dam at Big Falls.

The Winnebago Comprehensive Management Plan ranked this watershed as a medium priority for watershed selection due to local soil erosion and animal waste problems. The data search for the Wolf River Basin Plan indicated that problems related to polluted runoff exist in this watershed.

The Lower Little Wolf River Watershed was selected as a priority watershed in 1995 and will expire at the end of year 2008. The priority watershed plan was prepared cooperatively by the WDNR, the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP), and the Waupaca Land and Water Conservation Department, with assistance from the University of Wisconsin-Extension and the USDA Natural Resources Conservation Service (NRCS). The approved watershed plan is considered an amendment to this plan.

The soils, geology and other physical resources of the western and central 20 percent of this watershed indicate the area is highly susceptible to groundwater contamination by poor land use practices (WDNR and WGNHS, 1987). The remaining 80 percent of the watershed lies in an area of medium susceptibility. A data search revealed groundwater samples contaminated mainly from pesticides.

REFERENCES

1. WDNR. 1989. Oshkosh Area: Fisheries Management files.
3. WDNR. 1995. Lake Michigan District: Water Quality Management files.
5. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.

WR06 Public Wells Map

WR06 Wastewater Map

WR06 Trout Streams Map

MANAWA WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	4 (average)	nd- 8	NO
BARIUM (ppm)	2	.034 (average)	.026- .043	NO
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	1.2000	1.2000	NO
FLUORIDE (ppm)	4	.5 (average)	.2- 1.0	NO
LEAD (ppb)	AL=15	14.00	14.00	NO
NICKEL (ppb)	100	.4967 (average)	nd- .7800	NO
NITRATE (NO ₃ -N) (ppm)	10	3.93 (average)	nd- 10.00	NO
SODIUM (ppm)	n/a	14.33 (average)	12.00- 17.00	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	1.80 (average)	nd- 3.60	NO
BROMOFORM (ppb)	n/a	.06 (average)	nd- .17	NO
CHLOROFORM (ppb)	n/a	2.87 (average)	nd- 4.70	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.72 (average)	nd- 1.70	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	5.4 (average)	nd- 10.2	NO

WR06 Lakes Tables

WR06 Streams Tables

UPPER LITTLE WOLF RIVER WATERSHED (WR07)

The Upper Little Wolf River watershed is in Marathon, Portage, Shawano and Waupaca Counties and is 171 square miles. This watershed includes 61 miles of the Little Wolf River and its tributaries above the Big Falls Dam.

The Winnebago Comprehensive Management Plan lists the Upper Little Wolf River watershed as a "medium" priority for watershed selection due to local significant animal waste problems and a soil erosion rate of 2.2 tons per acre per year. The data search for the Wolf River Basin indicated that habitat deterioration occurs from streambank pasturing and cropland runoff.

The soils, geology and other physical resources of the entire watershed indicate it is highly susceptible to groundwater contamination by poor land use practices (WDNR and WGNHS, 1987). A data search revealed groundwater samples contaminated mainly by pesticides.

REFERENCES

1. WDNR. 1985. Fisheries Management Master Plan - Little Wolf River.
3. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
4. Fassbender, Ronald L. 1970. Surface Water Resources of Shawano County. Wisconsin DNR.
5. Carlson, Harland and Lloyd M. Andrews. 1977. Surface Water Resources of Marathon County. Wisconsin DNR.
6. WDNR. 1989. Oshkosh Area: Fisheries Management files.
7. WDNR. 1995. Lake Michigan District: Water Quality files.
8. WDNR. 1989. Shawano Field Station: Fisheries Management files.
9. WDNR. 1989. North Central District: Water Quality files.
11. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
12. WDNR. 1980. *Wisconsin Trout Streams*. PUB1.6-3600(80).
13. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.
14. WDNR. 1993. Stream Habitat Evaluation Results/ Little Wolf River Watershed.-NCD WRM Files.
15. Niebur, A. 1994. "Draft" Trout & Habitat Survey of Comet Creek, Jackson Creek, and Little Wolf River. 1993. WDNR Wautoma.

WR07 Public Wells Map

WR07 Wastewater Map

WR07 Trout Streams Map

WR07 Lakes Tables

WR07 Streams Tables

SOUTH BRANCH LITTLE WOLF RIVER WATERSHED (WR08)

The South Branch Little Wolf River Watershed is approximately 165 square miles and is in Waupaca and Portage Counties. It also contains 64 miles of the South Branch of the Little Wolf River. The South Branch Little Wolf River watershed drains portions of the planning area generally to the north and east of the city of Waupaca and contains the South Branch Little Wolf River as the major water feature. Drainage generally flows northeastward through small tributaries to the Little Wolf River and eventually drains into the Wolf River and the Lake Winnebago/Fox River/Green Bay system. This watershed ranks “high” for lakes and groundwater and “low” for streams according to the WDNR’s draft Upper Fox River Basin Plan (1997). No point-source dischargers are contained within the Planning Area for this watershed.

REFERENCES

1. WDNR. 1989. Oshkosh Area: Fisheries Management files.
2. WDNR. 1989. Shawano Field Station: Fisheries Management files.
4. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
5. Doelger, Timothy. DNR LMD, WRM Biologist. 1989. Personal Communication. Wisconsin DNR, Green Bay.
6. WDNR. 1995. Lake Michigan District: Wastewater Management Files.
7. Waupaca Chain O' Lakes SSA Plan

WR08 Public Wells Map

WR08 Wastewater Map

WR08 Trout Streams Map

IOLA WATERWORKS for 1999

Microbiological Contaminants

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	2		YES

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ANTIMONY TOTAL (ppb)	6	1.9 (average)	1.9- 2.0	NO
BARIUM (ppm)	2	.046	.046	NO
COPPER (ppm)	AL=1.3	.2390	.2390	NO
FLUORIDE (ppm)	4	.2 (average)	.1- .3	NO
LEAD (ppb)	AL=15	5.42	5.42	NO
MERCURY (ppb)	2	.1 (average)	.1- .2	NO
NICKEL (ppb)	100	.6700 (average)	nd- 1.3400	NO
NITRATE (NO3-N) (ppm)	10	2.50 (average)	1.70- 3.29	NO
SELENIUM (ppb)	50	1 (average)	nd- 1	NO
SODIUM (ppm)	n/a	14.00 (average)	11.40- 16.60	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
SULFATE (ppm)	n/a	14.20	14.20	NO

Health effects for any contaminants with MCL violations

Contaminant	Health Effects
Coliform (TCR)	Coliforms are bacteria, which are naturally present in the environment and are used as an indicator that other, potentially-harmful, bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.

WR08 Lakes Tables

WR08 Streams Tables

NORTH BRANCH AND MAINSTEM EMBARRASS WATERSHED (WR09)

The North Branch and Mainstem Embarrass River Watershed lies in Outagamie, Waupaca, and Shawano Counties and covers 292 square miles. This watershed includes 99 miles of the North Branch and Mainstem of the Embarrass River. Those portions in Outagamie County are in the Lower Fox River Designated Planning Area. Refer to the discussion in the Fox Valley Water Quality Planning Agency (FVWQPA) planning documents for additional information.

The Winnebago Comprehensive Management Plan ranked this watershed a "high" priority because of critical animal waste and soil erosion problems. The data search for the Wolf River Basin plan indicates severe polluted runoff problems exist, with heavy soil losses, impaired fisheries, excess vegetation, and dissolved oxygen violations. Conservation Warden Mark Beilfuss documented significant runoff concerns along the mainstem of the Embarrass River at the confluence of the Wolf River. Photographs of the river show high levels of turbidity and total suspended solids during a summer storm.

REFERENCES

1. WDNR. 1989. Oshkosh Area: Fisheries Management files.
2. WDNR. 1989. Shawano Field Station: Fisheries Management files.
4. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
5. Doelger, Timothy. DNR LMD, WRM Biologist. 1989. Personal Communication. Wisconsin DNR, Green Bay.
7. Fassbender, Ronald L. 1970. Surface Water Resources of Shawano County. Wisconsin DNR.
8. Langhurst, Ross. 1989. LMD, Fisheries Manager. Personal Communication. Wisconsin DNR, Shawano.
9. WDNR. 1995. Lake Michigan District: Water Quality files.
13. WDNR. 1995. Lake Michigan District: Wastewater Management

WR09 Public Wells Map

WR09 Wastewater map

WR09 Trout Streams Map

BEAR CREEK WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	.2110	.2110	NO
FLUORIDE (ppm)	4	.3 (average)	nd- .6	NO
LEAD (ppb)	AL=15	8.00	8.00	NO
NICKEL (ppb)	100	1.1000 (average)	1.0000- 1.2000	NO
NITRATE (NO3-N) (ppm)	10	1.80 (average)	nd- 3.60	NO
NITRITE (NO2-N) (ppm)	1	.065 (average)	nd- .130	NO
SODIUM (ppm)	n/a	14.20 (average)	5.40- 23.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	2.6	2.6	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
SULFATE (ppm)	n/a	30.00 (average)	11.00- 49.00	NO

BOWLER WATERWORKS for 1999**Microbiological Contaminants**

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	1		NO

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.030	.030	NO
COPPER (ppm)	AL=1.3	.4100	.4100	NO
FLUORIDE (ppm)	4	.2	.2	NO
LEAD (ppb)	AL=15	3.55	3.55	NO
NICKEL (ppb)	100	.8200	.8200	NO
NITRATE (NO3-N) (ppm)	10	4.90 (average)	1.20- 9.80	NO
SODIUM (ppm)	n/a	4.40	4.40	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	2.60	2.60	NO
CHLOROFORM (ppb)	n/a	5.60	5.60	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.61	.61	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	8.8	8.8	NO

EMBARRASS WATERWORKS for 1999**Microbiological Contaminants**

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in $\geq 5\%$ of monthly samples	2		NO

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.033	.033	NO
COPPER (ppm)	AL=1.3	.8360	.8360	NO
FLUORIDE (ppm)	4	.1	.1	NO
LEAD (ppb)	AL=15	4.00	4.00	NO
NITRATE (NO ₃ -N) (ppm)	10	5.20	5.20	NO
SODIUM (ppm)	n/a	12.60	12.60	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	.6	.6	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	.40 (average)	nd- .79	NO
BROMOFORM (ppb)	n/a	.12 (average)	.10- .14	NO
CHLOROFORM (ppb)	n/a	.70 (average)	.30- 1.10	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.34 (average)	nd- .68	NO
SULFATE (ppm)	n/a	14.00	14.00	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	1.6 (average)	.4- 2.7	NO

WR09 Lakes Tables

WR09 Streams Tables

PIGEON RIVER WATERSHED (WR10)

The Pigeon River Watershed lies in south central Shawano and north central Waupaca Counties and covers 115 square miles. This also includes 25 mile of the South Branch of the Pigeon River.

The *Winnebago Comprehensive Management Plan* ranked the Pigeon River a "high" priority due to animal waste and soil erosion problems with a critical average soil loss rate of 3.7 tons per acre per year.

The data search for the Wolf River Basin Plan indicated problems with excess vegetation, turbidity, and habitat degradation (Gansberg, 1993).

The soils, geology and other physical resources in the watershed's northwest portion indicate it is highly susceptible to groundwater contamination by poor land use practices. Approximately 70 percent of the remaining land area is of medium susceptibility. A data search revealed no runoff-related groundwater contamination problems in this area.

REFERENCES

1. WDNR. 1989. Oshkosh Area: Fisheries Management files.
2. WDNR. 1989. Shawano Field Station: Fisheries Management files.
3. WDNR. 1989. Winnebago Comprehensive Management Plan. Oshkosh, Wisconsin.
4. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
5. Fassbender, Ronald L. 1970. Surface Water Resources of Shawano County. Wisconsin DNR.
7. WDNR. 1995. Lake Michigan District: Water Quality files.
8. Gansberg, Mary. 1993. Pigeon River Watershed Nonpoint Source Assessment Report. Wisconsin DNR, Green Bay.
9. WDNR. 1995. Lake Michigan District: Wastewater Management Files.

WR10 Public Wells Map

WR10 Wastewater Map

WR10 Trout Streams Map

CLINTONVILLE UTILITIES for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	4 (average)	nd- 7	NO
BARIUM (ppm)	2	.044 (average)	.031- .073	NO
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	1.0200	1.0200	NO
FLUORIDE (ppm)	4	.6 (average)	.2- .9	NO
LEAD (ppb)	AL=15	10.50	10.50	NO
NICKEL (ppb)	100	.4817 (average)	nd- 1.1000	NO
NITRATE (N03-N) (ppm)	10	.87 (average)	.14- 1.60	NO
NITRITE (N02-N) (ppm)	1	.007 (average)	nd- .018	NO
SELENIUM (ppb)	50	0 (average)	nd- 2	NO
SODIUM (ppm)	n/a	9.67 (average)	4.60- 31.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	4.9	4.9	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	.06 (average)	nd- .23	NO
CHLOROFORM (ppb)	n/a	.23 (average)	nd- .85	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.02 (average)	nd- .13	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	.3 (average)	nd- 1.2	NO

MARION WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.044	.044	NO
COPPER (ppm)	AL=1.3	.2300	.2300	NO
FLUORIDE (ppm)	4	1.2 (average)	1.0- 1.5	NO
LEAD (ppb)	AL=15	3.80	3.80	NO
NITRATE (N03-N) (ppm)	10	7.05 (average)	5.60- 8.20	NO
SODIUM (ppm)	n/a	17.00	17.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	7.4	7.4	NO
RADIUM, (226 + 228) (pCi/l)	5	1.8	1.8	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	1.80	1.80	NO
BROMOFORM (ppb)	n/a	.38	.38	NO
CHLOROFORM (ppb)	n/a	1.00	1.00	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	1.90	1.90	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	5.1	5.1	NO

WR10 Lakes Tables

WR10 Streams Tables

MIDDLE AND SOUTH BRANCHES EMBARRASS RIVER WATERSHED (WR11)

The Middle and South Branches of the Embarrass River Watershed are in Shawano, Marathon and Langlade counties and cover 251 square miles. This consists of 52 miles of the Middle Branch of the Embarrass River.

The soils, geology and other physical resources indicate there are areas highly susceptible to groundwater contamination due to poor land use practices. A data search revealed groundwater samples with contamination, mainly from pesticides, in this area.

The *Winnebago Comprehensive Management Plan* rated this watershed a "medium" priority because of locally significant soil erosion and animal waste problems. Most of the buffer areas along the streams are natural and undisturbed.

The data search for the *Wolf River Basin Plan* indicates moderate polluted runoff problems exist, with excess vegetation and habitat deterioration.

REFERENCES

1. WDNR. 1989. Oshkosh Area Field Station: Fisheries Management files.
2. WDNR. 1989. Shawano Field Station: Fisheries Management files.
3. WDNR. 1995. Lake Michigan District: Water Quality files.
4. WDNR. 1989. *Winnebago Comprehensive Management Plan*. Oshkosh, Wisconsin. Oshkosh, Wisconsin.
5. Steuck, Ralph. 1977. Surface Water Resources of Langlade County. Wisconsin DNR.
6. Andrews, Lloyd M. and C.W. Threinen. 1968. Surface Water Resources of Shawano County. Wisconsin DNR.
7. Andrews, Lloyd M. and C.W. Threinen. 1977. Surface Water Resources of Marathon County. Wisconsin DNR.
8. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
9. WDNR. 1980. *Wisconsin Trout Streams* [PUB1.6-3600 80].
10. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.
12. WDNR. 1995. Lake Michigan District: Wastewater Management Files

WR11 Public Wells map

WR11 Wastewater Map

WR11 Trout Streams Map

BIRNAMWOOD WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	2 (average)	nd- 4	NO
BARIUM (ppm)	2	.023 (average)	.022- .023	NO
CADMIUM (ppb)	5	1.2 (average)	nd- 2.4	NO
COPPER (ppm)	AL=1.3	.3100	.3100	NO
FLUORIDE (ppm)	4	.2	.2	NO
LEAD (ppb)	AL=15	2.90	2.90	NO
NITRATE (NO3-N) (ppm)	10	4.24 (average)	.09- 8.40	NO
SODIUM (ppm)	n/a	6.35 (average)	5.90- 6.80	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	9.3	9.3	NO
RADIUM, (226 + 228) (pCi/l)	5	1.4	1.4	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.47 (average)	nd- .94	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	.5 (average)	nd- .9	NO

TIGERTON WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	3 (average)	nd- 5	NO
BARIUM (ppm)	2	.028 (average)	.024- .031	NO
COPPER (ppm)	AL=1.3	.8400	.8400	NO
FLUORIDE (ppm)	4	1.2 (average)	.1- 1.4	NO
LEAD (ppb)	AL=15	2.60	2.60	NO
NICKEL (ppb)	100	.3900 (average)	nd- .7800	NO
NITRATE (NO3-N) (ppm)	10	1.45 (average)	nd- 2.90	NO
NITRITE (NO2-N) (ppm)	1	.037 (average)	.018- .055	NO
SODIUM (ppm)	n/a	6.95 (average)	6.40- 7.50	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.9	1.9	NO
RADIUM, (226 + 228) (pCi/l)	5	.6	.6	NO

WITTENBERG WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.024 (average)	.021- .027	NO
COPPER (ppm)	AL=1.3	.7000	.7000	NO
FLUORIDE (ppm)	4	.1 (average)	.1- .2	NO
LEAD (ppb)	AL=15	4.90	4.90	NO
NITRATE (NO3-N) (ppm)	10	4.46 (average)	1.30- 6.00	NO
SODIUM (ppm)	n/a	21.00 (average)	13.00- 29.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.2	1.2	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	.15 (average)	nd- .29	NO
CHLOROFORM (ppb)	n/a	.25 (average)	nd- .49	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.09 (average)	nd- .18	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TRICHLOROETHYLENE (ppb)	5	.2 (average)	nd- .3	NO
TTHM (ppb)	100	.5 (average)	nd- 1.0	NO

WR11 Lakes Tables

WR11 Streams Tables

Streams Tables continued

WOLF RIVER/NEW LONDON AND BEAR CREEK WATERSHED (WR12)

The Wolf River/New London and Bear Creek Watershed is in west central Outagamie County and covers 145 square miles. This watershed includes 25 miles of the Mainstem Wolf River from the confluence with the Shioc River to the City of New London.

REFERENCES

1. WDNR. 1989. Oshkosh Area Field Office: Fisheries Management Files.
2. WDNR. 1995. Lake Michigan District: Water Quality Files.
3. WDNR. 1989. *Winnebago Comprehensive Management Plan*. Oshkosh, Wisconsin.
4. Fassbender, Ronald L. 1972. Surface Water Resources of Outagamie County. Wisconsin DNR.
5. Gansberg, Mary. 1994. Black Otter Creek NPS Assessment Report. Wisconsin DNR, Green Bay.
6. WDNR. 1995. Lake Michigan District: Wastewater Management Files.
8. Bougie, Cheryl, and Rob McLennan. 1995. Bear Creek Subwatershed Ranking. DNR, Green Bay.

WR12 Public Wells Map

WR12 Wastewater Map

HORTONVILLE WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	1 (average)	nd- 2	NO
BARIUM (ppm)	2	.121 (average)	.061- .180	NO
COPPER (ppm)	AL=1.3	2.1250	2.1250	*
FLUORIDE (ppm)	4	.9 (average)	nd- 1.3	NO
LEAD (ppb)	AL=15	1.80	1.80	NO
NITRATE (NO3-N) (ppm)	10	.57 (average)	.37- .76	NO
SODIUM (ppm)	n/a	8.48 (average)	6.86- 10.10	NO

* Systems exceeding a lead and/or copper action level must take actions to reduce lead and/or copper in the drinking water. The lead and copper values represent the 90th percentile of all compliance samples collected. If you want information on the number of sites or the actions taken to reduce these levels, please contact your water supply operator.

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	7.0	7.0	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
SULFATE (ppm)	n/a	9.79 (average)	4.58- 15.00	NO

SHIOCTON UTILITIES for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.071 (average)	.060- .082	NO
COPPER (ppm)	AL=1.3	.4100	.4100	NO
FLUORIDE (ppm)	4	.2 (average)	.1- .2	NO
LEAD (ppb)	AL=15	13.00	13.00	NO
SODIUM (ppm)	n/a	5.90 (average)	3.50- 8.30	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	2.1	2.1	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
P-DICHLOROBENZENE (ppb)	75	.2 (average)	nd- .4	NO

WR12 Lakes Tables

WR12 Streams Tables

SHIOC RIVER WATERSHED (WR13)

The Shioc River is a tributary to the Wolf River, having its headwaters in Shawano County and flowing south and west to meet the Wolf River in Outagamie County, north of the City of Shiocton. This watershed holds the East, West and Mainstem Shioc River and is approximately 53 miles in its entirety.

The West Branch of the Shioc River begins in a cedar swamp just north of the Village of Bonduel. Groundwater input in the Village supports a Class 1 Brook Trout fishery- the only known brook trout fishery in the eastern part of the Wolf River Basin. Despite a history of extreme abuse-channelizing, death dealing discharges, and pumping sections of the stream dry- a small population of brook trout has survived. Habitat enhancement (1998) and removal of the sewage treatment plant discharge (2000) should allow for expansion of the population and expansion of suitable water for brook trout.

REFERENCES

1. WDNR. 1989. Oshkosh Area Field Office: Fisheries Management Files.
2. WDNR. 1995. Lake Michigan District: Water Quality Files.
4. Fassbender, Ronald L. 1972. Surface Water Resources of Outagamie County. Wisconsin DNR.
5. Andrews, Lloyd M. 1968. Surface Water Resources of Shawano County. Wisconsin DNR.
6. WDNR. 1989. Shawano Field Station: Fisheries Management Files.
7. WDNR. 1995. Lake Michigan District: Wastewater Management Files.

WR13 Public Wells Map

WR13 Wastewater map

BONDUEL WATERWORKS for 1999

Microbiological Contaminants

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	1		NO

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	5 (average)	nd- 11	NO
BARIUM (ppm)	2	.053 (average)	.047- .060	NO
COPPER (ppm)	AL=1.3	.9200	.9200	NO
FLUORIDE (ppm)	4	1.1 (average)	.1- 1.8	NO
LEAD (ppb)	AL=15	1.40	1.40	NO
NICKEL (ppb)	100	2.6000 (average)	1.1000- 4.9000	NO
NITRATE (N03-N) (ppm)	10	.60 (average)	nd- 1.80	NO
NITRITE (N02-N) (ppm)	1	.002 (average)	nd- .005	NO
SODIUM (ppm)	n/a	5.43 (average)	4.20- 6.40	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	6.9	6.9	NO
RADIUM, (226 + 228) (pCi/l)	5	2.3	2.3	NO

Synthetic Organic Contaminants including Pesticides & Herbicides

Contaminant (units)	MCL	Level Found	Range	Violation
DI(2-ETHYLHEXYL) PHTHALATE (ppb)	6	.3 (average)	nd- 1.0	NO

NICHOLS WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.140	.140	NO
COPPER (ppm)	AL=1.3	.1450	.1450	NO
FLUORIDE (ppm)	4	.2	.2	NO
LEAD (ppb)	AL=15	3.00	3.00	NO
NICKEL (ppb)	100	1.2000	1.2000	NO
SODIUM (ppm)	n/a	11.00	11.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	2.3	2.3	NO
RADIUM, (226 + 228) (pCi/l)	5	4.0	4.0	NO

WR13 Lakes Tables

WR13 Streams Tables

MIDDLE WOLF RIVER WATERSHED (WR14)

The 128-square-mile Middle Wolf River Watershed is in Shawano, Waupaca and Outagamie Counties. The watershed extends from the Shawano Dam to where the Shioc River meets the Wolf River north of Shiocton and holds 47 miles of the Wolf River.

The *Winnebago Comprehensive Management Plan* ranked the Middle Wolf River watershed a "high" priority due to animal waste problems and soil erosion rates of 3.1 tons/acre/year. The data search for the Wolf River Basin Plan found that streams of this watershed, including the mainstem Wolf River, are suffering from streambank erosion and animal waste problems. Groundwater concerns were ranked as medium under the priority watershed selection process. The northern 20 percent of the watershed are of highest concern for groundwater contamination due to poor land use practices. The remaining 80 percent of the land is of medium susceptibility (WDNR and WGNHS, 1987). A data search revealed no runoff-related groundwater contamination problems.

REFERENCES

1. WDNR. 1989. Oshkosh Area Field Office: Fisheries Management Files.
2. WDNR. 1995. Lake Michigan District: Water Quality Files.
3. WDNR. 1989. *Winnebago Comprehensive Management Plan*. Oshkosh, Wisconsin.
4. Fassbender, Ronald L. 1972. Surface Water Resources of Outagamie County. Wisconsin DNR.
5. Andrews, Lloyd M. 1968. Surface Water Resources of Shawano County. Wisconsin DNR.
6. WDNR. 1989. Shawano Field Station: Fisheries Management Files.
7. Fassbender, Ronald L. 1971. Surface Water Resources of Waupaca County. Wisconsin DNR.
10. WDNR. 1995. Lake Michigan District: Wastewater Management Files.
11. Shawano Lake SSA Plan

WR14 Public Wells Map

WR14 Wastewater Map

MAPLE LANE HEALTH CARE FACILITY for 1999

Microbiological Contaminants

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	1		NO

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	5 (average)	1- 9	NO
BARIUM (ppm)	2	.076 (average)	.074- .077	NO
COPPER (ppm)	AL=1.3	.3750	.3750	NO
FLUORIDE (ppm)	4	.2 (average)	.1- .3	NO
LEAD (ppb)	AL=15	7.30	7.30	NO
NITRATE (NO3-N) (ppm)	10	.00 (average)	nd- .01	NO
SODIUM (ppm)	n/a	9.72 (average)	6.44- 13.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	.1	.1	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.50	.30 .50	NO

SHAWANO LAKE SAN DIST #1 for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.016 (average)	.014- .017	NO
COPPER (ppm)	AL=1.3	.1500	.1500	NO
FLUORIDE (ppm)	4	.3 (average)	.1- .9	NO
LEAD (ppb)	AL=15	2.80	2.80	NO
NICKEL (ppb)	100	2.0333 (average)	1.2000- 3.1000	NO
NITRATE (NO3-N) (ppm)	10	.61 (average)	nd- 1.20	NO
SODIUM (ppm)	n/a	7.67 (average)	2.00- 19.00	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.2	1.2	NO

SHAWANO MUNICIPAL UTILITIES for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.029 (average)	.011- .039	NO
CHROMIUM (ppb)	100	1 (average)	nd- 1	NO
COPPER (ppm)	AL=1.3	.2300	.2300	NO
FLUORIDE (ppm)	4	.1	.1	NO
LEAD (ppb)	AL=15	10.00	10.00	NO
NICKEL (ppb)	100	.9133 (average)	.7200- 1.1000	NO
NITRATE (NO3-N) (ppm)	10	5.29 (average)	2.90- 9.20	NO
SODIUM (ppm)	n/a	4.13 (average)	2.90- 5.40	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	1.0	1.0	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	.51 (average)	nd- 1.90	NO
BROMOFORM (ppb)	n/a	.17 (average)	nd- .86	NO
CHLOROFORM (ppb)	n/a	.72 (average)	nd- 2.80	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.07 (average)	nd- .33	NO
SULFATE (ppm)	n/a	52.00	21.00 52.00	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
DICHLOROMETHANE (ppb)	5	.4 (average)	nd- .8	NO
TTHM (ppb)	100	1.5 (average)	nd- 5.6	NO

WR14 Lakes Tables

WR14 Streams Tables

SHAWANO LAKE WATERSHED (WR15)

The Shawano Lake Watershed covers 62 square miles in Shawano and Menominee Counties. A majority of the planning area is contained within this watershed with the 6,178-acre Shawano Lake as the main water resource. Shawano Lake is a hardwater drainage lake up to 40 feet deep and is an important year round recreational waterbody. This lake experiences excessive weed growth during July and August, which is likely, associated with non-point source pollution (i.e., phosphorus from lawn fertilizers, etc.). Other small lakes included in this watershed are Loon Lake, Washington Lake, Lulu Lake, White Clay Lake and Lily Lake. Rivers and streams associated with this subwatershed include the Shawano Lake Outlet, Duchess Creek, Loon Creek, and Murray Creek. This watershed has been ranked as being a “high priority” for selection as a Priority Watershed Project.

REFERENCES

1. WDNR. 1989. Shawano Field Station: Fisheries Management Files.
2. WDNR. 1995. Lake Michigan District: Water Quality Files.
3. Andrews, Lloyd M. 1968. Surface Water Resources of Shawano County. Wisconsin DNR.
4. WDNR. 1995. Lake Michigan District: Wastewater Management Fish
5. Shawano Lake SSA Plan
6. Shawano County Land & Water Resource Conservation Plan

WR15 Public Wells Map

WR15 Wastewater Map

SEYMOUR WATERWORKS for 1999**Inorganic Contaminants**

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	14 (average)	8- 20	NO
BARIUM (ppm)	2	.064 (average)	nd- .128	NO
COPPER (ppm)	AL=1.3	.7410	.7410	NO
FLUORIDE (ppm)	4	.3	.3	NO
LEAD (ppb)	AL=15	5.30	5.30	NO
NICKEL (ppb)	100	21.5000 (average)	10.0000- 33.0000	NO
SODIUM (ppm)	n/a	5.35 (average)	3.40- 7.30	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	5.0	5.0	NO
GROSS BETA PARTICLE ACTIVITY (pCi/l)	n/a	2.9	2.9	NO
RADIUM, (226 + 228) (pCi/l)	5	3.0	3.0	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	3.10	2.60 3.10	NO
CHLOROFORM (ppb)	n/a	15.00	11.00 15.00	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.60	.50 .60	NO
O-CHLOROTOLUENE (ppb)	n/a	.30	.00 .30	NO

WR15 Lakes Tables

WR 15 Streams Tables

RED RIVER WATERSHED (WR16)

The 208-square-mile Red River watershed is in southcentral Langlade County, northcentral Shawano County, and southwest Menominee County. The West Branch and Mainstem Red River are approximately 74 miles in length and flows through the Menominee and Stockbridge Reservations. Nearly all streams in this watershed are classified as trout waters. The upper reaches of the watershed, in Langlade County, support many dairy operations. Polluted runoff could affect the water resources of this watershed.

REFERENCES

1. WDNR. 1989. Shawano Area Field Station: Fisheries Management files.
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5. Steuck, Ralph. 1977. Surface Water Resources of Langlade County. Wisconsin DNR.
7. WDNR. 1980. *Wisconsin Trout Streams* [PUB1.6-3600 80].
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9. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
10. WDNR. 1980. *Wisconsin Trout Streams* [PUB1.6-3600 80].
11. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.

WR16 Public Wells Map

WR16 Wastewater Map

WR 16 Trout Streams Map

GRESHAM WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.040 (average)	.025- .055	NO
COPPER (ppm)	AL=1.3	1.0100	1.0100	NO
FLUORIDE (ppm)	4	.7 (average)	.4- 1.0	NO
LEAD (ppb)	AL=15	9.13	9.13	NO
NITRATE (NO3-N) (ppm)	10	1.27 (average)	.60- 1.93	NO
SODIUM (ppm)	n/a	16.59 (average)	2.97- 30.20	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	24.0	24.0	YES
GROSS BETA PARTICLE ACTIVITY (pCi/l)	n/a	15.0	15.0	NO
RADIUM, (226 + 228) (pCi/l)	5	1.6	1.6	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
SULFATE (ppm)	n/a	20.05 (average)	16.00- 24.10	NO

Health effects for any contaminants with MCL violations

Contaminant	Health Effects
GROSS ALPHA, EXCL. R & U	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.

MATTOON WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
ARSENIC (ppb)	50	7	7	NO
BARIUM (ppm)	2	.017	.017	NO
CHROMIUM (ppb)	100	1	1	NO
COPPER (ppm)	AL=1.3	1.1700	1.1700	NO
FLUORIDE (ppm)	4	.2	.2	NO
LEAD (ppb)	AL=15	1.80	1.80	NO
NICKEL (ppb)	100	2.7000	2.7000	NO
NITRATE (NO3-N) (ppm)	10	12.29 (average)	.58- 24.00	NO
SODIUM (ppm)	n/a	2.70	2.70	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	3.0	1.0 3.0	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
CHLOROFORM (ppb)	n/a	.23	.23	NO

Volatile Organic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
TTHM (ppb)	100	.2	.2	NO

WR16 Lakes Tables

WR16 Streams Tables

Streams Tables Con't

WEST BRANCH WOLF RIVER (WR17)

The West Branch Wolf River Watershed includes the portion of the Wolf River from the Shawano Dam in the City of Shawano to near the mouth of the Evergreen River in Menominee County. This watershed includes much of the Menominee Reservation. An increasing amount of cleared land for dairy and other agriculture is evident in the Langlade County portion, while the Menominee Reservation remains predominantly wooded or wild. Nearly all streams in this watershed are classified as trout waters. U.S. Geological Survey (USGS) has written a report on the water quality of the Menominee Indian Reservation of Wisconsin. The report called *Water Resources of the Menominee Indian Reservation of Wisconsin; USGS Water-Resources Investigations Report, 93-4053, 54p.* is available through USGS, Water Resources Division, 6417 Normandy Lane, Madison, WI, 53719.

The dam at the Shawano Paper Company controls the head of Shawano Lake and cannot be operated as a peaking facility.

The Neopit Dam on the West Branch Wolf River is non-functional as a hydroelectric dam. The gate is controlled only to prevent flood overtopping of the Mill Access and possible dam loss at a during high discharge. A scheduled rebuild design will incorporate a weir type with stage controlled by discharge. The dam will not be removed because it is a reservoir for fire control at the Menominee Tribal Enterprises mill (Howlett, 1996).

The Keshena Falls Dam washed out in 1973-76 and was not functioning as a hydroelectric facility.

REFERENCES

1. WDNR. 1989. North Central District: Fisheries Management files.
2. Steuck, Ralph. 1977. Surface water Resources of Langlade County. Wisconsin DNR.
3. Andrews, Lloyd M. 1963. Surface Water Resources of Menominee County, Wisconsin DNR.
4. Johnson, Max. 1989. WDNR Area Fish Manager, Antigo. Personal Communication.
5. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
6. WDNR. 1980. *Wisconsin Trout Streams* [PUB1.6-3600 80].
7. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.

WR17 Public Wells map

WR17 Wastewater Map

WR17 Lakes Tables

WR17 Streams Tables

Streams Tables Con't

WOLF RIVER/LANGLADE AND EVERGREEN RIVER (WR18)

The Wolf River/Langlade and Evergreen Rivers Watershed is in north central Menominee and eastern Langlade Counties covering 147 square miles. The watershed includes the Wolf River from the mouth of the Evergreen River in Menominee County, north to below the mouth of the Lily River in Langlade County. The entire stretch of the Wolf River above the Menominee County line is included in Chapter NR 102, Wisconsin Administrative Code, as an Outstanding Resource Water. This watershed has generally good water quality. The problems associated with the heavy recreational use on the Wolf River and the natural impacts of beaver activity are the main concerns.

The only point source discharger in the Wolf River/Langlade and Evergreen Rivers Watershed is the Village of White Lake.

This watershed was not ranked by the Wisconsin Nonpoint Source Water Pollution Abatement Program in support of the findings of the *Winnebago Comprehensive Management Planning* process, which did not identify it as a priority area.

Wolf River Mainstem

The mainstem Wolf River flows for 33 miles through this watershed. The Wolf River downstream from the Village of Lily is a favorite attraction for canoeing, float trips and other recreational activities. Its heavy use has created some problems with immediate bank damage, compaction and littering. The Town of Wolf River has begun to address some of these problems by prohibiting disposable containers on the Wolf River.

Evergreen River

The Evergreen River extends for 20 miles through Langlade and Menominee counties. The river is a Class I trout stream. In Langlade County, the watershed is about 60 percent wooded or wild; in Menominee, nearly 100 percent is wooded or wild. As with most streams in this watershed, the Evergreen River is affected by intense beaver activity. As a result, Antigo fish management staff conducted beaver control projects in the Langlade county reach in 1993. The Evergreen River State Fishery Area is located here with 80-90 percent of the shoreline in state ownership.

REFERENCES

1. WDNR. 1989. North Central District: Fisheries Management files.
2. Steuck, Ralph. 1977. Surface water Resources of Langlade County. Wisconsin DNR.
3. Andrews, Lloyd M. 1963. Surface Water Resources of Menominee County. Wisconsin DNR.
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7. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Water.

WR18 Public Wells map

WR18 Wastewater Map

WHITE LAKE WATERWORKS for 1999

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.026 (average)	.018- .034	NO
CHROMIUM (ppb)	100	0 (average)	nd- 1	NO
COPPER (ppm)	AL=1. 3	.4550	.4550	NO
FLUORIDE (ppm)	4	.4 (average)	.3- .4	NO
LEAD (ppb)	AL=15	.85	.85	NO
NITRITE (NO2-N) (ppm)	1	.005 (average)	nd- .010	NO
SELENIUM (ppb)	50	1 (average)	nd- 1	NO
SODIUM (ppm)	n/a	3.15 (average)	2.40- 3.90	NO

Radioactive Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
GROSS ALPHA, EXCL. R & U (pCi/l)	15	.6	.6	NO

WR18 Lakes Tables

WR18 Streams Tables

LILY RIVER WATERSHED (WR19)

The Lily River Watershed is in the north central portion of Langlade County and the southwest corner of Forest County, covering 205 square miles.

The Elcho Sanitary District No. 1 is the only point source discharger in the watershed.

This watershed was not ranked by the Wisconsin Nonpoint Source Water Pollution Abatement Program in support of the findings of the *Winnebago Comprehensive Management Planning* process, which did not identify the watershed as a priority area.

REFERENCES

1. WDNR. 1989. North Central District: Fisheries Management files.
4. Johnson, Max. 1989. Area Fish Manager, Antigo. Personal Communication.
5. Ave Lallemand, Steve. 1989. Fisheries Biologist, Woodruff. Personal Communication.
6. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
7. WDNR. 1980. *Wisconsin Trout Streams* [PUB1.6-3600 80].
8. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.

WR19 Public Wells map

WR19 Wastewater map

ELCHO SANITARY DISTRICT 1 for 1999

Microbiological Contaminants

Contaminant	MCL	Level Found	Range	Violation
Coliform (TCR)	presence of coliform bacteria in >=5% of monthly samples	4		YES

Inorganic Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BARIUM (ppm)	2	.017 (average)	.014- .019	NO
COPPER (ppm)	AL=1.3	.5650	.5650	NO
FLUORIDE (ppm)	4	.2	.2	NO
LEAD (ppb)	AL=15	5.34	5.34	NO
NICKEL (ppb)	100	5.2000 (average)	1.1000-9.3000	NO
NITRATE (NO3-N) (ppm)	10	.05 (average)	.04- .06	NO
SODIUM (ppm)	n/a	3.80 (average)	3.20- 4.40	NO

Unregulated Contaminants

Contaminant (units)	MCL	Level Found	Range	Violation
BROMODICHLOROMETHANE (ppb)	n/a	1.10	.00 1.10	NO
CHLOROFORM (ppb)	n/a	2.90	.00 2.90	NO
DIBROMOCHLOROMETHANE (ppb)	n/a	.30	.00 .30	NO

Health effects for any contaminants with MCL violations

Contaminant	Health Effects
Coliform (TCR)	Coliforms are bacteria which are naturally present in the environment and are used as an indicator that other, potentially-harmful, bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.

WR19 Lakes Tables

WR19 Streams Tables

Streams Tables Con't

UPPER WOLF RIVER AND POST LAKE WATERSHED (WR20)

The headwaters of the Wolf River originate above Pine Lake in Forest County. The river flows southwestward into Oneida County before flowing southward through Post Lake into Langlade County. The Wolf River from Post Lake to Little Rice Lake meanders through low country. This watershed covers 192 square miles in Forest, Langlade, and Oneida counties.

There are presently no point sources in the Upper Wolf River and Post Lake Watershed. A portion of the City of Crandon lies within the watershed, but its wastewater discharge is to the Peshtigo River basin. Further information about this facility can be found in the Upper Green Bay Basin Plan.

No polluted runoff problems have been identified for this watershed. The majority of the streams are affected by beaver – severely in some cases.

This watershed was not ranked by the Wisconsin Nonpoint Source Water Pollution Abatement Program as per the *Winnebago Comprehensive Management Plan* because it did not identify the watershed as a priority area.

The Department is reviewing a proposed underground zinc-copper-lead mine near Crandon in the Wolf River Watershed. During the public review phase for the Wolf River Basin Water Quality Management plan, several comments were received regarding the status and impact of the proposed mine. A decision on whether the project could be permitted is unlikely before late 1997 or early 1998. The current proposal is to discharge treated wastewater to the Wisconsin River south of Rhinelander, out of the Wolf River watershed. Approximately equal amounts of the finely ground waste rock or tailings would be backfilled into the underground openings and stored above ground in a tailings management facility. The proposed design of the tailings management area is conceptually similar to a modern landfill, but totals about 350 acres.

The Department's draft environmental impact statement for the proposed mine should be available for public review and comment late in 1996.

If the proposed mining project were permitted, the Department and company would conduct comprehensive environmental monitoring of the groundwater, surface waters, air quality project wastes and aquatic organisms in affected waters to determine if the project was meeting the required level of environmental protection established in the approval process. If not, the company would have to invoke its contingency plan to alleviate the environmental problem. If there would be a continuing history of environmental problems associated with the project, the Department has the authority to make the permit conditions stricter or even suspend or revoke the mining permit.

The Wolf River is classified as an Outstanding Resource Water (ORW) in Chapter NR 102, Wisconsin Administrative Code. Under the water quality antidegradation rule, NR 207, any discharges will not be allowed to lower water quality in the Wolf River.

The policy of the state, as expressed in the mining laws and rules, is to prevent degradation of natural groundwater quality through strict design and construction standards and to protect the public rights regarding the availability of groundwater. Measures used to monitor and protect groundwater quantity and quality before mining begins, during site development and mining operations, and following site reclamation are summarized in a WDNR fact sheet, *Protecting Groundwater at Mining Sites*.

REFERENCES

1. WDNR. 1989. North Central District: Fisheries Management files.
2. Steuck, Randy. 1977. Surface water Resources of Langlade County. Wisconsin DNR.
3. Steuck, Randy. 1976. Surface water Resources of Forest County. Wisconsin DNR.

5. Ave Lallemand, Steve. 1989. Fisheries Biologist, Woodruff. Personal Communication.
6. Fago, D. 1994. Printout of the Master Fish File for the Wolf River Basin. WDNR - Research Monona.
7. WDNR. 1980. *Wisconsin Trout Streams*. [PUB1.6-3600 80].
8. Wisconsin Administrative Code NR102. Water Quality Standards for Wisconsin Surface Waters.

WR20 Public Wells map

WR20 Wastewater Map

WR20 Lakes Tables

WR20 Streams Tables

Appendix A: HOW TO USE THE STREAMS TABLES

The following information is included in the stream tables. Unknowns in the tables indicate that we have insufficient data to assess the given stream(s). In the future we hope to provide data on these unassessed waterbodies.

Name of Stream: All named streams and some unnamed streams are listed. Stream names are those found on U.S. Geological Survey (USGS) quadrangle maps unless the Wisconsin Geographic Names Council has established a different name. Unnamed streams are identified by location of the stream mouth as indicated by township, range, section and quarter-quarter section.

Waterbody ID Code All waterbodies require a waterbody I.D. in order to link them to other databases. When an I.D. can't be found, one can be requested from Don Fago 221-6366

Length: The stream length is either the total length of the stream, or the starting and ending mile of the portion of the stream described based on the Master Waterbody System, developed from a Fish Distribution Study conducted by the Bureau of Research (WDNR Research Report 126, 1984). The stream mile at the stream mouth is zero ("0") and increases as one moves upstream.

Existing Use: This column indicates the biological use that the stream or stream segment currently supports. This is not a designation or classification; it is based on the current condition of the surface water and the biological community living in that surface water. Information in this column is not designed for, and should not be used for, regulatory purposes. If the existing use is unknown, "UNK" should be entered. The biological use categories are defined in NR102(04)(3) under fish and aquatic life uses, which are the same categories used to describe the stream's codified use. The following abbreviations for existing stream uses are used in the table. See also *Guidelines for Designating Fish and Aquatic Life Uses for Wisconsin Surface Waters (6/98 Draft)*. *This draft guidance should be used for determining existing and potential use for Cold (generally) WWSF, WWFF, LFF, and LAL. Until this draft is formally adopted, the categories listed below will be used, as opposed to the proposed revisions incorporating CWT-1-3, CWF, and GLM waters.*

COLD Cold Water Community; includes surface waters that are capable of supporting a community cold water fish and other aquatic life or serving as a spawning area for cold water fish species. The cold water community may be indicated by a trout class based on the document, *Wisconsin Trout Streams* (DNR Publ. 6-3600[80]). The approximate length or portion of stream meeting each of the use classes is indicated.

Class I high-quality stream where populations are sustained by natural reproduction;

Class II stream has some natural reproduction but may need stocking to maintain a desirable fishery;

Class III stream has no natural reproduction and requires annual stocking of legal-size fish to provide sport fishing.

WWSF Warm Water Sport Fish Communities; includes waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.

WWFF Warm Water Forage Fish Communities; includes surface waters capable of supporting an abundant, diverse community of forage fish and other aquatic life.

LFF Limited Forage Fishery (intermediate surface waters); includes surface waters of limited capacity due to low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of tolerant forage fish and aquatic life.

LAL Limited Aquatic Life (marginal surface waters); includes surface waters severely limited because of low flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.

Potential (Attainable) Use: This column indicates the biological use that the investigator believes the stream or stream segment could achieve through proper management of "controllable" pollution sources.

Beaver dams, hydroelectric dams, low gradient streams, and naturally occurring low flows are generally not problems that can be controlled.

The potential (or attainable) use may be the same as the existing use or it may be higher. Abbreviations for "potential use" are the same as those used in the "existing use" column. Information sources used to determine stream potential are indicated by footnotes in each table. Unless otherwise noted, the source for trout streams was *Wisconsin Trout Streams* (DNR Publ. 6-3600[80]), Wis. Adm. Code NR102.10 and NR102.11, and the professional judgment of WDNR personnel.

Integrity Indicator This is the HBI score for the stream. Very good, good, poor, very poor are the categories (indicated by VG, G, P, or VP).

Supporting Potential Use: This column indicates whether a stream is threatened, or is fully, partially, or not meeting its potential biological use. An entry in this column shows the relationship between the stream's current and potential biological use. To determine if a waterbody or segment supports a potential use, one or more of the following is used: chemical, physical (habitat, morphology, etc.), or biological information, or direct observation and professional judgment. When biological data contrary to chemical or physical data exists, the biological data overrides the other data.

Fully Supporting "FULLY"

A stream or stream segment's existing biological use is the same as its potential biological use (E = P). This includes stream or stream segments that are *not affected* and stream or stream segments that have *culturally irreversible* impacts. An example of culturally irreversible impacts are those effects in a river system with an "optimally operating" dam--a dam that operates with minimal to no effect on the fish and aquatic life community assemblage, productivity, and diversity. Note that fairly to poorly operating dams are not considered "culturally irreversible" and their effect on biological resources is factored into the use support designation (see partially supporting).

Fully Supporting/Threatened "FULLY-THR"

A stream or stream segment's existing biological use is the same as its potential biological use (E = P), but there is a *clear and imminent* "threat" to the existing use remaining at its current level of biological productivity and ecological health. This threat could be due to actions likely to occur on or to the stream and/or in the watershed, such as:

- ! Rapid commercial, residential, and/or industrial development in the watershed,
- ! The advent of large-scale industrial operations in the watershed,
- ! Planned or active channel modifications that have been, or will be permitted, or cannot be regulated under existing state or federal rules (i.e., drainage districts).

Partially Supporting "PART"

A stream or stream segment's existing biological use is the same as its potential biological use, except that implementation of management practices could enhance the overall ecological health of the biological community. Management practices in this category include modification of hydro-regimes to reduce the impact of dam operations on the biological community. Thus, E = P, but the potential use assessment is below the stream or stream segment's maximum biological potential and this "less than optimal" condition is reversible.

Not Supporting "NOT"

When a stream or stream segment's existing biological use is less than its potential biological use by a factor of 1 or more of the following codified use classifications:

- Cold (includes Cold I, II, IIN, and III in one group);
- WWSF
- WWFF
- LFF
- LAL

Thus, E < P, with problems considered reversible by implementation of management actions.

Miles Assessed -- Monitored, Evaluated, or Unassessed: To substantiate the Use Support of "fully," "partially," "not" or "threatened," the terms *monitored*, *evaluated* or *unassessed* are defined as the following:

Monitored: A stream has been "monitored" for the purposes of Wisconsin water quality management plans and/or Wisconsin's Water Quality Assessment Report to Congress (305[b]) if:

! Site-specific data has been collected on that stream or stream segment in the past five years;

For the purposes of this document, data is defined as structured information gathered to assess the quality or integrity of a resource. Data from outside the WDNR can be used to help determine the quality or integrity of waters in the State of Wisconsin.

! The data are adequate to develop a best professional judgment about the existing and potential biological use of that stream or stream segment;

! The data should be adequate to judge the difference between the "existing" versus "potential" biological use for that stream or stream segment.

This information is used to determine if the Existing Biological Use matches or supports the Potential Biological Use "fully," "partially," or "not:"--and if that use is "threatened."

Evaluated: A stream has been "evaluated" if information other than site-specific data is adequate to determine a Potential Biological Use and to determine if the stream is currently meeting that level of biological use.

Sources of "evaluated" information include:

! Site-specific data that is more than five years old,

! Information on file provided by the public or others,

! Best professional judgment of a WDNR biologist or a WDNR fish manager.

Unassessed: A stream has been not been assessed.

Codified Use This is the waterbody's classification that is formally and legally recognized by NR102 and 104, Wis. Adm. Code. This column shows the classification that will be used to determine water quality criteria and effluent limits. A stream can obtain a codified use by applying formal stream classification procedures, which are undergoing revision in 1996. Classifications in this column are derived from:

1. Streams classified in NR102 and NR104;
2. Trout streams as defined by *Wisconsin Trout Streams* (1980) and listed in NR 104.
3. ORW and ERW streams officially approved as such by the DNR board and listed in NR102.10 and NR102.11. [In addition, a stream's fish and aquatic life use designation is in this column. Officially, ORW/ERW waterbodies are not fish and aquatic life use designations but are a separate category for the WDNR antidegradation program. These waterbodies also receive a fish and aquatic life use designation for the purpose of determining water quality criteria.]

All other waters will be codified Warm Water Sport Fishery (WWSF) which is the default (DEF) classification.

Streams that are listed in a wastewater permit as "cold," that are not codified as a cold water fish and aquatic life use should not be listed as cold in the codified classification column. The codified class for these streams should be the "default."

Streams classified as trout streams under 1.02(7) by the Bureau of Fisheries Management since publication of *Wisconsin Trout Streams* (1980), are not formally classified as trout waters. These streams will be added to NR102 and/or NR104 during 1996 code revisions. Until the code is revised and approved, however, the "default" code is used for these streams and stream segments (WWSF).

Streams classified as ORW and ERW in NR102.10 and NR102.11:

Outstanding Resource Waters, have excellent water quality and high-quality fisheries. They do not receive wastewater discharges; these point source discharges will not be allowed in the future unless the

quality of such discharges meets or exceeds the quality of the receiving water. This classification includes national and state wild and scenic rivers and the highest quality Class I trout streams.

Exceptional Resource Waters have excellent water quality and valued fisheries but may already receive wastewater discharges or may receive future discharges necessary to correct environmental or public health problems.

Use Impairment:

Use Problems, Source/Impact: This column indicates probable sources of pollution in the stream and types of water quality problems present (impact). All streams other than FULLY or UNKNOWN will show use problems and impacts in this column. These situations are usually explained in the narrative. Following is a key to abbreviations in the stream tables:

Source (cause of problem). This is the source of threat or impairment. Be as specific as possible.

ACC - No or limited access

CM - Cranberry marsh

BDAM - Beaver dam

DRDG - Dredging

EX - Introduced species

F - Forestry activities (logging, logging roads, stream crossings)

HM - Hydrological modification (dam, ditching, wetland drainage)

LF - Landfill

NMM - Non-metallic mining

NPS - Unspecified nonpoint sources

Specified Nonpoint sources:

CL - Cropland erosion

SB - Streambank erosion

PSB - Streambank pasturing

PWL - Woodlot pasturing

BY - Barnyard or exercise lot runoff

CE - Construction site erosion

RS - Roadside erosion

URB - Urban storm water runoff

DEV - Intense development pressure

PSM - Point source, municipal treatment plant discharge

PSI - Point source, industrial discharge

MS - Mine wastes and/or roaster piles

Impact (effect or impact of source on a stream) Variously known as the cause, impact or stressor, this column lists the effect on the stream as a result of the source.

AD - Animal deformity

BAC - Bacteriological contamination

CL - Chlorine toxicity

COM - Competition (i.e, encroachment by introduced species)

DO - Dissolved oxygen

FAD - Fish advisory

FLOW - Stream flow fluctuations caused by unnatural conditions

HAB - Habitat (in-stream sedimentation, scouring, etc.)

HM - Heavy metal toxicity

MAC - Undesirable rooted aquatic plant (macrophyte) or algal growth

MIG - Fish migration interference

NH₃ - Ammonia toxicity

NUT - Nutrient enrichment

ORG - Organic chemical toxicity or bioaccumulation

PCB - PCB bioaccumulation

pH - pH (fluctuations or extreme high or low)

PST - Pesticide/herbicide toxicity
SC - Sediment contamination
TEMP - Temperature (fluctuations or extreme high or low)
TOX - General toxicity problems
TURB - Turbidity

Trend This column can be based upon best professional judgment, or by comparing data from past plans to find that a waterbody has improved over previous assessments, or declined. This decline/improvement should not be the result of gaining data, but a relative assessment of changes occurring on the waterbody. The stream may be improving (I), stable (S), declining (D) or unknown (U).

Comments (Com): This column should contain an "N" if there is a narrative for the stream, and/or "R" if there is a management or monitoring recommendation. A detailed recommendation is included in the narrative section for the watershed. Any recommendation specific to a stream should be addressed with a narrative. Overall narratives for a watershed can sufficiently cover general recommendations such as for watershed wide data collection. Other comments may be included in this column and will be described in footnotes at the bottom of the table, such as the stream's inclusion in a priority watershed project (PW), listing as a critical habitat (CH), or a site containing endangered species (ES), etc.

Data Level In this column, indicate what level of data was used to make your decisions on this stream/segment. Ideally, the number is a composite of physical, chemical, biological and habitat data. EPA guidance is available on how to fill in this column.

References: The reference material used to complete the table for each stream is indicated by a number. A numeric list of references is provided for each watershed. Streams for which there are recommendations, or identified water quality impairments should have at least one reference listed in this column.

Appendix B: HOW TO USE THE LAKES TABLES

The following explains the information used in the following lakes table. *Note: A blank space anywhere in the table means that data is unassessed or unavailable.*

LAKE NAME: All named and unnamed lakes are listed. Lake names are those found on U.S. Geological Survey quadrangle maps unless the Wisconsin Geographic Names Council has established a different name. Some lakes are known locally by other names; where available, local names have been listed with the official name.

COUNTY (CO): Indicates the county in which the lake is located.

TOWNSHIP, RANGE, SECTION: Lake locations are identified by township, range, and section.

WATERSHED NUMBER: (ie., "LR01") The watersheds are identified for each lake listed using the WDNR Master Waterbody File in conjunction with U.S. Geological Survey seven minute topographic maps.

SURFACE AREA: The surface area is the size of the lake, in acres, as listed on the WDNR Master Waterbody File, *Wisconsin Lakes* PUB-FM-900 (1995), *Surface Water Resources of Dane County* (WDNR, 1985), and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

MAX/MEAN DEPTH: Maximum depths are those listed in *Wisconsin Lakes*, WDNR PUBL-FM-800-95REV and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

LAKE TYPE: Each lake type displays unique limnological characteristics based on physical and chemical properties. Production of plant and animal life generally varies in accordance with lake type. Basic classifications and qualifying criteria are:

Drainage lake (DG): Impoundments and natural lakes with the main water source from stream drainage. Has at least one inlet and one outlet.

Drained lake (DR): Natural lake with the main water source dependent on the groundwater table and seepage from adjoining wetlands. Seldom has an inlet but will have an outlet of very little flow similar to the seepage lake except for the outlet.

Seepage lake (SE): Landlocked. Water level maintained by groundwater table and basin seal. Intermittent outlet may be present.

Spring lake (SP): Seldom has an inlet, but always has an outlet of substantial flow. Water supply dependent upon groundwater rather than surface drainage.

The abbreviation **AIMPE** following any lake type denotes that an impounding structure (dam) is located on that lake. Shallow impoundments commonly experience sedimentation, turbidity, excess vegetation and algae, rough fish, and water level fluctuations.

WINTERKILL: Winterkill (winter oxygen depletion) is a common problem in many shallow Wisconsin lakes. A kill can occur when at least four inches of snow cover the lake, which prevents sunlight from reaching the water. All photosynthesis stops and plants begin to die and decompose. The extent of oxygen loss depends on the total amount of plant, algae and animal matter that decays. Drought increases the chance of winterkill by reducing the volume of water in the lake. A **AYE** indicates the lake has experienced winterkill at least once. If blank, winterkill is not known to have occurred.

ACCESS:

BR = Boat Ramp

BF = Barrier-free boat ramp (boating dock and/or wheelchair access)

P = Barrier-free pier (wheelchair access)

T = Walk-in trail

R = Roadside

W = Wilderness

BW = Barrier-free wilderness access (wheelchair access)

NW = Navigable water access to lake

X = Some type of access available, but not specified

SH (Self Help Monitoring) This column identifies existing or recommended Self-Help monitoring. The following letters in each column signify that Self-Help monitoring is:

R = recommended

X = completed

C = currently being done

HG (Mercury) Numerous lakes in Wisconsin contain fish with elevated levels of mercury. Fish consumption advisories are issued semi-annually for lakes with fish mercury levels of 0.5 parts per million (ppm) or greater. Generally, predator fish from soft water, poorly buffered, low pH lakes have the highest concentrations of mercury. The most updated listing of waterbodies with fish consumption advisories can be obtained by writing to: Fish Advisory, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

Groups:

R Fish mercury monitoring is recommended.

X Multiple fish populations have been tested for mercury content and a fish consumption advisory DOES NOT exist

XX Multiple fish populations have been tested for mercury content and a fish consumption advisory DOES EXIST due to mercury contamination.

MAC (Macrophytes): This column identifies the status of macrophytes or aquatic plants in the lake. Specifically, it indicates if the lake experiences Eurasian water milfoil and/or purple loosestrife, two invasive non-native species of plants that can impair the lake's aesthetic, ecological, and recreational values.

EM = indicates that Eurasian water milfoil is present in the lake and may be a problem

EM-W = lake part of research project to study the effectiveness of Eurasian water milfoil weevil in reducing and/or eradicating this plant from the lake.

PL = indicates that purple loosestrife is present in the lake and may be a problem

LMO (LAKE MANAGEMENT ORGANIZATION): Indicates whether or not a lake management organization (LMO) exists for the lake. An LMO can range from a small, loosely organized group of lake property owners to an association to a district, complete with by-laws and taxing authority. In the lakes table, the following letters are used to indicate whether the LMO is an association or district. If the type of organization is not known, but one does exist, a **AYC** is used.

Y Indicates that a LMO does exist

ASSC Indicates that a lake management association exists

DIST Indicates that a lake management district exists

R Recommends that a LMO be developed; this recommendation is usually accompanied by a narrative recommendation in the watershed analysis section.

TROPHIC STATUS INDEX (TSI) CLASS: Lakes can be divided into three categories based on trophic state: oligotrophic, mesotrophic and eutrophic. These categories are general indicators of lake productivity.

Oligotrophic lakes are generally clear, cold and free of many rooted aquatic plants or large blooms of algae. Because they are low in nutrients, oligotrophic lakes generally do not support large fish populations. However, they often have an efficient food chain with a very desirable fishery of large predator fish.

Mesotrophic lakes are in an intermediate stage between oligotrophic and eutrophic. The bottoms of these lakes are often devoid of oxygen in late summer months, limiting cold water fish and resulting in phosphorus cycling from sediments.

Eutrophic lakes are high in nutrients. They are likely to have excessive aquatic vegetation or experience algae blooms, sometimes both. They often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow lakes are especially vulnerable to **A**winterkill, **C** which can reduce the number and types of fish.

Lakes with a TSI less than or equal to 39 are generally considered oligotrophic, those with a TSI of 40-49 are considered mesotrophic, and those with a TSI equal to or greater than 50 are generally considered eutrophic.

All lakes naturally age, or progress from being oligotrophic to eutrophic. In many places, people have accelerated this process by allowing nutrients from agriculture, lawn fertilizers, streets, septic systems, and urban storm drainage to enter lakes.

LAKE PLAN OR PROT: This column refers to whether the lake has been the recipient of a lakes planning or lakes protection grant in the past and if either of these grants are recommended for the lake. If a lakes planning or protection grant is recommended, a narrative in the lake's respective watershed section will describe the recommended purpose of the grant.

PLAN = Lake has received a Lakes Management Program Planning Grant in the past.

PROT = Lake has received a Lakes Management Program Protection Grant in the past.

PLAN-R = A Lakes Management Planning Grant is recommended for a specific purpose identified in the lake's individual narrative in the Surface Water Quality Report watershed section.

PROT-R = A Lakes Management Protection Grant is recommended for a specific purpose identified in the lake's individual narrative in the Surface Water Quality Report watershed section.

PHOSPHORUS SENSITIVITY (P SENS): This analysis classifies lakes according to their relative sensitivity to phosphorus loading and existing trophic condition. The screening identifies high quality lakes that should receive highest priority for nutrient control management. The analysis first separates lakes into two major categories; lakes that are sensitive to increased phosphorus loading (Class I) and lakes less responsive to changes in phosphorus loading (Class II). Lakes in each general classification are then subdivided into management groups based on data needs or existing water quality conditions.

Class I:

A = existing water quality fair to excellent; potentially most sensitive to increased phosphorus loading.

B = existing water quality poor to very poor; less sensitive to increased phosphorus loading than Group A.

Ins = data is inadequate or insufficient to assess trophic condition; classification monitoring recommended.

Class II:

A = existing water quality fair to excellent; may not be as sensitive to phosphorus loading as Class I lakes.

B = existing water quality poor to very poor; low sensitivity to increased phosphorus loading.

Ins = data inadequate or insufficient to assess trophic condition.

These classification groups are used to establish appropriate management recommendations and priorities.

COMMENTS: Additional information that was available for the lakes has been included in the comments column. Abbreviations were used to conserve space as follows:

Source - sources are the facilities or activities that contribute pollutants or stressors, resulting in impairment of designated uses in a waterbody.

AGSPR - Agricultural land spreading site

HM - Hydrological modification (dam, ditching, wetland drainage)

NPS - Unspecified nonpoint sources

CL - Cropland erosion

SB - Streambank erosion

PSB - Streambank pasturing

PWL - Woodlot pasturing

BY - Barnyard or exercise lot runoff (animal operations)

CE - Building construction site erosion

RS - Roadside construction erosion

SEP - Septic systems are or may be causing water quality problems

URB - Urban storm water runoff

DEV - Intense development pressure

WLF - Water level fluctuations

Causes/Stressors - causes are those pollutants or other conditions that contribute to the impairment of designated uses in a lake. Stressors are factors or conditions - other than specific pollutants - that cause impairment of designated uses in a lake.

HAB - Habitat

MAC - Undesirable macrophyte

ALG - Undesirable algae growth

NUT - Nutrient enrichment

SED - Sedimentation

TOX - General toxicity problems

TURB - Turbidity

DO - low dissolved oxygen

ACC - Access problems relate to the general public's inability to access the lake, which as a navigable waterbody is considered a water of the state.

Appendix C: LAKES TABLE REFERENCES

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Appendix D: Wolf River Basin Wells Table