LOWER FOX RIVER BASIN INTEGRATED MANAGEMENT PLAN

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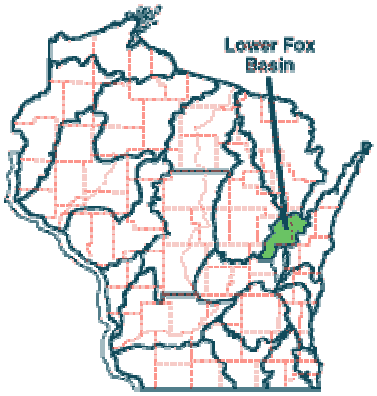

A Report by the Wisconsin Department of Natural Resources in cooperation with the Lower Fox River Basin Partnership Team

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To interested parties of the Lower Fox River Basin:

The Wisconsin Department of Natural Resources is pleased to present you with the Lower Fox River Basin Integrated Management Plan. This strategic plan provides background information on the basin, identifies threats to basin resources, and details actions to improve the health of the ecosystems in the basin.

The plan was developed with input from both WDNR staff and the Lower Fox River Basin Partner Team. A "Basin Kickoff" meeting was held February 28, 2000 at the Brown County Land Conservation offices in Green Bay. Partner Team agencies and WDNR staff presented the issues and priorities they felt were important for the plan to address. They also shared their own plans and other relevant documents. George Boronow, Lower Fox River Basin Water Team Leader, discussed the plan format, project approach, and project timeline. Comments were solicited from the audience. A list of key issues and threats, priorities, and recommended strategic actions was developed to serve as the cornerstone of the plan.

After developing an outline for the plan, fisheries and habitat, wildlife, and watershed staff reviewed existing plans and evaluated the necessary actions to address the issues and priorities identified at the Basin Kickoff meeting. Sections of the plan were presented at the monthly Partner Team meetings, to allow the partners to comment on and ask questions about each section. Tim Rasman, TMDL Specialist, presented the Water Tables; Scott Szymanski, former Water Quality Biologist, and Terry Lychwick, Fisheries Manager, presented the fisheries and habitat portion; and, Dick Nikolai, Wildlife Manager, presented the wildlife portion of the plan. A list of existing agency plans relevant to overall basin planning was compiled and incorporated into the plan.

The first draft of the plan was distributed to staff for review and changes. Once those changes were made, a second draft was distributed to staff and the Partner Team. Their comments were reviewed again and additional changes were made to the plan. A final draft of the plan was then completed in December of 2000 and sent to the central office in Madison for review.

The public review draft of the plan was issued in June 2001. The public meeting was held June 26, 2001 at the Wrightstown High School Community Room. Comments were received at the public meeting and incorporated into the plan. Additional comments were accepted through July 23, 2001. The final plan incorporates comments received from WDNR staff, Partner Team members, and private citizens.

We hope this new plan will serve as a means to establish a consistent process within the Partner Team for identifying basin resource issues, priorities, and strategic actions, as well as establishing additional partnerships and joint projects with a variety of groups and citizens. The Lower Fox River Basin Integrated Management Plan encompasses a broad range of ideas and needs; therefore, it is hoped that the plan will serve as a work planning document not only for

WDNR staff, but also for all other agencies and groups working within the basin. The ultimate goal of this plan is to provide everyone with one document that can be used to develop projects at all levels, and that serves to improve basin resources.

Sincerely,

George Boronow

Lower Fox River Basin Water Team Leader Leader

Arnie Lindauer

Lower Fox River Basin Land Team

LOWER FOX RIVER BASIN INTEGRATED MANAGEMENT PLAN

August 2001

A Report by the Wisconsin Department of Natural Resources in cooperation with the Lower Fox River Basin Partnership Team

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ACKNOWLEDGMENTS

The development of the Lower Fox River Basin Integrated Management Plan has been an effort of the Wisconsin Department of Natural Resources Lower Fox River Basin Land and Water Teams, with support from staff in the Bureaus of Fisheries and Habitat Protection, Wildlife Management, and Watershed Management. The Lower Fox River Basin Partner Team also provided support, suggestions, information, and review of the plan. The team was an integral part of ensuring that this plan encompassed issues and actions important to a variety of Lower Fox River Basin inhabitants. Much of the information that was used in this plan came from existing plans such as the Lower Fox River Basin Water Quality Management Plan. To those of you who contributed to the existing plans and to this one, your help is greatly appreciated.

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Wisconsin's Fisheries, Habitat and Wildlife Strategic Implementation Plan.

This report can also be found on the DNR website at http://www.dnr.state.wi.us/org/gmu/lowerfox/index.htm

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Acronyms

APHIS	Animal and Plant Health Inspection Service
ASR	Aquifer Storage and Recovery
BMP	Best Management Practice
DATCP	Department of Agriculture, Trade and Consumer Protection
DMU	Deer Management Unit
DComm	Department of Commerce
DOT	Department of Transportation
ERW	Exceptional Resource Waters
FEMA	Federal Emergency Management Agency
FH	WDNR Fisheries and Habitat Protection Program
FWHMP	A Fisheries, Wildlife and Habitat Management Plan For Wisconsin
GIS	Geographic Information Systems
LCD	Land Conservation Department
LMIFMP	Lake Michigan Integrated Fisheries Management Plan
MCL	Maximum Contaminant Level
NHI	Natural Heritage Inventory
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
NRDA	Natural Resource Damage Assessment
ORW	Outstanding Resource Waters
PCB	Polychlorinated Biphenyl
RAP	Lower Green Bay Remedial Action Plan
TMDL	Total Maximum Daily Load
UDC	Uniform Dwelling Code
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WA	Waterfowl Areas
WDNR	Wisconsin Department of Natural Resources
WHP	Wellhead Protection
WM	WDNR Wildlife Management Program
WS	Wildlife Services
WT	WDNR Watershed Protection Program

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EXECUTIVE SUMMARY

The Wisconsin Department of Natural Resources (WDNR) and the Lower Fox River Basin Partner Team members prepared the Lower Fox River Basin Integrated Management Plan during 2000-2001. This plan provides background information on the basin, identifies threats to basin resources, and details actions to improve the health of the ecosystems in the Lower Fox River Basin. The ultimate goal of the plan is to improve basin resources through coordinated work planning and issue prioritization.

The plan is organized in such a way that it presents detailed information, while allowing plan users to quickly identify the topics relevant to their specific areas. The "Basin Ecology" section describes the physical features of the basin as well as the cultural and natural resources of the basin. The "Basin Challenges" section presents the major resource issues affecting the Lower Fox River Basin, and highlights general priorities for addressing those issues. The "Strategic Goals and Objectives" section lists in greater detail the actions that are recommended to address the issues. The "Lower Fox River Basin Watershed Issues and Programs" section discusses in greater detail the issues identified for the Lower Fox River Basin. It also discusses the existing Department programs and regulations that address those issues.

The physical features and geology of the Lower Fox River Basin influence the types of issues and problems that occur in the basin. The Fox River and the lower part of Green Bay are the major surface water resources within this watershed. Other major surface water features in the basin serve as the basis for dividing the basin into watersheds. These surface water features (watersheds) include the East River (LF01); Apple and Ashwaubenon Creeks (LF02); Plum and Kankapot Creeks (LF03); Fox River/Appleton (LF04); Duck Creek; and, Little Lake Butte des Morts (LLBDM; LF06). The topography, surface water drainage, and drinking water availability are dictated by the local geology. The geology consists of glacial deposits underlain by a series of eastward-dipping sedimentary bedrock units. The sedimentary bedrock consists of carbonates (dolomite and limestone), shale, and sandstone.

The Lower Fox River Basin is home to a variety of unique and delicate ecosystems. These include open land, woodlands, wetlands, riverine, and lacustrine ecosystems. Open lands and woodlands ecosystems are important because they provide habitat for wildlife, provide recreational opportunities for area residents, and provide areas for groundwater recharge. The wetlands ecosystems support a variety of unique plant and animal species. They also protect water quality by buffering surface water runoff to rivers and streams. The riverine and lacustrine ecosystems are important because they provide habitat for wildlife, support commercial fisheries, and provide recreational opportunities. The Niagara Escarpment is an especially unique ecosystem located within the basin.

These ecosystems are threatened by past and current industrial activities, agricultural practices, and residential and commercial development. The primary challenges identified for the basin include the following:

- Habitat loss, deterioration, and fragmentation;
- Nonpoint source pollution of surface waters;
- Deteriorating groundwater quality and diminishing groundwater quantity;
- Heavy recreational use of some resources, such as lakes and shorelines;
- Contaminated sediments;
- Inadequate program support and enforcement; and,
- Lack of education.

The main priorities identified to address the above issues include the following:

- Increase and protect critical habitats and habitat integrity;
- Sustain a diverse, balanced and healthy ecosystem;
- Improve surface water and groundwater quality and identify water conservation opportunities;

- Establish a self-sustaining, balanced, and diversified edible fish community;
- Manage resources for multiple users;
- Strengthen program support and enforcement initiatives; and
- Improve educational programs.

The specific actions that are necessary to improve the resources of the Lower Fox River Basin are identified in the "Strategic Goals and Objectives" section. This section is subdivided into the four missions: Making People Our Strength, Sustaining Ecosystems, Protecting Public Health and Safety, and Providing Outdoor Recreation, to be consistent with the Department's Strategic Plan (WDNR, 1999). The actions, if implemented, will enhance WDNR staff technical and administrative capabilities; protect specific fish and wildlife species and their habitats; improve educational and outreach programs; and heighten the enjoyment of natural resources by recreational users. Some priorities are addressed in several different "Strategic Goals and Objectives" categories, due to the inter-relationships of land and water systems.

Existing programs and regulations are currently addressing some of the issues identified for the basin. WDNR staff are working to improve and protect basin resources through the programs, including Wellhead Protection Planning, the Wisconsin Storm Water Management Permit program, the Priority Watershed program, and Impaired and Outstanding Waters and Wetlands regulations. These programs and regulations provide a framework within which future actions may be conducted. Workload for WDNR staff will continue to be an issue as the population grows and development increases within the basin, creating a corresponding increase in environmental issues.

1.0 INTRODUCTION

The Lower Fox River Basin Integrated Management Plan is a collaborative effort between WDNR Water and Land staff, and the Lower Fox River Basin Partner Team. The plan describes the natural resources of the basin and identifies the ecological resource needs of the basin. This plan will replace the format of Lower Fox River Basin Water Quality Management Plans that were previously prepared. Unlike the Water Quality Plan, the Integrated Plan will convey an ecosystem management approach because it includes both land and water resource issues, specifically focusing on fish, wildlife, and watersheds. Because this is the first of this new type of plan, its focus will initially be narrow to keep the process manageable; therefore, the plan may not include all programs. As the plan is revised, other programs or topics may be added as time and resources allow. The new plan is not intended to be a compendium of every activity that the Department or the Partner Team is conducting in the basin. Rather, it focuses on joint priorities and responses to those priorities.

Since WDNR staff and Partner Team members felt it made sense to use existing information rather than to try and "re-invent the wheel," six existing plans or documents are referenced throughout this plan. The documents are as follows:

1. WDNR. Bougie, C. 1999. *Lower Fox River Basin Water Quality Management Plan - Draft*. PUBL-WT-291-99-REV.
2. WDNR. 2000. *A Fisheries, Wildlife and Habitat Management Plan For Wisconsin, 2001 through 2007*.
3. WDNR Bureau of Fisheries Management. 1995. *Lake Michigan Integrated Fisheries Management Plan, 1995 - 2001*. Administrative Report No. 39.
4. WDNR and Green Bay Remedial Action Plan (GBRAP) Public Advisory Committee. 1988. *Lower Green Bay Remedial Action Plan*.
5. WDNR. 1993. *Lower Green Bay Remedial Action Plan. 1993 Update for the Lower Green Bay and Fox River Area of Concern*.
6. Science and Technical Advisory Committee (STAC). 2000*. Nutrient and Sediment Management in the Fox-Wolf Basin* (White Paper).

To be consistent with the Department's strategic plan, the four missions: Making People Our Strength, Sustaining Ecosystems, Protecting Public Health and Safety, and Providing Outdoor Recreation, are also the headings under the “Strategic Goals and Objectives” heading in this plan. If all stakeholders carry out the strategic actions identified in the plan, the Department and Partner Team can meet the goals of improving and protecting the ecosystems in the Lower Fox River Basin.

This plan will also serve as the basis for WDNR staff work planning. Since the issues, priorities, and strategic actions in the plan were developed by both WDNR staff and the Partner Team, staff will be able to develop their work plans based on the plan and know that those projects are a joint priority. It is hoped that the plan will foster cooperation, as well as encourage joint projects that will effectively use the time and resources of everyone involved. Funding decisions regarding proposed projects under the state's Fish and Wildlife grant will involve evaluating how that need or issue is addressed in this plan. By working with the wide variety of agencies and groups represented in the Lower Fox River Basin Partner Team, many priorities, strategic actions, and specific projects have been identified. The plan, by identifying steps to achieve a healthy ecosystem, will support the need for funding when funding sources become available.

Finally, the watershed tables will be the main source of information for 305(b) reporting to congress and determining the level of 106 funding WDNR receives under the Clean Water Act.

2.0 BASIN ECOLOGY

The Lower Fox River Basin encompasses a variety of unique ecosystems that result from particular combinations of land uses, water resources, geology, climate, and topography. The following sections summarize the major factors influencing the Lower Fox River Basin ecology, and describe the ecosystems found within the basin.

The Lower Fox River Basin is comprised of six watersheds (East River, Apple/Ashwaubenon, Plum Creek, Fox River/Appleton, Duck Creek and Little Lake Butte des Morts), encompassing the Fox River, Duck Creek, East River, Apple Creek, Plum Creek, Mud Creek, Dutchman Creek and Ashwaubenon Creek, and covering most of Brown, eastern Outagamie, northern Calumet and small sections of Winnebago counties. **Figure 1** shows the communities located within the boundaries of the basin, as well as watershed boundaries. **Figure 2** shows just the boundaries of the watersheds. Maps of individual watersheds are included as **Figures 3 through 9**. The 638 square mile (1,654 square kilometers) drainage basin is bordered by the Twin Door Kewaunee Basin to the north and east, the Manitowoc River Basin to the south and east, the Upper Fox River Basin to the south, the Wolf River Basin to the west and the Upper Green Bay Basin to the north.

Aerial Photo taken over De Pere, 1997. Agricultural and urban land use surrounds the Lower Fox River.

The Lower Fox River originates at the outlet of Lake Winnebago and flows northeast for 39 miles where it empties into the bay of Green Bay. With an average daily flow of 4,320 cubic feet of water per second (Holmstrom et. al. 1996), the Lower Fox River is characterized as a large, non-wadeable, low-transparency river interrupted by a series of locks and dams. The Lower Fox River empties a drainage basin of 6,349 square miles (including drainage from the Wolf River and Upper Fox River Basins) (WDNR, 1999). From Neenah/Menasha downstream to Kaukauna, the elevation of the river drops 15 feet. Between Neenah/Menasha and De Pere are eight rapids, each of which influenced settlement and navigation.

The main stem of the Fox River in the Lower Fox River Basin is fragmented by a series of 17 locks and 12 dams that were built in the mid 1800's to aid navigation or produce power. These structures impeded the free movement of fish up and down the river and continue to do so today. The locks and dams also influenced the movement of aquatic exotic and invasive species into Wisconsin lakes and

Insert **Figure 1**: The Lower Fox River Basin

Insert **Figure 2** –Watersheds of the Lower Fox River Basin

Insert **Figure 3**: East River Watershed (LF01)

Insert **Figure 4**: Apple and Ashwaubenon Creeks Watershed (LF02)

Insert **Figure 5**: Plum and Kankapot Creeks Watershed (LF03)

Insert **Figure 6**: Fox River/Appleton Watershed (LF04)

Insert **Figure 7**: Duck Creek Watershed (LF05)

Insert **Figure 8**: Little Lake Butte des Morts Watershed (LF06)

streams. In addition, sediments deposited behind locks and dams influenced water levels and downstream sedimentation patterns.

A portion of lower Green Bay is also included in the Lower Fox River Basin. Green Bay is an elongated arm of Lake Michigan partially separated from the lake by the Door County peninsula. The bay runs northeast from the Fox River's mouth, is 119 miles long, and has a maximum width of 23 miles. The Bay is relatively shallow, ranging from an average of 10 to 15 feet at the southwestern end to 120 feet at its deepest point. The water coming out of the Fox River flows northward up the east side of the lower Bay, with the currents in the Bay flowing in a counter-clockwise direction. Water levels in the bay and in the Great Lakes basin have varied seven feet since 1860 due to climatic variations (WDNR, 1988). Water levels recorded in 2000 were approximately 20 inches below normal. The record low water year for Lake Michigan was 1964, with water levels at approximately 30 inches below normal (USACE, 2001). Low water levels benefit shoreland wetlands and wetland dependent species, but can negatively impact navigation.

The Fox River Valley is the second largest urbanized area in the State of Wisconsin, with a population of nearly 500,000 (Boyer, Turk, and Farchmin, 1996). According to the 1990 U.S. census, over 306,000 people live in the Lower Fox River Basin. Most of the basin's urban areas are near the river, and localized urban and industrial runoff has contributed to water quality problems. **Figure 9** shows the current land cover of the Lower Fox River Basin. **Table 1** summarizes current land uses along the Fox River corridor in the basin[1].

Table 1. Land Uses Along the Lower Fox River

Land Use	Fox River Corridor in the Fox Cities (1996)	Fox River Corridor in Brown County (1990)	Entire Lower Fox River Corridor
Residential	32.9%	25.5%	29.2%
Industrial/Commercial	26.2%	25.3%	25.8%
Woodlands	14.6%	17.9%	16.2%
Parks	11.6%	6.8%	9.3%
Agricultural	0.5%	11.4%	5.8%
Public	7.2%	1.3%	4.3%
Wetlands	5.1%	1.6%	3.4%
Vacant	2.0%	10.2%	6.0%

Notes:
Percentages are approximate and are intended to provide a general indication of land use along the Lower Fox River.
The Fox Cities includes all communities between Neenah/Menasha and Kaukauna.
Public land includes school properties
The two source maps do not cover an approximate one-mile stretch of river.
Source: ThermoRetec. 1999. *Draft Remedial Investigation*. ThermoRetec used information from the following sources:
1) East Central Wisconsin Regional Planning Commission. 1996. Fox Cities Area Existing Land Use Map.
2) Brown County Planning Commission. 1990. Fox River Corridor Land Use Map.

[1] Land use percentages for the Lower Fox River Basin as a whole were not available at the time of this writing. Brown County Planning, East Central Regional Planning, and Bay Lake Regional Planning are in the process of compiling 2000 census data to summarize land uses in the area. This information is estimated to be available in 2002.

Insert **Figure 9**: Lower Fox Basin – Current Land Cover

2.1 GEOGRAPHY/GEOLOGY/METEOROLOGY

A strong relationship exists between the physical characteristics of an area, surface and groundwater quality and quantity, and the overall hydrologic cycle. Therefore, this plan includes general information about the geology, geography and meteorology of the Lower Fox Basin. These components need to be considered when addressing some of the major resource issues within the basin.

2.1.1 GEOGRAPHIC AND GEOLOGIC SETTING

The Lower Fox River Basin is in the Eastern Ridges and Lowlands geographical province **(Figure 10)**. In this region glacially derived sediments overlie southeastward dipping bands of sedimentary rocks. The erosion of the sedimentary rocks (both dolomites and sandstones) formed south-southwest trending ridges. The most prominent ridge is the Niagara escarpment, which runs from Door County to south of Lake Winnebago, forming the eastern border of the basin.

2.1.1.1 Major Soils of the Basin

Soils are comprised of various organic and inorganic materials of different sizes, ranging from boulders to very fine-sized particles of clay. Soil types are classified according to the percent of gravel, sand, silt, clay and organic material, in combination with other physical properties. Other physical properties may include structure, thickness, permeability, chemistry, and slope. The soil types present in an area are among the most significant factors determining groundwater contamination potential, aquifer recharge rates, and surface water flow patterns. The soil types are also important in determining the ability of the soil to attenuate contaminants.

Figure 10. Geographical Provinces of Wisconsin (Hole, 1980)

The dominant soils of the basin belong to the Kewaunee-Manawa-Hortonville soil association. These soils developed on the glacial deposits and minor amounts of loess, a wind blown silt. Area soils are well to somewhat poorly drained silt loams with loamy or clayey subsoil underlain by loamy or clayey glacial till. The Oshkosh-Manawa soil association covers the stretch of the Fox River from Wrightstown to Green Bay. These soils are well drained to somewhat poorly drained with a clayey subsoil. The low permeability of these clayey soils limits infiltration of water to the subsurface, thus exacerbating nonpoint source pollution runoff to surface water bodies. **Figure 11** shows the surficial deposits that are present in the basin.

2.1.1.2 Depth to Bedrock and Type of Bedrock

The composition of the subsurface influences the surface topography and drainage patterns of the area, and determines the availability of groundwater supplies. Generally, the geology of the area consists of glacial sediments draped over a series of sedimentary Paleozoic (570 to 250 million years old) rocks. The sedimentary rocks are underlain by crystalline Precambrian rocks. The sedimentary rocks dip towards the east and consist of a basal Cambrian sandstone unit overlain by limestone and dolomite units. The Prairie du Chien dolomite (the unit above the basal sandstone) forms a ridge in northwestern Outagamie County that runs approximately parallel to the Wolf River. The Prairie du Chien dolomite is overlain by the St. Peter sandstone, followed by the Galena/Platteville dolomite (part of the Sinnipee Group), the Maquoketa shale, and Silurian dolomite. The Silurian dolomite forms a ridge east of the Fox River known as the Niagara Escarpment. **Figure 12** summarizes the bedrock types that are found in

Insert **Figure 11:** Surficial Deposits

Insert **Figure 12:** Bedrock Geology of Wisconsin

the basin. The Paleozoic rocks and structural trends control the drainage of the Fox River, resulting in the northeasterly flow of the river (Boyer et.al., 1996).

The bedrock does not entirely control surface geomorphology, as the glacial advances and retreats planed off the bedrock highs and filled in bedrock valleys with till and outwash (Boyer et.al., 1996). The entire basin falls within the glaciated part of the state **(Figure 13)**. The basin's topography, relief and drainage primarily reflect glacial activity, with the influence of the easterly dipping underlying bedrock units. Thicknesses of surficial deposits in the basin range from zero to over 200 feet in buried bedrock valleys. The depth to bedrock generally increases to the east. The thickest deposits are found in the central portions of the basin. **Figure 14** shows a cross-section of the area geology and **Figure 15** identifies the cross-section line.

A unique geologic feature in the basin is The Niagara Escarpment. The escarpment runs through Illinois, Wisconsin, and Lower Michigan, through Canada and eventually to New York near Niagara Falls. In 1990 the United Nations Educational, Scientific and Cultural Organization (UNESCO) designated the Niagara Escarpment an International Biosphere Reserve in order to protect and monitor its ecosystem. It is one of over 300 Biosphere Reserves throughout the world (Garbisch, 2000). In Green Bay, many threatened and endangered snail species survive in the unique micro-environments that exist on the escarpment. Their future existence is currently threatened by increasing development and other changing land uses.

2.1.1.3 Aquifers

An aquifer is defined as a geologic layer of either unconsolidated material or bedrock, lying below the ground surface that is all or partially saturated with water and permeable enough to allow water to be extracted as from a well. In the Lower Fox River Basin, aquifers can include glacial unconsolidated materials, the fractured upper zone of the Galena/Platteville dolomite, and the lower (deeper) sandstone units.

Glacial deposits often supply sufficient amounts of water for domestic purposes where they are thicker and more extensive. Glacial ice or meltwater transported and deposited these glacial sediments within the last million years. The most recent deposits were left as the Green Bay Lobe retreated from the area around 10,000 years ago. The deposits are unconsolidated and range up to 200 feet thick in some areas. These deposits consist mostly of silty clayey tills and lake clays that are not productive aquifers. Over most of the central portion of the basin, the heavy lacustrine (lake) clays retard or limit infiltration of water. Within the basin productive sand and gravel deposits are not extensive. For this reason wells are rarely finished in the unconsolidated materials.

Along the eastern edge of the basin Silurian dolomite is utilized as an aquifer. It is a productive aquifer due to extensive fracturing and weathering. Under the Silurian dolomite is the Maquoketa Shale. The shale is a strong aquitard and typically does not produce enough water for domestic use. Because the shale is over 300 feet thick, wells are rarely drilled through it to the underlying sandstone aquifer.

The uppermost bedrock over most of the basin is the Galena/Platteville dolomite **(Figure 12**, above**)**. The upper weathered zone of this aquifer is often a high-yielding aquifer. Many wells draw water from this aquifer, however increased demand and declining water levels have forced wells to be drilled deeper. The sandstone aquifer is made up of sandstones and dolomitic limestones of the Ordivician and Cambrian systems (i.e., all of the units including and below the St. Peter sandstone). Water quantities produced by formations in this aquifer are excellent, but water quality can be somewhat diminished due to contact time with minerals in the rock. For example, water from the deep sandstone aquifer in the Green Bay area has elevated levels of radium. Sulfate, iron and dissolved solids are commonly elevated throughout the basins in the deeper aquifer.

Groundwater is the source of potable water for all residents within the Lower Fox Basin, except those served by municipal water systems in the cities of Green Bay, Appleton, Neenah, and Menasha. A few

Insert **Figure 13**: Glaciated Regions of Wisconsin

Insert **Figure 14:** Cross-Section of the Geology of the Lower Fox River Basin

Insert **Figure 15**: Cross-Section Locator Line

private wells draw water from the Galena-Platteville dolomite, although many of the shallow limestone wells have required deepening due to the declining water table. Most private wells draw water from the lower St. Peter sandstone. Municipal wells obtain water from the St. Peter and Cambrian age sandstone below it. Problems faced by municipalities using groundwater include levels of arsenic and radionuclides above the drinking water Maximum Contaminant Levels in wells, declining groundwater levels and increasing demand on groundwater due to increasing population.

Water quantity is also a problem in the basin. Excessive pumping in Green Bay and Fox Cities areas has resulted in substantial declines in water levels in the lower aquifer system. This in turn has resulted in declines in the shallow aquifer as well. In 1957, due to declining water levels, the City of Green Bay switched to surface water (Lake Michigan). While the water levels quickly rebounded, they have been falling steadily at a rate of 1 to 3 feet/year across much of the basin since 1961 (**Figure 16**). Arsenic, radionuclides, increasing water demands, and rapidly declining water levels are major concerns in the Lower Fox Basin and will require improved planning in the future.

2.1.2 CLIMATE

Northeastern Wisconsin is characteristic of continental climate with distinct changes in weather over the region. Summers are warm and occasionally hot and humid while the winters are cold and snowy. Spring and autumn are transitional seasons, with gradual to abrupt changes in weather. In the vicinity of the Lower Fox River, Lake Winnebago, Lake Michigan, and Green Bay provide a modifying influence on local weather, creating the 'lake effect' of cooler temperatures near the lakes during the summer and slightly warmer temperatures during the winter. The mean temperature in the City of Green Bay for winter is 17.6 °F, for spring is 43.2 °F, for summer is 67.1 °F, and for autumn is 47.1 °F. The rest of the Fox Valley experiences mean temperatures generally 1 to 2 degrees warmer than the temperatures for the City of Green Bay (ThermoRetec, 1999).

The average annual precipitation in the basin is approximately 0.7 meters (29 inches). Most of the precipitation occurs as rain and snow with occasional episodes of sleet and hail. Over half the annual precipitation (56%) falls from May through September, with August typically the wettest month and February typically the driest. Snowfall is variable, with the mean annual snowfall at approximately 1.2 meters (44-48 inches) (ThermoRetec, 1999).

2.2 ECOLOGICAL LANDSCAPES AND NATURAL RESOURCES

The Lower Fox River Basin encompasses three of the state's ecological landscapes: Northern Lake Michigan Coastal, Southeast Glacial Plains, and Northeast Plains (**Figure 17**). The Northern Lake Michigan Coastal area is characterized by a Lake Michigan climate influence, and gently rolling to flat topography with clay and loam soils. The area is dominated by agriculture in the south and mixed hardwood forest in the northern areas. The Southeast Glacial Plans is characterized by rolling topography with silt loam soils. The area is primarily agricultural with small wetlands and mixed hardwood forests. The Northeast Plains is characterized by gently rolling to flat topography with sandy soil and has a mixture of agriculture, mixed hardwood forests and wetlands.

Wildlife diversity and populations in the Lower Fox River Basin are affected by the variability of habitats within the basin. The two main terrestrial habitats within the Lower Fox River Basin are open land and woodland. Aquatic habitats within the area are wetland, riverine, and lacustrine. Aquatic habitats are generally more complex than terrestrial habitats. Cities and villages represent an urban environment, which is low in wildlife diversity and mainly supports scavengers (i.e., raccoons, vermin, etc.) or certain passerines that nest almost anywhere (i.e., swallows, sparrows, etc.).

Open land consists of cropland, orchards, pastures, and meadows, and comprises the largest type of habitat within 0.5 mile of the Lower Fox River. Dominant wildlife in open land include songbirds, white-

Insert **Figure 16**: Groundwater Levels and Rate of Decline in the Lower Fox River Valley

Insert **Figure 17**: Ecological Landscapes of the Lower Fox River Basin

tailed deer, rabbits, red fox, coyote, pheasant, Hungarian partridge, and waterfowl, as well as domesticated livestock. Snakes, turtles, frogs, bats, small mammals and invertebrates can also be found in this habitat.

Woodland habitat includes hardwood and conifer forest land and wooded lots with an associated understory of shrubs, grasses, legumes, and herbaceous plants. Development, urban expansion, and agriculture have significantly decreased the once expansive woodland habitat to small, fragmented tracts that often are scattered near farm fields. The dominant wildlife that is found in woodland habitat includes white-tailed deer, squirrel, skunk, raccoon, upland game birds, songbirds, thrushes, and woodpeckers, as well as various invertebrates, reptiles, and amphibians.

Many types of **wetlands** can be found in this basin including submergent marsh (submerged aquatic vegetation and/or floating vegetation such as water lilies, pond weeds, and duck weeds), emergent marsh (cattails, bulrush, arrowhead, rushes, sedges, and reeds), shoreland wetlands (herbaceous vegetation similar to emergent marsh), wet meadow (sedges, grasses, herbaceous vegetation), shrub-carr (dogwood, cottonwood, willow, elderberry, and ash as well as herbaceous species), forested wetland or floodplain wetland (elm, cottonwood, ash, maple, oak, box elder, dogwood, buckthorn, jewelweed and other herbaceous species), and the rarest type, alvar (red cedar, big and little Bluestem, dwarf lake iris, and more). **Figure 18** shows the percentages of wetlands by watershed in the Lower Fox River Basin.

Wetlands provide critical habitat for numerous fish and wildlife species, as well as storm water attenuation, water filtration, and shoreline buffering. Fish such as northern pike, bass, sunfish, yellow perch, rainbow smelt, and shiners use emergent marsh and shoreland wetland types for spawning and foraging. The dominant species of birds in wetlands include geese, mallards, blue-winged teal, wood ducks, scaup, goldeneye, common and hooded mergansers, bald eagles, osprey, night herons, great blue herons, rails (greater & lesser yellowlegs), spotted sandpiper, Wilson's Phalarope, common snipe, woodcock, plovers (killdeer), red-winged black birds, sparrows, and other migratory songbirds. Mammals common to wetlands include muskrat, mink, otter, raccoon, bats**,** star nosed moles and other small mammals like shrews. In forested or floodplain wetlands as well as typical seasonally flooded wetlands, many wildlife species common to uplands such as white-tailed deer, raccoon, coyotes, red and gray fox, gray and fox squirrels and others can often occur. Frogs, toads, and turtles as well as numerous macroinvertebrates require wetland or shoreland habitat, and are a food source for wading birds and mammals. Snakes and toads will associate with both wetlands and uplands.

Riverine habitat includes rivers and tributaries. Many of the tributaries are flashy, surging full during large rain events and becoming dry at other times. Rivers and tributaries are also influenced by the amount of development adjacent to them or within the drainage basin. Increasing non-permeable surfaces increases the amount of fluctuation of water levels in the waterways. Approximately 44.6 percent of the river shoreline is developed with either riprap or seawalls, while the remaining 55.4 percent of the river is natural bank.

The Fox River is the life-blood of the Lower Fox River Basin, for both people and wildlife living in the basin. All of the Lower Fox's major urban areas are located adjacent to Green Bay, the Fox River and their tributaries. In the past, the Lower Fox River was a gateway to the Mississippi River and the site of early settlements by Native American Tribes and European explorers. As the area was settled, urban and industrial development along the river degraded water quality and devastated resident fisheries. The passage of the Clean Water Act in 1972 has resulted in improved water quality, which has in turn resulted in recovering fish populations and increased recreational use of the river.

The Lower Fox River is often referred to in two sections: upstream of the De Pere dam, and downstream of the De Pere dam. Upstream reaches to Little Lake Buttes des Morts and downstream extends to Green Bay. Different aquatic habitat types within the Lower Fox River and its tributaries can include: island/peninsula habitat, backwater, cuts and coves, riffles, runs, pools, submerged rocks and piling, and riparian canopy. Organisms living in the river include fish and benthic macroinvertebrates. Benthic

Insert **Figure 18**: Lower Fox River Basin Wetland Percentages

macroinvertebrates are primarily bottom/sediment-dwelling invertebrates that include adult and larval insects, mollusks, crustaceans, and worms. A lower diversity of species occurs in the lower river than what occurs upstream and at locations in Green Bay, due to lower water quality and high sedimentation in the lower river. Presently a diverse fish population inhabits the river and its tributaries, although contaminants continue to plague the fishery through fish consumption advisories. Refer to **Appendix A** for a list of fish species occurring in the Fox River.

Lacustrine habitat is the fifth habitat type in the basin. Portions of Green Bay which lie in this basin can be considered lacustrine. Lacustrine systems have deeper water, which allows thermoclines to form. These layers of different water temperatures provide opportunities for a wider variety of fish species and aquatic organisms to occur. Green Bay also has varying directions and strengths of currents, allowing large, complex wetland systems to form in the shallower areas, as can be seen on the western shore of Green Bay.

Historically, the abundance and diversity of fish species that populated the Great Lakes, including the Lower Green Bay and Lower Fox River Area, was very different from what it is today (WDNR, 1988). Overfishing of the Great Lakes was evident before the beginning of the 20th Century, and it greatly reduced the native fish populations. The invasion of exotics such as carp, alewife, sea lamprey, white perch and rainbow smelt also reduced some native fish numbers. To rehabilitate the commercial fishing industry, attempts have been made to restore an ecological balance to the Great Lakes through sea lamprey control, fish stocking and commercial harvesting of exotics. However, the system remains dramatically altered in fish species composition. The diversity may actually be higher in some cases, but the exotics displace more desirable native species (WDNR, 1999).

Today, the unbalanced fish community of the inner Bay and Lower Fox River is characterized by low abundance and low diversity of top predators (such as northern pike, walleye, and smallmouth bass) and native forage species (the spottail shiner) combined with the presence of certain exotic species (carp, alewife, white perch and sea lamprey). Excess carp populations may also present other problems. These fish are suspected of adversely affecting the Bay's ecosystem by uprooting native underwater plants (possibly allowing invader species to grow) and by re-suspending sediments (increasing turbidity). Abundant carp populations are present from the Little Lake Buttes des Morts dam to Wrightstown. Carp add to the problems of eutrophication and lack of habitat in the inner Bay. High phosphorus and sediment loadings lead to the excessive production of algae and excess sediment loadings which prevent rooted aquatic plants from establishing in the inner Bay (WDNR, 1999).

There are many **unique natural communities** in the basin. The west shore of the Bay is a large shallow estuary containing fluctuating water levels either seasonally or long term. The dolomite outcrops along the Fox River and throughout the eastern portion of the basin provide for unique alvar communities and ancient cedars. Prairie savanna still exists along the banks of the Fox River, on some islands associated with the Fox Locks, along railroads (especially in and near Kaukauna heading east), near UW-Green Bay, and along the Bay. The area known as the Burma Swamp located in Northern Outagamie County is a large forested wetland containing the headwaters of Duck Creek and Apple Creek. The Bay (waterfowl) and Burma Swamp (neo-tropical forested birds) are important sites for bird migrations. Savanna sites and the alvar sites are important sites for rare snails, possible rare plants, and rare invertebrates. All sites are vulnerable with human threats from dredging in the Bay, contaminants either known or unknown from the past and current industry and household use, urban expansion and wetland drainage.

Few **Department lands** are located within this basin. The Department lands within the basin consist of fragmented parts of the Green Bay West-Shore Waterfowl Areas (WA) (northwest), Holland WA (southeast), and Red Glades Scientific Area (northeast). **Figure 19** shows the public land located within the Lower Fox River Basin.

The Fox River Basin has some **unique wildlife species**. Three eagle nests occur near the Fox Cities (near the mouth of Mud Creek flowing into the Fox River, Thousand Islands Sanctuary, and east of

Insert **Figure 19**: Public Land in the Lower Fox River Basin

Heesaker's Park on an island in the Fox River) and a great blue heron rookery near the third eagle's nest. Many black-crowned night herons forage on Little Lake Butte des Morts as well as in the Kaukauna vicinity. An osprey nest occurred on a platform near Heesaker's Park prior to the platform's demise. Concentrations of waterfowl occur on the Fox River as well as on the new Appleton detention pond facilities near the Aid Association for Lutherans headquarters, Grand Chute, and Kaukauna. Concentrations are generally geese and mallards near these sites. Thousand Islands in Kaukauna has large concentrations of golden eye, mergansers, mallards, and eagles occurring in the winter (Nikolai, 2000).

2.3 CULTURAL RESOURCES

The Lower Fox River has historically been a significant waterway. For centuries, Native Americans occupied the banks of the Fox River and used the water as a source of food and water, as well as for recreation, transportation, and crop irrigation. Beginning in the 1600's, European pioneers used the Fox River for fur trading and as an exploration route. Settlements were established in the early 1800's, including Fort Howard (which is now the City of Green Bay). Paper mills began to flourish in the mid 1800's, after the flour mill industry peaked. The Fox River corridor now contains the world's highest concentration of paper mills along a single river segment [20 mills in approximately 37 miles (c. 1989)] (Boyer et.al., 1996). The early 1900's saw a booming timber industry followed by rapid urbanization (WDNR, 1988). Industries, municipalities, small businesses, farms, and thousands of residents now occupy the Lower Fox River corridor.

There are many known archaeological sites within the Lower Fox River Basin in the Duck, Apple and Ashwaubenon Creeks Priority Watershed. Ancestors of the Menominee and Ho Chunk people have lived in the watershed since the ice age (at least 10,000 years ago). The Oneida Reservation, established by Treaty in 1838, also exists within the project area. Prehistoric, historic and archaic Native American villages and settlements constitute the bulk of the known sites; these are primarily located within the Duck Creek and Trout Creek corridors (WDNR, Brown County LCD, Outagamie County LCD, and Oneida Nation, 1997).

In addition to the abundant examples of Native American history and culture evident throughout the area, remnants of the first European settlers to inhabit northeastern Wisconsin exist. These include sawmills, grain mills, and the remains of Fort Howard within the present-day location of Pamperin Park, Brown County (WDNR et. al., 1997).

3.0 BASIN CHALLENGES

The resource integrity of the Lower Fox River Basin is threatened by expanding residential and commercial development, groundwater, surface water, and sediment pollution, and loss of wetlands and wildlife habitat. The Lower Fox River Basin Partner Team and WDNR Land and Water Staff have worked together to identify important basin issues, threats to basin resources, priorities for the basin, and recommended actions to improve basin resources. The following sections outline these issues, threats, priorities, and recommended actions.

Urban Sprawl

3.1 KEY RESOURCE ISSUES OR THREATS

WDNR staff and the Lower Fox River Basin Partner Team developed the following list of issues and threats at a kickoff meeting in February 2000. Partner agencies presented information about papers or projects that they have worked on which identified 1) issues and threats to the basin's natural resources, and 2) plans and objectives to improve the health of the basin's ecosystems. Many of the identified issues, threats, and objectives were similar among the agencies, emphasizing the need to work together and pool resources to execute efficient, high quality projects.

The following list of issues and threats was compiled for the Lower Fox River Basin:

Habitat loss, deterioration, and fragmentation.

- Degradation of spawning habitat for game fish.
- Development pressures and urban sprawl.
- Increasing lakeshore and river front development.
- Stream and wetland alterations.
- Illegal wetland filling and lack of enforcement.
- Disturbance of habitat leading to high and increasing numbers of exotic and invasive species accompanied by decreasing or unstable numbers of native fish and wildlife populations.

Nonpoint source pollution of surface waters.

- Nutrient and suspended solids loading.
- Poor construction site storm water management and erosion control practices.
- Lack of adequate naturally vegetated buffers adjacent to shorelines.
- Current agricultural practices.
- Increasing amount of impervious surfaces (urban runoff).

Deteriorating groundwater quality and diminishing groundwater quantity.

Heavy recreational use of some resources (lakes, shorelines).

- Lack of low-impact recreational opportunities and educational programs.
- Increase in recreational boating use.

Contaminated sediments.

Inadequate program support and enforcement.

- Lack of enforcement of local ordinances and federal and state regulations due to too few resources; inadequate staff, training or knowledge; and, fragmented responsibility and authority for administration and enforcement.
- Staff have heavy workloads and lack the time and resources to carry out educational and management projects.

Lack of Education

- Lack of awareness or education of various decision makers, the public, or other agencies regarding the importance of habitat preservation, wetland qualities, functions, and diversity, storm water management, over-development, etc.
- Lack of public knowledge regarding nonpoint source pollution.

3.2 BASIN PRIORITIES

(in no specific order)

General priorities were established for the basin in response to the issues listed above. These general priorities serve as a checklist against which specific actions and initiatives can be measured, to ensure that projects are achieving overall basin objectives.

Increase and protect critical habitats and habitat integrity.

- Increase riparian habitat to sustain a suitable diversity of plants and wildlife.
- Increase wetland restoration activities without altering existing natural wetlands, and decrease wetland loss through education, enforcement, monitoring and regulation.
- Increase populations of threatened and endangered species and their habitats.
- Increase populations of desirable aquatic invertebrates, fish, and waterfowl.
- Protect sensitive areas on the Niagara Escarpment.
- Educate the public on wildlife habitat components, especially shorelines and wetlands, and the restoration and preservation of those habitats.
- Cooperate with local citizens and partners to identify and protect critical habitats through basin planning and monitoring processes (FWHMP).
- Increase waterway and wetlands monitoring efforts; acquire sound data and determine changes in systems due to natural and man-made alterations.
- Implement the use of alternate and natural shoreline restoration methods.
- Cooperate with other agencies to increase and improve diverse wetland habitats, and prevent the loss of high quality and unique wetlands through filling, draining, and alteration of one wetland type to another.
- Identify and prioritize habitat improvement and restoration projects (as part of the Natural Resource Damage Assessment, or NRDA, process).

Sustain a diverse, balanced, and healthy ecosystem.

- Understand the overall landscape when creating habitat, wildlife, and fisheries management projects and apply the projects accordingly.
- Manage entire ecosystems rather than managing specific sites or species; to be done by counties and local entities with help from the State.
- Provide suitable and sufficient habitat to enhance and sustain a diversity of wildlife in the bay and river (WDNR, 1993).

- Sustain an ecosystem that meets fishable and swimmable standards in addition to the WDNR's strategic objectives for biodiversity (FWHMP).
- Restore dammed streams to their natural state.
- Prevent the spread and introduction of exotic species.

Improve surface water and groundwater quality and identify water conservation opportunities.

- Significantly reduce phosphorus and sediment delivery to waterways from agriculture and construction sites.
- Improve enforcement of existing storm water ordinances by local governments.
- Develop and implement Total Daily Maximum Load (TMDL) standards as an approach to water quality.
- Achieve and maintain water quality that protects the ecosystem from the adverse effects of toxic substances on shoreline and aquatic vegetation, fish, aquatic life and wildlife utilizing the aquatic resources, and protects human health (WDNR, 1993).
- Improve the water quality and trophic state of the area of concern to relieve ecological stresses and support a full range of public uses (WDNR, 1993).
- Continue to work with Partners and Trustees on the NRDA and polychlorinated biphenyl (PCB) remediation of the Fox River and Green Bay.
- Improve planning for water supply and groundwater protection; protect groundwater recharge areas to sustain the base flow of basin streams.

Establish a self-sustaining, balanced, and diversified edible fish community.

- Establish a diverse, multi-species sport fishery within the productive capacity of Green Bay and Lake Michigan (Goal II, LMIFMP).
- Establish a stable commercial fishery within the productive capacity of Green Bay and Lake Michigan (Goal III, LMIFMP).
- Improve spawning habitat in lakes, rivers, streams, and wetlands.
- Achieve an increase in population levels of important or rare fish species.

Manage resources for multiple users.

- Develop a blend of public and private shoreline uses, ensuring adequate public access (WDNR, 1993).
- Protect the multiple uses of the Bay and River.
- Ensure the sustainability of a restored and healthy environment through pollution prevention and the development of economies, resources and facilities that will support the beneficial uses of the water resource into the future (WDNR, 1993).
- Develop a management strategy and organizational structure that will coordinate public and private efforts to improve and protect the natural resources, and consider cost-effectiveness, whenever possible, as a primary measure of such efforts (WDNR, 1993).

Strengthen program support and enforcement initiatives.

- Protect waters and shoreline habitat through enforcement of state statutes and rules, using enforcement mechanisms for habitat restoration (FWHMP).

Improve educational programs.

- Educate developers, contractors, and landowners about the problems associated with construction site erosion and storm water management.
- Educate farmers regarding erosion control and manure management.
- Educate the public on the adverse effects of shoreline development.
- Educate developers and landowners about the importance of protecting groundwater recharge areas.

4.0 STRATEGIC GOALS AND OBJECTIVES

A number of specific goals, objectives, and strategic projects were developed by WDNR staff with the help of the Partner Team, to support the general objectives identified in the Basin Challenges section. Because the list of goals and projects is extensive, it is presented in outline form to make it easier for Plan users to find specific items. The Strategic Goals and Objectives portion has been subdivided into four sections. Section 1, "Making People Our Strength," outlines activities that people can do to become better at protecting and managing the resources. Section 2, "Sustaining Ecosystems," discusses activities that should be implemented for general ecosystems or specific sites to improve fish, wildlife, and water quality in those ecosystems or specific sites. Section 3, "Public Health and Safety," advises of monitoring and other activities needed to keep the public safe while enjoying our natural resources. Finally Section 4, "Outdoor Recreation," provides projects which promote enjoyment of our natural resources by the public while preserving the resources for fish and wildlife.

Thornberry Creek

Other comprehensive management plans have been developed by the WDNR and other agencies, more specifically describing strategic goals and objectives for improving the health of the resources in this basin. Two examples of these plans produced by the WDNR are the *Lake Michigan Integrated Fisheries Management Plan, 1995 - 2001* (LMIFMP) and *A Fisheries, Wildlife and Habitat Management Plan for Wisconsin, 2001-2007* (FWHMP). Please refer to those plans directly for more information. A list of those additional plans can be found in **Appendix B** in the back of this plan. Also, please refer to the *Lower Fox River Basin Water Quality Management Plan* (WDNR, 1999) for a further description of individual watersheds and recommendations for each watershed.

4.1 MAKING PEOPLE OUR STRENGTH

4.1.1 INTERNAL STAFF

A. Attend and participate in technical training.
B. Ensure all new employees attend and participate in training sessions.
C. Attend and participate in the annual statewide training conference, regional trainings, and local workshops.
D. Acquire additional permanent staff and funding to provide work relief to the programs, as well as work on carrying out additional objectives as described in this plan or as needed.
E. Acquire the necessary tools, technology, and training to do the job.
F. Integrate with other staff and programs for external project review [WDNR Wildlife Management program (WM) reviewing water regulation applications], for implementing restoration or management projects, and to accomplish goals.
G. Construct demonstration projects on office property to teach those practices to other staff.

4.1.2 PARTNERS AND PUBLIC

A. Create and present training workshops for the public, groups, local decision makers, etc., to educate them on issues, programs, rules and regulations, environmental protection, new alternatives, etc. (hunting, recreation, animal damage, habitat preservation).
B. Create and publish a newsletter informing the public about various projects, the Lower Fox Basin Partner Team meeting agendas and events, success stories, and other issues. Distribute via e-mail and post on WDNR's website (www.dnr.state.wi.us/org/gmu). Promote the use of UW-Extension's website, http://clean-water.uwex.edu/foxwolf.
C. Devise a way to communicate to the public and other groups (e.g., educational institutions) that the WDNR has a Partner Team they can participate in. Distribute the basin newsletter to other public access agencies.
D. Identify and recruit a citizen group that could represent the general public at the partner team meeting, and bring the public's issues to the table.
E. With the partner team, develop an annual public meeting/open house to show the public our accomplishments, programs, partner team, etc., via poster sessions or other informal method.
F. Provide the public with "one stop shopping" for accessing quality data.
G. Provide general information/education/outreach to the public on a day to day basis, as requested, or when initiated by staff.
H. Establish an office file with general information about the various programs in the office, program regulations, etc., to assist other staff who are not familiar with all the programs and enable them to assist any walk-ins with questions if the program staff is not available.
I. Develop and maintain an agency reference guide containing staff pictures, descriptions, and duties, as well as agency locations. The guide would enable the public to identify the appropriate staff member and agency to contact, and would provide field and office staff with contact information to provide to the public.
J. Host a day with Animal and Plant Health Inspection Service (APHIS), and Wildlife Services (WS), to tour counties and projects that WDNR has done to discuss accomplishments, problems, etc.
K. Construct grassland and wetland restorations on school properties and follow up with prescribed burning.
L. Continue to educate staff, other agencies, and the public on the importance of prescribed burning to ecological management and the safe use of this tool (FWHMP).
M. Educate municipalities on detention pond construction, design, and maintenance; also educate municipalities about the relationships between ponds, urban wildlife, and wildlife damage.
N. Assist nature centers and non-profit organizations with a variety of activities, as requested.
O. Work with schools and universities to do research and surveys.

4.2 SUSTAINING ECOSYSTEMS

4.2.1 TERRESTRIAL ECOSYSTEMS

4.2.1.1 General

A. Protect, preserve, manage, restore, and connect grassland, wetlands, agricultural land, riparian land, and forests, as corridors for wildlife and as groundwater recharge areas.
B. Conduct an inventory of the resources in the basin, to identify critical habitats, potential wildlife corridors, and areas of concern.
    1. Create a map of the habitats, corridors, and links as a tool for making management decisions and for use in reviewing regulated projects.

2. Stakeholders: schools, municipalities, planning commissions, WDNR Fisheries and Habitat Protection program (FH), WM, WDNR Watershed Protection program (WT), Partner Team.

C. Identify and implement strategies to buffer the effects of rural residential development adjacent to critical habitat (FWHMP).
   1. Participate in the Regional Land Use Committee and local committees.

D. Develop and carry out habitat improvement projects on the Fox Locks property.
   1. Where possible conduct Oak savanna restoration on islands turned over to the state by the U.S. Army Corps of Engineers (USACE).
   2. Stakeholders - FH, WM, Partner Team.

E. Restore and protect various community types through the use of the duck stamp and the pheasant stamp, and through turkey permits and other funding sources.

F. Implement Smart Growth strategies to maintain forested, agricultural, and grassland systems and corridors.
   1. Describe specific projects.
   2. Stakeholders - WM, Municipalities, Counties, Landowners, Regional and County Planning Commissions.

G. Work with foresters to manage forests in the Lower Fox River Basin, on private and public lands as needed.

4.2.1.2 Niagara Escarpment

A. Work with other agencies, schools, and communities to assess impacts to the Niagara Escarpment from development or other impacts, and to monitor Endangered and Threatened species on the escarpment (e.g., Midwest Pleistocene vertigo snail).

B. Assess location, population characteristics, and movements of bats along the Niagara Escarpment.

4.2.2 AQUATIC ECOSYSTEMS

4.2.2.1 General

A. Assist the Central Office in implementing the monitoring strategy in this basin in 2001 as well as assisting in the development of bio-criteria, habitat indices, and databases for aquatic systems through 2007 (FWHMP).

B. Identify and investigate the causes of habitat loss or impairment and take corrective actions (FWHMP).

C. Assess aquatic habitat (wetlands, streams, lakes, etc.) to identify and protect critical habitat for species of concern, and to protect this habitat from development and other adverse impacts.
   1. Implement acquisition programs to protect habitat.

4.2.2.2 Watersheds

A. Assist and work with Partners and other staff in the evaluation of land use impacts (nonpoint, agricultural, storm water, etc.) on water quality, habitat, fish and wildlife, and work with the partners to implement Best Management Practices (BMPs) and other strategies to reduce land use impacts.
   1. Work with WM, FH, counties, and municipalities to install buffers and other waterway conservation and restoration projects to improve water quality.
      a. Stakeholders: WM, FH, counties, municipalities, land conservation departments (LCDs), U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service (USFWS), County and Regional Planning Commissions.

2. Educate communities and developers on natural methods of shoreline protection, alternatives to riprap, and natural detention pond design, which stabilize waterways, provide habitat for beneficial wildlife and fish, deter nuisance wildlife, and improve water quality.
    a. Stakeholders: WM, FH, WT, UW-Extension, LCD, USFWS, NRCS, local consultants or natural landscapers, communities, county zoning.

B. Assist municipalities in the Lower Fox River Basin in adopting and enforcing storm water control ordinances that address both water quality and quantity associated with constructed storm water runoff systems. Water quality considerations for receiving waters must be addressed in the design controls and ordinances.
C. Help communities in the Lower Fox River Basin adopt and enforce a construction site erosion control ordinance, encompassing construction of single-home building sites, subdivisions, industrial, and commercial sites.
D. Help cities, towns, and counties in the Lower Fox River Basin adopt a construction site erosion control ordinance for land-disturbing activities not covered under administrative rules, such as locally funded road and bridge construction.
E. Work with the nonpoint source program of the WDNR and Lower Fox River Basin Partner Team to develop a guidance document describing BMPs for fish and wildlife.
F. Continue to work with local agencies to create and hold a series of workshops on construction site erosion control for developers and contractors, that provides up to date information on erosion control practices, regulations, etc.
    1. Stakeholders: UW-Extension, Fox-Wolf Basin 2000.
G. Develop specific land acquisition goals related to watershed improvement needs.
H. Continue working with the Fox River Remediation Project to assess, restore, and evaluate remedial actions.

4.2.2.3 Streams

A. Cold Water
    1. Implement strategies on cold water streams that will protect and enhance the populations of Brook Trout and other cold water fish in those streams.
    2. Update the list of classified trout streams and merge it with NR 104.
    3. Conduct a sub-watershed study to assess the physical and biological condition of Lancaster Brook and its tributaries, including Thornberry Creek.
        a. Determine the effects of prior, current, and future developments on the geomorphology of the waterways, water quality, and the ability of those waterways to support cold water fish and other wildlife.
        b. Determine areas of those waterways in need of bio-engineering, habitat improvements, buffer establishment, and other shoreline protection activities.
        c. Identify locations in the sub-watershed where storm water detention is needed to reduce the runoff to those waterways.
        d. Identify land in the sub-watershed that would protect the waterways by being enrolled in an easement or acquisition program. Acquire funding to purchase land and easements, and to carry out monitoring, assessment and management of those lands and waterways.
        e. Stakeholders: FH, WT, WM, USFWS, Oneida Tribe, United States Geological Survey (USGS), Town of Hobart.
    3. Study the impacts of developments (ponds, residential) on cold water watersheds.
B. Warm Water
    1. Assess the impacts of potentially negative waterway activities (dredging, solid structures, solid bank stabilization materials). Work with adjacent Geographic Management Units (GMUs) on this.
    2. Identify critical habitat sites for shoreline protection, restoration, or in-stream habitat restoration, to enhance sport fisheries, water quality, and the littoral zone.

3. Continue and/or expand baseline monitoring of streams and rivers, and expand baseline monitoring protocols to include data requirements for NR 104 stream classification.
4. Create a monitoring schedule for the waterways.
5. Evaluate the impacts of removing dams to the streams, fish, wildlife, and other users.

4.2.2.4 Little Lake Butte des Morts

A. Establish a native population of Spotted Muskie in Little Lake Butte des Morts.
B. Establish monitoring protocol for this population to determine preferred habitats, etc.

4.2.2.5 Great Lakes

A. Continue the evaluation of the effects of habitat restoration below the De Pere Dam.
B. Integrate the Lower Fox River Basin Team's goals with the Lake Michigan Integrated Fisheries Management Plan (LMIFMP).
   1. Follow through with the goals and objectives of the LMIFMP. Each section lists a variety of tactics that can be implemented to achieve these objectives.
C. Monitor changes in shoreland and near shore vegetation due to low lake levels. Document types of vegetation (natives vs. exotics) and extent of the vegetation.
   1. Monitor "submerged" islands and the break in Long Tail Point to determine if any of the islands are slowly re-establishing themselves during this low water period.
D. Work with partner groups and other agencies to design, support, and implement the restoration of the Cat Island Chain restoration project.
E. Develop a phosphorus and sediment loading reduction goal for the Green Bay ecosystem and work with other agencies to implement activities to achieve that goal.

4.2.2.6 Wetlands
(Refer to **Appendix C** for additional wetlands discussion)

A. Train and educate WDNR staff and other wetland regulators on the compensatory wetland mitigation program, to ensure that staff know what wetlands are suitable for this program and which are not. Train staff on the various wetland communities and their importance to ensure that critical habitat is not lost.
B. Initiate enforcement of Water Quality Certification violations under Act 147.
C. In association with the Partner Team, identify and prioritize wetland complexes in need of protection, restoration, and enhancement. Develop strategies with other agencies to carry out those goals.
   1. Create an up-to-date wetland information resource accessible to all agencies, to maintain information regarding delineated wetlands, wetland community types, wetland regulations, and plans that provide goals, objectives, and priorities.
      a. Stakeholders: Lower Fox River Basin Partner Team, WDNR Water Regulation and Zoning staff, County Zoning Administrators, USACE, County LCDs, NRCS, Municipalities, and interested local conservation organizations.
      b. List available and desired funding sources.
      c. Desired Outcome: To provide sound data and information to all agencies who regulate, protect, enhance, or do other projects in wetlands, so that projects can be carried out which benefit rare or highly functional communities, large ecosystems, watersheds, and fish and wildlife, as well as providing regulators with good information for making decisions for the wetland permitting process.
   2. Protect wetland complexes with exceptionally high value through acquisition, incentives and other strategies by federal, state, and local government and not-for-profit conservation organizations (FWHMP).
D. To the largest extent possible and working with the Partner Team, monitor and evaluate the quality, diversity, function, and use of wetlands in the basin, to provide regulators with

data to deny or approve permits or activities. Where it is not possible to avoid wetland loss, mitigation and restoration efforts should provide optimal habitat for wildlife and fish. This may involve re-creation of micro-habitats (undercut banks, riffles, rocks, prairie buffers, etc.).

E. Restore degraded wetland complexes on public and private lands to recapture ecosystem function and value, and in certain areas enhance migratory waterfowl habitat (FWHMP).

4.2.2.7 Drinking Water and Groundwater

A. Encourage well owners to properly abandon unused wells.
B. Continue working with private well owners to monitor arsenic levels in drinking water. Continue routine inspections of private wells.
C. Work with Extension and Runoff Management staff to assist farmers with nutrient and pest management plans.
D. Assist communities in Wellhead and Source Water Protection planning.
E. Evaluate any pilot test data generated for the proposed Aquifer Storage and Recovery (ASR) program. Identify the potential effects on aquifer systems of injecting chlorinated surface water into the subsurface.
F. Strengthen water conservation education efforts, to try and slow the decline in groundwater levels.
G. Educate well drillers on special recommendations for installing private wells in the arsenic zone between Seymour and Greenville. Those recommendations include: 1) avoid drilling in the St. Peter sandstone; 2) case to 80 feet below the St. Peter if you do drill into that formation; and 3) use circulating mud when drilling through the mineralized zone between the Galena/Platteville formation and the St. Peter sandstone.

4.2.3 Endangered, Threatened, and Special Concern Species

(Refer to Appendix D for the lists of rare, threatened, and endangered species and natural communities for Brown and Outagamie Counties)

4.2.3.1 General

A. Cooperate with the Bureau of Endangered Resources to examine communities of importance on public lands. Document occurrences and share information.
B. Assist in surveys for monitoring and productivity of species.
C. Manage state properties for balanced plant and animal communities (FWHMP).
D. Assist Endangered Resources with master planning inventories, and updating the Natural Heritage Inventory (NHI).
E. Work with other programs and agencies to ensure that all federal, state, and local actions, as well as private management and development actions (when possible), are screened for endangered and threatened species and species of special concern.
F. Restore, purchase, and preserve critical habitat for rare, threatened, and endangered species.

4.2.3.2 Non-game Birds

A. Monitor detention ponds in the basin for the presence of unique or new bird species (such as egrets, swans, cranes, etc.)
B. Continue trumpeter swan, colonial waterbird, marsh/wetland birds, peregrine falcon, eagle and osprey population monitoring and productivity surveys. Track and monitor populations (FWHMP).
C. Develop or revise and implement population recovery plans for the species mentioned above, and monitor population responses to implemented recovery activities (FWHMP).

D. Develop and implement Partners in Flight Plans for migratory songbirds for the Areas 16 and 20 plans. Participate in planning efforts to determine the staff and resource costs for implementing the PIF plans and develop approaches for meeting those needs (FWHMP).
E. Integrate shorebird management in the management of wildlife impoundments, and develop other initiatives as opportunities present themselves in the Wisconsin Bird Initiative (FWHMP).
F. Coordinate with the Bureau of Integrated Science Services (ISS) to implement landscape scale management efforts for grassland birds (FWHMP).
G. Participate as a partner in further development of the Wisconsin Bird Conservation Initiative, and implement the specific goals and objectives established in that plan (FWHMP).
H. Serve as a partner in the recovery of Whooping Cranes. Work with the USFWS, International Crane Foundation, and others on the assessment, planning, and implementation of a project to reintroduce a migratory flock of whooping cranes to Wisconsin (FWHMP).
I. Develop and implement management guidelines for habitats supporting forest raptors (FWHMP).
J. Participate in studies to determine the status of the northern goshawk; contribute nesting data to the NHI database (FWHMP).

4.2.3.3 Herptiles

A. Participate in Partners for Amphibian and Reptile Conservation (PARCS) planning and implementation (FWHMP).
B. Monitor populations of rare snake species (FWHMP).
C. Improve herptile habitat along the Fox River, Green Bay, and other important areas.

4.2.3.4 Terrestrial Invertebrates

A. Work with other agencies and schools to identify, preserve, sample, and monitor sites with key or diverse invertebrate species (e.g., the Midwest Pleistocene vertigo snail).

4.2.3.5 Rare Plants and Vegetative Communities

A. Identify and preserve rare or important high quality (i.e., diverse) or improveable plant communities and monitor for the presence of other rare or important plant and animal species, and for the invasion of exotic or unwanted species.
    1. On state lands undergoing master planning, locate and describe these communities and manage them effectively.
B. Identify, designate, and manage State Natural Areas (FWHMP).
C. Develop approaches for recovery planning for multiple species and/or species assemblages (FWHMP).

4.2.3.6 Fish Species

A. Assess and protect the native population of Brook Trout in Lancaster Brook, Thornberry Creek, and wherever else they may occur.
    1. Conduct stream surveys, fish sampling, and water quality sampling on all streams where the potential to support Brook Trout exists.
    2. Use the data collected to classify trout streams.
B. Continue the re-establishment of the Great Lakes strain of Spotted Muskie (Muskellunge) and assess those populations.
C. Work jointly with other agencies to develop a Lake Sturgeon management plan for Green Bay and the Lower Fox River.
    1. Seek approval of the plan and implement strategies.

2. Assess and monitor sturgeon populations to gather information for the implementation of the plan.

WDNR / USFWS measuring Sturgeon - De Pere Dam


Lake Sturgeon at the De Pere Dam - Fox River

4.2.3.7 Aquatic Invertebrates

A. Assess native mussel populations and potential threats to them from zebra mussels and other sources.
B. Identify and preserve key mussel sites.
C. Support continued assessment of aquatic invertebrates. Continue long-term trend data acquisition.

4.2.4 Commercial Activities

A. Gather information on the set-line catfish fishery in the Fox River.
B. Work with central office staff, law enforcement, and other agencies to implement regulations concerning the harvest of native reptiles, amphibians, other wildlife, and fish (FWHMP).
C. Work with other programs and agencies to inspect, license, and monitor game, fur, and wildlife farms, inspect the animals for compliance, and find escapees. Review and improve regulations for these farms.
D. Support efforts to study declining yellow perch populations.

4.2.5 Exotic and Invasive Species

A. Prevent the spread of invasive exotics, following the statewide invasive species management plan. Participate in the development of local plans and strategies.
B. Implement those strategies and maintain current barriers (Rapide Croche Lock and Dam) which prevent the spread of exotics.
C. Educate the public on exotic species identification**,** control, how to prevent their spread, methods to remove exotics, and who to contact when a new exotic is encountered in the system. Educate people in the aquarium and pet trades as well as operators of fish and game farms.
D. Attend and actively participate in Northeast regional invasive species meetings.
E. Promote the use of proven biological controls and education for the prevention or control of exotic invasives.
F. Work with students, partners, and other groups to inventory, identify, and map exotic species on state lands. Assist local agencies in performing these activities on locally owned lands.

G. Encourage continued exploration of practical control and harvest methods for carp and other undesirable non-indigenous species (LMIFMP).
H. Develop additional strategies for controlling inadvertent transport of non-indigenous species by bait dealers, the aquarium industry, and recreational boaters (LMIFMP).
I. Implement activities to control exotics and restore native species to suitable habitats.

4.2.6 FISH AND WILDLIFE HEALTH

A. Facilitate the Fox River PCB cleanup.
B. Monitor the health of fish and wildlife populations in the Fox River as the system is cleaned up.
C. Maintain a disease monitoring program, including surveillance of all significant species to detect changes in disease patterns and enhanced monitoring for emerging diseases such as TB and chronic wasting disease in deer (FWHMP).
D. Provide health management for reintroduction and conservation programs for endangered, threatened and rare species (FWHMP).
E. Investigate and manage disease risks at the captive wildlife/free-ranging population interface (FWHMP).
F. Continue contaminant monitoring in identified geographic areas of concern (FWHMP).
G. Monitor contaminant levels in urban goose populations to facilitate harvest for consumption as a population management alternative (FWHMP).
H. Work with FH, counties, municipalities, and federal agencies to monitor waterways for diseases in fish and wildlife, such as botulism.
I. Post areas on the Fox River with warning signs near eagle nests and rookeries, to reduce traffic in sensitive areas.

4.2.7 ANIMAL DAMAGE

A. Work with communities to manage nuisance wildlife populations.
B. Work with the Law Enforcement (LE) program**,** LCDs, U.S. Department of Agriculture (USDA), APHIS, and WS to educate farmers on nuisance wildlife prevention and control, as well as how to provide water quality protection.
C. Continue to implement the Wildlife Damage and Nuisance Abatement program (FWHMP).
D. Implement Deer 2000 program changes to programs as they become available (FWHMP).
E. Educate the public and municipalities on land use changes, urban wildlife, and preventing wildlife damage. Work with partners and agencies to prevent and manage problems.

4.3 PUBLIC HEALTH AND SAFETY

4.3.1 CONTAMINANT MONITORING

A. Monitor fish in the major pools of the Fox River (from Neenah downstream) and in Green Bay using the same complex of fish as in the past to develop trend patterns and determine results of the remediation effort.
B. Test dredge spoils and wastewater of Chapter 30 dredging projects to determine impacts of wastewater discharges and compliance.
C. Acquire a set of maps showing all dredge samples collected for contaminant analysis during dredging projects, at each sample site. The maps could be used to summarize the concentrations and locations of detected contaminants. Links could be created to each site to view sample collector, laboratory, and methodology information, and to check quality control. This would also assemble all the existing information into one easy-to-use resource [Geographic Information Systems (GIS) and Water Reg. Project].

D. Conduct periodic contaminant monitoring of zebra mussels and benthic indicator species to determine the trends of contaminant levels in Green Bay and the Fox River.
E. Assist the Department of Health in increasing public awareness of the health risks of consuming fish from contaminated waters (FWHMP).
F. Implement TMDLs for impaired waters.
    1. Support the efforts of the Baird Creek watershed survey and East River TMDL pilot project as well as other TMDL projects.
G. Educate the public about wildlife diseases and how the public should respond to encounters with diseased wildlife.
H. When needed, collect samples of fish and wildlife for contaminant monitoring, in order to inform the public of consumption advisories, and assist partners and cooperating agencies. Inform agencies and the public of the current health advisory for waterfowl. This advisory has been placed on the Lower Fox River from Lake Winnebago at Neenah and Menasha, downstream to the northeast city limits of Kaukauna (including Little Lake Butte des Morts). The advisory also covers the Lower Fox River from the De Pere Dam to the river's mouth at Green Bay, and lower Green Bay south of a line from Point au Sable west to the western shore of Green Bay. This advisory specifies that all skin and visible fat should be removed before cooking mallard ducks that were known to have used these waters. The advisory also specifies that drippings or stuffing should be discarded because they may retain fat that contains PCBs. Additional sites may need to be sampled to reflect problem areas, cleanup of the Fox River, and other sub-watersheds.

4.3.2 Recreational Safety

A. Assist Law Enforcement with identification of problem areas and protection of resources. Also assist Law Enforcement in providing safe recreational opportunities.

4.3.3 Drinking Water and Groundwater Resources

A. Assist WDNR staff and counties with problem assessment sampling of private wells for arsenic, radionuclides, and bacteria.
B. Work with and educate private well owners to ensure a safe drinking water supply.
C. Continue inspections of public drinking water systems.
D. Promote practices to minimize loss of water infiltration due to development and promote conservation measures to maintain baseflow to surface water systems.

4.3.4 Other

A. Work with partners, APHIS, and county airports to address wildlife concerns and promote ways to make the airport safer.
B. Work with municipalities on safety issues concerning wildlife in urban areas.

4.4 Outdoor Recreation

4.4.1 Major Sport Fish

A. Protect and increase populations and fishing opportunities of game fish and centrarchids throughout the system by improving habitat and water quality, with the appropriate regulations. Get input from the public to create regulations that satisfy the wants of the recreational community.
B. Protect the health of fish species and the health of the public.
C. Continue to work with the Bureau of Fisheries Habitat, fishermen, and the fish tournament organizations to develop new regulations appropriate to large water tournament fisheries.

D. Create a public fishing pier/access at the Green Bay Metropolitan Sewerage District (GBMSD) interpretive center at the mouth of the Fox River.
E. Conduct public education projects which focus on shoreline restoration for improved fishing and passive outdoor recreational opportunities.
    1. Acquire funds to provide free aquatic and shoreline plants to landowners willing to revegetate their shoreline.
    2. Educate landowners on the relationships between fish and plants (i.e., intact ecosystems).
    3. Promote the idea of onshore or pier fishing and emphasize the problems caused by motorized boats.

4.4.2 MAJOR GAME SPECIES

A. Work with other agencies to bring the bear population to its goal size, through the use of liberal quotas when necessary. Coordinate with other agencies to perfect the population model and survey methods, and to keep abreast of new developments or technology available. Provide annual or biennial bear training for new wildlife biologists or for those who only recently began to see bears in their area. Educate the public on bear behavior, ecology, and populations (FWHMP).
B. Expand and optimize spring and fall turkey hunting opportunities while maintaining high hunt quality, hunter satisfaction, and strong safety record. Implement habitat management practices to meet objectives outlined in the wild turkey management plan using primarily turkey stamp revenues supplemented by segregated (SEG) funds[2]. Management practices to benefit turkeys include prairie ecosystem establishment and management, oak savanna establishment and management, barrens management, oak-hickory ecotype management, hunter education, and population monitoring and population dynamics research (FWHMP). **Figure 20** shows the Lower Fox River Basin Deer and Turkey Management Units.
C. Expand pheasant, turkey, or other upland game bird hunting opportunities while improving hunt quality and hunter satisfaction. Implement habitat management practices to meet objectives outlined in the pheasant management plan using primarily pheasant stamp revenues supplemented by SEG funds. Management practices for pheasants include: prairie ecosystem establishment and management, Conservation Reserve Program (CRP) expansion and implementation, wetlands preservation and restoration, and population monitoring and population dynamics research. Continue to provide game farm pheasants for public hunting grounds, sports clubs, dog trailing clubs, dog training classes, and youth hunts (FWHMP).
D. Promote high hunter interest in ruffed grouse hunting. Implement habitat management practices to meet objectives outlined in the ruffed grouse management plan. Where appropriate, work with foresters, planners, county personnel and USFWS personnel to ensure that timber harvest remains a primary use of Wisconsin's forests (FWHMP).
E. Assist in waterfowl monitoring. Continue to implement the objectives in the Great Lakes Region (GLR) Joint Venture of the North American Water Fowl Management Plan, including cooperation of "all bird objectives." This will be done by restoring and enhancing wetlands and upland cover important for ducks and other bird species. The key to success will be working through partners to achieve the goals established in the Joint Venture. Continue to funnel dollars through a non-profit organization for waterfowl habitat work in Canada that achieves the objectives of our state waterfowl program. Continue the spring waterfowl breeding survey as well as winter waterfowl surveys.
F. Continue to carry out and improve Canada goose harvest management procedures to ensure hunters are offered a simple system that meets scientific and management

[2] Segregated Funds are those funds that are generated from the sale of fishing, hunting, boating, etc. licenses and stamps (in other words, non-tax general revenue funds).

Insert **Figure 20**: Lower Fox River Basin Deer and Turkey Management Units

needs. Work with other agencies and groups such as the Flyway Council to monitor the status of migrant birds and participate in the collection of data to address critical information needs. Continue to monitor the status of Canada geese nesting/summering in the basin and adjust hunting seasons as appropriate to maintain population at specified goals. Assist local governments and individuals to address the problems they are having with injurious Canada geese (FWHMP).

G. Continue to enhance habitats for other hunted species of migratory birds, monitor their populations and adjust harvest consistent with those populations (FWHMP).
H. Identify locations where beaver occur, obtain funding for and assist with developing a beaver survey to monitor populations. Work with other agencies to monitor beavers and protect trout streams and other sensitive habitat from beaver dam alterations (FWHMP).
I. Continue to monitor the population of white-tailed deer in the basin to determine how much the pre-hunt population exceeds the pre-hunt goal number. Use this data to establish special seasons to include more deer management units (DMUs) each year. The seasons should be standardized statewide for metro units.
J. Assist the central office in implementing Deer Management for 2000 and Beyond Project Recommendations and aggressive harvest management strategies to lower the size of the deer population in areas of the basin.
K. Continue to monitor the population of white-tailed deer in the basin to determine how much the pre-hunt population exceeds the pre-hunt goal number. Use this data to establish special seasons to include more DMUs each year. The seasons should be standardized statewide for metro units.
L. Review DMUs on a regular basis and consider boundary changes and over-winter deer density goals.
M. Continue to monitor deer populations on a unit by unit basis including mandatory registration. Make efforts to improve the quality of this monitoring data and subsequent modeling outputs. Explore survey enhancement and models other than Sex-Age-Kill.
N. Achieve high levels of harvest reporting compliance to ensure sound scientific management programs.
O. Assist Central Office with reviewing hunting regulations, identifying those that do not significantly improve or protect wildlife or public safety, and eliminate them to simplify regulations (FWHMP).

4.4.3 WATCHABLE WILDLIFE

A. Create projects that both protect resources and provide outdoor recreation opportunities.
B. Work with the Department of Transportation (DOT) to attempt to create a sturgeon spawning viewing area on the new Claude-Allouez Bridge, if the opportunity arises.
C. Take advantage of any other opportunities that would provide non-invasive fish, wildlife, and/or habitat viewing areas. Work with other state, federal, local, and private groups to achieve these projects.
D. Promote passive recreational uses and educational programs on private and public lands.
E. Provide shoreline and habitat restoration, natural landscaping, etc., along the Fox River Trail to develop a natural greenway with interpretive stations.
F. Interact with the University of Wisconsin - Green Bay to increase the public awareness of local wildlife opportunities.
G. Provide to the public, and increase staff awareness of the viewable wildlife and fish statewide brochure. Expand on this information to create a brochure specific to this basin, including other local (non-state owned) sites.
H. Promote the Fox River corridor and Fox Locks area as a watchable wildlife area, with public access to those areas.
I. Establish a variety of habitats on the Cat Island chain of islands to provide habitat for numerous species. Encourage viewing of wildlife on the islands without physical human disturbance to the islands.

4.4.4 MANAGING USER CONFLICTS

A. Work with the public, Partner Team, and law enforcement to identify sources of user conflicts resulting from different types of recreation, and address those conflicts. Help municipalities create regulations, ordinances, or management plans to protect resources and recreational opportunities.
B. Provide information to hunters and anglers on how their behavior affects other outdoor users through public service announcements, safety education programs, warden contacts, brochures, and pamphlets (FWHMP).
C. Provide sufficient enforcement presence on water bodies and public lands to ensure that all users have the opportunity for a safe and enjoyable experience (FWHMP).
D. Assist municipalities in developing ordinances and management plans that ensure compatible use opportunities appropriate to their resources (FWHMP).
    1. Work with municipalities to provide hunting opportunities of nuisance wildlife species within the city or municipal limits.
E. Assist the Central Office in conducting an annual assessment of the impacts of various types of recreation (dog training, snow mobiles, nature centers, biking, hiking, boating, etc.) on the land, including scientific or rare communities (FWHMP).
F. Work with communities to develop and disseminate effective public awareness messages that are re-emphasized and repeated through multiple channels of communications within the Department (FWHMP).

4.4.5 ACCESS TO FISH AND WILDLIFE OPPORTUNITIES

A. Identify and develop access points to the Fox River pools, for boating, shore use, and other recreation.
B. Ensure that the hunting, angling, and recreational public have equal access opportunities to natural resources through enforcement and education.
C. Assist the Central Office in developing a Six-Year Facilities Plan for fisheries and wildlife properties. Identify facilities and boat access needs (FWHMP).
    1. Develop public uses and access for the Fox Locks.
    2. Improve parking and existing access points/facilities on state lands.
    3. Use Master Plans to address acquisition boundaries to roads, simplifying access for the public.
    4. Post boundary signs on public lands adjacent to private lands to ensure that the public does not trespass.
D. Work with the Partner Team and other agencies to define reasonable access, appropriate development, and use of the properties and resources managed by the Partner Team and agencies (FWHMP).
E. Assist the Central Office in working with the legislature and the public to include a regular increase in the operating budget for WDNR's fish and wildlife properties and state natural areas (FWHMP).
F. Assist the Central Office in seeking legislative approval and funding for a development, rebuilding, and facilities maintenance program for WDNR fish and wildlife properties to provide an adequate outdoor recreational infrastructure well into the next century (FWHMP).
    1. Develop minimum property maintenance standards for properties.
G. Participate in public and private planning efforts to develop public use and recreation approaches that sustain ecosystems.

4.4.6 FISH PRODUCTION

A. Explore the possibility of using Fox River pools for brood stock of Spotted Muskie.
B. Continue to provide a walleye egg source for partnerships with sport clubs for their portable hatcheries.
C. Use the best techniques available to prevent the transfer/transmission of fish pathogens and occurrence of fish diseases in stocked fish, to prevent fish from spreading diseases to predators.

5.0 LOWER FOX RIVER BASIN WATERSHED ISSUES AND PROGRAMS

WDNR staff and partners are working to improve and protect basin resources through existing programs and regulations, some of which are discussed in detail in this section.

5.1 DRINKING WATER AND GROUNDWATER RESOURCES

Groundwater is the source of potable water for all residents within the Lower Fox River Basin, except those served by municipal water systems in the City of Green Bay (which draws water from Lake Michigan) and the cities of Appleton, Neenah and Menasha (which draw water from Lake Winnebago). Major groundwater concerns in the Lower Fox River Basin include declining groundwater levels, and the presence of naturally-occurring arsenic and radionuclides in groundwater.

5.1.1 GROUNDWATER QUANTITY

Areas in Brown County (outside of the City of Green Bay) and the Fox Cities rely on groundwater for drinking water supplies. About 13 million gallons per day (Mgal/d) of groundwater was pumped in Brown County in 1979 (Lawrence and Ellefson, 1982). Estimated use in 1995 was 17.2 Mgal/d (Ellefson, Fan, and Ripley, 1997). (Brown county industry uses a good deal of surface water as well although much of that is just pass-through on hydro-electric.) Projected future withdrawals are going to be much greater, with estimated increases in central Brown County of 240% by 2030 (Walker et.al., 1997). Pumping from closely spaced wells and pumping for industrial purposes has resulted in a steady decline in groundwater levels during the last 50 years. It is estimated that at current pumping rates, wells located in central Brown County, including those in Allouez, Ashwaubenon, Bellevue, De Pere, Hobart, Howard, Lawrence, Ledgeview, Scott, Suamico and the Oneida Tribe will not be able to provide enough groundwater in 10 to 15 years without additional wells and optimized pumping schedules. Population growth and urban sprawl in the Fox Cities area is resulting in increased numbers of private wells, which are also contributing to declining water levels north of the City of Appleton.

5.1.1.1 Aquifer Storage and Recovery

Increased demand for water is causing problems in the Lower Fox River Valley, Dane County, and in portions of southeastern Wisconsin. As a result of these problems, many Wisconsin communities are taking steps to secure safe drinking water supplies for the future. The City of Green Bay is seeking approval to test on a limited basis a new method known as aquifer storage and recovery (ASR) that may help the city meet its future water needs. An ASR system enables treated drinking water from a municipal water system to be stored in a deep sandstone aquifer during periods of low demand and subsequently recovered during periods of high demand. ASR technology is being used in California, Florida, and New Jersey. In the Midwest, the only operational ASR systems are located in Des Moines, IA and Oak Creek, WI. These systems have been in operation for approximately three years.

The site for the Green Bay test has been identified as Well #10 located at 1474 N. Military Avenue. The water utility has collected a geologic core at this site and has constructed a monitoring well. The Department is currently reviewing the operations plan for the ASR pilot study and plans and specifications for modifications to the injection well. The results of the Green Bay pilot study, in conjunction with the results obtained from the Oak Creek system, will be used by the WDNR to evaluate the viability of ASR systems in Wisconsin. The City of Green Bay wishes to obtain long-term approval for the ASR system because ASR would allow them to defer costly alternatives involving the expansion of water treatment plants and the construction of additional storage tanks. In addition, Brown County urban communities that currently draw municipal water from groundwater sources also have an interest in ASR since the City of Green Bay has proposed “selling” stored water to these municipalities. This would save these communities the cost of jointly constructing their own pipeline to Lake Michigan. This additional Lake Michigan pipeline has been proposed to supplement groundwater withdrawals and prevent future water supply shortages.

The WDNR is seeking answers to environmental, legal, and operational questions associated with using ASR in Wisconsin, before granting full approval of the ASR system. The Department has convened a group of outside experts from the University of Wisconsin system, U.S. Geological Survey, and the state health division to review the potential benefits and limitations of this innovative water management technique. This technical advisory group is expected to issue a report by the end of 2001. Unresolved regulatory issues relating to ASR include the following:

- The water that is injected complies fully with federal and state drinking water standards; however, the drinking water that is injected may still exceed groundwater standards established in ch. NR 140 for certain disinfection by-products. It is not known whether the trihalomethanes that are formed as a result of treatment and disinfection degrade sufficiently so as not to adversely impact local groundwater quality.

- During the storage cycle, the water may pick up additional contaminants (i.e. radium, arsenic, manganese, etc.) released from the native bedrock that would require treatment or removal prior to discharge into the water distribution system. Also, an ASR system may cause other geochemical or biological transformations within the storage aquifer that need to be considered.

- Ownership of the stored water is uncertain. As the water is stored underground, it may be owned by the water utility or it may revert to common ownership as part of the waters of the state.

The WDNR will review the report issued by the independent ASR technical review panel as it proceeds further with the Department's internal evaluation of ASR technology. At the time of this writing, no final decision to either approve or disapprove the use of ASR techniques has been made. In the meantime, the Department will continue to support and encourage water conservation efforts.

5.1.2 GROUNDWATER QUALITY

Declining water levels affect water quality. As water levels decline, wells must be deepened. This means that groundwater is being taken from deeper aquifers. The deeper the aquifer, the longer water has been exposed to surrounding rock layers. Over time, minerals in these rocks dissolve in groundwater leading to higher concentrations of natural contaminants such as radium, iron, or arsenic.

The lowering of the water table also changes flow fields and allows oxygen deeper into the aquifer system. This has been associated with the release of arsenic and metals to groundwater. Nickel, cadmium, cobalt and zinc have all been detected at levels well above Maximum Contaminant Level (MCL) and NR 140 standards. In the Lower Fox River Basin, the mineralized zone between the Galena/Platteville and St. Peter formations is being exposed to air when groundwater levels are drawn below it. When the minerals are exposed to air they oxidize and dissolved arsenic can be released to the open borehole.

Naturally occurring contaminants that are commonly found in groundwater in the Lower Fox River Basin include arsenic, radium and nitrate. Naturally-occurring arsenic is found in private wells in much of the basin, particularly southern Brown County, and most of Outagamie and Winnebago Counties. During late 2000 and early 2001, the Outagamie County Health Department in conjunction with WDNR, conducted private well sampling to determine the extent of arsenic contamination, and to inform private well owners of the health risks associated with arsenic. Arsenic was detected at greater than 50 parts per billion (the current standard) in 11 out of 206 wells. Contamination by arsenic seems to be present in areas where Ordovician-age dolomite (Galena/Platteville formation) overlies the older sandstone aquifer (St. Peter formation). At the contact between these two rock formations, there is a zone that contains arsenic-bearing minerals. The WDNR recommends that drillers of private wells do the following in this area:

- Avoid drilling into the St. Peter formation. However, this is not practical in many areas due to continued regional draw-down of the water table, combined with the inability of the upper Galena-Platteville dolomite to produce sufficient quantities of water.
- Private wells should be cased to 80 feet below the Galena/Platteville-St. Peter contact.
- Use drilling methods other than air rotary to install wells.
- Grout the well from the bottom up to ensure that the steel well casing is protected by a complete circumferential grout envelope.
- Minimize the use of hypochlorite disinfection products in the arsenic advisory area.

Radium is present in municipal wells at levels above the federal drinking water MCL in the Lower Fox River Basin. The declining water levels may be related to the increasing radium since less water in the system means less dilution of the radium. The Lower Fox River Basin communities of Allouez, Ashwaubenon, Bellevue, De Pere, Forest Junction, Howard and Ledgeview will be required to install water softening units to treat groundwater high in radium.

Contamination of groundwater by bacteria is also a concern for the basin. Detects of total coliform bacteria and fecal bacteria are not uncommon in private wells, particularly those short-cased wells located in the southern portion of the basin where the fractured dolomitic bedrock is not very far below the ground surface (e.g., Neenah, Menasha, Green Bay).

5.1.2.1 Nonpoint Source Groundwater Contamination Potential Ranking by Watershed

Each watershed within the Lower Fox River Basin was ranked based on land coverage and groundwater sample analytical results in the WDNR's Groundwater Retrieval Network (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. Nitrate and pesticides sample analytical results were used for the evaluation because they are common nonpoint source contaminants. Natural contaminants were not used in the ranking. A score of 20 or more is considered medium. At 30 or greater, the score is considered high for groundwater contamination potential. The Lower Fox River Basin has some areas of dense urban land use as well as areas of agricultural land use. High intensity urban areas can contribute contaminants via infiltration of storm water. Very few groundwater sample analytical results were available for scoring in the Lower Fox River Basin. There are 8 permitted Confined Animal Feeding Operations in the basin.

Table 2. Nonpoint Source Groundwater Contamination Potential Ranking by Watershed

Watershed	Score	Comments
East River	87.76	The watershed consists of 12% urban and 70% agricultural land cover. There are 4 CAFOs in the watershed.
Apple and Ashwaubenon	91.01	The watershed consists of 78 % agricultural and 6% urban land cover. There are 3 CAFOs in the watershed.
Plum and Kankapot Creeks	89.2	The watershed consists of 78% agricultural and 10% urban land cover.
Fox River/Appleton	83.2	The watershed consists of 39% urban (15% is high intensity urban) and 37% agricultural land cover.
Duck Creek	78.78	Duck Creek consists of 73% percent agricultural land cover. There is one CAFO in the watershed.
Little Lake Butte de Morts	92.18	The watershed is 50% agricultural and 28% urban land cover. Of 6 well samples collected in the watershed, 16% exceeded the PAL for nitrate. No samples exceeded the ES for nitrate.

Key:

1. ES: Groundwater enforcement standard as per NR 140 Wis. Adm. Code. For nitrate the groundwater ES is 10 parts per million (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 that consists of the equivalent of 1000 animal units.

5.1.2.2 Wellhead Protection Planning

Wellhead protection (WHP) is a method for protecting water supplies by managing the land area around a well (WDNR, 2001a). Wellhead protection involves identifying the area needing protection, and potential threats to the groundwater within that area. The wellhead protection area is the land area that contributes water to the well, and is therefore the area to be protected. An accurate delineation requires an understanding of the groundwater conditions in the vicinity of the well. Potential contamination sources within the WHP area can include landfills, service stations, agriculture, chemical handling and storage, spills, and others. By taking steps to manage the land area around a well, the potential for contamination is minimized.

There are a number of benefits to a community in developing and implementing a wellhead protection plan. A wellhead protection plan saves money on cleaning up groundwater, minimizes health risks to the community, and protects the water supply for future users. Wisconsin's WHP program includes both a regulatory and voluntary component. The regulatory component covers wells constructed May 1, 1992 or after. Communities constructing a new well must develop a WHP plan and submit it to the WDNR for approval. The well can't be used until the WDNR approves the plan. Wellhead protection is voluntary for existing municipal wells constructed before May 1, 1992. The Department encourages communities to be proactive in protecting its existing wells through WHP planning, but cannot require a community to do so.

The following communities in the Lower Fox Basin have approved wellhead protection plans: Ashwaubenon, Bellevue, Darboy, Greenville, Lawrence, Ledgeview, Little Chute, Sherwood, Wrightstown and Sanger Powers.

5.2 NONPOINT SOURCE POLLUTION

The Lower Fox River Basin drains a large watershed, and therefore has the potential to contribute significant pollutant loads from runoff and atmospheric deposition into the river and bay (ThermoRetec, 1999). Urban nonpoint sources include runoff from residential, commercial and industrial areas, as well as roadways. Agricultural nonpoint sources include runoff from barnyards and fields. Fertilizers, pesticides, and winter spreading of livestock manure add to nitrogen and phosphorus loading and other

contaminants in the basin. Plowing and tilling conducted at the many farms in the basin contributes to erosion. In some areas, cattle still contribute to erosion by accessing stream banks continuously on streams or waterways. Other large contributors are residential and commercial developments with poor land use practices. Soil eroded from agricultural land, construction sites, and street runoff as well as erosion from unstable stream banks is estimated to contribute 100,000 tons of solids to the Lower Fox River each year. Currently, nonpoint sources account for 95% of the solids load, while only 5% is contributed by point sources such as municipal or industrial dischargers.

Nonpoint source pollution is identified as a key threat to the resources in this basin, and is a main focus of the Partner Team and member agencies. Loading reduction goals should be set and enforced in order to achieve better water quality in the basin. The "White Paper" entitled "Nutrient and Sediment Management in the Fox-Wolf Basin," prepared by the Scientific and Technical Advisory Committee, provides in-depth information and recommendations for sediment and nutrient loading in Green Bay and the Fox River. The following paragraphs summarize the programs currently in place to manage urban and rural nonpoint source pollution issues.

5.2.1 THE WISCONSIN STORM WATER MANAGEMENT PERMIT PROGRAM (NR 216)

Urban nonpoint sources of pollution are a problem in many parts of the basin, particularly in the developing areas in Brown, Calumet, Outagamie and Winnebago Counties. Urban polluted runoff takes two general forms: storm water flowing from impervious surfaces such as rooftops, parking lots and streets, carrying sediments, nutrients, and other pollutants; and, sediment-laden water flowing from development sites into streams and lakes. **Figure 21** shows the Lower Fox River Basin municipal features.

5.2.1.1 Characteristics of Storm Water

Storm runoff is a major problem for surface water quality in many developed areas. In urban areas, a large percentage of land area is covered by impervious surfaces such as buildings and pavement, which collect and channel pollutant-laden storm water. Many water quality problems for urban streams result from the following factors:

- Stream channel modifications, including straightening and lining with concrete.
- High loading of pollutants, including sediment, nutrients, bacteria, heavy metals, and other toxic materials.
- Hydrologic disturbances, including flashy high flows, and loss of base flow.
- Streambank erosion due to flashy high flows.

Studies conducted in Madison, Milwaukee and Eau Claire documented levels of metals, suspended solids, and nutrients in storm water effluent that exceeded some in-stream water quality standards for storm water runoff effluent. Storm water runoff is a definitive source of pollutants, which can be a significant cause of surface water quality degradation.

5.2.1.2 Municipal Storm Water

Under Phase I regulations at the federal level, the U.S. Environmental Protection Agency (USEPA) currently requires cities with populations greater than 100,000 to adopt and implement a storm water management plan to control discharge of pollutants. In Wisconsin, USEPA has delegated the authority to administer comparable storm water regulations to WDNR. Under Chapter 216, Wis. Adm. Code, the following municipalities are required to obtain coverage under a municipal storm water discharge permit: Madison, Milwaukee; municipalities in the Great Lakes Areas of Concern (Green Bay, Allouez, Ashwaubenon, De Pere, Marinette, Sheboygan and Superior); municipalities in a priority watershed with a population of 50,000 or more and other municipalities identified by WDNR meeting the criteria for permitting in NR 216.

Insert **Figure 21**: Lower Fox Municipal Features

USEPA Phase II storm water regulations will require municipal storm water discharge permits for certain municipalities with populations less than 100,000[3]. Phase II storm water regulations will require that governmental entities with populations of 10,000 or more, population densities of 1,000 or more per square mile, and locations outside of urbanized areas be examined by the NPDES Permitting Agency (WDNR) for potential designation under the Storm Water Discharge Permit Program. Other municipalities such as Green Bay, De Pere, Allouez, Appleton, Ashwaubenon, Neenah and Menasha may be designated and required to obtain coverage under a municipal storm water discharge permit.

To address flooding and control water quantity, the Federal Emergency Management Agency (FEMA) requires municipalities to perform floodplain mapping and management plan development to receive federal flood insurance.

Regulation of storm water at the local level is generally confined to developing plans that "detain" water at some predetermined level--before development occurs--during the plat review and permit approval process. This local regulatory action takes place through voluntary ordinance development and its effectiveness hinges on enforcement, which requires resources and expertise in a time of diminishing public funds. Further, while site-specific management helps with localized flood impacts and erosion, working with "the big picture" through comprehensive planning is a more effective water management strategy.

5.2.1.3 Industrial Storm Water

Under NR 216, discharges of storm water from certain facilities require coverage under an industrial storm water discharge permit. The owner or operator of the permitted industrial facility is required to develop and implement a site-specific storm water pollution prevention plan. The plan must be designed to ensure that there are practices in place to reduce exposure of industrial materials to storm water, such as good housekeeping, spill prevention and cleanup and structural and non-structural controls.

5.2.1.4 Construction Site Erosion Control

As land is developed and disturbed, sediment moving off-site can be significant unless proper erosion control measures are implemented.

Regulation of construction site erosion falls under several different programs in the state. Locally, municipalities are required to adopt and enforce the Uniform Dwelling Code (UDC) under a program administered by the Department of Commerce (DComm). The UDC contains provisions to control erosion during construction of one- and two-family dwellings. Implementation of the UDC erosion control provisions is only as effective as the local municipality's willingness and ability to enforce the provisions. DComm evaluates a municipality's effectiveness at administering the UDC.

Larger construction sites (those involving land-disturbing activities that affect five or more acres) are regulated by WDNR's Chapter NR 216, or equivalent programs administered by DComm or the Department of Transportation (DOT). NR 216 requires the landowner of a larger construction site to obtain a construction site storm water discharge permit. The landowner must ensure that a site-specific erosion control plan and storm water management plan are developed and implemented at the site. Typical sites regulated by WDNR include residential subdivision development, industrial and business park development, parks and golf courses, and private local and county roads. Regulation of erosion control at larger commercial building sites is administered by DComm, and state and interstate highways are handled by the DOT, via state statute and interagency agreements.

[3] Federal Phase II regulations were published in the December 8, 1999 Federal Register. The Phase II regulations are being phased in during a five year period (full implementation in 2003).

The jurisdictional overlap and division of regulatory responsibility between WDNR, DComm, DOT and local governments regarding erosion control has grown complex. Two areas that currently fall between the cracks of erosion control include the following:

1. Erosion from construction sites that do not include one- or two-family dwellings, disturb less than five acres, and are not regulated by a voluntary municipal or county ordinance; and
2. Erosion from non-DOT road and bridge construction that disturbs less than five acres, and that is not regulated by a voluntary municipal or county ordinance.

Currently, no state-level mechanism exists to address the first category. DComm has authority under state statute (Wisconsin Administrative Code, chapter Comm 65) to develop a uniform commercial building code for erosion control, regardless of the size of the commercial development. As for the second category, WDNR and DOT have signed a joint memorandum of understanding that addresses water quality impacts during construction of DOT-administered projects, typically state and interstate highway construction. Under the agreement, these transportation projects administered by DOT must have an erosion control plan that is implemented throughout the construction period. Many small-scale transportation projects funded with local money are not, however, required to implement erosion controls. Local ordinances passed by a county, city, village or town are the only tools to protect water resources under these circumstances.

The effectiveness of existing erosion control provisions is not known. WDNR staff have observed various municipalities where local erosion control could be improved. Observations range from no control measures at major development sites to inadequate or improperly installed management practices (i.e., silt fences apparently only serving to mark the limits of the projects). At other sites poor or nonexistent follow-up maintenance measures were implemented.

While some developers genuinely attempt to control erosion, others have not initiated effective controls. The need for heightened awareness about the consequences of, and laws relating to, erosion control is evident. A better understanding of problems associated with construction site erosion by developers and contractors, coupled with improved enforcement of existing ordinances by local government, should be a priority.

During the past few years, the UW Extension has held a series of workshops on construction site erosion control for developers and contractors. The workshop series outlined the major features of the *Wisconsin Construction Site Best Management Practice Handbook* (WR-222 92 REV). Community ordinances should remain consistent with current administrative rules and the model ordinance provided in the handbook. In addition, incorporating new information about the effectiveness of best management practices into local ordinances and outreach strategies by municipalities and counties would help resolve storm water problems. For example, a 1996 report titled, “Urban Ecological Analysis for Milwaukee, WI,” describes and encourages the benefits of developing and maintaining tree canopy cover through tree planting in communities (American Forests). Implementing this type of practice in community design or open space plans would help reduce storm water problems.

Chapter 144.266 of the Wisconsin State Statutes gives municipalities the option of enacting local construction site erosion control and storm water management plans. Where the plans and ordinances exist, often they are not adequately enforced due primarily to inadequate funding and staffing.

USEPA Phase II storm water regulations dropped the acreage threshold for a construction site requiring coverage under a storm water discharge permit down to one acre. Consequently, like other states with delegated authority from USEPA to administer the storm water discharge program, Wisconsin will need to modify its regulatory program to address these smaller construction sites.

There are many development pressures in basin communities, including Green Bay, Allouez, Ashwaubenon, De Pere, Suamico, Wrightstown, Kaukauna, Appleton, Neenah, and Menasha. Communities should develop and adopt local erosion control and long-term storm water management ordinances to protect water quality and to have more project oversight in their respective areas.

5.2.1.5 Storm Water Management Planning

The thorough nature of comprehensive storm water planning implies long-range and geographically broad consideration of flows and water quality during and after development of major land parcels, such as highways, industrial parks and residential neighborhoods. With few exceptions, maintenance of pre-development hydraulics is most desirable. The large-scale nature of comprehensive planning allows the integration of resources to reach multiple regulatory and management goals, such as those of FEMA, NR 216, sewer service area planning, local water management regulations and even management for aquatic and terrestrial wildlife. Further implementation of the municipal storm water discharge permit program under NR 216 and the final Phase II regulations promulgated by USEPA will require some municipalities that meet certain criteria to obtain municipal storm water discharge permits and develop comprehensive storm water management programs.

As communities begin storm water management, financing becomes an important issue. A good source of information for communities is the following webpage: http://www.dnr.state.wi.us/org/water/wm/nps/admrules.html. This website contains links to Administrative Rule NR153 (relating to the targeted runoff management grant program), and a fact sheet about NR153. The document assists communities in choosing available funding options to develop and implement an adequate storm water management program.

There are currently 846 active industrial and construction site storm water discharge permits in the Lower Fox River Basin.

5.2.2 Wisconsin Nonpoint Source Water Pollution Abatement Program

Nutrient-rich polluted runoff poses a major threat to Wisconsin's surface rivers, lakes and streams, and groundwater in both rural and urban areas. The Priority Watersheds program, one of WDNR's mechanisms for addressing nonpoint source water pollution, is being phased out. New programs are being implemented, as discussed below.

5.2.2.1 Nonpoint Source Program Redesign Initiative

During 2000 and 2001, the State of Wisconsin developed a new approach to address nonpoint source pollution. Through provisions in 1997 Act 27 and 1999 Act 9, the Legislature directed the WDNR to

- develop performance standards to control polluted runoff from non-agricultural activities;
- to develop performance standards and prohibitions for agricultural activities through cooperation with the DATCP, including four manure management prohibitions developed through a previous advisory committee effort; and,
- to make other changes to address polluted runoff problems from rural and urban sources.

In response to these directives, the WDNR and DATCP undertook a redesign of their nonpoint source programs. The DComm and the DOT worked with the WDNR to develop non-agricultural and transportation performance standards. A diverse advisory committee provided feedback and recommendations during the design process. The redesign is the result of years of discussion and consideration given to the views of citizens from throughout the state: farmers, city dwellers, business operators, contractors, educators, researchers, and government representatives. The redesigned

Nonpoint Source Program involves a restructuring of current efforts and an addition of resources to help stem the major threat to Wisconsin's surface rivers, lakes and streams, and groundwater -- polluted runoff in both rural and urban areas. The focus of the revision involves three basic areas:

- Statewide performance standards.
- Local implementation and enforcement.
- Expanded financial assistance.

WDNR drafted new administrative rules and revised existing rules to implement the statutory changes:

NR120: Priority Watershed and Priority Lake Program: primarily covers nonpoint source grant activities in current priority watershed projects.

NR151: Runoff Management: covers the areas of agricultural performance standards and prohibitions, non-agricultural performance standards, transportation facility performance standards and a process for the development and dissemination of non-agricultural technical standards.

NR152: Model Ordinances for Construction Site Erosion Control and Storm Water Management: includes examples of ordinances for construction site erosion control and storm water management.

NR153: Targeted Management Grant Program: addresses funding of urban portions of priority watershed and lake projects and a newer grant program. Note that this is the first half of the document containing both NR153 and NR155.

NR154: Best Management Practices, Technical Standards, and Cost-Share Conditions: lists acceptable best management practices, technical standards, and cost-share conditions for projects outlined in NR 120, NR 153, and NR 243.

NR155: Urban Nonpoint Source and Storm Water Management Program: details the procedures and criteria for a new grant program. Note that this is the second half of the document containing both NR153 and NR155.

NR216: Storm Water Discharge Permits: requires municipalities, industries, and construction sites to follow the non-agricultural performance standards as part of their storm water permits they receive from the WDNR.

NR243: Animal Feeding Operations: adds the NR 151 performance standards and prohibitions to the Manure Management Program.

DATCP revised ATCP 50 to incorporate the legislative changes it is required to make. The WDNR and DATCP conducted public hearings on the nonpoint rules in March 2000. Based on the many comments it received on the rules, the WDNR convened four work groups to develop solutions to the complex issues involved in agricultural performance standards, implementation and enforcement, urban storm water, and transportation. After their meetings during the summer and early fall of 2000, the work groups developed recommendations for the second draft of the nonpoint rules.

Public comments from the 2000 hearings, recommendations from the Rule Workgroups, recommendations from the Legislative Clearinghouse, and modifications requested by the Natural Resources Board at its meeting on January 24, 2001, were incorporated into the second draft of the rules. This second draft included the creation of NR155 with information previously included in NR153.

Public hearings were held in March 2001, on the second draft of the nonpoint administrative rules. Department staff are currently reviewing 2001 hearing testimony and written comments. Department staff will then incorporate these comments into a third draft of the administrative rule package. This should be completed by late summer or fall of 2001. When available, a summary of the 2001 comments

and information on future nonpoint administrative rule actions will be posted on-line at http://www.dnr.state.wi.us/org/water/wm/nps/admrules.html. Contact the WDNR Bureau of Watershed Management, Runoff Management Section, at (608) 267-7694 with any questions.

5.2.2.2 Grant Programs for Runoff Management

The WDNR offers financial assistance for local efforts to control nonpoint source pollution. These grants support both the implementation of source-area controls to prevent runoff contamination and the installation of treatment systems to remove pollutants from runoff. The main goal of these nonpoint grants is to improve the quality of Wisconsin's water resources by decreasing the impacts of nonpoint pollution. The grants are available through two programs: the Targeted Runoff Management (TRM) Grant program, and the Urban Nonpoint Source and Storm Water Grant program.

5.2.2.2.1 Targeted Runoff Management Grant Program

Targeted Runoff Management (TRM) Grants are competitive financial awards to support small-scale, short-term projects that are completed by local governmental units within 24 months of the start of the grant period. Both urban and rural projects can be funded through a TRM Grant. Up to 70% of a project can be funded through a TRM grant, to a maximum of $150,000 in state funding. Project selection is based on geographical water quality priorities, local support for the project, the ability of the project to control nonpoint pollution and other factors.

5.2.2.2.2 Urban Nonpoint Source and Storm Water Grant Program

Urban Nonpoint Source and Storm Water Grants promote urban runoff management for existing urban areas, developing urban areas and urban re-development. The primary goals include implementing urban runoff performance standards (Wis. Admin. Code NR151), achieving water quality standards, protecting groundwater, and helping municipalities meet municipal storm water permit conditions (Wis. Admin. Code NR216). Eligible projects could include storm water detention pond construction, urban streambank stabilization, and land acquisition to increase permeable areas for infiltration. Urban Nonpoint Grants can fund 70% of technical assistance while standard cost-share funds are available at 50% of the project cost.

5.2.2.3 Continuing Priority Watersheds

Because of the Nonpoint Source Redesign Initiative, no new Priority Watersheds will enter the planning phase and TRM and Urban/Storm Water will eventually be the only water quality grants available. However, the Priority Watershed programs will continue until their missions have been completed. Any watersheds that were already in Priority Watershed planning will be implemented, and those Priority Watersheds that have already been implemented will continue through their grant ending date.

Existing Priority Watershed projects are scheduled to receive annual Nonpoint Source implementation grants from the WDNR until their grant retirement date. Some Priority Watershed projects in the Northeast Region of WDNR will continue to implement water quality practices for many more years. For example, the Duck-Apple/Ashwaubenon Creek project in the Lower Fox River Basin will continue to implement water quality practices until January 1, 2010.

Since 1978, the Priority Watershed program has provided grants to local governmental units (for example, county, city, village, town, metropolitan sewerage district, town sanitary district, or regional planning commission) in both urban and rural watersheds selected for priority watershed projects. Grants can reimburse up to 70 percent (or more for economic hardship) of the cost of installing best management practices, which reduce the likelihood of pollutants being carried to streams, lakes or groundwater via runoff. Examples of best management practices include:

- Cropped Fields: contour strip cropping, changes in crop rotations, reduced tillage methods, nutrient management, pesticide management and other practices;
- Eroding or Trampled Streambanks: shaping and reseeding, fencing to restrict cattle access, alternate livestock watering locations, controlled grazing and rip-rap;
- Animal Feedlots (Barnyards): upslope diversion berms, filter walls and vegetated filter strips;
- Developing Urban Areas: construction site erosion control and storm water management; and,
- Existing Urban Areas: accelerated street sweeping and wet detention basins.

The program is a joint effort of the WDNR, the Department of Agriculture, Trade and Consumer Protection (DATCP), the University of Wisconsin Extension (UWEX), counties (usually through their Land Conservation Departments), municipalities, and lake districts with assistance from a variety of federal, state, and local agencies. The Wisconsin Land and Water Conservation Board designates priority watershed and lake projects, approves implementation plans, recommends funding levels and priorities, and recommends changes to the governor and WDNR that will improve program effectiveness.

5.2.2.4 How Priority Watershed Projects Were Selected

Projects were selected from watersheds ranked in water quality management (basin) plans. To assist the targeting and selection of new priority watershed or lake projects, and to meet federal and state requirements for ranking priority waters, Wisconsin developed and incorporated watershed ranking criteria into the water quality management plans written for each of the state's major river basins. The system ranked streams, lakes, and groundwater separately, by watershed, in categories of high, medium, or low priority based on factors including:

- Potential to respond positively and/or be protected by nonpoint source controls,
- Presence of a unique environment for endangered or threatened species,
- Water quality and habitat degradation impacts on fish populations and diversity,
- A variety of water chemistry criteria,
- The macroinvertebrate biotic index rating,
- Presence of negative changes in the stream morphology and vegetation,
- Classification as a threatened stream,
- Classification as an outstanding or exceptional resource water,
- Sensitivity of a lake to phosphorus loading,
- Classification of a lake as a high resource or high recreation use lake, and
- Susceptibility of groundwater to contamination based on depth to bedrock, bedrock type, depth to water table, soil characteristics, and surface deposits.

The ranking system used numeric criteria for streams and lakes with the highest number representing the highest priority watershed. Watersheds were eligible for consideration if they ranked high for streams, lakes, and/or groundwater. Potential local sponsors were notified of watershed project eligibility and, if interested, they submitted an application to the WDNR. Projects were then further reviewed and ranked by regional advisory committees and other state agencies prior to being recommended to the Land and Water Conservation Board for placement on the board's five year planning schedule.

Once projects received formal designation by the Land and Water Conservation Board, funding was provided to support local staff and the establishment of local project teams. The priority watershed planning process, which on average took two years, included extensive land use inventories and detailed water resources appraisals. The appraisal information provided guidance on establishment of the water resources objectives and the pollutant load reductions needed to meet various water resource objectives. The land inventory results were used to identify major pollutant sources and the management practices that could be used to obtain needed pollutant reductions. Finally, critical site criteria and cost-share eligibility criteria were established to complete the implementation plan.

Prior to project implementation, watershed plans were formally approved by both the appropriate County Board(s) and by the Land and Water Conservation Board. The implementation of watershed plans was then carried out at the local level, in large part, through staff supported by grants from the WDNR. Implementation of priority watershed plans generally occurred over a 10 to 12 year period. The Department provided cost sharing for up to seventy percent of the installation costs of the practices. Best management practices were required to conform to watershed plans and be maintained for at least ten years after the practices have been installed.

The vast majority of practices installed within a watershed were done so on a voluntary basis; however, state statute required that all projects identify critical sites. These critical sites were sites that contributed significant pollutant loads. For the critical sites, implementation of best management practices was necessary to achieve the water quality objectives established in the plan. During implementation, local project managers worked closely with critical site landowners to obtain pollutant loading reductions. For those cases where progress was not being made, enforcement actions were then begun.

The following table describes each watershed in the basin, its priority watershed ranking, the counties covered and projects that are or have been carried out in the watershed.

Table 3. Lower Fox River Basin Watersheds with Ranking for Nonpoint Source Priority Watershed Projects

Watershed Number	Watershed/ Basin ID	Watershed Name	Hectares	Acres	Square Miles	Rank	TMDL* Sites	Counties	Projects
LF01	LF01-113	East River	53437.58	132044.25	206.32	High	Full	05, 08	PWS-c/86-99
LF02	LF02-113	Apple/ Ashwaubenon Creeks	29355.44	72537.29	113.34	High	Full	45, 05	PWS/94-05
LF03	LF03-113	Plum/Kankapot Creeks	21766.32	53784.57	84.04	High	Full	05, 08	
LF04	LF04-113	Fox River/Appleton	10197.90	25199.01	39.37	High	Full	45	
LF05	LF05-113	Duck Creek	39266.81	97028.28	151.61	High	Full	45, 05	PWS/94-05
LF06	LF06-113	Little Lake Butte des Morts	11335.18	28009.23	43.77	High		08, 71	

* "Full" means that the entire reach of the stream is an impaired water (refer to TMDL explanation in Section 5.3 below).

5.3 IMPAIRED AND OUTSTANDING WATERS AND WETLANDS

A TMDL or Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Under Sec. 303(d) of the Clean Water Act (CWA), TMDLs specify the amount of a particular pollutant a waterbody can contain without violating state water quality standards. Sec. 303(d) requires each state to identify and list waterbodies within its boundaries that do not meet such standards, submit the list to the USEPA, and establish TMDLs for the impaired waterbodies. The TMDLs are then used to determine allowable discharge levels for specified pollutants in the listed waterbodies. **Table 4** lists the 303(d) impaired waters in the Lower Fox River Basin.

Table 4. Impaired Waters of the Lower Fox River Basin

Name	Water Body Code	Stream mile	Total miles	W/S #	impact	source	Priority rank	Contam sed	ATM depo	Habitat dom	NPS dom	Pt. Source dom	Nps/ps blend
Apple creek	124100	5-24	19	LF02	1,2,4,5,6,	a,b,c,d,e,f,	Med				X		
Apple creek	124100	0-4	4	LF02	1,2,4,5,6	a,b,c,d,e,f,g	Med				X		
Duck Creek (1)	409700	0-10	10	LF05	1,2,3,5,8,6,	a,d,c,f,e,g,h,	Med				X		
Duck Creek (1)	409700	11-32	21	LF05	1,2,3,6,5	a,d,c	Med				X		
Dutch-man Creek	121600	0-7	7	LF02	2, 10	a	Med				X		
East River	118000	0-13. 4	13.4	LF01	1,6,2,11,12,3,8,13	a,c,e,j,g,k,l	Med				X		
East River	118000	13.5-39	25.5	LF01	1,2,6,12,3,13	a,g,e	Med				X		
Fox R. Seg. 3 lower (1)	0117900	0-7.3	7.3		3,8,14		High	X					X
Fox R. lower seg. 1 (1)	0117900	32.4-40	7.6		3,8,14		High	X					X
Fox R. lower Seg. 2 (1)	0117900	7.3-32.4	25.1		3,8,14		High	X					X
Kanka-pot Creek	0126800	0-9	9	LF03	6		High						X
Mud Creek	0129500	0-8	8	LF04	6		High						X
Neenah slough	0130800	0-6	6	LF06	8,14,3		Med	X					
Plum Creek	0125100	0-19	19	LF03	6,7		High						X
Trout Creek (2)		0-8	8	LF05	1,2,3,5,6,8,	A,b,d,c	Med				X		

Key:

Impact. 1= sedimentation, 2=excessive nutrient inputs, 3=low levels of dissolved oxygen for the designated use, 4= documented dissolved oxygen violations for designated use, 5=hydrologic modifications leading to unacceptable flows for designated use, 6=loss of in-stream habitat, 7= elevated temperature for designated use, 8=fish consumption advisory for PCBs, 10=ammonia toxicity, 11=toxic levels of contaminants, 12=excessive suspended solids leading to turbidity, 13=fish kills from unspecified factors, 14=Fish Consumption Advisory. **Source**. a=unspecified nonpoint sources, b=ditching, c=urban storm water runoff, d=streambank pasturing, e=barnyard or excessive lot runoff, f=construction, g=cropland erosion, h= fish consumption advisory for PCBs, j=excessive suspended solids in water column, k=streambank erosion, l=hydrologic modification.

Outstanding Resource Waters (ORW) have the highest resource values, excellent water quality, and high quality fisheries. ORW waters include those with unique characteristics that are largely unaffected by cultural activities. New or increased wastewater discharges to these waterbodies must provide effluent quality equal to or better than background water quality of the receiving waterbody. This classification includes wild and scenic rivers and most Class I trout streams (those Class I trout waters that had no existing permitting discharge at the time of ORW/ERW designation). There are no ORW waters in the Lower Fox River Basin at this time. The potential exists for some waterbodies in the Duck Creek watershed to be classified at this level if monitoring of those waterbodies provides data for this.

Exceptional Resource Waters (ERW) have excellent water quality and valued fisheries. These streams are generally those Class I trout streams that had an existing discharge at the time of program development or they may be Class II, III trout waters or a WWSF with significant resources value, exceptional biodiversity and high water quality. The anti-degradation procedure for these waterbodies is similar to that for outstanding resource waters, except that some minimal degradation due to a new wastewater discharge may be allowed if that discharge is necessary to solve an environmental or public health problem. There are no ERW waters in the Lower Fox River Basin at this time. Current and additional monitoring of Thornberry Creek and other Tributaries to Lancaster Brook may warrant a classification of a Class I, II, or III trout water to be placed on some of those waterways.

5.4 FOX WOLF BASIN NONPOINT SOURCE POLLUTION ABATEMENT INITIATIVE

The surface water bodies of the Lower Fox River and Wolf River Basins contribute polluted runoff to downstream waterbodies. The ultimate goal of the Fox-Wolf Basin Nonpoint Source Pollution Abatement Initiative is to restore balanced aquatic ecosystems and to protect waterbodies from future polluted runoff impacts. The initiative provides a long range framework for integrating existing WDNR programs with other agencies, local governments, and public and private sector interests. The initiative is designed to guide water quality restoration and protection efforts over the next two decades and will be modified as needed to meet the needs of the resources and public being served.

A key factor in improving surface water quality is reducing the sediment and phosphorus loads that are discharged to streams and rivers. As part of the initiative, the Simulator for Water Resources in Rural Basin Water Quality (SWRRBwq) model was used to identify watersheds in the Fox-Wolf Basin that are the *largest contributors of phosphorus and sediments to Lake Winnebago and Green Bay* (Northeast Wisconsin Waters for Tomorrow, 1994). The model identifies watersheds based on estimated pollution loads. The highest contributors to the Lower Green Bay from the Lower Fox River Basin include: LF01 East River (currently a priority watershed), LF02 Apple-Ashwaubenon Creeks (currently a priority watershed), LF03 Plum Creek (ranked high for streams via the NPS Basin Plan criteria), LF05 Duck Creek (currently a priority watershed) and LF06 Little Lake Butte des Morts (ranked high for streams by the NPS Basin Plan Criteria). Additional information about the Fox-Wolf Basin Nonpoint Source Pollution Abatement Initiative can be found in the *Fox-Wolf Basin Nonpoint Source Pollution Abatement Initiative* draft report (WDNR, 1994).

5.5 WATERSHED TABLES FOR THE LOWER FOX RIVER BASIN

The tables are a summary of water quality information throughout the Basin. Each of the six sub-basins is listed and available information is provided. The watershed tables are the main source of information for the Department's 305(b) report to congress that determines the level of 106 funding WDNR receives under the Clean Water Act. The columns in each of the tables have separate headings that for the most part are self-explanatory and consistent with previous versions of the tables. Each table contains footnotes that explain abbreviations. Some column headings that may need better explanation include:

The Waterbody ID is a numerical link to other databases and managed by WDNR's Bureau of Integrated Science Services.

Existing use is the biological use that the stream or stream segment currently supports. It is based on the current conditions of the surface water and biological community living in that stream. Statutorily it is defined in NR 102(04)(3) under fish and aquatic life uses.

The following abbreviations for stream uses are in the tables:

> **COLD**: Cold Water Communities. Includes surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species. This use includes, but is not restricted to, surface waters identified as trout waters in the publication (6-3600[80]) *Wisconsin Trout Streams*.
>
> **WWSF**: Warm Water Sport Fish Communities. Includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for these 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 Fish Communities. Includes surface waters of limited capacity because of low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of forage fish and aquatic life.
>
> **LAL**: Limited Aquatic Life. Includes surface waters severely limited because of very low or intermittent flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.

Potential use is the biological use that the investigator believes the stream or stream segment could achieve through proper management of "controllable" pollution sources.

Supporting potential use determines whether a stream is threatened, or is fully, partially or not meeting its potential biological use. It shows the relationship between the streams current and potential biological use; based on physical, chemical and biological information or direct observation and professional judgment. Biological data overrides other data.

The **integrity indicator** is the Hilsenhoff Biotic Score (HBI) that determines water quality of the stream on a numerical basis (1 excellent/10 very poor) where data is available. The index is most easily applied to streams with riffles that support macroinvertebrates that are attracted to that type of habitat. Other macroinvertebrate data that was applied to the integrity indicator was taken from work done in 1994 by the consulting firm IPS and noted in the appropriate column.

The **assessment category** is monitored (data in last 5 years), evaluated (data more than 5 years old or best professional judgment) or unassesed data.

Codified use is the waterbody's classification that is formally and legally recognized by NR 102 & 104 Wis. Admin. Code. It is the classification used to determine water quality criteria and effluent limits. The DEF or default classification is WWSF, when there is insufficient data.

Environmental problems are the source of threat or impairment. They include everything from no or limited access to specified pollution sources. Other columns include the corresponding impact created from the source, everything from animal deformity to nutrient enrichment.

The **trend** designates improving (I), stable (S), declining (D), or unknown (U).

The **comments** column contains "N" if there is a narrative for the stream and/or "R" if there is management or monitoring recommendation. It may include other comments such as (PW) for priority watershed, (CH) for critical habitat, (ES) for endangered species.

The **data level** column indicates what level of data was used to make decisions on each stream or stream segment. The data is divided into four categories: 1) Bioassessment data (B); 2) Habitat data (H); 3) Toxicological data (T); and, 4) Physical/Chemical data (P/C). Data within each category is assigned a number ranging from 1 to 4, with 1 being the least precise data and 4 being the most precise data.

Insert **Table 5** (page 1): East River (LF01) Watershed

Insert **Table 5** (page 2): East River (LF01) Watershed

Insert **Table 5** (page 3): East River (LF01) Watershed

Insert **Table 6** (page 1): Apple & Ashwaubenon Creeks (LF02) Watershed

Insert **Table 6** (page 2): Apple & Ashwaubenon Creeks (LF02) Watershed

Insert **Table 7** (page 1): Plum Creek (LF03) Watershed

Insert **Table 7** (page 2): Plum Creek (LF03) Watershed

Insert **Table 8**: Fox River – Appleton (LF04) Watershed

Insert **Table 9**: Duck Creek (LF05) Watershed

Insert **Table 10**: Little Lake Butte des Morts (LF06) Watershed

Insert **KEY** for Tables 5 through 10

5.6 FLOODPLAIN AND SHORELAND ZONING

Effective administration of floodplain and shoreland zoning ordinances is necessary to protect life, health, property and the natural values of shorelands. The demand for administrative services related to these ordinances will continue to increase as the trend in rural development continues. The individual counties must be aware of these needs and allocate staff accordingly.

Increasing development of lake shorelines throughout the basin threatens the natural integrity of waterbodies and is a priority water quality issue in the basin. Much of the lake shoreline has been sold for residential development. Shoreline alterations have negative impacts on the productivity, diversity and natural scenic beauty of lakes. Many wetland habitats have been lost to shoreline development. As the amount of wetlands in a watershed decreases, the likeliness of more frequent and larger flooding events increases. The WDNR is interested in managing riparian zones to protect water quality and aquatic life resources, whatever the land use may be. The WDNR Water Regulation and Zoning Program protects the riparian zone through state statues (Chapter 30) and with the local county zoning offices. Section 59, Wisconsin State Statutes, requires counties to adopt and administer regulations to control development along shorelands of lakes and streams and within flood plains. Shoreland control is confined to lands within 1,000 feet of a navigable lake, pond, or flowage, or within 300 feet of a river or navigable stream or to the landward side of the flood plain. The WDNR should encourage shoreline management that protects water quality support education efforts for all lakes in the basin.

Increasing development of lake shorelines throughout the basin threatens the natural integrity of waterbodies and is a priority water quality issue in the basin. Much of the lake shoreline has been sold for residential development. Shoreline alterations have negative impacts on the productivity, diversity, and natural scenic beauty of lakes. Many wetland habitats have been lost to shoreline development.

5.7 FOX RIVER LOCKS SYSTEM

The Fox River Locks System (Fox Locks) includes 17 locks and 12 dams between Lake Winnebago and the De Pere dam (ThermoRetec, 1999). All of the locks and 10 of the dams were operated by the USACE for the Federal Government beginning in 1872 (the remaining two dams are owned and operated by Kaukauna Electric and Water Utility). Over time, the traffic passing through the Fox Locks changed from primarily commercial vessels to primarily recreational vessels. The 17 locks were closed in 1988; three locks (those in De Pere, Menasha, and Kaukauna) were subsequently reopened (Appleton Public Library, 1999). A sea lamprey (exotic species) barrier was established at the Rapide Croche Lock and Dam in 1987. The barrier was installed to stop the upstream movement of exotic species into the Lake Winnebago, Fox and Wolf River Basins (WDNR, 1999). According to the USACE, the operation and maintenance of the system for mainly recreational use fell outside the jurisdiction of the USACE. In 1991, the USACE recommended that the system no longer served federal interests and began discussions with the State of Wisconsin to take over the system (WDNR, 2001b).

In 2000, a memorandum of understanding between the State of Wisconsin and the USACE was signed, that outlined the transfer of the locks system to the State. At the time of this writing, the State of Wisconsin has approved funding for the Fox River Navigational System Authority. The Authority would rehabilitate, repair, replace, operate, and maintain the navigational system on the Fox River (Carol Roessler Online, 2001). The Authority plans to reopen 16 of the 17 locks. The lock at Rapide Croche will remain closed and will be maintained according to WDNR specifications to prevent the movement of the sea lamprey and other aquatic nuisance species into the Lake Winnebago system from the Great Lakes. If the Authority decides to construct a means to transport watercraft around the Rapide Croche lock, they will have to develop a plan for construction that includes steps to control sea lampreys and other aquatic nuisance species and must submit it to WDNR for approval prior to implementation.

Insert **Appendix A** (page 1): List of Fish Species in the Lower Fox River (.xls file)

Insert **Appendix A** (page 2): List of Fish Species in the Lower Fox River (.xls file)

Insert **Appendix A** (page 3): List of Fish Species in the Lower Fox River (.xls file)

Insert **Appendix A** (page 4): List of Fish Species in the Lower Fox River (.xls file)

Appendix B

References

Appendix B1

List of Relevant Plans and Documents

The following documents were used in the creation of the Lower Fox River Basin Integrated Management Plan. These plans contain additional information about the issues, priorities, and strategic actions that were identified for the Lower Fox River Basin. Please refer to these plans directly for additional information.

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Appendix B2

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Appendix B3

Additional Lower Fox River Basin References

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Appendix C

Identified Barriers and Recommendations For Wetland Protection and Restoration in the Lower Fox River Basin Submitted by the Lower Fox Basin Partnership Team March 7, 2000

The Lower Fox Basin Partner Team identified wetland protection and restoration as an important issue in the Lower Fox River Basin. Through a series of meetings and discussions, several common themes arose, including the following:

- *Need to Share - Get Updated* -- Groups/agencies haven't met in a while and there is a need to hear again what everyone is doing related to wetland restoration, what maps exist out there, what databases exist, where to get them, coverage, restoration plans and priority areas etc. (i.e. Surface Water Integration System, or SWIS, RAP wetland recommendations, NRCS, USACE, USFWS and WDNR plans). Group also felt it would be valuable to discuss emerging issues re: wetlands such as wetland buffers, ESAs, new mitigation program, "Reversing the Loss", variations in delineations etc.
- *Adequacy of wetland mapping, databases, restoration plans* -- Results of information sharing would help the group understand if there are data gaps that need to be filled and if the existing maps/data are adequate for restoration and decision making purposes.
- *Opportunity vs. Priority* -- Wetland restorations occur as opportunities arise, and some existing plans prioritize wetland restoration sites. Is this adequate? Or is a more systematic, Basin-wide, prioritized approach necessary to coordinate restoration activities? Do areas that receive high development pressures need to have dollars and energy focused to better protect them?
- *Value Added* -- Some coordination already occurs between agencies. Would a more coordinated restoration plan be value-added to those agencies and organizations working on wetland restoration and protection?
- *What Next?* -- What opportunities exist for the Lower Fox Partner Team? Do links need to be made to local governments? How do we best share information with each other and other decision-makers and planners?

The Lower Fox Partner Team held a meeting on November 6, 2000 specifically to explore issues and barriers related to wetlands in the basin. Several barriers were identified that hinder or slow the protection and restoration of wetlands in the basin. Recommendations and action steps are identified for each barrier.

Barrier A: Mapping

- Wetland Inventory maps need better (higher resolution) delineation.
- NRCS wetland maps used aerial photos, not field checks down to a tenth of an acre. These maps are not digital and only cover cropped acreage. Not a comprehensive look at wetlands across the basin.
- NRCS wetland maps won't be digitized until soil surveys have been completed.
- The entire state won't receive updated digital maps for a long time.
- Wetland delineation maps do not exist at small-enough scales to be useful for administering ordinances.

Recommendations:

- Pull all map pieces, inventories and assessments together and develop a digitized database. Work with East Central RPC to identify gaps in map layers and data, and to obtain these layers for incorporation into land use planning maps. Note: current map of Lower Fox wetlands is attached.

- Identify nuances of data and map difficulties by homing in on specific data gaps or needs. For example, Outagamie County does not have digitized wetland maps for planning purposes, and Brown County needs higher resolution maps for ordinance administration.
- Work toward standardizing data such as projections, definitions of delineation and metadata for GIS.
- Provide RPC with digital maps of basin and watershed boundaries.
- Partner to identify funding sources to incorporate maps and data into RPC land use planning maps.
- Try to gather historic wetland data to look at trends over time.

Barrier B: Land Use Planning and Wetlands

- County-wide zoning does not exist in Brown County.
- Proximity of development to wetlands is an issue. There are typically no buffers provided for in zoning or planning.
- ECWRPC is currently working on updating and creating land use maps to aid in Smart Growth planning. They do not currently have sufficient funds, time or resources to include all necessary natural resource layers into planning maps.
- Development pressures are increasing in the Lower Fox Basin.

Recommendations:

- Encourage counties and towns to require buffers and setbacks from wetlands especially in sensitive areas.
- Develop and promote citizen support for wetland protection.
- Endorse a watershed approach for wetland protection.
- Invite and involve Baylakes RPC in mapping and planning.
- Tie wetlands protection to impervious surface area planning.

Barrier C: Private Landowners, restoration and wetlands

- Use value assessment designates wetlands, or lands enrolled in WRP as "recreational" land, not crop land. This increases tax liability to landowner and results in a dis-incentive to enroll or protect wetlands.
- Wetland boundaries do not typically match private landowner boundaries which makes large scale wetland restoration difficult due to greater coordination.
- Price of land and rental rates is not an incentive for wetland protection.

Recommendations:

- Recommendations were not yet developed for this Barrier.

Barrier D: Regulatory barriers

- Regulatory authority of USACE to protect isolated wetlands is currently being challenged in court. Recent (1/9/01) court rulings suggest that the USACE does not have this authority which would directly affect the WDNR's authority to protect these wetlands as well.
- Bulkhead lines, legal boundaries established in the 1960s and 1970s which cede state authorities over lake beds and wetlands to communities and riparian owners, allow filling of shorelands without state permits and threaten this habitat.
- Too many permits are required to get a project done which is a frustration to developers and planning and zoning departments.

Recommendations:

- Review the following STAC recommendations regarding bulkhead lines for applicability and accuracy. The following recommendations came from a September 1992 STAC document.

- *USFWS and USACE should discourage filling out to bulkhead lines and allow only what is necessary for water-dependent development (see Section 404 and NR 103 for details)*
- *Additional bulkhead lines in the Area of Concern should not be granted except where necessary to maintain existing shorelines.*
- *Bulkhead lines in Segment 2 should be rescinded or modified by the State and riparian communities to protect littoral habitats from filling, dredging and extensive alteration. Exceptions may be appropriate to maintain existing developments.*
- *Bulkhead lines in selected areas of Segment 4 should be rescinded to protect remaining wetlands under the Tower Drive Bridge in the James River Slough and along the southern shore of Green Bay beyond existing dikes.*

Other Recommendations:

- Review RAP and STAC recommendations for wetland restoration and protection priorities
- Develop an in-depth "white paper" which fleshes out issues, barriers and recommendations beyond the initial scope of this paper.
- Work on "operationalizing" wetland data and maps for public use and decision making. Work with RPC to build natural resources element of Smart Growth Planning and Implementation.
- Given the existing changes in wetland regulations, determine what needs to be done to maintain and/or increase wetland protection in the Basin. Note: The Partner Team sent a letter of support for the recent Wisconsin legislation to protect wetland resources left unprotected by recent U.S. Supreme Court decision.
- Ensure that wetlands and water quality are linked upstream.

Appendix D

Inventories

Appendix D1

Rare, Threatened and Endangered Species and Natural Communities in Brown County

PLANTS		
Common Name	**Species Name**	**Wisconsin Status[1]**
American Gromwell	*Lithospermum latifolium*	Special Concern
American Sea-Rocket	*Cakile edentula*	Special Concern
Blunt-Lobe Grape-Fern	*Botrychium oneidense*	Special Concern
Bog Bluegrass	*Poa paludigena*	Threatened*
Christmas Fern	*Polystichum acrostichoides*	Special Concern
Climbing Fumitory	*Adlumia fungosa*	Special Concern
Crawe Sedge	*Carex crawei*	Special Concern
Crinkled Hairgrass	*Deschampsia flexuosa*	Special Concern
Dwarf Lake Iris	*Iris lacustris*	Threatened**
Handsome Sedge	*Carex formosa*	Threatened*
Heart-Leaved Plantain	*Plantago cordata*	Endangered
Hooker Orchis	*Platanthera hookeri*	Special Concern
Indian Cucumber-Root	*Medeola virginiana*	Special Concern
Lake-Cress	*Armoracia lacustris*	Endangered*
Large Roundleaf Orchid	*Platanthera orbiculata*	Special Concern
Limestone Oak Fern	*Gymnocarpium robertianum*	Special Concern
Long-Spur Violet	*Viola rostrata*	Special Concern
Male Fern	*Dryopteris filix-mas*	Special Concern
Marbleseed	*Onosmodium molle*	Special Concern
Northern Bog Sedge	*Carex gynocrates*	Special Concern
Pale Green Orchid	*Platanthera flava var herbiola*	Threatened
Purple False Oats	*Trisetum melicoides*	Endangered
Richardson Sedge	*Carex richardsonii*	Special Concern
Seaside Crowfoot	*Ranunculus cymbalaria*	Threatened
Small Yellow Lady's-Slipper	*Cypripedium parviflorum*	Special Concern
Snow Trillium	*Trillium nivale*	Threatened
Variegated Horsetail	*Equisetum variegatum*	Special Concern
White Adder's-Mouth	*Malaxis brachypoda*	Special Concern
Yellow Gentian	*Gentiana alba*	Threatened

ANIMALS			
Common Name	**Species Name**	**Wisconsin Status[1]**	**Taxa**
Giant Carrion Beetle	*Nicrophorus americanus*	Endangered**	Beetle
Black-Crowned Night-Heron	*Nycticorax nycticorax*	Special Concern	Bird
Caspian Tern	*Sterna caspia*	Endangered	Bird
Common Tern	*Sterna hirundo*	Endangered*	Bird

Forster's Tern	*Sterna forsteri*	Endangered	Bird
Snowy Egret	*Egretta thula*	Endangered	Bird
Broad-Winged Skipper	*Poanes viator*	Special Concern	Butterfly
Dion Skipper	*Euphyes dion*	Special Concern	Butterfly
Mottled Dusky Wing	*Erynnis martialis*	Special Concern	Butterfly
Mulberry Wing	*Poanes massasoit*	Special Concern	Butterfly
Regal Fritillary	*Speyeria idalia*	Endangered*	Butterfly
Two-Spotted Skipper	*Euphyes bimacula*	Special Concern	Butterfly
American Eel	*Anguilla rostrata*	Special Concern	Fish
Greater Redhorse	*Moxostoma valenciennesi*	Threatened*	Fish
Lake Sturgeon	*Acipenser fulvescens*	Special Concern*	Fish
Longear Sunfish	*Lepomis megalotis*	Threatened	Fish
Redfin Shiner	*Lythrurus umbratilis*	Threatened	Fish
Redside Dace	*Clinostomus elongatus*	Special Concern	Fish
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	Endangered	Frog
Angular Disc	*Discus catskillensis*	Special Concern	Snail
Bark Snaggletooth	*Gastrocopta corticaria*	Special Concern	Snail
Cherrystone Drop	*Hendersonia occulta*	Threatened	Snail
High Spire Column	*Columella simplex*	Special Concern	Snail
Midwest Pleistocene Vertigo	*Vertigo hubrichti*	Endangered*	Snail
Variable Vertigo	*Vertigo gouldi*	Special Concern	Snail
Blanding's Turtle	*Emydoidea blandingii*	Threatened*	Turtle
Wood Turtle	*Clemmys insculpta*	Threatened	Turtle

Natural Communities
Important examples of the following natural community types have been found in this county. Although communities are not legally protected, they are critical components of Wisconsin's biodiversity and may provide the habitat for rare, threatened and endangered species.

Alvar	Migratory Bird Site	Northern Wet Forest
Emergent Aquatic	Moist Cliff	Southern Mesic Forest
Forested Ridge And Swale	Northern Dry-Mesic Forest	Southern Dry-Mesic Forest
Lake--Shallow, Hard, Seepage	Northern Mesic Forest	Stream--Slow, Hard, Warm

[1]Wisconsin Status:
Endangered: continued existence in Wisconsin is in jeopardy.
Threatened: appears likely, within the foreseeable future, to become endangered.
Special Concern: species for which some problem of abundance or distribution is suspected but not yet proven.
Rule: protected or regulated by state or federal legislation or policy; neither endangered nor threatened.
*** indicates: A candidate for federal listing.**
**** indicates: Federally Endangered or Threatened.**
Last Revised: June 1998
Source: WDNR

Appendix D2

Rare, Threatened and Endangered Species and Natural Communities in Outagamie County

PLANTS		
Common Name	**Species Name**	**Wisconsin Status[1]**
American Gromwell	*Lithospermum latifolium*	Special Concern
Cuckoo Flower	*Cardamine pratensis var palustris*	Special Concern
Handsome Sedge	*Carex formosa*	Threatened*
Heart-Leaved Plantain	*Plantago cordata*	Endangered
Indian Cucumber-Root	*Medeola virginiana*	Special Concern
Marbleseed	*Onosmodium molle*	Special Concern
Marsh Valerian	*Valeriana sitchensis ssp uliginosa*	Threatened
Northern Bog Sedge	*Carex gynocrates*	Special Concern
Ram's-Head Lady's-Slipper	*Cypripedium arietinum*	Threatened
Showy Lady's-Slipper	*Cypripedium reginae*	Special Concern
Small White Lady's-Slipper	*Cypripedium candidum*	Threatened
Small Yellow Lady's-Slipper	*Cypripedium parviflorum*	Special Concern
Snow Trillium	*Trillium nivale*	Threatened
Yellow Gentian	*Gentiana alba*	Threatened

ANIMALS			
Common Name	**Species Name**	**Wisconsin Status[1]**	**Taxa**
Bald Eagle	*Haliaeetus leucocephalus*	Special Concern**	Bird
Barn Owl	*Tyto alba*	Endangered	Bird
Broad-Winged Skipper	*Poanes viator*	Special Concern	Butterfly
Columbine Dusky Wing	*Erynnis lucilius*	Special Concern	Butterfly
Dion Skipper	*Euphyes dion*	Special Concern	Butterfly
Gorgone Checker Spot	*Chlosyne gorgone carlota*	Special Concern	Butterfly
Henry's Elfin	*Incisalia henrici*	Special Concern	Butterfly
Karner Blue Butterfly	*Lycaeides melissa samuelis*	Special Concern**	Butterfly
Little Glassy Wing	*Pompeius verna*	Special Concern	Butterfly
Mulberry Wing	*Poanes massasoit*	Special Concern	Butterfly
Tawny Crescent Spot	*Phyciodes batesii*	Special Concern*	Butterfly
Two-Spotted Skipper	*Euphyes bimacula*	Special Concern	Butterfly
Lake Sturgeon	*Acipenser fulvescens*	Special Concern*	Fish
Pugnose Minnow	*Opsopoeodus emiliae*	Special Concern	Fish
Weed Shiner	*Notropis texanus*	Special Concern	Fish
Western Sand Darter	*Ammocrypta clara*	Special Concern	Fish
A Primitive Minnow Mayfly	*Parmeletus chilifer*	Special Concern	Mayfly
Buckhorn	*Tritogonia verrucosa*	Threatened	Mussel
Elktoe	*Alasmidonta marginata*	Special Concern*	Mussel
Round Pigtoe	*Pleurobema sintoxia*	Special Concern	Mussel
Salamander Mussel	*Simpsonaias ambigua*	Threatened*	Mussel
Snuffbox	*Epioblasma triquetra*	Endangered*	Mussel
Wood Turtle	*Clemmys insculpta*	Threatened	Turtle

Natural Communities Important examples of the following natural community types have been found in this county. Although communities are not legally protected, they are critical components of Wisconsin's biodiversity and may provide the habitat for rare, threatened and endangered species.		
Alder Thicket	Northern Dry Forest	Northern Wet-Mesic Forest
Floodplain Forest	Northern Mesic Forest	Open Bog
Lake--Shallow, Hard, Seepage	Northern Sedge Meadow	Southern Dry-Mesic Forest
Lake--Soft Bog	Northern Wet Forest	

[1]Wisconsin Status:
Endangered: continued existence in Wisconsin is in jeopardy.
Threatened: appears likely, within the foreseeable future, to become endangered.
Special Concern: species for which some problem of abundance or distribution is suspected but not yet proven.
Rule: protected or regulated by state or federal legislation or policy; neither endangered nor threatened.
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Last Revised: June 1998
Source: WDNR

Insert **Figure (Inside back cover)**: WDNR Geographic Management Units (GMUs)
Shows State of Wisconsin outline, county borders, DNR region borders and GMU boundaries.

Insert **Figure (outside back cover)**: Our Mission
Shows State of Wisconsin outline with Mission statement, and DNR logo in bottom part of state outline.