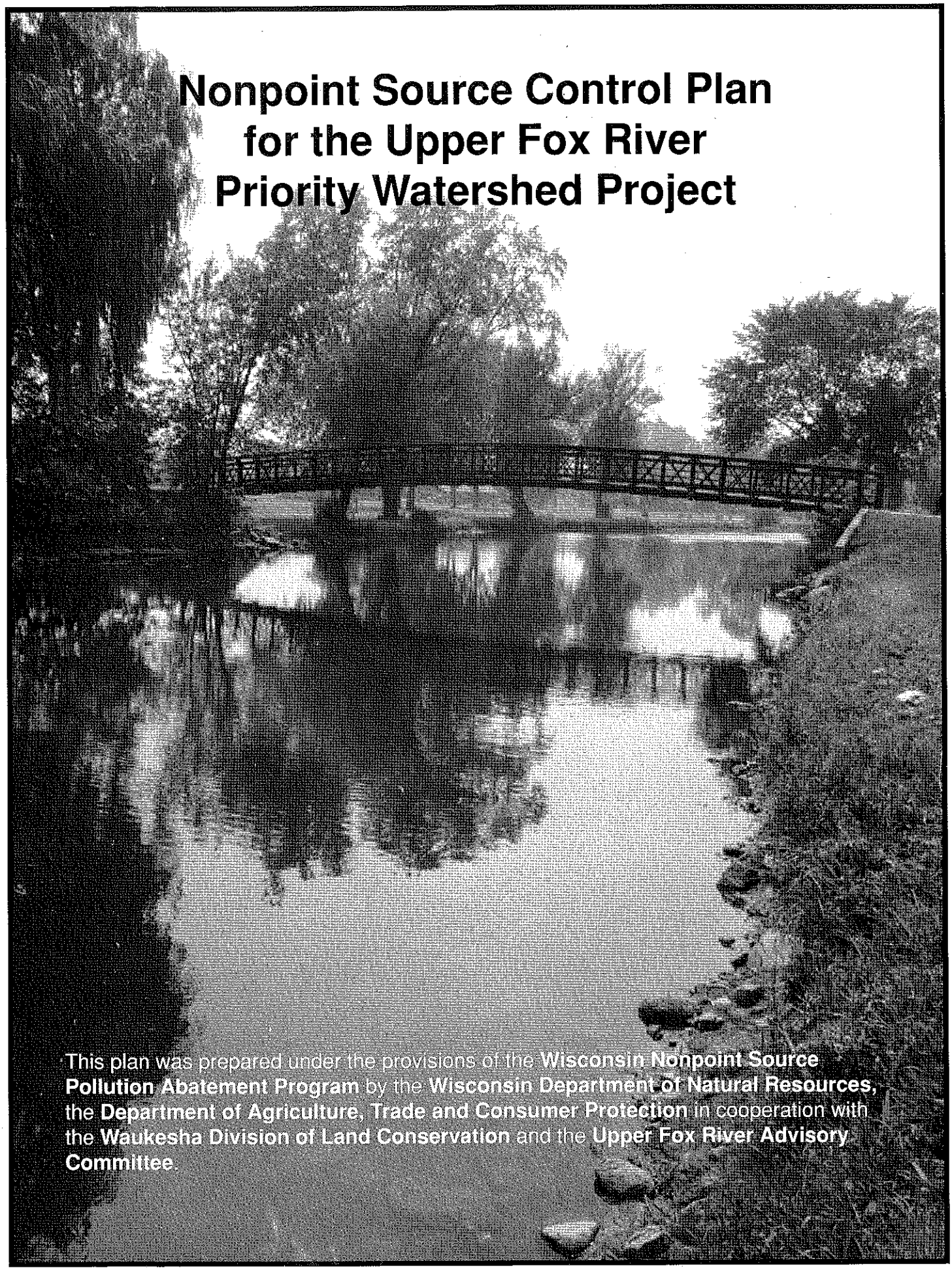
Nonpoint Source Control Plan for the Upper Fox River Priority Watershed Project



This plan was prepared under the provisions of the **Wisconsin Nonpoint Source Pollution Abatement Program** by the **Wisconsin Department of Natural Resources,** the **Department of Agriculture, Trade and Consumer Protection** in cooperation with the **Waukesha Division of Land Conservation** and the **Upper Fox River Advisory Committee**.

Watershed Plan Organization Information

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1994

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Trygve A. Solberg, Vice Chairman
Neal W. Schneider, Secretary
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Bruce Baker, Director, Bureau of Water Resources Management
Rebecca Wallace, Chief, Nonpoint Source & Land Management Section

Wisconsin Department of Agriculture, Trade and Consumer Protection

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Dave Jelinski, Director, Bureau of Land and Water Resources
Keith Foye, Chief, Soil and Water Resource Management Section

Nonpoint Source Control Plan for the Upper Fox River Priority Watershed Project

The Wisconsin Nonpoint Source Water Pollution Abatement Program

June, 1994

This Plan Was Cooperatively Prepared By:

The Department of Natural Resources
WI Department of Agriculture, Trade and Consumer Protection
in cooperation with
The Waukesha Division of Land Conservation
The Upper Fox River Advisory Committee

Publication WR-366-94

For copies of this document please contact:

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Bureau of Water Resources Management
Nonpoint Source and Land Management Section
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The Department of Natural Resources acknowledges the Environmental Protection Agency's Region V Office for their involvement in the partial funding of this activity through Section 319 of the Water Quality Act.

Watershed Plan Credits

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Upper Fox River Citizens Advisory Committee

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

101 South Webster Street
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Madison, Wisconsin 53707
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January 7, 1994

James Luebke, County Board Chair
Waukesha County Office Building
500 Riverview Avenue
Waukesha, WI 53188

Dear Mr. Luebke:

I am pleased to approve the Upper Fox (Illinois) River Priority Watershed Plan prepared through the Wisconsin Nonpoint Source Water Pollution Abatement Program. This plan meets the intent and conditions of s. 144.25, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. The plan has been reviewed by the Department of Agriculture, Trade and Consumer Protection. I am also approving the plan as an amendment to the Fox River (Illinois) Areawide Water Quality Management Plan.

I would like to express the Department's appreciation to the Waukesha County staff that participated in preparing the plan. We look forward to assisting Waukesha County and other units of government in the watershed in implementing the plan.

Sincerely,

George

George E. Meyer
Secretary

cc: Dale Shaver - Waukesha Co. LCD
Ruth Johnson - SED
Dave Jelinski - DATCP
Becky Wallace - WR/2
Cindy Hoffland - CA/GEF 1
Carolyn Betz - WR/2

State of Wisconsin
Department of Agriculture, Trade and Consumer Protection

Alan T. Tracy, Secretary

801 West Badger Road • PO Box 8911
Madison, WI 53708-8911

RECEIVED
DEC 23 1993
BUREAU OF
WATER RESOURCES

December 21, 1993

Mr. Bruce Baker, Director
Bureau of Water Resources Management
Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707

Dear Mr. Baker:

The Department of Agriculture, Trade, and Consumer Protection has reviewed the document titled Upper Fox River Priority Watershed Project: A Nonpoint Source Control Plan. Our comments had earlier been transmitted to your staff and our review reveals that these comments have been incorporated.

We look forward to assisting the Department of Natural Resources and the Land Conservation Committee and staff in Waukesha County in implementing the project.

Please contact Lynne Hess (273-6206) if we can be of any further assistance in moving the project to implementation.

Sincerely,

Dave Jelinski, Director
Bureau of Land and Water Resources
DIVISION OF AGRICULTURAL RESOURCE MANAGEMENT
(608) 273-6411

cc: Becky Wallace, WR/2
Dale Shaver, Waukesha County Land Conservation Manager

Daniel M. Finley
County Executive

Waukesha
COUNTY

OFFICE OF COUNTY EXECUTIVE

RECEIVED

December 17, 1993

Mr. George E. Meyer
Secretary
Wisconsin Department of Natural Resources
101 S. Webster Street
Box 7921
Madison, WI 53707

Dear George:

We are pleased to inform you that the Waukesha County Board of Supervisors overwhelmingly approved the Nonpoint Source Control Plans for the Muskego-Wind Lakes and Upper Fox River Priority Watersheds at their December 14, 1993 meeting. Copies of the resolutions are attached for your reference.

The approval of these plans provides an excellent opportunity for several municipalities to cooperatively embark on a water quality improvement initiative. We look forward to continued work with your agency to achieve the water quality goals set forth in these documents.

Sincerely,

Daniel M. Finley
County Executive

cc: Gloria McCutcheon, Director, DNR-Southeast District
Rebecca Wallace, Chief, Nonpoint Source Section, DNR-Madison
John Toshner, Director, Department of Environmental Resources
Dale Shaver, Manager, Land Conservation Division

Attachments

515 West Moreland Boulevard
Waukesha, Wisconsin 53188-2428
(414) 548-7902
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APPROVAL OF THE NONPOINT SOURCE POLLUTION CONTROL PLAN FOR THE UPPER FOX (ILLINOIS) RIVER WATERSHED

WHEREAS on August 15, 1989, the Waukesha County Board adopted resolution 144-27 to accept the Upper Fox (Illinois) River Priority Watershed Project, and

WHEREAS the Upper Fox (Illinois) River Citizen Advisory Committee has prepared and approved a nonpoint pollution control plan for the watershed, and

WHEREAS the objective of the Upper Fox River Watershed Plan is to achieve optimum biological and recreational uses and control nonpoint pollution in the Upper Fox (Illinois) River and tributary streams, and

WHEREAS the Plan provides grant assistance to participating landowners and municipalities for installing nonpoint pollution control practices and instituting water quality improvement programs.

NOW THEREFORE BE IT HEREBY RESOLVED by the Waukesha County Board of Supervisors that the report entitled "A Nonpoint Source Control Plan For The Upper Fox (Illinois) River Priority Watershed," be adopted, a copy of which is on file in the County Clerk's Office and adopted by reference, as a guide for the future implementation of the provisions, suggestions and recommendations contained in the plan.

REFERRED ON: 10/26/93

FILE NUMBER: 148-R-039

REFERRED TO: LU

TABLE OF CONTENTS

Page

Page

List of Tables

List of Maps

List of Appendices

CHAPTER ONE
Introduction

The Upper Fox River and its tributaries were designated as a "priority watershed" in 1990 under the Wisconsin Nonpoint Source Water Pollution Abatement Program. It joined 46 other watersheds statewide in which the clean-up and protection of water resources through the control of nonpoint sources of pollution is a priority for the Department of Natural Resources (DNR).

A priority watershed project is guided by a plan prepared cooperatively by the DNR, Department of Agriculture, Trade and Consumer Protection (DATCP) and local units of government. The priority watershed plan assesses nonpoint and other sources of water pollution and identifies best management practices needed to meet specific water resource objectives. The plan guides implementation of these practices to improve water quality.

Nonpoint Source Control Program

The Wisconsin Nonpoint Source Water Pollution Abatement Program (the Program) was created in 1978 by the State Legislature. Its goal is to improve and protect the water quality of streams, lakes, wetlands and groundwater by reducing pollutants from urban and rural nonpoint sources.

Nonpoint sources include, but are not limited to: eroding agricultural lands, eroding streambanks and roadsides, runoff from livestock wastes, erosion from developing urban areas and runoff from established urban areas. Pollutants from nonpoint sources are carried to the surface water or groundwater through the action of rainfall runoff, snowmelt, and seepage.

The Program is administered by the DNR and the DATCP. It focuses on critical hydrologic units called priority watersheds. The program is implemented through priority watershed projects for which a plan has been prepared.

Implementation is conducted by local units of government. Water quality improvement is achieved through voluntary implementation of nonpoint source controls (best management practices) and adoption of ordinances. Landowners, land renters, counties, cities, villages, towns, sanitary districts, lake districts, and regional planning commissions are eligible to participate.

Technical assistance, including survey, design and construction checks, is provided to aid in the implementation of best management practices. Technical assistance is provided by Waukesha County Division of Land Conservation, the Soil Conservation Service and the DNR. State level cost-share assistance is available through the Waukesha County Division of Land Conservation and the DNR to help offset the cost of installing these practices. Other types of assistance such as staffing, training and support costs are available through the Local Assistance Grant Agreement (LAGA) with the DNR. Further discussion of assistance available through a LAGA is included in Chapter Five.

Informational and educational activities are employed during project planning and implementation phases to encourage participation.

Priority Watershed Project Planning and Implementation

Planning Phase

The planning phase of the project began in 1990 and included the following information-gathering and evaluation steps:

1) Determine the conditions and uses of streams and lakes.

2) Inventory types of land uses and severity of nonpoint sources impacting streams and lakes.

3) Evaluate the types and severity of other factors which may be affecting water quality. Examples include discharges from municipal sewage treatment plants and natural or endemic stream conditions.

4) Determine levels of nonpoint source control and measures necessary to improve and/or protect water quality.

5) Prepare and gain approval for a priority watershed plan documenting the above evaluations, implementation procedures and costs.

Implementation Phase

The implementation phase will begin following review of the priority watershed plan by the Upper Fox River Advisory Committee, a public hearing and approval by the DNR, DATCP, and the Board of Supervisors for Waukesha County. This phase is characterized below:

1) DNR enters into local assistance agreements with local units of government with implementation responsibilities identified in the plan. These agreements provide funds necessary to maintain the resources and staff required for plan implementation.

2) In the rural portions of the watershed, landowners identified as nonpoint source pollution contributors are contacted by the Waukesha County Division of Land Conservation to determine their interest in voluntarily installing best management practices identified in the plan.

3) Cost-share agreements for rural practices are signed by the landowner and the county outlining the practices, costs, cost-share amounts and a schedule for installation of management practices. All practices are scheduled for installation up to five years from the date the agreement is signed. Similar agreements for urban practices are signed by the local unit of government and the DNR.

Legal Status of the Nonpoint Source Control Plan

The Upper Fox River priority watershed plan was prepared under the authority of the Wisconsin Nonpoint Source Water Pollution Abatement Program described in Section 144.25 of the Wisconsin Statutes and Chapter NR 120 of the Wisconsin Administrative Code. It was prepared under the cooperative efforts of DNR, DATCP, Waukesha County Division of Land Conservation, local units of government, and the Upper Fox River Advisory Committee.

This watershed plan is the basis for the DNR to enter into cost-share and local assistance grants and will be used as a guide to implement measures to achieve desired water quality conditions. In the event that a discrepancy occurs between this plan and the statutes or the administrative rules, or if the statutes or rules change during implementation, the statutes and rules will supersede the plan.

Comprehensive water quality management plans pertaining to the Upper Fox River Watershed have been completed by the Southeastern Wisconsin Regional Planning Commission (SEWRPC 1969, 1970). The SEWRPC more recently completed a water quality management plan for Pewaukee Lake (SEWRPC 1984). These reports recognize the importance of reducing nonpoint sources to achieve improved water quality in the streams and lakes in the Upper Fox River Watershed.

Additionally, a Park and Open Space Plan was prepared by the SEWRPC (1989) for Waukesha County. This plan provides a land use planning mechanism to preserve and enhance the natural resource base. A Regional Land Use Plan for Southeast Wisconsin: 2010 has been prepared by the SEWRPC and includes projected land use information through the year 2010.

Following approval of this priority watershed plan by the DATCP and Waukesha County, the DNR will approve this plan. This watershed is covered under the adopted Areawide Water Quality Management Plan for Southeastern Wisconsin prepared by the SEWRPC. Consequently, the DNR will request that the SEWRPC recommend to the DNR that the priority watershed plan be approved as an amendment to the adopted areawide water quality management plan for Southeastern Wisconsin.

Relationship of the Nonpoint Source Control Plan to the Federal Stormwater Discharge Permit Program

The Stormwater Discharge Permit Program is a result of the 1987 amendments to the federal Clean Water Act. These amendments require permits for discharges of stormwater from municipalities with populations of 100,000 or more, certain industrial sites, and construction sites with ground disturbances of 5 or more acres.

Phase 1 of the municipal stormwater discharge permits are required for municipalities with populations of 100,000 or more. In phase 2 it is likely stormwater discharge permits will be required for municipalities with populations of less than 100,000. The EPA has not determined the population size of municipalities that will be required to be included in the next phase of the stormwater permit program nor has it established a starting date for the next permitting phase. It is not known when a decision on these issues will be determined.

Some of the required activities of the municipal permit program are to identify and locate existing stormsewer outfalls, check for illicite connections, develop a stormwater plan to deal with identified pollution problems, adopt a stormwater ordinance, and to monitor designated sites. Many of the activities that will be required as part of the EPA municipal permit are eligible for state funding through the Nonpoint Source Program.

Industrial permits will be required for those industries that are likely to introduce pollutants to stormwater runoff. Generally, industries that have outside material storage will be required to apply for industrial permits. Industries that fall under this requirement will be directed to submit a permit application to the Bureau of Waste Water in the DNR. Most of these industries have been notified of this permit requirement.

To deal with the issue of construction site erosion control on land disturbances of 5 acres or more, a Memorandum of Understanding, or MOU, is being developed by the DNR, and the Department of Industry Labor and Human Relations (DILHR). The agency responsibility for activities and types of construction has not been decided at this is time. The DNR, and the Department of Industry Labor and Human Relations are expected to have a final agreement on the Memorandum of Understanding some time in 1993.

In order to fulfill the EPA permit requirements, as part of the MOU agreement, contractors will be directed to follow the erosion control guidance in the Wisconsin Construction Site

Best Management Practice Handbook published by the DNR. Some of the other MOU conditions that satisfy the EPA requirements for the construction site erosion control permit program are to provide an existing and planned future site map indicating planned erosion control practices that will be implemented on the site, a description of the type of development and construction that will occur on the site, a written description of the erosion control plan for the site, a description of the construction sequence, a maintenance schedule for erosion control devices on the site, the location of the site, and identification of the owner and developer of the construction site.

Note: It is likely that ground disturbances of less than 5 acres will be a required permit activity. The EPA has not made a determination of size area of disturbance, or a date of initiating these requirements. In the future the EPA is likely to require stormwater management plans for new developments. As a part of the watershed plan, communities are strongly advised to devise stormwater management plans in developing areas.

CHAPTER TWO
General Watershed Characteristics

The Upper Fox River watershed is a 151 square mile drainage area located almost entirely in Waukesha County with a small portion (1%) in Washington County, Wisconsin. The watershed contains approximately 153 miles of perennial and intermittent streams and one major lake, Pewaukee Lake, with a surface area of 2,493 acres. It is divided into 9 smaller hydrologic subwatersheds as shown on map 2-1. Land uses within the watershed vary considerably from rural agriculture to urban and suburban residential, commercial and industrial uses.

Following is a brief overview of the watershed's natural resource and cultural features important in planning a nonpoint source pollution control effort. Additional descriptive information is contained in A Comprehensive Plan For The Fox River Watershed, Volume 1, Planning Report Number 12, Southeastern Wisconsin Regional Planning Commission (1969), A Water Quality Management Plan for Pewaukee Lake (SEWRPC, 1984), and A Park and Open Space Plan for Waukesha County (SEWRPC, 1989).

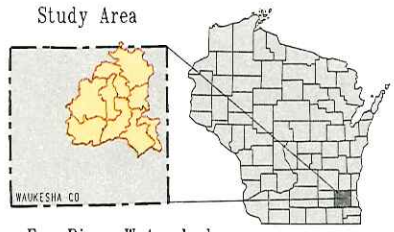
Natural Resource Features

Climate

The frequency, duration and amount of precipitation influences surface and groundwater quality and quantity, soil moisture content, runoff characteristics, and the physical condition of waterways. Precipitation events throughout the watershed are most frequently moderate in duration and quantity. An event is defined as a distinct period when precipitation is equal to or greater than 0.1 inch. Approximately 50 events per year occur in the watershed.

The drainage area annual precipitation is an average of 30.5 inches. The driest months are December, January, and February, with an average of 1.89 inches, 1.25 inches, and 1.14 inches of precipitation, respectively. These are also the months of greatest snow accumulation, when normally 28 inches or 65 percent of the average annual snowfall occurs. The wettest period of the year are the months of June, July, August, and September when more than 13 inches or 44 percent of the average annual rainfall takes place. Most runoff occurs in March, April, and May when the land surface is frozen and soil moisture is highest.

Map 2.1 Upper Fox River Watershed



Upper Fox River Watershed

Subwatershed Key

DC = Deer Creek
NF = Northern Fox
PB = Pebble Creek
PC = Poplar Creek
PL = Pewaukee Lake
PR = Pewaukee River
SC = Sussex Creek
UF = Upper Fox
WK = Waukesha Fox

LEGEND

- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Lake or River

0 1 2 3 4 5 Miles
0 1 2 3 4 5 6 7 8 Kilometers

Wisconsin Department of Natural Resources
BIM - GEO Services Section
April 1994

Topography

Topographic relief in the watershed ranges from approximately 1,140 feet above sea level in the town of Delafield to about 789 feet above sea level at the confluence of Pebble Creek and the Fox River in the town of Waukesha. South of this point is the Middle Fox River Watershed. Physiography is typical of rolling ground moraine, although surface drainage networks are generally well connected leaving relatively few areas of the watershed that are internally drained.

Soils

The most common soil associations occurring in the watershed are the Hocheim-Theresa, the Ozaukee-Morley-Mequon, the Houghton-Palms-Adrian, the Pella, moderately shallow variant Knowles, and the Warsaw-Lorenzo Associations. The erosion potential of these soils is based on their texture, structure, organic matter content, permeability, slope, and position on the landscape. All of these soils are susceptible to erosion.

Surface Water Resources

Streams

Perennial and intermittent streams are the predominant surface water features. The undulating, irregular topography resulted in the natural creation of the 153 miles of streams.

Perennial streams, which have a combined length of about 131 miles, maintain at least a small continuous flow throughout most of the year. The Upper Fox River, 33 miles in length, is the principal perennial stream in the watershed. Other perennial streams of significant length include Sussex Creek (10.9 stream miles), Deer Creek (8.0 stream miles), Poplar Creek (7.5 stream miles), Pebble Creek (6.5 stream miles), the Pewaukee River (6.4 stream miles), and Brandy Brook (4.8 stream miles).

Intermittent streams, with a combined length of 22 miles, flow only when there is runoff or when groundwater discharge is highest. Intermittent waterways are the headwaters of many of the larger perennial streams and their small size makes them particularly susceptible to nonpoint source pollution. Their dynamic nature does allow rapid improvement, however, if pollution sources are reduced.

Channelization

Channelization has had a major impact on the main stem of the Fox River and all major tributaries. Up to 70% has been dredged and/or channelized.

Lakes

Pewaukee Lake is the only lake of significant size occurring in the watershed. It was originally formed when the retreating glacier blocked a valley creating an impoundment. Its original size has been doubled since the early 1800's when a dam was constructed at the outlet which resulted in the flooding of the wetlands east of the main lake basin. Lake levels continue to be controlled by a dam at the outlet. Currently, Pewaukee Lake has a surface area of 2,493 acres, an average depth of 15 feet, and a maximum depth of 45 feet. (SEWRPC, 1984)

Wetlands

Wetlands are some of the most valuable natural resource features in the watershed. Their values include wildlife habitat, fish spawning and rearing, recreation, attenuation of runoff and flood flows and removal of pollutants. They comprise 12,540.8 acres, or 13 percent, of the watershed.

Groundwater Resources

The principle sources of groundwater in the Upper Fox River watershed are, in order of depth below land surface, the sand and gravel aquifer in the glacial drift, the Niagara aquifer, and the sandstone aquifer. An aquifer is an underground rock or soil formation that stores and transmits water to lakes, streams, and wells. Aquifers in the Upper Fox River watershed are discussed in order of occurrence.

Sand and Gravel Aquifer

The sand and gravel aquifer is comprised of surface material deposited from glacial ice that covered the watershed approximately 10,000 years ago. These deposits, which are generally 0 to 100 feet thick, are unconsolidated soil material with physical and chemical characteristics different from agricultural soils.

Groundwater in these deposits occurs and moves in the void spaces among the grains of sand and gravel. It is locally important as a source of groundwater for both public and private use where there are relatively thick unconsolidated deposits. The potential for contamination is high because of the shallow depth to groundwater and permeability of the bedrock.

Niagara Aquifer

The Niagara aquifer occurs beneath the sand and gravel formation, and is the water source for the majority of residents from non-municipal wells in the Upper Fox River watershed. This aquifer consists of dolomite which is a brittle rock similar to limestone. Large volumes of groundwater occur and move within the interconnected cracks or joints throughout the aquifer which is generally 200 to 300 feet thick. Underlying the Niagara aquifer is a layer of Maquoketa shale which formed from impermeable clays and prevents water from moving

between the Niagara dolomite and the deeper aquifers. The potential for contamination is moderate.

Sandstone Aquifer

The sandstone aquifer occurs beneath the Niagara aquifer in deposits 800 to 2000 feet thick. It consists of sandstone and dolomite bedrock with variable water yielding properties. This aquifer is the principle source of water tapped by high capacity wells to supply municipalities, commercial and industrial users, and some subdivisions. In areas where the Maquoketa shale underlies the Niagara aquifer, the potential for contamination is low.

Environmental Corridors

Areas within southeastern Wisconsin having the highest concentrations of natural, recreational, historic, aesthetic and scenic resources are called environmental corridors. These areas normally include selected elements of the natural resource base (lakes, rivers, streams, wetlands, woodlands, prairies, wildlife habitat areas, wet and poorly drained soils, rugged terrain and areas of high-relief) as well as existing outdoor recreation sites, historic and archaeological sites, and natural and scientific areas.

Environmental corridors and isolated natural areas have been identified by the DNR and the SEWRPC (SEWRPC, 1976). These areas contain primarily wetlands, woodlands and surface water and comprise approximately 35.2 square miles, or about 23 percent of the watershed. Preservation of these areas is important for improving water quality in this watershed and the basin as a whole.

Endangered Resources

Information on endangered resources was obtained from the Bureau of Endangered Resources of the DNR. Endangered resources include rare species and natural communities.

It should be noted that comprehensive endangered resource surveys have not been completed for the entire Upper Fox River Priority Watershed. The lack of additional occurrence records does not preclude the possibility that other endangered resources are present in the watershed.

In addition, the Bureau's endangered resource files are continuously updated from ongoing field work. There may be other records of rare species and natural communities which are in the process of being added to the database and so are not in the lists below. Updates or revisions of this watershed plan should be reviewed by the Bureau of Endangered Resources to include new records.

Rare Species

The biological status and locations of rare species are tracked by Wisconsin's Natural Heritage Inventory of the Bureau of Endangered Resources. Species tracked by the Inventory include those that are listed by the U.S. Fish and Wildlife Service or by the State of Wisconsin.

Wisconsin Endangered Species: Any species whose continued existence as a viable component of this state's wild animals or wild plants is determined by the DNR to be in jeopardy on the basis of scientific evidence. Wisconsin endangered species found within the Upper Fox River Watershed include:

Luxilus chrysocephalus (Striped Shiner)
Platanthera leucophaea (Prairie White-fringed Orchid)*
Prenanthes aspera (Rough White Lettuce)

Wisconsin Threatened Species: Any species which appears likely, within the foreseeable future, on the basis of scientific evidence to become endangered. Wisconsin threatened species found in the Upper Fox River Watershed include:

Buteo lineatus (Red-shouldered Hawk)
Casmerodius albus (Great Egret)
Cypripedium candidum (White Ladies Slipper)
Gentiana alba (Yellowish Gentian)

Wisconsin Special Concern Species: Any species about which some problem of abundance or distribution is suspected in Wisconsin, but not yet proven. The purpose of this category is to focus attention on certain species *before* they become endangered or threatened. Wisconsin special concern species located within the Upper Fox River Watershed include:

Cacalia muhlenbergii (Great Indian plantain)
Erimyzon sucetta (Lake Chubsucker)
Etheostoma microperca (Least Darter)
Lithospermum latifolium (American Gromwell)
Penstemon hirsutus (Hairy Beardtongue)
Accipiter cooperii (Cooper's Hawk)

* This species is also on the Federal Endangered Species list as Endangered. A federally endangered species is any species or subspecies which is in danger of extinction throughout all or a significant portion of its range.

Natural Areas

Natural areas, in general, are sites that contain high quality examples of natural communities. State Natural Areas (SNA's) have been officially designated by the DNR Natural Areas

Program as deserving protection. They are owned by the DNR, other state and local agencies, or conservation organizations, and are managed to protect their natural features.

There are no State Natural Areas (owned by DNR) in the Upper Fox River Watershed. Other natural areas in the Upper Fox River Watershed have been identified and include:

Brookfield Maple Forest (southern mesic forest)

Cultural Features

Civil Divisions

Within the Upper Fox River Watershed, there are eight towns including Merton, Lisbon, Delafield, Pewaukee, Brookfield, Genesee and Waukesha within Waukesha County and Richfield in Washington County. There are six villages including Sussex, Lannon, Pewaukee, Hartland, Wales, and Menomonee Falls and three cities including Brookfield, New Berlin and Waukesha. Table 2-1 defines the extent of counties, cities, villages, and towns within the Upper Fox River Watershed. Map 2-2 shows the municipal areas of the watershed.

Population Size and Distribution

The 1990 population in the Upper Fox River watershed was estimated to be 122,028 persons, with almost all residing in Waukesha County. Regional and watershed specific trends suggest that the watershed's population will increase by almost 30,000 people over the next 20 years.

Land Uses

The Upper Fox River watershed is a rapidly developing and urbanizing watershed, with urban land uses comprising about 53.7 square miles, or 35.8%. Existing land use composition is shown in map 2-3. Residential and transportation uses predominate, occupying about 77% of the urbanized area.

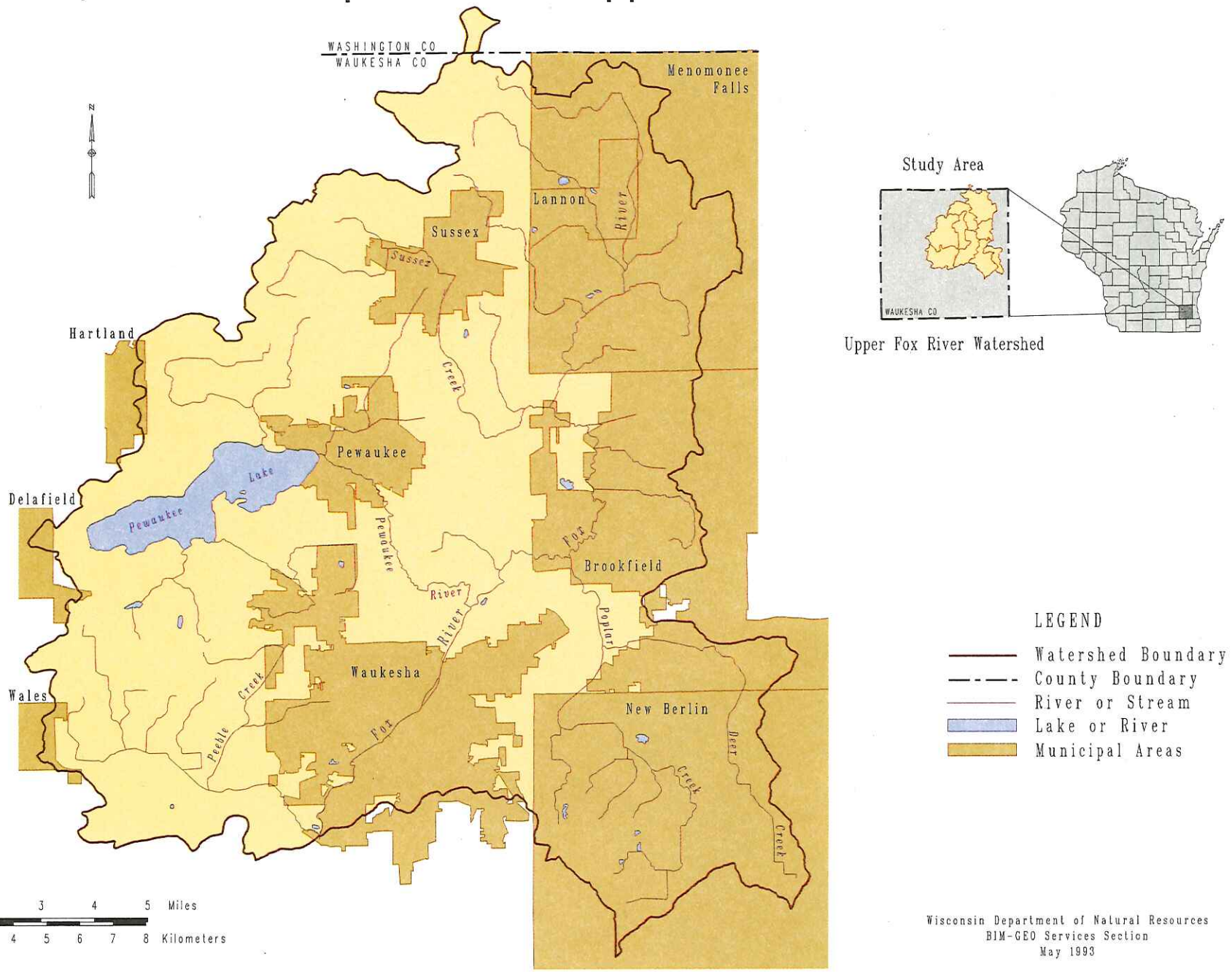
Rural land uses occupy 96.2 square miles or 64.2% of the watershed. Agricultural and related open space uses are the most important rural land uses, comprising 68% of the non-urbanized area.

Table 2-1. Extent of Counties, Cities, Villages, and Towns - Upper Fox River Watershed

Waukesha County	Civil Division	Square Miles	Percent of Total Watershed
City of	Brookfield	12.9	8.6
	New Berlin	17.2	11.5
	Waukesha	13.8	9.2
Village of	Hartland	0.2	0.2
	Lannon	2.5	1.7
	Menomonee Falls	14.8	9.8
	Pewaukee	2.9	1.9
	Sussex	3.8	2.5
	Wales	0.3	0.2
Town of	Brookfield	6.2	4.1
	Delafield	14.7	9.8
	Genesee	6.8	4.5
	Lisbon	19.9	13.2
	Merton	1.4	1.0
	Pewaukee	27.0	18.0
	Waukesha	5.3	3.5
Washington County	**Civil Division**	**Square Miles**	**Percent of Total Watershed**
Town of	Richfield	0.3	0.2
Total	150 square miles		

Source: Southeastern Wisconsin Regional Planning Commission

Map 2.2 Municipal Areas of Upper Fox River Watershed



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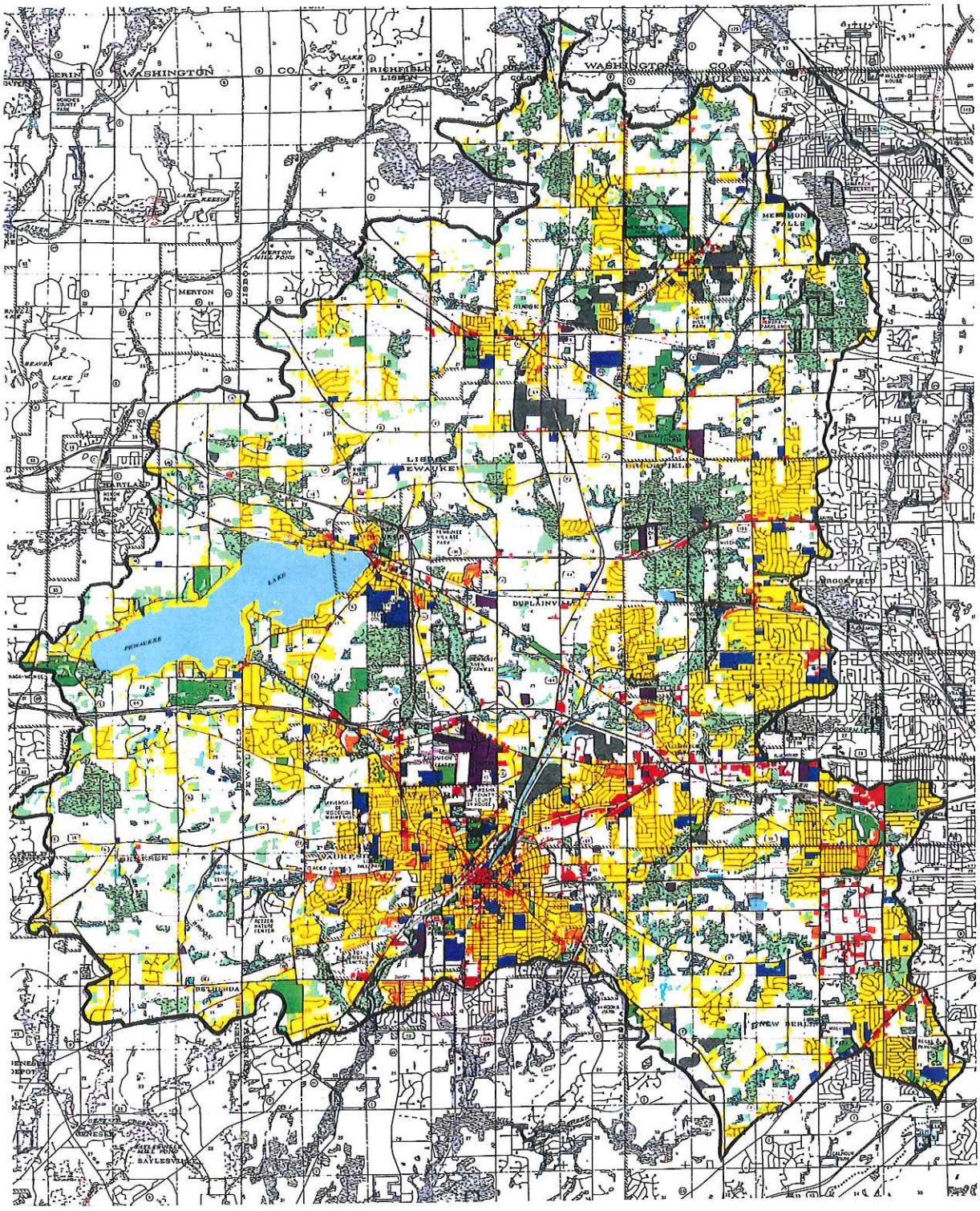
May 1993



EXISTING LAND USE IN THE UPPER FOX RIVER SUBWATERSHED: 1985

LEGEND

PRIMARY LAND USES

- SINGLE-FAMILY RESIDENTIAL
- MULTI-FAMILY RESIDENTIAL
- RETAIL AND SERVICE
- MANUFACTURING, WHOLESALE AND STORAGE
- LANDFILL AND EXTRACTIVE
- TRANSPORTATION, COMMUNICATION AND UTILITIES (except highways, railways and transmission lines)
- WATER
- GOVERNMENTAL AND INSTITUTIONAL
- WOODLAND AND WETLAND
- RECREATIONAL
- AGRICULTURAL AND OTHER OPEN LANDS

Source: SEWRPC.

0 8000 16000 FEET

Municipal and Industrial Point Sources of Water Pollution

Discharges of wastewater from permitted municipal and industrial sources are important considerations for improving and protecting surface water resources. Most of these point sources are controlled through permits issued by the DNR under the Wisconsin Pollution Discharge Elimination System (WPDES) permit system.

WPDES permits are divided into one of three categories. Municipal wastewater treatment facilities such as the ones that serve residents in and around Brookfield, Sussex, and Waukesha are controlled through a municipal WPDES permit. Effluent limits are set on a case-by-case basis and monthly reports of facility performance are submitted to the DNR for review. Currently there are 5 municipal WPDES permits issued within the Upper Fox River watershed: Brookfield Fox Water Pollution Control Board, village of Sussex Wastewater Treatment Plant, city of Waukesha Wastewater Treatment Plant, New Berlin Public Schools, and the American Mobile Home Communities.

A second category of WPDES permits are known as general WPDES permits. Under this portion of the permit system, one permit number is assigned to a group of facilities that have very similar operations and therefore, very similar effluents. All public swimming pools in an area, for example, may be covered by one general permit number to control the discharge of chlorinated water into local storm sewers. Other general permits include those issued to cement and concrete companies, container manufacturing companies, and water utilities. Currently, there are 35 different facilities covered by general WPDES permits in the Upper Fox River watershed.

The third category of WPDES permits are those issued to cover specific industrial activities. The operations in these facilities are unique enough that they are not easily classified or grouped with others under a general permit. Currently within the Upper Fox River watershed there are 12 specific industrial WPDES permits issued.

Sanitary Sewer Service

Sanitary sewer service is available throughout most of the Upper Fox River watershed. More than 60% of the residents in the watershed are provided with sanitary sewer service. Service is provided for most of the area by the Waukesha Wastewater Plant, Sussex Wastewater Treatment Facility, and Brookfield Waste Treatment Plant. The city of Brookfield, city of New Berlin and village of Menomonee Falls also receive services from Milwaukee Metropolitan Sewerage District which extend into small portions of the Upper Fox River watershed. The remaining residents dispose of wastewater through private onsite systems. There are an estimated 9,000 septic systems existing in the watershed with an additional 100 permits for new systems issued annually.

Water Supply Service

Water supplies used in the Upper Fox River watershed are obtained from groundwater resources. There are three principle aquifers lying beneath the watershed from which groundwater is obtained. Water obtained from these aquifers is either pumped from individual wells owned by homeowners or businesses, or is obtained by municipal pumping.

Generally speaking, water obtained from private wells within the watershed is of good quality, although most of it is very hard and may require softening for some uses. There are some areas, however, where geological and cultural conditions pose special problems for the construction of new private wells or the modification of existing wells.

Fractured bedrock beneath portions of the towns of Lisbon and Pewaukee, and also the villages of Lannon and Menomonee Falls provide conduits for bacteria to enter the groundwater supply. In an effort to control this, the DNR Bureau of Water Supply under NR 112 Wisconsin Administrative Code, has issued special casing requirements in these areas.

Concern over groundwater contamination by volatile organic compounds (VOC's) and landfill leachate in portions of the town of Delafield has resulted in special casing requirements in those areas as well. A complete list of the locations within the watershed with special casing requirements is shown in table 2-2.

Municipal water supply systems in the cities of Brookfield, New Berlin, and Waukesha and the villages of Menomonee Falls, Pewaukee and Sussex supply water to the majority of the watershed population. Most of these high capacity wells are drilled down to the sandstone aquifer and provide a dependable source of water to the customers of the water utilities.

Landfills

The DNR has identified approximately 65 active and abandoned landfills in the Upper Fox River watershed. The Master Disposal Corporation landfill in Section 5 of the town of Brookfield has been designated by the U.S. Environmental Protection Agency as a priority for cleanup under the Superfund program. Three other landfills, the city of Waukesha Sanitary Landfill on S. West Avenue, the Anchor Coatings Incorporated landfill, and the Martha Zaretzke landfill have been identified for state action.

Table 2-2. Special Well Casing Requirement Areas - Upper Fox River Watershed

Location	Contaminant	Casing Requirements
Town of Delafield		
Portions of Sections 22 & 27 Shale	VOC, landfill leachate	Casing to base of Maquoketa
Town of Pewaukee		
A portion of Section 12 (Hill n' Dale Subdivision)	Bacteria	135'
Portions of Sections 1 & 2	Bacteria	100'
Village of Lannon Village of Menomonee Falls	Bacteria	100'
- Within 1/2 mile of quarries or rock outcrops	Bacteria	100' or special approval
- Slightly greater than 1/2 mile of quarries or rock outcrops	Bacteria	100' recommended
Town of Lisbon		
Sections 25, 26, 35, & 36	Bacteria	Casing to bottom of Maquoketa Shale
Sections 22, 27, & 34	Bacteria	150'
Within 1/2 mile of quarry or rock outcrops	Bacteria	100' or special approval
Slightly greater than 1/2 mile of a quarry or rock outcrops	Bacteria	100' Recommended

CHAPTER THREE
Water Resources Conditions, Nonpoint Sources and Water Resources Objectives

This chapter discusses the type and extent of urban and rural nonpoint pollution in the Upper Fox River Watershed and identifies the observed impacts on rivers and streams. It also sets forth water quality improvement objectives for the Upper Fox River and its tributaries. These objectives determine the needed level of nonpoint source pollution control which is the basis for the pollution control strategy presented in Chapter Four, "Nonpoint Source Control Needs".

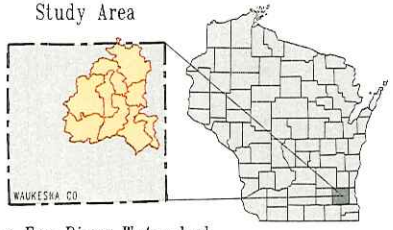
Water Quality Conditions and Objectives

Water quality problems attributable to pollutants or limiting factors are shown in table 3-1 and summarized below. Surface waters (map 3-1) are impacted by sediment, excess nutrients, pesticides and bacteria from the rural landscape. Stream turbidity and degraded aquatic habitat are two obvious results. Livestock pasturing along streambanks results in sedimentation, as well as ammonia and phosphorus contributions from livestock waste, causing severe impacts to fish and other aquatic life habitat. Pasturing results in trampled banks, and wider, shallower streams which provide fewer pools for feeding and hiding. Loss of streambank vegetation also increases water temperature and reduces instream woody cover used by most fish species. Nonpoint source urban runoff carrying heavy metal contaminants, grease, oil, debris, and sediment particularly from construction sites, further degrades water quality. Increased runoff from urban areas also causes flash flooding of small streams and increases scouring and erosion along streambanks.

Ditching and channelizing streams or wetlands to improve drainage is also a problem having immediate effects on chemical water quality in addition to long-term effects on stream base flows and temperature, and fish and wildlife habitat. Turbidity in the Upper Fox River main stem is also aggravated by relatively high numbers of bottom-feeding and rough fish.

Past municipal and industrial wastewater discharges have contributed heavy organic loads to the Upper Fox River watershed. Low dissolved oxygen levels and excessive weed and algae growth result. Treatment facility upgrading with recommended toxic screening capability is currently progressing under the Wisconsin Pollution Discharge Elimination System (WPDES) permitting process. Spills of toxic materials from industrial accidents or intentional disposal continue to degrade water quality.

Map 3.1
Surface Waters of the Upper Fox River Watershed



Upper Fox River Watershed

Subwatershed Key

DC = Deer Creek
NF = Northern Fox
PB = Pebble Creek
PC = Poplar Creek
PL = Pewaukee Lake
PR = Pewaukee River
SC = Sussex Creek
UF = Upper Fox
WK = Waukesha Fox

LEGEND

- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- River or Stream
- Lake or River

0 1 2 3 4 5 Miles
0 1 2 3 4 5 6 7 8 Kilometers

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May 1993

Table 3-1. Water Resource Conditions - Upper Fox River Priority Watershed

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Deer Creek Subwatershed			
Deer Creek	8.0	Loss of fish and invertebrate habitat Loss of wildlife habitat	Channelization; Bank debrushing; Drainage of wetlands; Ponding
		Trophic/community imbalance; Nuisance vegetation	Nutrients
		Stream flow fluctuation or low flow	Low flow and flashy flow
		Embedded substrates; Turbidity	Sediment
		Temperature extremes	Bank debrushing; Channelization/snagging
		Toxicity (potential)	Metals; Pesticide or herbicides
		Size and Depth	Natural
		Bacteria	Septage (potential)
Intermittent A (DC012) (T6N,R20E,S.10,SESE)	0.25	Loss of fish and invertebrate habitat	Channelization/snagging; Drainage of wetlands
		Loss of wildlife habitat	Bank debrushing; Filling of wetlands
		Stream flow fluctuation or low flow	Low flow and flashy flows
		Potential toxicity	Metals; Pesticides or herbicides
		Size and depth	Natural
Intermittent B (DC011) (T7N,R20E,S.34,NESE)	0.50	Loss of fish and invertebrate habitat	Channelization; Ponding
		Potential toxicity	Metals; Pesticides or herbicides
		Size and depth	Natural
Intermittent C (DC010) (T7N,R20E,S.33,NENW)	No information is available for this tributary and the water resource problems are assumed similar to other tributaries.		
Intermittent D (DC008) (T7N,R20E,S.32,NENE)	No information is available for this tributary and the water resource problems are assumed similar to other tributaries.		

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Northern Fox Subwatershed			
Fox River	17.7	Loss of fish and invertebrate habitat	Channelization; Bank debrushing
		Loss of wildlife habitat	Drainage of wetlands; Streambank pasturing; Excessive instream vegetation; Streambank erosion
		Stream flow fluctuation or low flow	Natural
		Trophic/community imbalance	Nutrients; Nuisance vegetation
		Low dissolved oxygen	Excessive vegetation
		Embedded substrates	Sediment
		Toxicity (potential)	Metals; Pesticide or herbicides
		Bacteria	Barnyard runoff; Floodplain pasturing; Septage (potential)
Perennial Stream A (NF007) (T8N,R20E,S.20,SESE)	1.5	No information available on this tributary	
Perennial Stream B (NF014) (T8N,R20E,S.29,NENE)		No information available on this tributary	
Perennial Stream C (NF022) (T8N,R20E,S.29,SWSW)	5.0	Loss of fish and invertebrate habitat	Streambank erosion; Streambank pasturing
		Embedded substrates	Sediment
		Streambank erosion or scour	Bank instability
		Toxicity (potential)	Ammonia
		Trophic/community imbalance	Nutrients
		Temperature extremes	Natural
		Stream flow fluctuation or low flow	Loss of bank cover
		Size and depth	Natural
		Bacteria	Barnyard runoff; Streambank pasturing; Floodplain pasturing Septage (potential)
Intermittent Stream A (NF005) (T8N,R20E,S.17,SENE)	No information available for this tributary		

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Northern Fox Subwatershed (con't)			
Intermittent Stream B (NF013) (T8N,R20E,S.19,NENE)	6.0	Loss of fish and invertebrate habitat	Channelization/snagging; Bank debrushing
		Loss of wildlife habitat	Dam (ponding)
		Migration interference	Dam (ponding)
		Stream flow fluctuation or low flow	Natural
		Toxicity (potential)	Unspecified; Metals; Pesticide or herbicides
		Trophic/community imbalance	Nutrients
		Size and depth	Natural
		Bacteria	Barnyard runoff; Floodplain pasturing; Cropland runoff Septage (potential)
Intermittent Stream C (NF024) (T8N,R20E,S.31,SESE)		No information available for this tributary	
Pebble Creek Subwatershed			
Pebble Creek	6.5	Loss of fish and invertebrate habitat	Channelization/snagging; Bank debrushing
		Loss of wildlife habitat	Drainage of wetlands; Streambank pasturing
		Trophic/community imbalance	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Metals; Pesticide or herbicides
		Turbidity	Suspended solids
		Temperature extremes	Bank debrushing
		Streambank erosion	Channelization/snagging; Streambank pasturing
		Bacteria	Barnyard runoff; Streambank pasturing; Floodplain pasturing Cropland runoff; Septage (potential)

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Brandy Brook	4.8	Loss of fish and invertebrate habitat	Channelization/snagging; Bank debrushing
		Loss of wildlife; habitat	Drainage of wetlands
		Trophic/community imbalance	Nutrients; Low dissolved oxygen
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticide or herbicides
		Temperature extremes	Bank debrushing
		Stream flow fluctuation or low flow	Channelization/snagging; Drainage of wetlands
		Bacteria	Barnyard runoff; Streambank pasturing; Cropland runoff
Perennial Stream A (PB023) (T6N,R18E,S.2,SWNW)	1.0	Trophic/community imbalance	Nutrients
		Bacteria	Bacteria
		Fish migration interference; Temperature extremes	Dam
		Toxicity (potential)	Pesticide or herbicides
		Stream flow fluctuation or low flow	Dam; Natural low flows
		Bacteria	Barnyard runoff; Cropland runoff
Perennial Stream (??) (T6N,R18E,S.12,NWSE)	0.75	Loss of fish and invertebrate habitat Loss of wildlife habitat	Drainage of wetlands; Channelization/snagging
		Substrate embeddedness	Sediment
		Low dissolved oxygen; Temperature extremes; Ponding	Dam in headwaters
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Perennial Stream C (PB018) (T6N,R19E,S.6,SWNE)	2.0	Loss of fish and invertebrate habitat Loss of wildlife habitat	Channelization/snagging; Filling of wetland; Streambank erosion; Culvert (enclosure)
		Fish migration interference; Temperature extremes; Low dissolved oxygen; Ponding	Dam; Culvert (enclosure)
		Toxicity (potential)	Pesticide or herbicides; Metals
		Stream flow fluctuation or low flow	Dam; Urban runoff
		Substrate embeddedness	Sediment
		Trophic/community imbalance	Nutrients
		Bacteria	Failed septic system (potential)
		Size and depth	Natural
Perennial Stream D (PB016) (T6N,R19E,S.8,NESW)	1.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Filling of wetland; Streambank erosion
		Toxicity (potential)	Pesticide or herbicides; Metals
		Stream flow fluctuation or low flow	Channelization/snagging; Filling of wetlands; Urban runoff
		Substrate embeddedness; Trophic/ community; imbalance	Sediment; Nutrients
		Streambank erosion or scour; Hydraulic scour	Channelization/snagging; Urban runoff
		Size and depth	Natural
Intermittent Stream A (PB004) (T6N,R18E,S.2,SESW)	2.5	Loss of fish and invertebrate habitat	Channelization/snagging Cropland runoff Drain tiles
		Toxicity (potential)	Pesticide or herbicides
		Substrate embeddedness	Sediment
		Size and depth	Natural
Intermittent Stream B (PB022) (T6N,R18E,S.2,NWSW)	No information available for this tributary		

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Intermittent Stream C (PB021) (T6N,R18E,S.2,SWSE)	1.5	Loss of fish and invertebrate habitat	Streambank pasturing; Floodplain pasturing; Barnyard runoff; Cropland runoff
		Streambank erosion or scour	Streambank pasturing
		Trophic/community imbalance	Nutrients
		Size and depth	Natural
		Bacteria	Floodplain pasturing; Streambank pasturing; Barnyard runoff
Intermittent Stream A (PB004) (T6N,R18E,S.2,SESW)	2.5	Loss of fish and invertebrate habitat	Channelization/snagging; Cropland runoff; Drain tiles
		Toxicity (potential)	Pesticide or herbicides
		Substrate embeddedness	Sediment
		Size and depth	Natural
Intermittent Stream B (PB022) (T6N,R18E,S.2,NWSW)	No information available for this tributary		
Intermittent Stream C (PB021) (T6N,R18E,S.2,SWSE)	1.5	Loss of fish and invertebrate habitat	Streambank pasturing; Floodplain pasturing; Barnyard runoff; Cropland runoff
		Streambank erosion or scour	Streambank pasturing
		Trophic/community imbalance	Nutrients
		Size and depth	Natural
		Bacteria	Floodplain pasturing; Streambank pasturing; Barnyard runoff
Intermittent Stream D (PB020) (T6N,R18E,S.12,NWSE)	2.5	Loss of fish and invertebrate habitat	Channelization/snagging; Streambank pasturing
		Toxicity (potential)	Pesticide or herbicides
		Substrate embeddedness	Sediment
		Bacteria	Bacteria
		Trophic/community imbalance	Nutrients
		Stream flow fluctuation or low flow	Dam; Natural low flow
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Pewaukee Lake Subwatershed			
Zion Creek (T7N,R18E,S.24,NENW)	1.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Dam; Culvert; Concrete slide
		Fish migration interference; Stream flow fluctuation or low flow; Temperature extremes; Low dissolved oxygen	Dam; Culvert and concrete slide; Natural low flows
		Trophic/community imbalance	Nutrients
		Low dissolved oxygen	
		Embedded substrates	Sediment
		Streambank erosion or scour	Increased discharge
		Toxicity (potential)	Pesticides or herbicides; Metals
		Size and depth	Natural
		Bacteria	Cropland runoff; Failed septic systems (potential)
Perennial Stream A (PL013) (T7N,R19E,S.19,NWNW)	1.25	Loss of fish and invertebrate habitat; Loss of wildlife habitat; Temperature extremes	Channelization/snagging; Bank debrushing; Drainage of wetlands
		Fish migration interference; Temperature extremes; Low dissolved oxygen	Dam; Beaver dam
		Trophic/community imbalance; Low dissolved oxygen	Nutrients
		Embedded substrates	Sediment
		Streamflow fluctuations or low flow	Dam; Drain tiles
		Toxicity (potential)	Pesticides or herbicides
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Perennial Stream B (PL005) (T7N,R19E,S.7,NENE)	0.5	Loss of fish and invertebrate habitat	Channelization/snagging; Filling of wetlands
		Loss of Wildlife habitat	Drainage of wetlands
		Trophic/community imbalance; Low dissolved oxygen	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticides or herbicides; Metals; Unspecified
		Septage; Bacteria	Failed septic systems
		Size and depth	Natural
		Bacteria	Failed septic systems; Floodplain pasturing; Barnyard runoff
West Branch (PL004) of Stream B (PL005) (T7N,R19E,S.6,SENE)	4.5	Loss of fish and invertebrate habitat; Loss of Wildlife habitat	Channelization/snagging; Filling of wetlands; Drainage of wetlands
		Trophic/community imbalance	Nutrients
		Embedded substrates	Sediment
		Fish migration interference	Stream enclosure; Excessive vegetation
		Toxicity (potential)	Pesticides or herbicides; Metals/salts; Unspecified
		Bacteria	Failed septic systems
		Size and depth	Natural
East Branch (PL003) of Stream B (PL005) (T7N,R19E,S.6,SENE)	2.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Streambank pasturing; Floodplain pasturing
		Trophic/community imbalance	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticides or herbicides
		Stream flow fluctuation; or low flow	Natural
		Bacteria	Streambank pasturing; Floodplain pasturing
		Size and depth	Natural; Streambank pasturing; Floodplain pasturing

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Unnamed Intermittent Stream A (PL027) (T7N,R19E,S.7,SWNW)	No information is available for this tributary.		
Intermittent Stream B (PL006) (T7N,R18E,S.13,NWNW)	0.5	Loss of fish and invertebrate habitat; Stream flow fluctuation; or low flow; Hydraulic scour	Channelization/snagging
		Embedded substrates	Sediment
and		Toxicity (potential)	Pesticides or herbicides
Intermittent Stream C (PL007) (T7N,R18E,S.14,NWNE)	0.5	Bacteria	Drain tiles; Failed septic systems
		Size and depth	Natural
		Bacteria	Drain tiles; Floodplain pasturing
Intermittent Stream D (PL008) (T7N,R18E,S.14,SWNW)	0.5	Loss of fish and invertebrate habitat	Channelization/snagging; Ponding
		Stream flow fluctuations or low flows	Natural
		Streambank erosion or scour	Channelization/snagging; Natural
		Size and depth	Natural
Intermittent Stream E (PL009) (T7N,R18E,S.22,NENE)	1.0	No information is available for this tributary.	
Intermittent Stream F (PL014) (T7N,R19E,S.18,SENW)	0.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Filling of wetlands; Stream enclosure
		Stream flow fluctuation or low flow	Stream enclosure
		Toxicity (potential)	Metals; Pesticides or herbicides
		Stream enclosure	Stormwater management

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Pewaukee River	6.4	Loss of fish and invertebrate habitat; Loss of wildlife; habitat	Channelization; Construction site erosion; Urbanization
		Stream flow fluccuation or low flow	Dam
		Trophic/community imbalance	Nutrients; Nuisance vegetation
		Bacteria	Bacteria
		Turbidity	Suspended solids
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticide or herbicides
		Bacteria	Barnyard runoff; Floodplain pasturing; Septage (potential)
Perennial Stream A (PR004) (T7N,R19E,S.9,SWNW)	4.5	Loss of fish and invertebrate habitat	Channelization
		Trophic/community; imbalance	Nutrients; Nuisance vegetation
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticide or herbicides
		Size and depth	Natural
Perennial Stream B (PR010) (T7N,R19E,S.15,SESW)	1.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Drainage of wetlands; Filling of wetlands
		Streambank erosion or scour	Increased discharges
		Toxicity (potential)	Metals
		Size and depth	Natural
Intermittent Stream A (PR009) (T7N,R19E,S.15,SESW)	0.5	Trophic/community imbalance	Nutrients; Nuisance vegetation
		Embedded substrates	Sediment
		Toxicity (potential)	Metals
		Stream flow fluctuation or low flow	Natural; Wetland drainage
		Size and depth	Natural
		Bacteria	Barnyard runoff

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Poplar Creek Subwatershed			
Poplar Creek	7.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Filling of wetlands; Drainage of wetlands; Construction site erosion; Streambank erosion
		Trophic/community imbalance; Nuisance vegetation	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Metals; Pesticide or herbicides; Unspecified
		Turbidity	Suspended solids
		Bacteria	Barnyard runoff; Cropland runoff; Floodplain pasturing; Septage (potential)
Perennial Stream A (PC015) (T6N,R20E,S.5,SWSE)	5.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Culvert-stream enclosure; Drainage of wetlands
		Trophic/community; imbalance	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Pesticides or herbicides
		Hydraulic scour	Increased flow
		Fish migration interference	Culvert-enclosing channel
		Bacteria	Barnyard runoff; Floodplain pasturing; Cropland runoff Septage (potential)
Perennial Stream B (PC006) (T6N,R20E,S.5,SWSE)	No information is available for this stream		
Perennial Stream C (PC019) (T6N,R20E,S.5,NWNW)	2.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Filling of wetlands; Drainage of wetlands
		Toxicity (potential)	Metals; Unspecified
		Low dissolved oxygen	Natural
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Perennial Stream D (PC009) (T6N,R20E,S.6,NESE)	4.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Bank debrushing; Streambank pasturing; Barnyard runoff
		Stream flow fluctuation or low flow	Natural
		Trophic/community imbalance; Bacteria	Nutrients
		Substrate embeddedness	Sediment
		Toxicity (potential)	Pesticide or herbicides
		Size and depth	Natural
		Bacteria	Barnyard runoff; Streambank pasturing
Intermittent Stream A (PC013) (T6N,R20E,S.21,SWNE)	No information is available for this tributary		
Intermittent Stream B (PC003) (T6N,R20E,S.16,NESE)	No information is available for this tributary		
Intermittent Stream C (PC020) (T6N,R20E,S.15,NWNW)	No information is available for this tributary		
Intermittent Stream D (PC014) (T6N,R20E,S.9,SWNW)	1.25	Loss of fish and invertebrate habitat; Temperature extremes; Nuisance vegetation; Low dissolved oxygen	Dam; Channelization/snagging
		Trophic/community imbalance	Nutrients
		Toxicity (potential)	Pesticide or herbicides
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Sussex Creek Subwatershed			
Sussex Creek	10.9	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization; Bank debrushing; Drainage of wetlands
		Stream flow fluctuation or low flow	Natural; Permitted discharges
		Trophic/community imbalance; Bacteria	Nutrients; Nuisance vegetation
		Embedded substrates; Turbidity	Sediment; Suspended solids
		Toxicity (potential)	Metals; Pesticide or herbicides
		Ponding	Dam
		Bacteria	Cropland runoff; Septage
Perennial Stream A (SC003) (T8N,R19E,S.22,NESW)	2.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization; Drainage of wetlands
		Stream flow fluctuation or low flow	Natural
		Trophic/community imbalance; Bacteria	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Metals; Unspecified toxicity; Pesticide or herbicides
		Bacteria	Cropland runoff; Septage
		Size and depth	Natural
Perennial Stream B (SC005) (T8N,R19E,S.26,NWNE)	1.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Culvert (enclosure of stream)
		Fish migration interference	Culvert (enclosure of stream)
		Trophic/Community imbalance; Bacteria	Nutrients
		Toxicity (potential)	Metals; Pesticide or herbicides
		Stream flow fluctuation	Surface runoff
		Size and depth	Natural septage

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Perennial Stream C (SC011) (T7N,R19E,S.1,NESE)	2.5	Loss of fish and invertebrate habitat; Turbidity; embedded substrates	Channelization/snagging; Cropland runoff; Suspended solids Sediments
		Stream flow fluctuation; Hydraulic scour	Increased flows
		Toxicity (potential)	Unspecified
		Size and depth	Natural
		Bacteria	Bacteria
Intermittent Stream A (SC014) (T8N,R19E,S.2,SESE)	0.5	No information is available for this tributary.	
Intermittent Stream B (SC013) (T7N,R19E,S.12,NWNW)	No information is available for this tributary.		
Upper Fox Subwatershed			
Fox River	5.0	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization; Streambank erosion; Drainage of wetlands
		Embedded substrates	Sediment
		Toxicity (potential)	Metals; Unspecified (PCBs, metals, and etc.)
		Bacteria	Septage (potential)
Unnamed Streams (A-G) **UF002 (INT-D)** **UF005 (FAL-C)** **UF007, UF008, UF003, UF009** **UF010, (MAR-E)**		Loss of fish and invertebrate habitat	Channelization
		Embedded substrates	Sediment
		Toxicity (potential)	Metals
		Bacteria	Septage (potential)

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Waukesha Fox Subwatershed			
Fox River	10.0	Loss of fish and invertebrate habitat; Fish migration interference; Low dissolved oxygen; Temperature extremes	Dam
		Trophic/community imbalance	Nutrients
		Embedded substrates	Sediment
		Turbidity	Suspended solids
		Toxicity (potential)	Metals; Pesticide or herbicides; Unspecified; PCBs
		Bacteria	Barnyard runoff
Frame Park Creek (WK014) (T7N,R19E,S.35,SWSW)	2.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Drainage of wetlands; Filling of wetlands
		Trophic/community	Nutrients
		Embedded substrates	Sediment
		Toxicity (potential)	Metals Pesticide or herbicides Unspecified
		Sludge deposits	Oil and grease (?)
		Bacteria	Failed septic systems Urban runoff
		Size and depth	Natural
Intermittent Stream A (WK009) (T7N,R20E,S.19,SWNW)	No information is available for this tributary.		
Intermittent Stream B (WK010) (T7N,R19E,S.24,SENE)	0.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Cropland runoff
		Substrate embeddedness	Sediment
		Toxicity (potential)	Metals
		Size and depth	Natural

Table 3-1. Water Resource Conditions (cont.)

Subwatershed Waterbody	Length (Miles)	Problems or Threats to Potential Uses	Pollutants or Limiting Factors Causing Problems or Threats
Intermittent Stream C (WK011) (T7N,R19E,S.24,NWSE)	0.5	Loss of fish and invertebrate habitat; Loss of wildlife habitat	Channelization/snagging; Wetland drainage
		Substrate embeddedness	Sediment
		Toxicity (potential)	Metals
		Fish migration interference	Culvert-stream enclosure
		Size and depth	Natural
Intermittent Stream D (WK002) (T7N,R19E,S.24,NESW)	2.0	Loss of fish and invertebrate habitat	Channelization/snagging
		Embedded substrates	Sediment
		Toxicity (potential)	Metals
		Size and depth	Natural
Intermittent Stream E (WK012) (T7N,R19E,S.24,SESW)	0.5	Loss of fish and invertebrate habitat	Urban runoff (?)
		Embedded substrates	Sediment
		Toxicity (potential)	Metals
		Size and depth	Natural

There are three municipal wastewater discharges within the Upper Fox River Watershed where storm sewer bypasses and overflows are a major concern. The city of Waukesha Wastewater Treatment Facility has experienced bypasses associated with electrical and mechanical failures. Since 1991, major changes and improvements in operation and maintenance of wastewater pumping stations have been initiated.

The Upper Fox River and most of its perennial and intermittent tributary streams are classified by the DNR (DNR) according to their potential to support recreational, fish, and aquatic life uses. The stream classifications, shown on map 3-2 recognize the capability to support these uses assuming that cultural limitations, such as point and nonpoint pollution sources are reduced or eliminated. The stream classifications are based on the State stream classification system and supporting water quality criteria contained in Chapters NR 102, 104, and 106 of the Wisconsin Administrative Code.

Warm water sport fish communities have the potential to be supported along many stretches of rivers and streams of the Upper Fox River Watershed. Diverse forage fish communities have the potential to exist in the Pewaukee River, Deer Creek, Sussex Creek, Zion Creek and several other tributaries. However, streams in the Upper Fox River watershed exhibit fair to poor water quality. As shown on table 3-2 and map 3-2, there are approximately 33 miles of streams with the potential to support warm water forage fish communities, and approximately 82 miles which could support warm water sport fish such as northern pike, smallmouth bass and bluegill. Currently, however, because of human-induced changes in the landscape and persistent pollution, none of these streams are meeting their full biological or recreational potential, as shown on map 3-3.

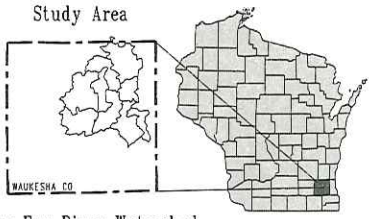
The objectives of this plan focus on achieving optimum biological and recreational uses in the Upper Fox River and its tributary streams. These objectives provide the basis for controlling nonpoint pollution and for a water quality evaluation to be conducted upon completion of the project.

The following objective statements are tied closely to the State stream classification system. Generally, the objective will be either to "protect", "enhance", or "improve" the existing biological and recreational use of a surface water.

"Protection" is used for streams fully supporting their potential biological and recreational uses. Controlling nonpoint sources is necessary to assure that the resource quality is maintained. For example, if a stream is supporting a healthy warm water sport fish population, this objective seeks to protect that use. Currently, 0.5 miles of perennial and intermittent streams are meeting their potential biological use.

"**Enhancement**" is used for streams that are moderately degraded and only partially meeting their potential biological and recreational uses. Controlling nonpoint sources is necessary to enhance water quality and support a healthier aquatic community. For example, nonpoint source controls may result in a more widely diverse and vigorous forage fish community by restoring lost habitat, even though natural conditions preclude the stream from ever

Map 3.2
Potential Biological Uses of Surface Waters
Upper Fox River Watershed



Potential Biological Uses Of Surface Waters

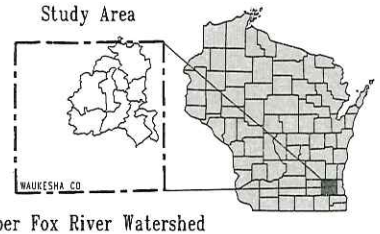
CWF	Cold Water Communities
WWS	Warm Water Sport Fish Communities
WWF	Warm Water Forage Fish Communities
LFF	Limited Forage Fish Communities
LAL	Limited Aquatic Life

Subwatershed Key

DC = Deer Creek
NF = Northern Fox
PB = Pebble Creek
PC = Poplar Creek
PL = Pewaukee Lake
PR = Pewaukee River
SC = Sussex Creek
UF = Upper Fox
WK = Waukesha Fox

Map 3.3
Surface Waters Fully, Partially, or Not Meeting Potential Biological Uses

Upper Fox River Watershed



Upper Fox River Watershed

Surface Waters Fully Partially, or Not Meeting Potential Biological Uses

- Fully Meeting Potential Biological Uses
- Partially Meeting Potential Biological Uses
- Not Meeting Potential Biological Uses

Subwatershed Key

DC = Deer Creek
NF = Northern Fox
PB = Pebble Creek
PC = Poplar Creek
PL = Pewaukee Lake
PR = Pewaukee River
SC = Sussex Creek
UF = Upper Fox
WK = Waukesha Fox

Table 3-2. Summary of Water Quality Conditions - Upper Fox River Watershed

Classifications	Existing Use (Miles)	Supporting Highest Potential Use Classifications			
		Fully (miles)	Partially (miles)	Not (miles)	Total
Fish and Aquatic Life Uses					
1) Cold water communities (CWF - b)	0	0	12.0	1	13
2) Warm water sport fish communities (WWS - c)	66.4	0	45.4	36.2	81.6
3) Warm water/Forage fish communities (WWF - d)	31.9	0	19.4	13	32.4
4) Limited forage fish communities (LFF - e)	31.8	0	3.0	8	11
5) Limited aquatic life (LAL -f)	21.2	0.5	11.8	1	13.3
Unclassified					
	13.2	-	-	-	13.2
Total	164.5	0.5	91.6	59.2	164.5

Source: DNR, Administrative Code NR 102.04(3)(b-g).

supporting a warm water sport fish population. The objective for the Upper Fox River watershed will be to enhance the 91.6 miles of perennial and intermittent streams which are only partially meeting their potential biological uses.

"**Improvement**" is used for streams that are severely degraded and not meeting their potential biological and recreational uses. In this case, nonpoint source controls can help achieve potential uses for the stream that cannot otherwise be attained. For example, nonpoint source controls may result in a stream moving from supporting a limited forage fish community to a healthy warm water sport fishery. The objective for the Upper Fox river watershed will be to improve 59.2 miles of perennial and intermittent streams currently not meeting their potential biological uses.

Achieving the objectives will mean that 114 miles of stream, or more than 69%, will support warm water sport/forage fish communities. Currently, only 98 miles or 59% of the Upper Fox River and its principal tributaries are even partially supporting and none are fully supporting their potential biological use for warm water sport/forage fish communities. Reducing pollutants from nonpoint sources could result in significant improvement in water quality and aquatic habitat in an estimated 164.5 miles of streams.

In many cases other cultural factors that limit these water resources, such as point sources, channelization, dams, or limited public access, will also need to be rectified to see the full benefits of nonpoint source controls. The water resources objectives presented below will be met in a manner consistent with the protection of existing fish and wildlife habitat, including wetlands. In addition, opportunities will be sought to achieve nonpoint source pollution reduction goals in ways that enhance currently degraded fish and wildlife habitat, such as through the use of restored wetlands and shoreline buffers.

Rural Nonpoint Pollution Sources

Rural nonpoint sources include barnyards, winter spread manure, cropland erosion and streambank erosion. In general, these sources are not a widespread threat to water quality. Nevertheless, rural sources to some degree degrade the condition of streams within each subwatershed, especially the headwater areas of the Upper Fox River, Pebble Creek, Poplar Creek, Sussex Creek, and several tributaries into Pewaukee Lake. Rural nonpoint pollution was assessed throughout all of the watershed where rural land uses occur. These sources are discussed below.

Barnyard Runoff

Seventy-five barnyard/livestock operations were inventoried; 24 are hydraulically connected to rivers or streams, and 9 are hydraulically connected to wetlands. Further, 3 flow to small depressions causing potential groundwater concerns, but 1990 well water nitrate levels on these farms were each less than 3.4 mg/l with 10 mg/l being the safe water standard. Runoff from the remainder flows either to internally drained areas overlain by deep soils or have animals confined on grass lots or inside buildings. With few exceptions, those remaining operations are not major contributors to nonpoint source pollution in the Upper Fox River Watershed.

As shown in table 3-3, an estimated 770 pounds, or 58% of the phosphorus attributed to barnyards originates from 33 barnyards. Twenty-four barnyards are hydraulically connected to rivers and streams which contribute 658 pounds phosphorus and 9 are hydraulically connected to wetlands (hydric soils). The highest barnyard pollution loading to streams occurs in the Pebble Creek (33% of total), Pewaukee Lake (30% of total), and Sussex Creek (24% of total) subwatersheds.

Table 3-3. Pollution Potential of Barnyard Runoff - Upper Fox River Watershed [1]

	Rivers, Streams and Wetlands		Internally Drained[3]		Confined Animal Lots	Total	
Subwatershed	Number of Barnyards	Pounds of Phosphorus	Number of Barnyards	Pounds of Phosphorus	Number of barnyards with no runoff [2]	Number of Barnyards	Pounds of Phosphorus
Deer Creek	-	-	-	-	-	-	-
Northern Fox	4	41	3	16	3	10	57
Pebble Creek	6	213	6	107	4	16	320
Poplar Creek	-	-	-	-	1	1	-
Pewaukee Lake	10	180	11	251	2	23	431
Pewaukee River	6	92	3	2	1	10	94
Sussex Creek	7	244	5	140	-	12	384
Upper Fox	-	-	1	14	-	1	14
Waukesha Fox	-	-	1	7	1	2	7
Total	33	770	30	537	12	75	1307

[1] Pollution potential is based on the mass load of total phosphorus, in pounds, delivered by runoff annually.
[2] These operations have no runoff or pollution potential; the animals are confined on grass lots or are kept inside.
[3] Three of these flow to small depressions causing potential groundwater concerns.

Source: Waukesha County Environmental Resources Department - Land Conservation Division.

Only 149 pounds or 11% originates in barnyards connected to the 3 small potholes. These, as well as the remaining 27 barnyards which contribute 389 pounds of phosphorus, drain to internally drained areas overlain by deep soils. These barnyards are generally not a threat to either surface or groundwater quality. Of the 75 barnyards, 1 already has installed a Soil Conservation Service approved barnyard runoff management system, 2 are currently being addressed under NR243 regulatory action, and 6 have gone out of business since the 1991 inventory.

Winter Spread Manure

The potential for water quality problems caused by winter spreading manure generated at the 66 livestock operations was assessed using the barnyard and cropland inventory data. Seven operations with a total of 198 animals (93% are horses) have no cropland available for manure spreading year around.

Approximately 1082 acres of land are needed to daily spread the manure generated during the approximate 6 month period when the soil is frozen and the pollution potential from this source is greatest. Watershed wide, 3,111 acres of cropland are available for winter spreading manure; however, only about 2,162 acres are suitable. The remaining 949 acres are not suitable as they are located in floodplains or have slopes exceeding 6%, and have a high potential to be pollution sources during periods of heavy rainfall or rapid snowmelt.

Not all landowners have an adequate amount of suitable acres on which to spread manure. Consequently, some manure is spread on an estimated 193 acres of unsuitable land. Fortunately, the number of affected acres for any one operation is small and generally is not a serious source of pollution.

Upland Erosion and Sediment Delivery

Land uses, erosion rates and sediment delivery to streams attributable to the 19,305 acres of agricultural cropland evaluated is summarized in table 3-4. Gross soil erosion totals an estimated 86,000 tons per year. Very little of this eroded soil makes its way to surface waters. On a watershed basis, 1,236 tons, or only 1.4%, of eroded soil is washed into streams annually.

Virtually all of the rural upland sediment delivered to streams comes from eroding cropland; approximately 67% is over the tolerable soil loss rate at which the land can maintain its productivity. Cropland soil erosion reduces potential crop yield. Important organic matter and fine clay particles which carry most plant nutrients are most likely to be carried away. There are 254 sediment delivering fields - 13 fields, with slopes over 11%, can expect a 10-29% drop in yields; 87 fields, with slopes between 6-10%, can expect a yield drop of 6-24%; and 141 fields, with a slope of only 2-5% can expect a yield drop of as much as 4-21%.

Table 3-4. Summary of Upland Erosion and Sediment Delivery Analysis - Upper Fox River Watershed [1]

Subwatershed		Cropland	Farmstead	Grassland	Pasture	Woodlot	CRP	Wetland	Totals
Deer Creek	Acres	98	0	0	0	0	0	8	106
	Soil Loss (tons)	588	0	0	0	0	0	0	588
	Sediment (tons)	18	0	0	0	0	0	0	18
Northern Fox	Acres	3728	0	42	0	1	158	312	4,241
	Soil Loss (tons)	18,630	0	8	0	0	0	2	18,640
	Sediment (tons)	292	0	0	0	0	0	2	294
Pebble Creek	Acres	3684	4	251	64	75	750	498	5,326
	Soil Loss (tons)	18,349	0	3	12	2	49	5	18,420
	Sediment (tons)	254	0	1	4	1	1	5	266
Poplar Creek	Acres	2082	0	35	22	290	0	825	3,254
	Soil Loss (tons)	10,361	0	6	9	14	0	20	10,410
	Sediment (tons)	205	0	2	3	7	0	20	237
Pewaukee Lake	Acres	3735	4	60	82	124	283	176	4,464
	Soil Loss (tons)	14,914	0	2	18	6	0	0	14,940
	Sediment (tons)	211	0	0	6	3	0	0	220
Pewaukee River	Acres	1768	0	18	8	10	83	92	1,979
	Soil Loss (tons)	5,299	0	5	0	0	0	0	5,304
	Sediment (tons)	37	0	0	0	0	0	0	37
Sussex Creek	Acres	3104	0	217	35	256	342	437	4,391
	Soil Loss (tons)	12398	0	3	0	8	0	7	12,416
	Sediment (tons)	105	0	1	0	4	0	7	117
Upper Fox	Acres	587	0	8	0	0	12	383	990
	Soil Loss (tons)	2935	0	0	0	0	0	0	2,935
	Sediment (tons)	37	0	0	0	0	0	0	37
Waukesha Fox	Acres	519	0	6	0	5	0	14	544
	Soil Loss (tons)	2,592	0	3	0	0	0	0	2,595
	Sediment (tons)	10	0	0	0	0	0	0	10
Total	Acres	19,305	8	637	211	761	1,628	2,745	25,295
	Soil Loss (tons)	86,066	0	30	39	30	49	34	86,248
	Sediment (tons)	1,169	0	4	13	15	1	34	1,236

[1] "Soil loss" is erosion (tons/year); "Sediment" is soil delivered to surface waters (tons/year)

Most of the upland sediment impacting streams (1,134 tons, or 91%) originates in the five predominately rural subwatersheds; Northern Fox, Pebble Creek, Poplar Creek, Pewaukee Lake, and Sussex Creek. The urbanizing nature throughout the watershed means that cropland erosion will no longer occur in those areas undergoing development. However, without measures to control stormwater runoff, the new urban areas will become additional sources of pollution.

Streambank Erosion

Streambanks along 153 miles of perennial and intermittent streams in the watershed's rural areas were surveyed identifying two sources of damage to streambanks. Streambank trampling from livestock access is occurring on 16,800 linear feet within the five rural subwatersheds identified above. Erosion from other adjacent land uses was recorded as severe (0.5 - 1 ft/yr annual recession rate) on 3,000 linear feet and moderate (0.1 - 0.5 ft/yr) on 16,800 linear feet.

Pewaukee Lake Shoreline Inventory

An inventory of existing shoreline erosion problems on Pewaukee Lake was conducted by the Waukesha County Division of Land Conservation and the Pewaukee Sanitary District. The inventory was based on the Soil Conservation Service Method of inventorying length, height, and lateral recession rate of the eroding shoreline.

In general, it appears that the most severe shoreline erosion problems are on the northeast side of the lake. This is probably due to the prevailing winds and the wave action they induce, combined with the pressure of ice heaves in the winter months.

Shoreline erosion was also evident at selected sites on the southeast and far western end of the lake. These areas were identified by the Lake Pewaukee Sanitary District staff during annual aquatic weed harvesting operations. Table 3-5 presents the results of the selective inventory.

Table 3-5. Pewaukee Lake Shoreline Erosion Inventory

Site Number	Township, Section, Range, Quarter Section	Length (Feet)	Height (Feet)	Lateral Recession (Ft./yr.)	Tons per year	Adjacent Land Use
1	7,19,7,NW	1600	0.1	0.05	0.4	Grassland
2	7,19,7,NE	300	2	0.07	2.1	Residential
3	7,19,8,NE	1300	2.5	0.07	11.4	Industrial
4	7,19,8,SE	300	2.5	0.10	3.8	Grassland
5	7,19,17,NW	700	1.0	0.05	1.8	Residential
6	7,18,15,SE	1200	1.0	0.05	3.0	Developed
Totals		5400			22.5	

Urban Nonpoint Source Pollutants

Urban pollutant loadings were calculated for seventeen municipalities. Quantitative results are reported for the pollutants of Suspended Solids, Copper, Zinc, and Phosphorus. Qualitative descriptions are given for pollutants: PolyChlorinated Biphenyls (PCB's), pesticides, and Polycyclic Aromatic Hydrocarbons (PAH's).

Urban runoff carries a wide array of pollutants to surface water; some are unique to urban runoff while others also are contained in runoff from agricultural areas. Pollutants found primarily in urban runoff include heavy metals (lead, copper, zinc, cadmium or chromium) and a large number of toxic organic chemicals (PCB's, aromatic hydrocarbons, esters and many others). Other substances in urban runoff that are also contained in runoff from rural areas include sediment, nutrients, bacteria and other pathogens, and pesticides.

A computer model called the Source Loading and Management Model (SLAMM) was used to generate these data for the Upper Fox River Watershed. SLAMM is a deterministic model that predicts event mean concentrations, loads, and volumes of water for a given subwatershed, municipality of any other designated area. The data inputs for the model include rainfall, land use, pollutant concentrations (which is a standard coefficient for each source area), and existing control practices. The existing control practices are generated from inventories conducted within each municipality. The results from the SLAMM model are concentrations of lead, copper, zinc, cadmium, suspended solids and phosphorus for the seventeen municipalities (table 3-6) and for each subwatershed (tables 3-7 and 3-8).

Lead is a common pollutant found in most samples of urban runoff. The sources of lead and copper are automobiles and industrial areas. Zinc comes from automobiles, industry, and rooftop downspounds. Suspended solids are always found in urban runoff. The sources are many, but the primary source in urban areas is construction site erosion. Phosphorus also comes from a variety of sources. The primary concerns in an urban area are fertilizer use and leaves left in the street.

Runoff from urban areas also impacts stream hydrology. This occurs as runoff volume increases in magnitude and is produced in a short time period creating large increases in peak stream flows. In some areas, groundwater recharge is also significantly reduced as concrete and other impervious surfaces prevent rainwater and snowmelt from soaking into the ground. This reduces base stream flows needed to sustain fish and aquatic life during periods of low rainfall.

Overall, urban runoff produces "flashy" streams with temperatures and chemical characteristics which limit animal life and recreational uses. Streambank erosion may increase as the stream tries to cut a channel in equilibrium with widely variable stream flows. Flooding of adjacent property may also occur, sometimes requiring channelization and/or lining with concrete to accommodate flood flows or prevent flood damage. This often destroys the natural stream system and speeds the transport of pollutants downstream.

Table 3-6. Annual Pollutant Loadings for the Municipalities (1990) - Upper Fox River Watershed (Reported in pounds per year)

Municipality	Lead	Copper	Zinc	Cadmium	Phosphorus	Suspended Solids
City of Brookfield	482	282	1,528	10	1,374	830,748
Town of Brookfield	316	186	1,006	6	863	555,127
City of Delafield	4	3	14	0	10	64,505
Town of Delafield	98	87	366	2	258	164,934
Town of Genesee	17	5	32	0	54	24,704
Village of Hartland	4	3	15	0	13	7,197
Village of Lannon	47	18	127	1	137	81,858
Town of Lisbon	104	31	206	2	333	170,986
Village of Menomonee Falls	100	60	329	2	296	164,483
Town of Merton	18	25	91	1	36	33,213
City of New Berlin	585	234	1,654	10	1,727	1,036,405
Town of Pewaukee	891	757	3,363	23	2,171	1,577,758
Village of Pewaukee	205	111	673	4	599	364,731
Village of Sussex	150	59	420	2	444	265,688
Village of Wales	2	0	3	0	7	2,566
City of Waukesha	1,140	486	3,317	21	3,621	2,037,056
Town of Waukesha	62	22	152	1	198	102,602
Total	4,225	2,369	13,296	85	12,141	7,484,561

Table 3-7. Existing Pollutant Loadings by Subwatershed - Upper Fox River Watershed (Reported in pounds per year)

Subwatershed	Land (acres)	Lead	Copper	Zinc	Cd	Phos.	Suspended Solids
Poplar Creek	13,805	571	262	1,630	9.9	1,662	1,005,422
Pebble Creek	12,608	121	40	268	12	650	283,453
Pewaukee Lake	15,826	296	244	1,137	7	971	569,917
Waukesha	10,404	999	428	2,962	19.8	3,480	1,904,824
Deer Creek	5,077	562	305	1,834	11.5	1,074	1,036,143
Pewaukee River	8,828	736	678	2,770	11.8	1,515	966,265
Upper Fox	6,034	164	51	316	2	529	275,226
Sussex Creek	9,226	294	115	857	4	988	558,856
Northern Fox	15,665	482	208	1,269	7	1387	817,648
Total	97,473	4225	2331	13,043	85	12,256	7,417,754

Cd = Cadmium Phos. = Phosphorus

Table 3-8. Planned Land Use Pollutant Loading by Subwatershed - Upper Fox River Watershed (Reported in pounds per year)

Subwatershed	Land (Acres)	Lead	Copper	Zinc	Cd.	Phos.	Suspended Solids
Poplar Creek	771	75	30	212	2	387	184,899
Pebble Creek	1,372	66	27	201	5	587	236,456
Pewaukee Lake	907	49	20	145	3	366	154,061
Waukesha	1,177	242	99	680	6	901	498,300
Deer Creek	426	51	20	144	2	235	117,843
Pewaukee River	1,187	157	63	447	5	695	354,510
Sussex Creek	338	17	7	51	1	145	58,878
Northern Fox	306	17	8	58	1	139	59,897
Total	6,484	674	274	1,938	25	3,455	1,664,844

Urban nonpoint sources described below include: runoff from existing urban areas including established commercial, industrial, and residential land uses; and runoff from areas where new urbanization is anticipated.

Existing Urban Area Characteristics and Pollutant Loading. The delivery of urban pollutants to streams from existing urban areas depends on: 1) the type of urban land use; 2) the type of stormwater conveyance system; and 3) urban housekeeping practices including but not limited to street sweeping and leaf collection. Each factor is discussed below.

Urban Land Uses

Freeways, industrial areas, commercial areas, and high density residential areas are the greatest collectors of sediment, lead, and zinc on a per acre basis. Medium density residential areas are less important sources of sediment and lead, but are significant sources of pesticides, bacteria, and household or automotive maintenance products dumped into the storm sewer system. Low density residential areas are important where the improper use and disposal of pesticides, fertilizers, and automotive maintenance products occurs.

The variability of pollutants in urban runoff also depends on the configuration of "source areas". Source areas, defined as streets, parking lots, rooftops and lawn areas; are present in different proportions depending on the type of land use. For example, residential areas contain more lawn area than commercial areas, while commercial areas have more rooftop, street, and parking lot surfaces. Lawns can be important sources of fertilizers and pesticides. Rooftops, important sources of zinc and asbestos, vary in the proportion of land they cover in each urban land use, and also in the degree they are connected to the storm sewer system. Streets are sources of significant amounts of lead, cadmium, and other pollutants, depending on their area and the amount of traffic.

Stormwater Conveyance

Stormwater is most commonly conveyed to streams through storm sewers either separately or in combination with grassed swales or roadside ditches. Storm sewers transport runoff rapidly with no "treatment" or filtering of the runoff before it enters streams. Properly designed grassed swales generally transport lesser amounts of runoff because of infiltration and vegetation serves to remove some pollutants from the runoff before it flows into streams or storm sewer systems.

The types and amounts of pollutants transported by runoff, depends on the extent to which pollutant-producing surfaces are hydrologically "connected" to the storm sewer system. For example automobile traffic density, a prime determinant in the production of lead, asbestos, cadmium, and street dirt, is highest for street surfaces in commercial areas and freeways. Normally, these areas are connected to storm sewers.

Urban Housekeeping Practices

Street sweeping and stormwater conveyance systems affect the portion of pollutants from urban surfaces carried to streams by runoff. Street sweeping removes some of the particulate

pollutants from street and parking lot surfaces before they can be transported to surface waters. The most benefit is realized by repeated sweeping of commercial and industrial areas in the early spring. Other sweeping is primarily cosmetic, and serves little role in reducing urban pollutant loads.

New Urban Development

Runoff from new urban development anticipated to take place over about the next 10 to 15 years has the potential to impact stream water quality for two reasons. First constructing roads, utilities and buildings disturbs large areas, exposing large amounts of soil to erosion. This sediment can easily be carried by runoff to drainageways, storm sewers and ultimately streams. Without adequate controls, construction site erosion can have catastrophic impacts on urban rivers and streams, clog storm sewers, and accumulate on road surfaces and sidewalks.

Second, newly established urban surfaces accumulate pollutants which are carried in runoff to streams. Consequently, as new areas urbanize, water quality problems caused by urban pollutants and excessive stormwater runoff can worsen.

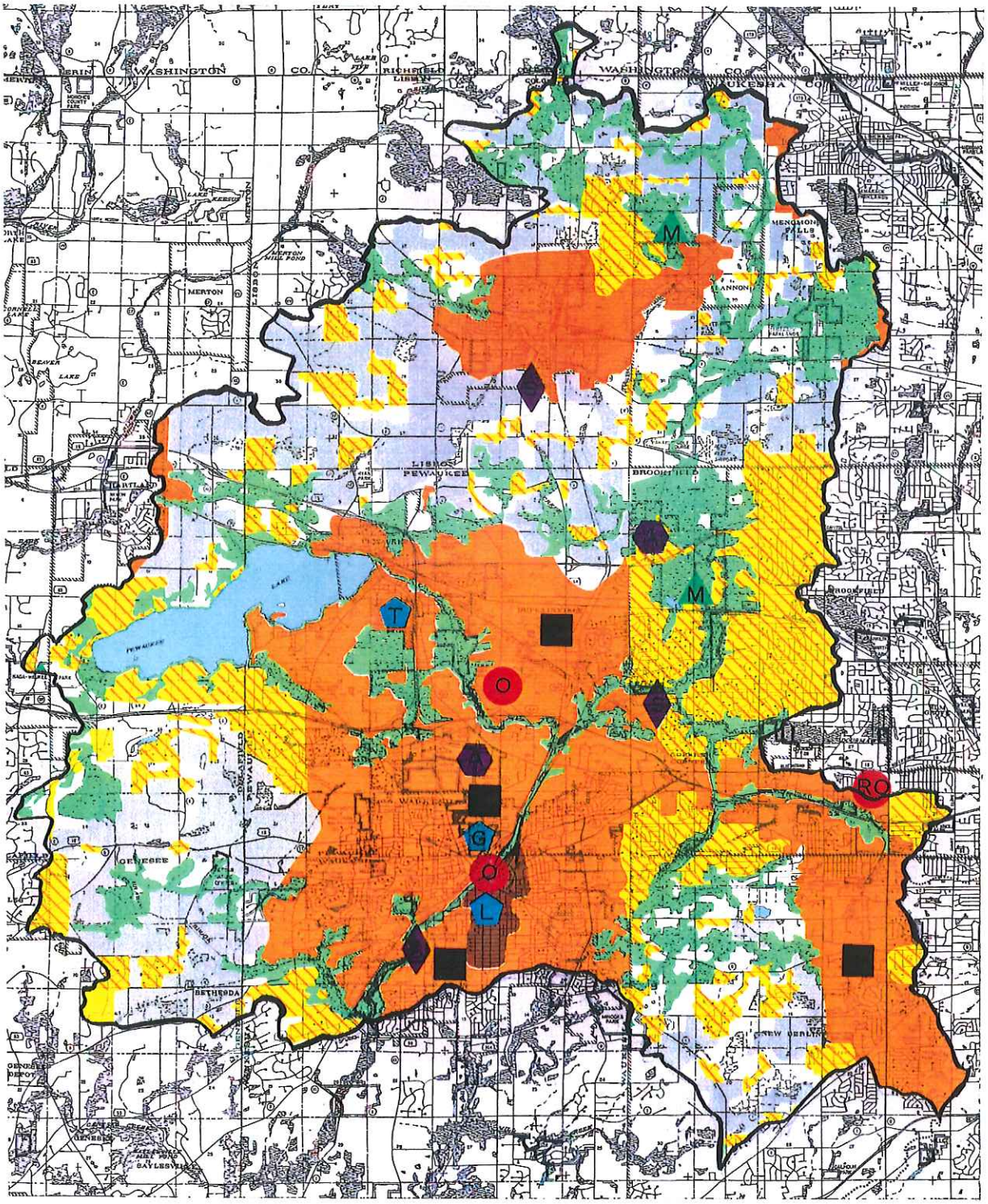
Map 3-4 shows the extent of anticipated new development in the watershed. Urban land use is expected to increase by nearly 6,874 acres, or 20% by about the year 2010. Runoff from new urban areas has the potential to further degrade stream water quality unless stormwater management practices are incorporated during development.

Renewal of established urban areas should be considered as new development for purposes of assessing their potential impact on water quality. Renovation of buildings and utilities can cause pollution from construction site erosion similar to new construction. In addition, even though urban renewal projects will not necessarily increase the amount of established urban surface, they represent opportunities to install stormwater management practices to treat runoff from both the renewal property and adjacent established areas.

Construction Site Erosion

Construction site erosion is an additional water quality concern associated with new urban development. Uncontrolled construction site erosion can introduce sediment to water bodies at rates of 10 to 100 times the rate of agriculture areas. Typically Wisconsin construction sites allow 30 tons of sediment per acre per year to leave the site.

The sediment generated from construction sites devastate aquatic communities in streams receiving sediment laden runoff. Sediment abrades mucus membranes of fish and crustaceans leaving them susceptible to disease and infection. It also restricts the vision on predatory species, increasing the chance of starvation. In streams, soil particles kill invertebrates and destroys their habitat by scouring stream bottoms. Soil particles that settle to the bottom of water bodies cover plant species, fill in interspacial voids in cobbles eliminating invertebrate habitat and fish spawning beds. Sediment also acts as a heat sink increasing water temperature. The combined affects of sediment reduced the bio-diversity of the water body and tip the scales in favor of pollutant tolerant species such as carp and bullheads.



YEAR 2010 PLANNED LAND USE IN THE UPPER FOX RIVER SUBWATERSHED

LEGEND

PRIMARY LAND USES

- SUBURBAN RESIDENTIAL (0.2–0.6 Dwelling Units per Net Residential Acre)
- LOW DENSITY RESIDENTIAL (0.7–2.2 D.U./ Net Res. Ac.)
- MEDIUM DENSITY RESIDENTIAL (2.3–6.9 D.U./ Net Res. Ac.)
- HIGH DENSITY RESIDENTIAL (7.0–17.9 D.U./ Net Res. Ac.)
- PRIMARY ENVIRONMENTAL CORRIDOR
- PRIME AGRICULTURAL LAND
- OTHER AGRICULTURAL AND RURAL LAND
- WATER

- MAJOR COMMERCIAL CENTER R—Retail O--Office
- MAJOR INDUSTRIAL CENTER
- MAJOR PUBLIC OUTDOOR RECREATION CENTER M--Multi-Use Site
- MAJOR TRANSPORTATION CENTER A--Airport
- MAJOR UTILITY CENTER S--Public Sewage Treatment Plant
- MAJOR GOVERNMENTAL OR INSTITUTIONAL CENTER L--Library
  - G--County, state, or Federal Administrative Office
  - T--Technical/Vocational

0 8000 16000 FEET

Source: SEWRPC.

Sediment from construction sites also plugs stormwater conveyance systems. This causes an increase in stormsewer maintenance expenses and may cause localized flooding.

Importantly, water quality improvements occurring through implementation of nonpoint source control practices for existing urban areas can be negated by these pollution sources. With the proper application of erosion control practices, the rate of erosion from construction sites can be reduced from 50 to 70 percent.

Waukesha County has a construction site erosion control ordinance that was established in 1992. The Division of Land Conservation is responsible for the administration and enforcement of the ordinance in the unincorporated portions of the county.

DNR/DILHR Memorandum of Understanding

A Memorandum of Understanding was signed between the DNR and the Department of Industry, Labor and Human Relations on September 28, 1993 for construction site erosion control. The next step is to develop a joint uniform erosion control code for activities regulated by each agency.

In the memorandum, DILHR agrees to assist the DNR in administering and enforcing construction site soil erosion and sediment control at all building sites except one and two-family dwellings, which are controlled through the Uniform Dwelling Code. DILHR will conduct on-site inspections to determine compliance with the erosion control program, and other mutually agreed upon aspects of the Wisconsin Pollution Discharge Elimination System (WPDES) stormwater construction site erosion control permit requirements not covered in DILHR's program. DILHR will enforce construction site erosion violations under DILHR jurisdiction, and refer to DNR violations on activities not regulated by DILHR. DILHR, with assistance from the DNR, will allow counties or local municipalities to assume an active role in controlling construction site runoff by assisting in the soil erosion control program.

The rules for construction site soil erosion and sediment control are currently being written by DILHR and the DNR, and will not be finalized until after the Upper Fox Watershed Plan has been approved and has moved into the implementation phase. Until the rules are finalized, the current memorandum of understanding will serve as a guide for construction site activities in the watershed as to the authority and roles of the state agencies.

Pollutant Reduction Goals

Recreational and biological water resources objectives were established for Pewaukee Lake and each of the streams in the watershed. These objectives identify how the project may change the quality of the aquatic environment for recreational and biological uses. Factors considered in setting water resources objectives include: existing water quality and aquatic habitat, factors or pollutants that may be keeping the surface water from meeting its full potential to support biological and recreational uses, and the practicality of reducing

pollutants. Achieving these objectives may go beyond the scope of the Nonpoint Source Pollution Control Program.

The nonpoint pollution reduction goals are estimates of the level of nonpoint source control needed to meet the water quality and recreational use objectives identified in this plan. Pollution reduction goals and water resources objectives are set together since they are integrally related. The goals are a refinement of recommendations contained in water quality management plans prepared by the Southeastern Wisconsin Regional Planning Commission (SEWRPC; 1969, 1970, 1989). The goals specifically target the control of sediment and phosphorus in rural areas and the control of sediment, phosphorus, urban toxic materials and streamflow changes in urban areas. Importantly, reducing the quantity of these substances reaching surface water decreases the amount of other substances such as pesticides and bacteria which degrade water quality.

The following is a summary of reductions to be targeted for the entire watershed.

- Agricultural Sediment: reduction goal of 50-75 percent, varying with each subwatershed.
- Barnyard runoff: reduction goal of 75 percent of phosphorus load.
- Winterspreading of Manure: reduction goal of 75 percent of the critical acres spread.
- Streambank erosion: reduction goal of 50-75 percent sediment delivered to streams.
- Urban runoff: reduction goal of 40-90 percent suspended solids.

Pollution reduction goals for the watershed are developed according to activities needed to achieve the water quality objectives. Table 3-9 is a summary of the reductions to be targeted for each subwatershed.

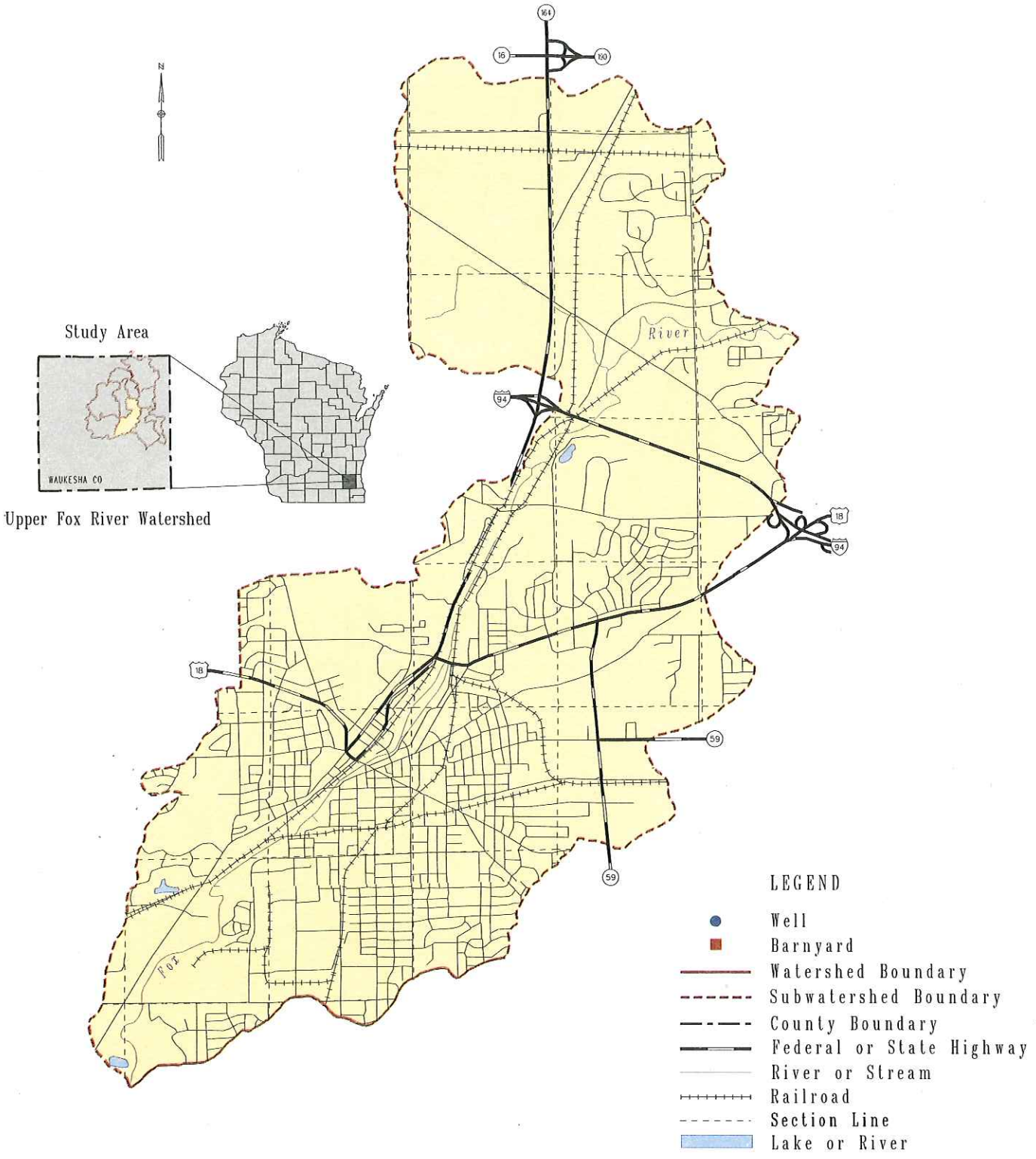
Table 3-9. Pollution Reduction Goals for the Upper Fox River Watershed

Subwatershed	Existing Suspended Solids (tons/yr)	Needed Reductions (percent)	Future Suspended Solids (tons/yr.)
Northern Fox	Urban - 409 (52%) Cropland - 355 (46%) Streambank - 13 (2%) Total - 777	50% 50% 0%	205 178 - 383 (49% reduction)
Sussex Creek	Urban - 279 (71%) Cropland - 355 (24%) Streambank - 20 (5%) Total - 395	90% 25% 0%	28 72 0 100 (75% reduction)
Upper Fox	Urban - 138 (78%) Cropland - 37 (21%) Streambank - 1 (1%) Total - 176	60%* 100% due to urbanization 0%	55 0 1 56 (68% reduction)
Pewaukee River	Urban - 483-existing (92%) *future Cropland - 38 (7%) Streambank - 0 Total - 521	60% * 70% due to urbanization N/A	18-existing 193-future 11 0 222 (57% reduction*)
Pewaukee Lake	Urban - 483-existing (92%) 77-future (7%) Cropland - 221 (21%) Streambank - 478 (45%) Total - 1,061	50% 90% 35% 75%	142 8 144 120 414 (61% reduction)
Waukesha Fox	Urban - 952-existing (79%) 249-future (20%) Cropland - 10 (<1%) Streambank - 0 Total - 1,211	40% 90% 100% due to urbanization	571 25 0 0 596 (50% reduction)
Deer Creek	Urban - 518-existing (86%) 59-future (10%) Cropland - 18 (3%) Streambank - 4 (<1%) Total - 599	50% 90% 100% due to urbanization 80%	259 6 0 0.8 266 (56% reduction)

Subwatershed	Existing Suspended Solids (tons/yr)	Needed Reductions (percent)	Future Suspended Solids (tons/yr.)
Poplar Creek	Urban - 502-existing (53%) 92-future (10%) Cropland - 194 (20%) Streambank - 161 (17%) Total - 1,548	60% 90% 35% 10%	201 9 13 145 368 (76% reduction)
Pebble Creek	Urban - 142-existing (17%) 118-future (14%) Cropland - 347 (41%) Streambank - 228 (27%) Total - 835	50% 90% 60% 50%	71 12 139 114 336 (60% reduction)

* 90% reduction of future developed areas

Map 3.5 Waukesha Fox Subwatershed



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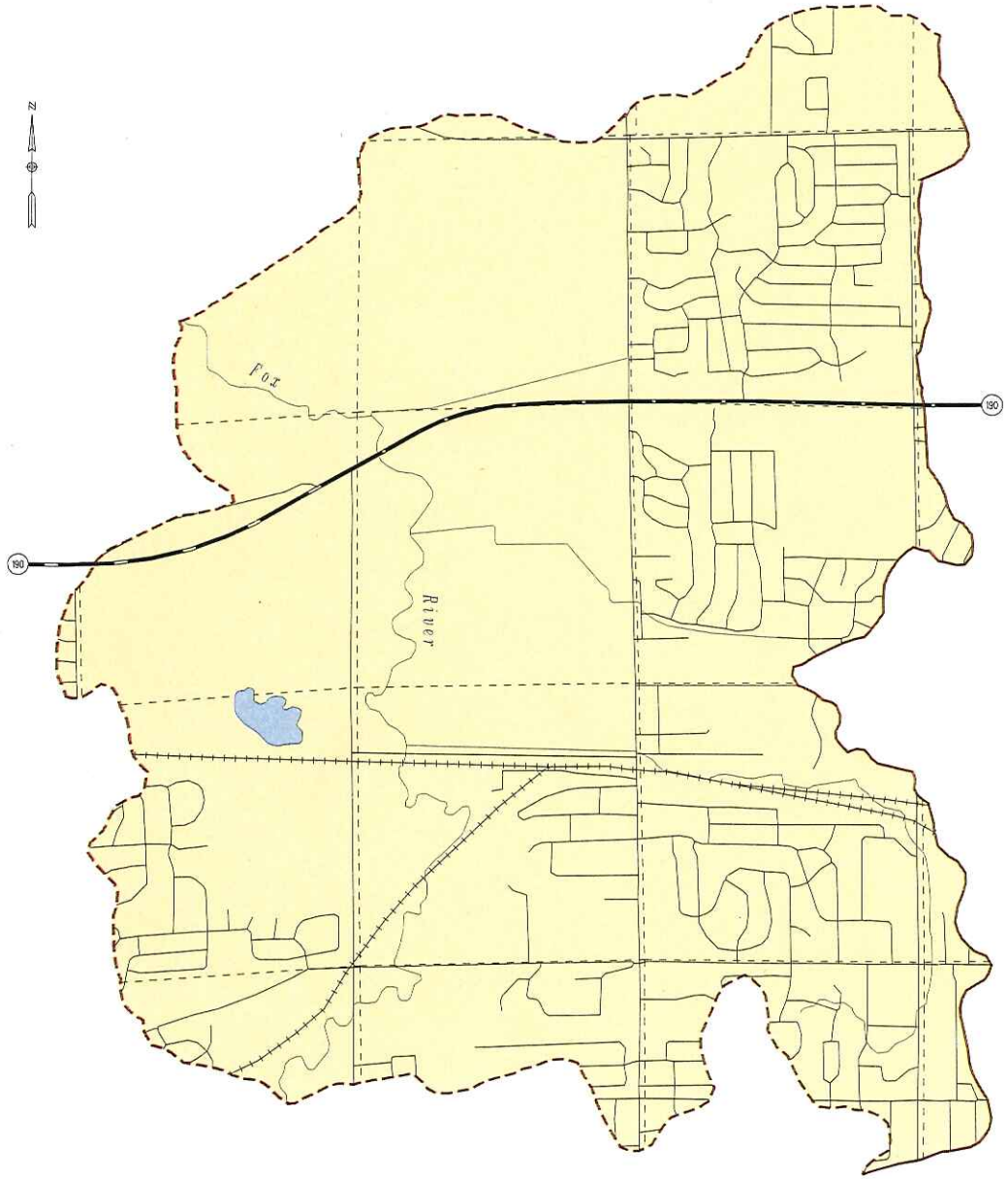
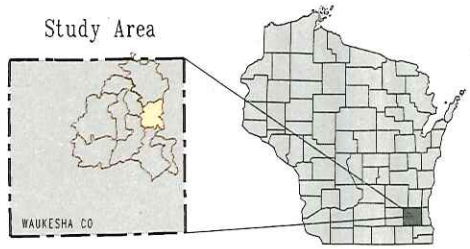
April 1994

Map 3.6 Upper Fox Subwatershed



LEGEND

- Well
- Barnyard
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River



Upper Fox River Watershed

0 1 2 Miles

0 1 2 3 Kilometers

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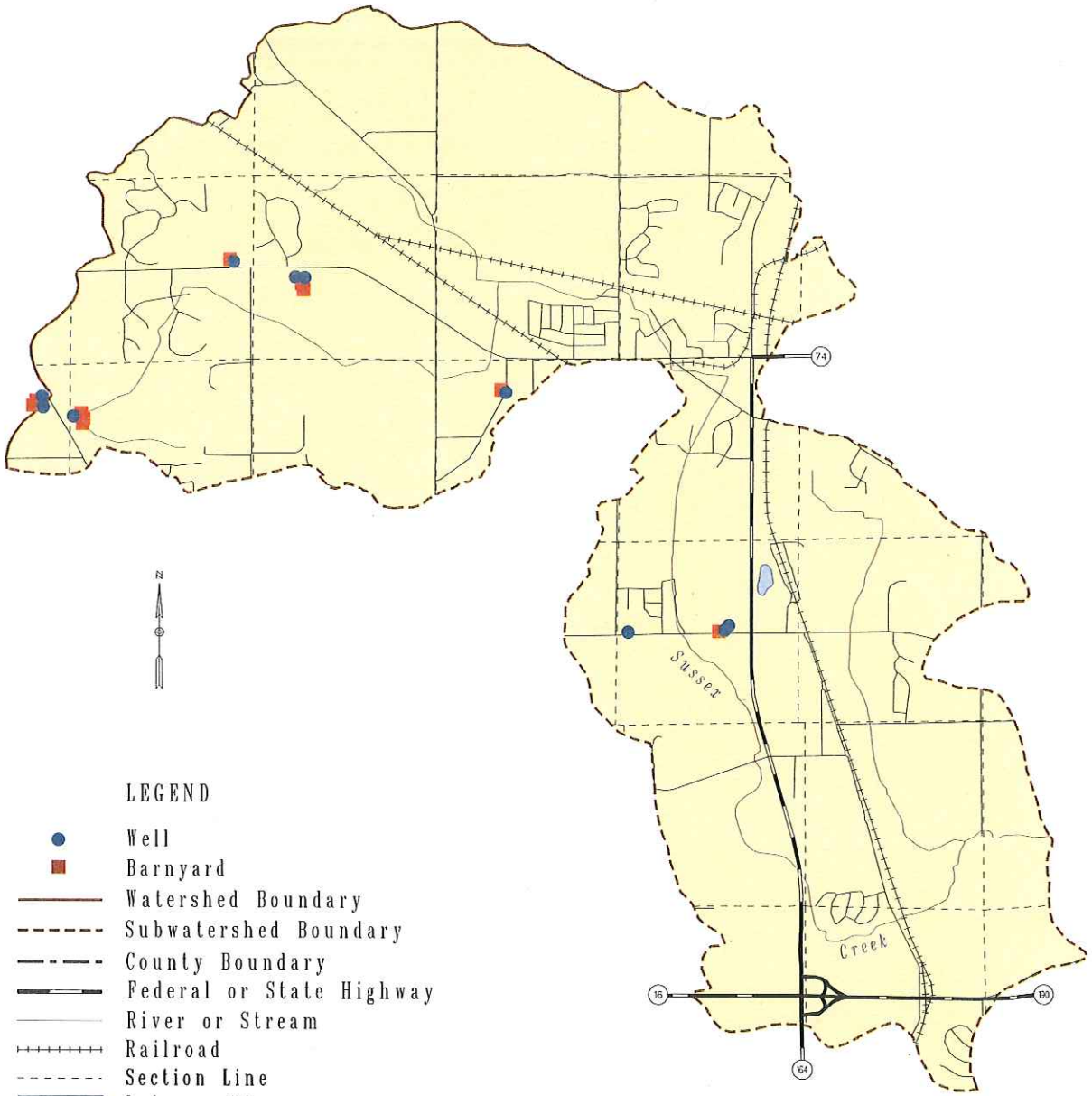
April 1994

Map 3.7 Sussex Creek Subwatershed



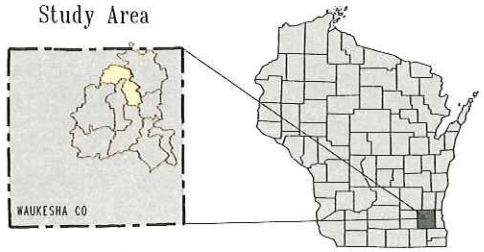
LEGEND

- Well
- Barnyard
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River

0 1 2 Miles

0 1 2 3 Kilometers

Study Area



Upper Fox River Watershed

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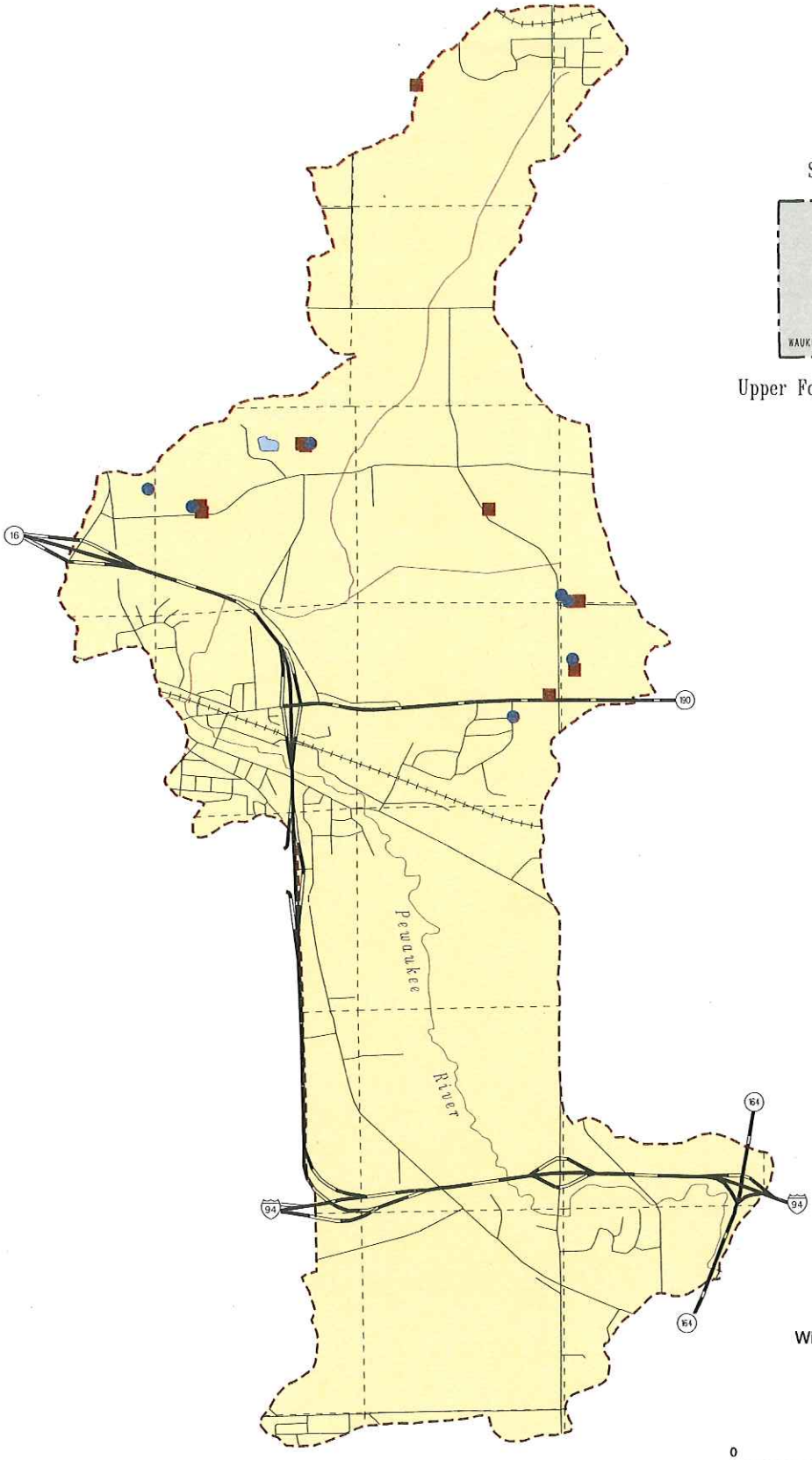
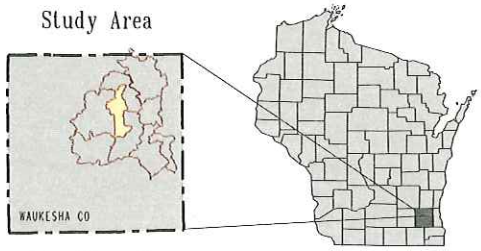
Map 3.8 Pewaukee River Subwatershed





Upper Fox River Watershed

LEGEND

- Well
- Barnyard
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River

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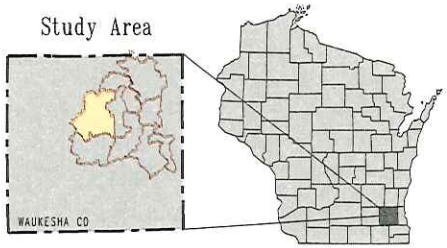
0 0.5 1 1.5 2 Miles

0 0.5 1 1.5 2 2.5 3 Kilometers

Map 3.9 Pewaukee Lake Subwatershed



Upper Fox River Watershed

LEGEND

- Well
- Barnyard
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River

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0 1 2 3 Kilometers

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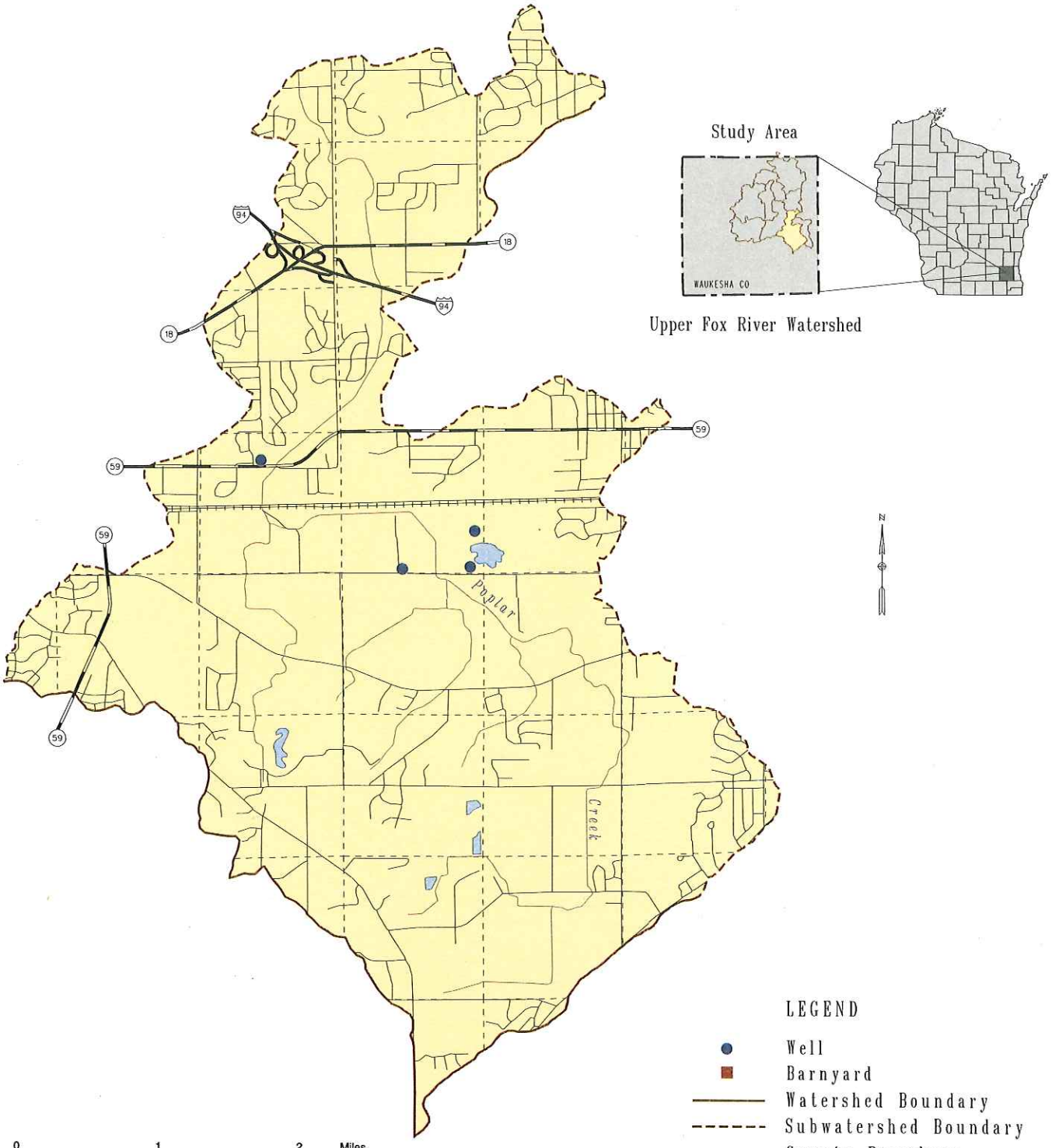
April 1994

Map 3.10 Poplar Creek Subwatershed



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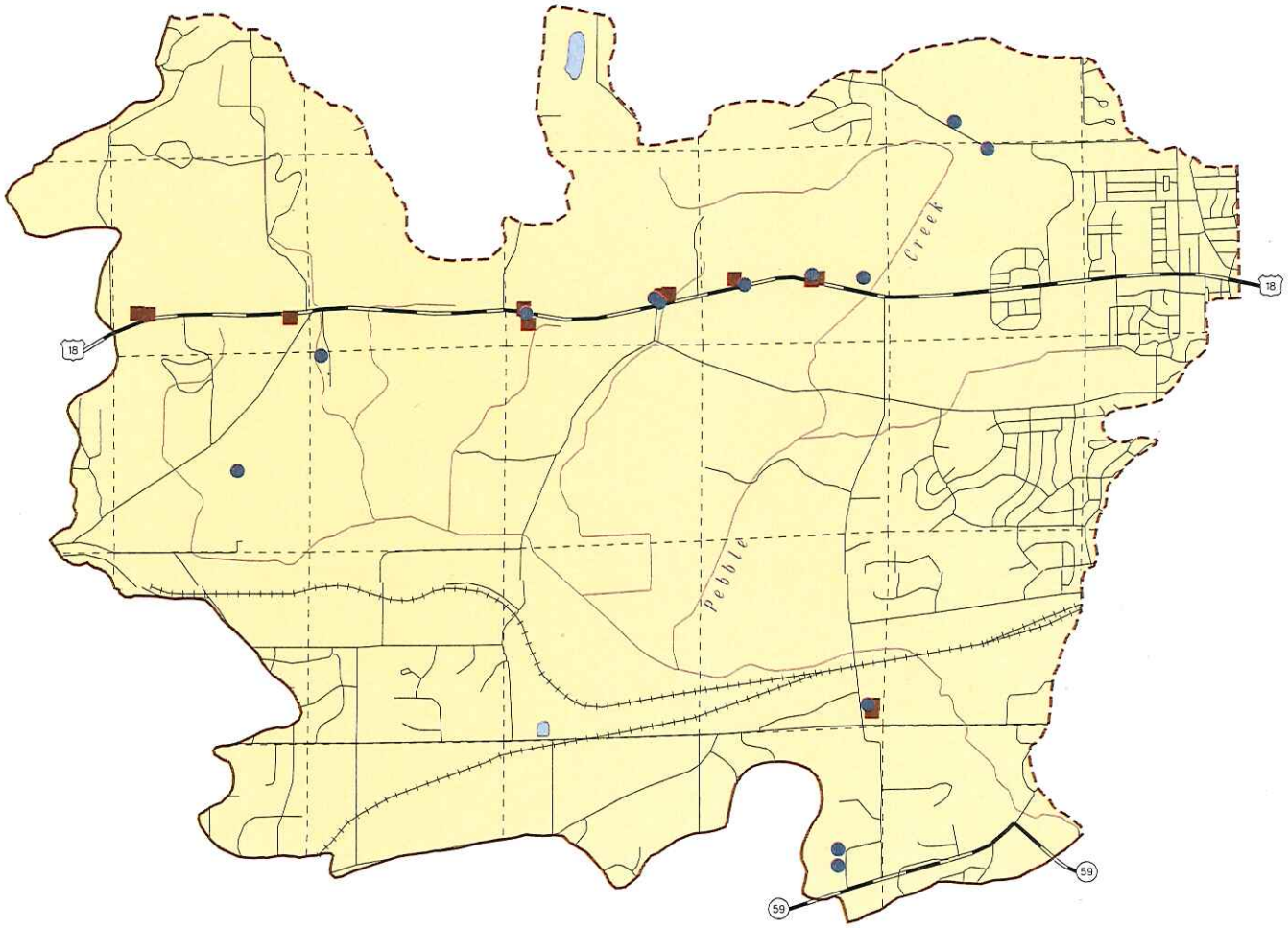
Map 3.11 Pebble Creek Subwatershed



LEGEND

- Well
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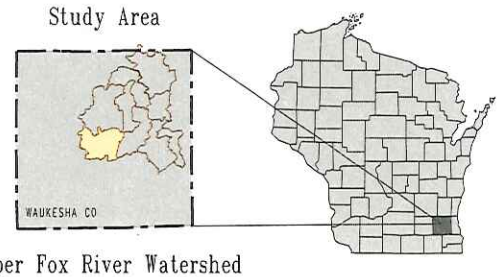
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River



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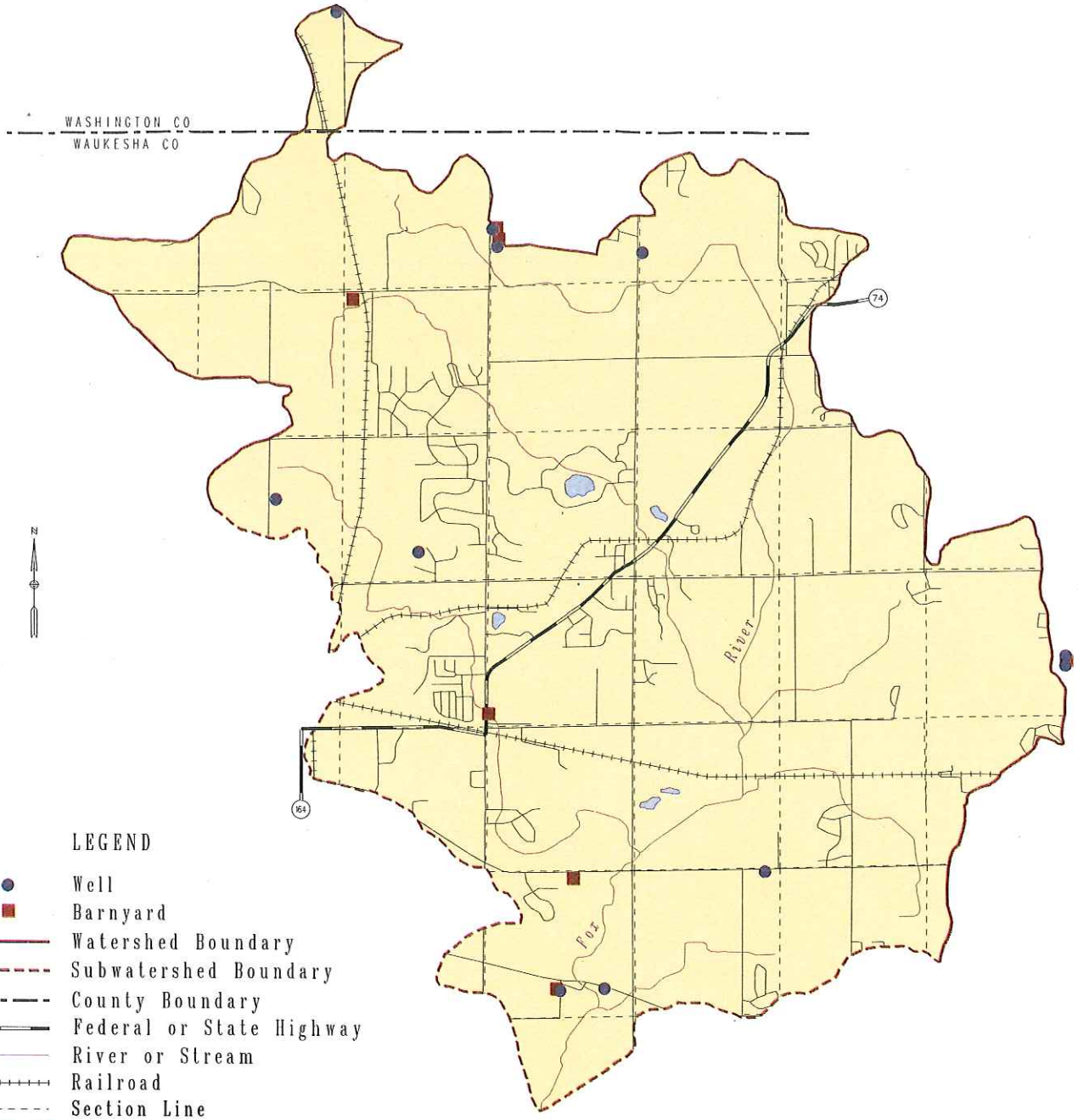
April 1994

Map 3.12 Northern Fox Subwatershed



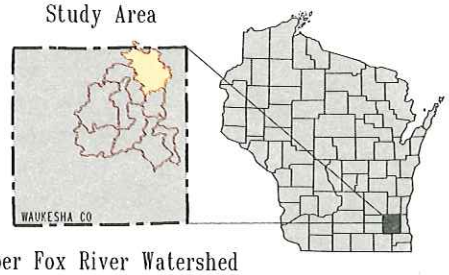
LEGEND

- Well
- Barnyard
- Watershed Boundary
- Subwatershed Boundary
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River

0 1 2 Miles

0 1 2 3 Kilometers

Study Area



Upper Fox River Watershed

Wisconsin Department of Natural Resources
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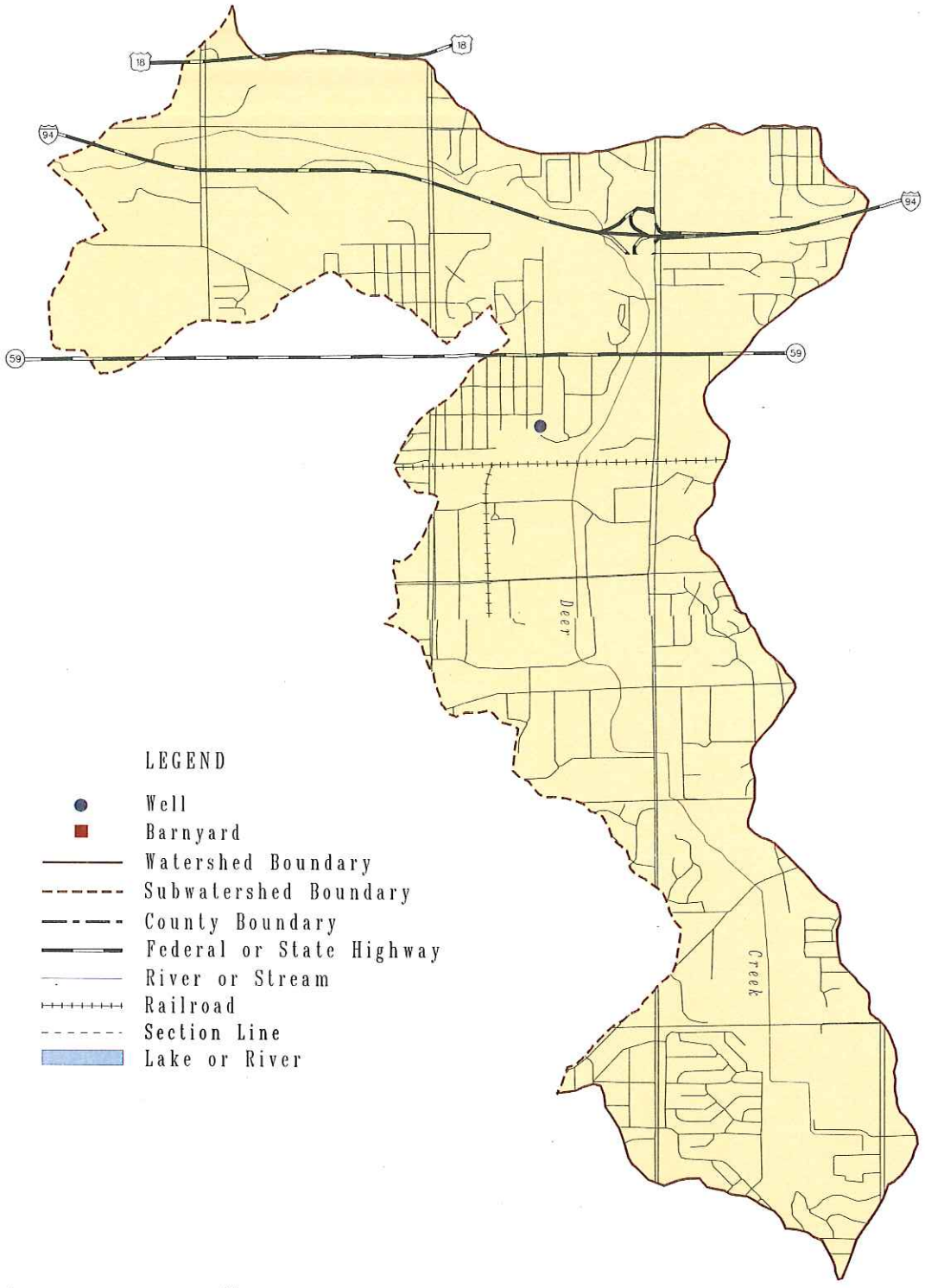
April 1994

Map 3.13 Deer Creek Subwatershed



LEGEND

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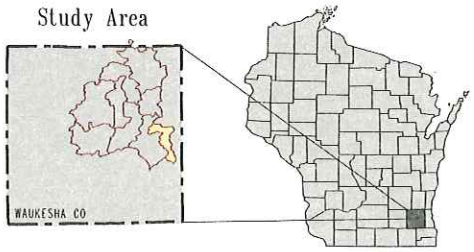
- County Boundary
- Federal or State Highway
- River or Stream
- Railroad
- Section Line
- Lake or River

Study Area



Upper Fox River Watershed

0 1 2 Miles

0 1 2 3 Kilometers

Wisconsin Department of Natural Resources
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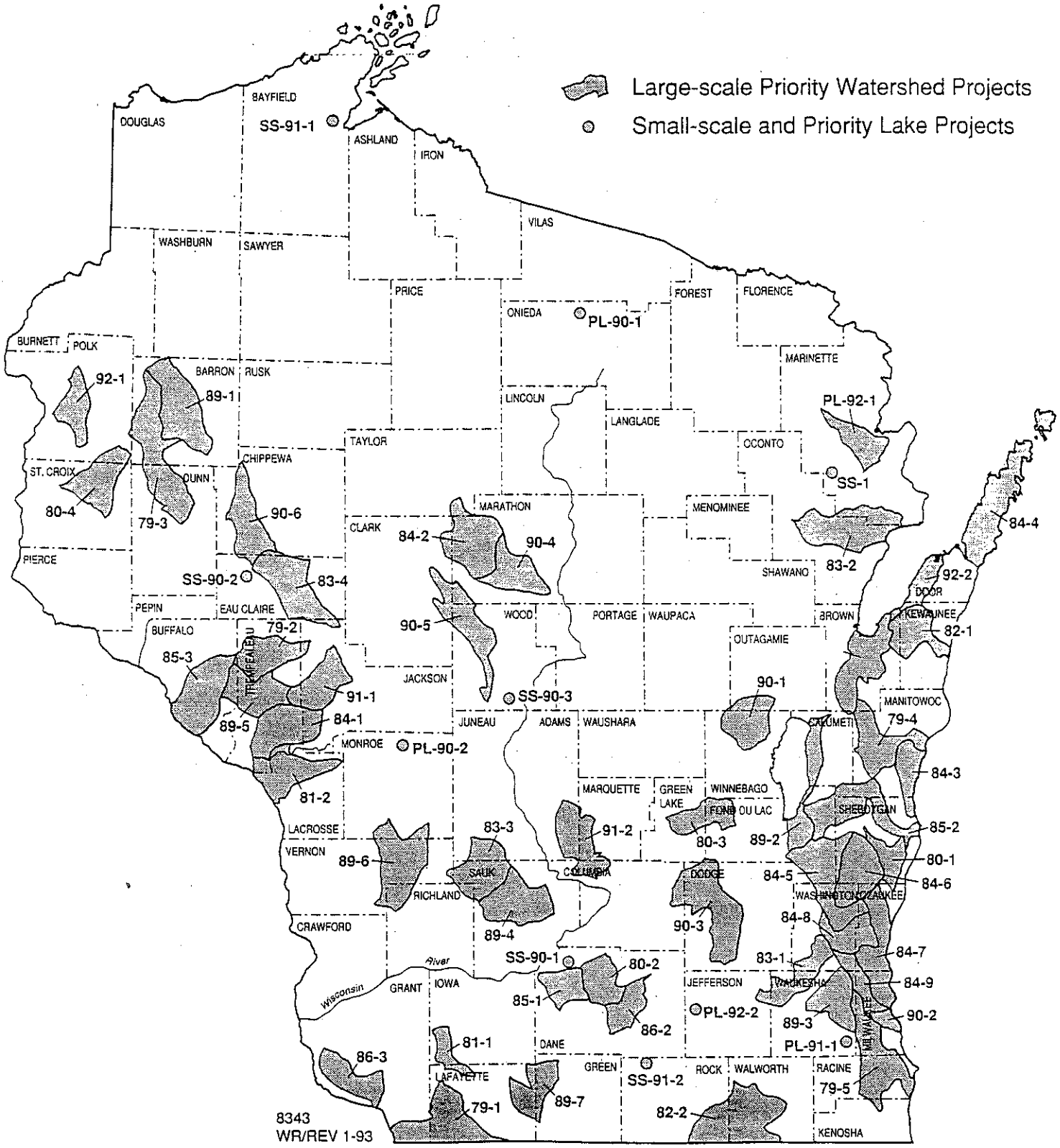
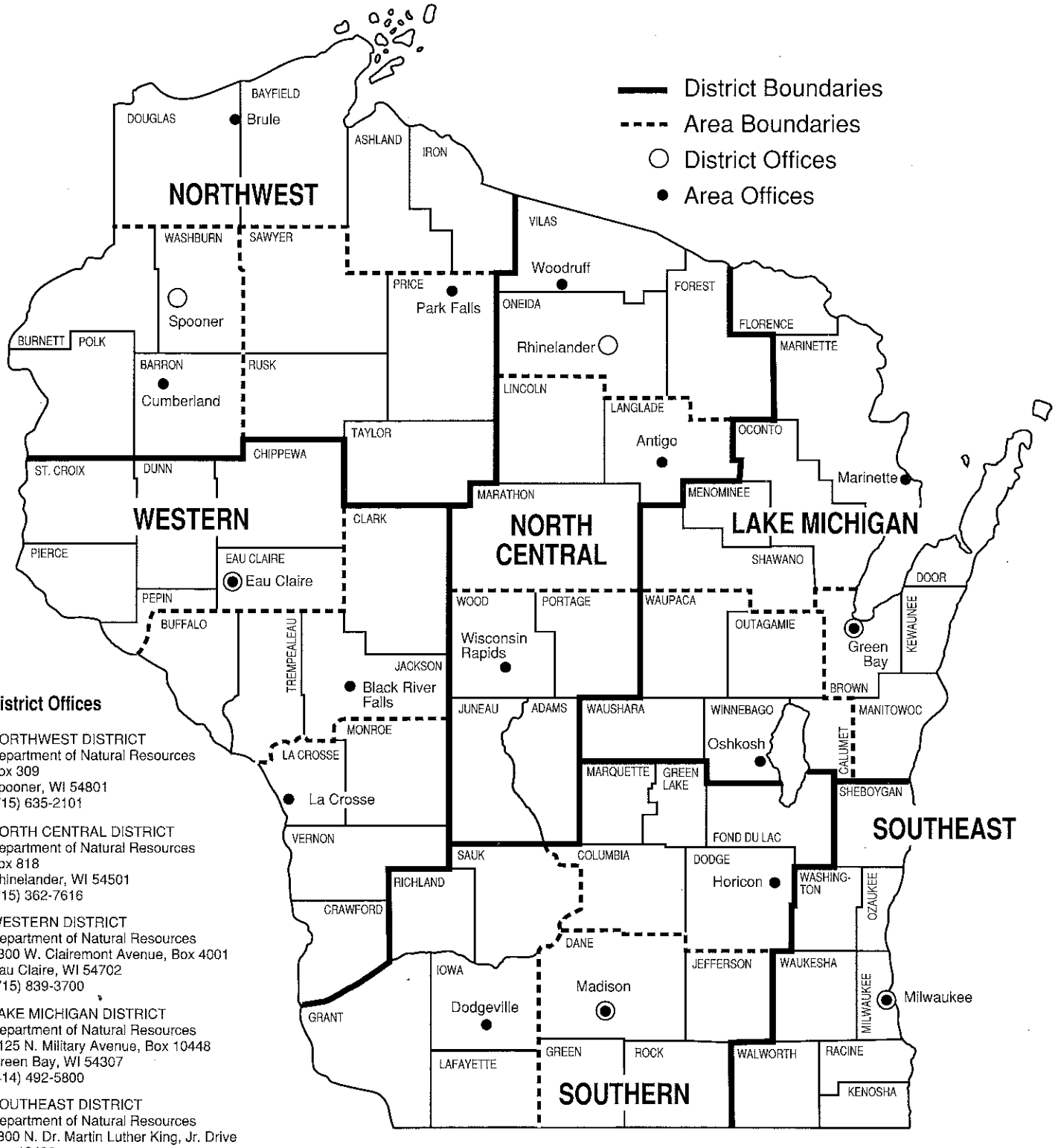
Priority Watershed Projects in Wisconsin
1992



DNR Field Districts and Areas



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Department of Natural Resources
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Spooner, WI 54801
(715) 635-2101

NORTH CENTRAL DISTRICT
Department of Natural Resources
Box 818
Rhinelander, WI 54501
(715) 362-7616

WESTERN DISTRICT
Department of Natural Resources
1300 W. Clairemont Avenue, Box 4001
Eau Claire, WI 54702
(715) 839-3700

LAKE MICHIGAN DISTRICT
Department of Natural Resources
1125 N. Military Avenue, Box 10448
Green Bay, WI 54307
(414) 492-5800

SOUTHEAST DISTRICT
Department of Natural Resources
2300 N. Dr. Martin Luther King, Jr. Drive
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Milwaukee, WI 53212
(414) 263-8500

DNR, Richards Street Annex
4041 N. Richards Street
Box 12436
Milwaukee, WI 53212
(414) 961-2727

SOUTHERN DISTRICT
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711
(608) 275-3266

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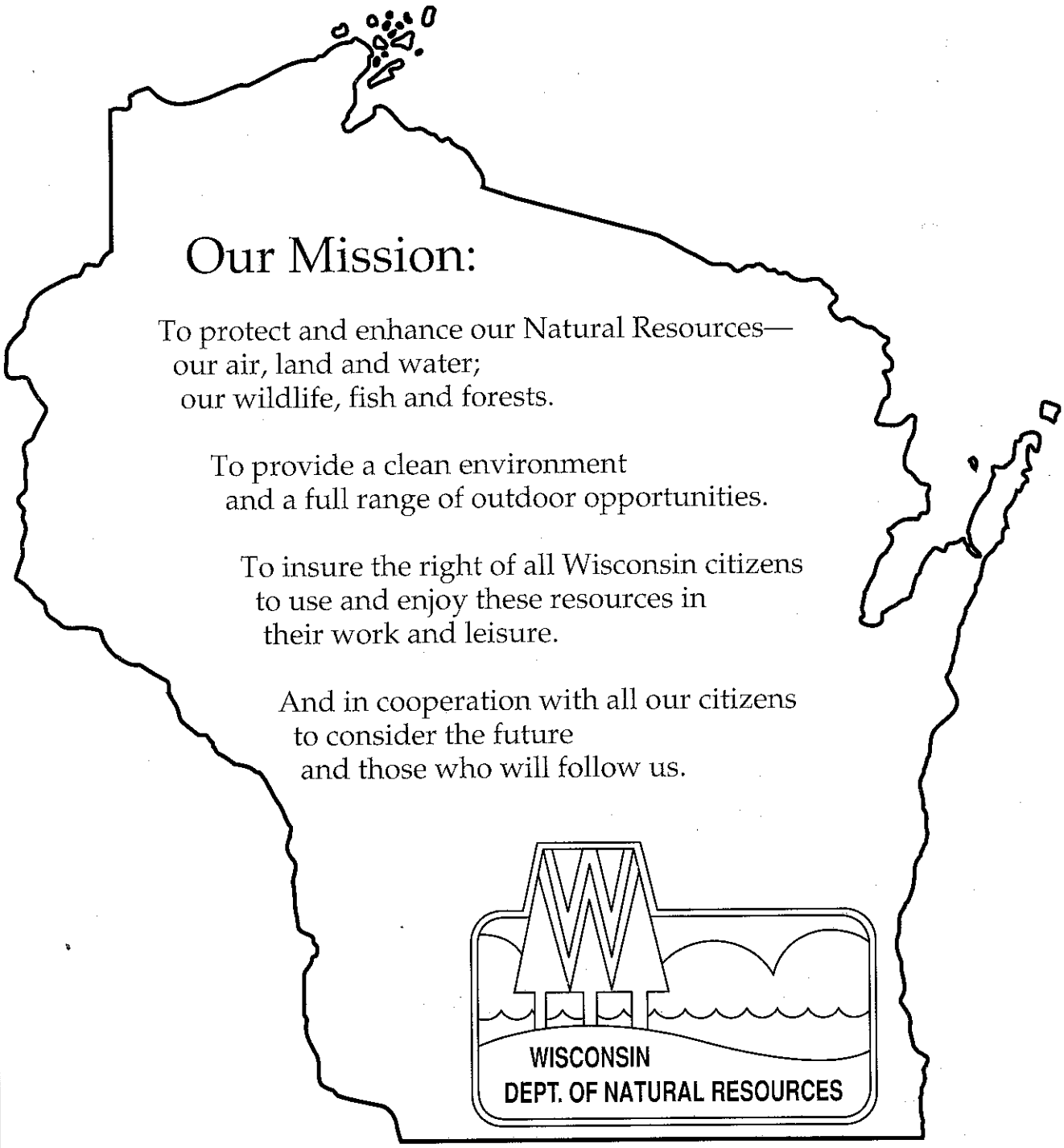

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To protect and enhance our Natural Resources—
our air, land and water;
our wildlife, fish and forests.

To provide a clean environment
and a full range of outdoor opportunities.

To insure the right of all Wisconsin citizens
to use and enjoy these resources in
their work and leisure.

And in cooperation with all our citizens
to consider the future
and those who will follow us.

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