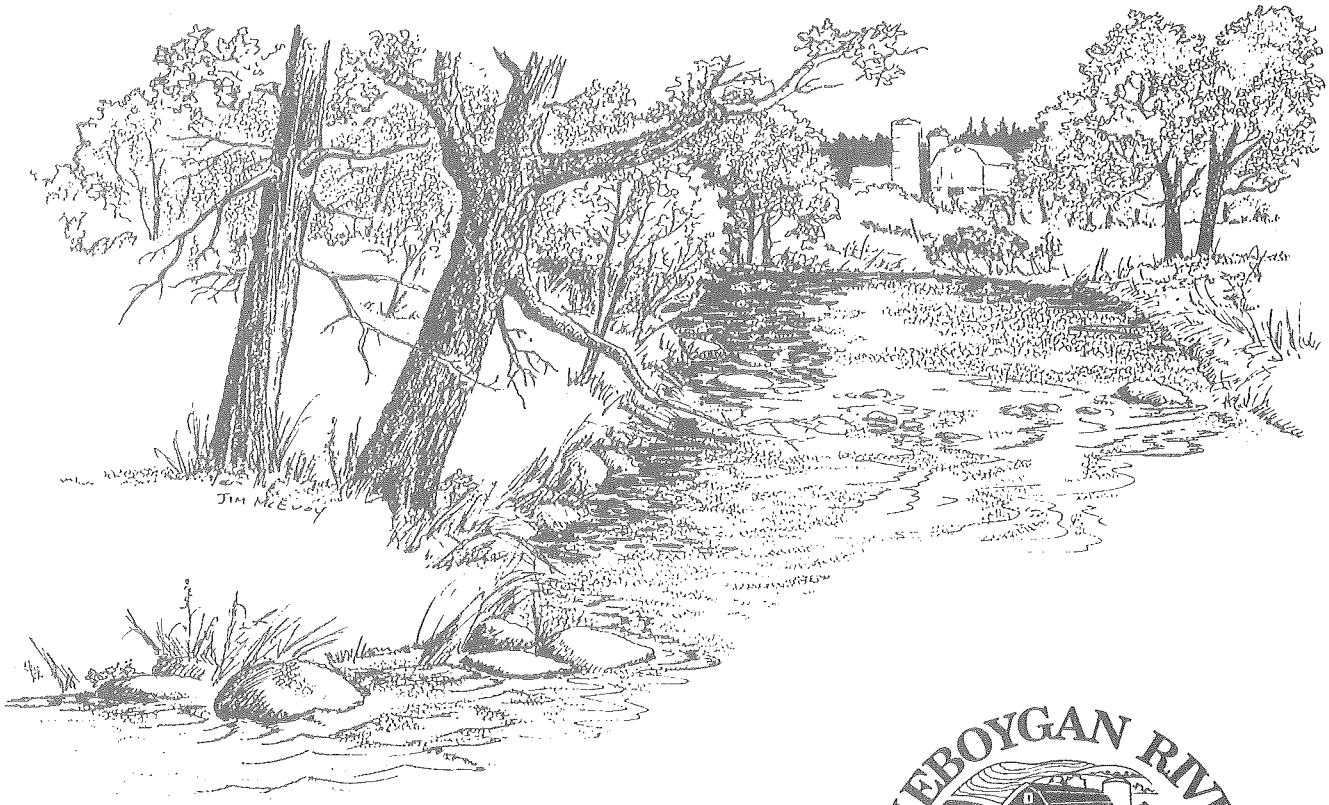
Nonpoint Source Control Plan for the Sheboygan River Priority Watershed Project



This plan was prepared under the provisions of the Wisconsin Nonpoint Source Water Pollution Abatement Program by the Wisconsin Department of Natural Resources, the Department of Agriculture, Trade and Consumer Protection, and the Land Conservation Departments of Sheboygan, Fond du Lac, Calumet and Manitowoc Counties.

WATERSHED PLAN ORGANIZATION INFORMATION

Natural Resources Board

Herbert F. Behnke, Chair
Trygve A. Solberg, Vice Chair
Neal W. Schneider, Secretary
Betty Jo Nelsen
Mary Jane Nelson
James E. Tiefenthaler, Jr.
Stephen D. Willett

County Land Conservation Committees

Calumet County

Donald Schwobe, Chair
Roman Kappus
William Barribeau
Patrick Laughrin
Peter Dorn
Ralph Steiner

Fond du Lac County

Leonard Rosenbaum, Chair
Mary Schuster
Ray Puddy
Henry Hayes
Wilbert Schuster
Paul Ruedinger

Manitowoc County

Robert Wenzel, Chair
Glen S. Skubal
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Marie B. Kohlbeck
Janice Leschke
Glenn Shambeau

Sheboygan County

Wiliam O. Hand, Chair
Bernard H. Kistner
Raymond Karsteadt
Carl Rigotti
George Meyer
Herbert Dickman

Wisconsin Department of Natural Resources

George E. Meyer, Secretary
Lyman Wible, Administrator, Division for Environmental Quality
Bruce Baker, Director, Bureau of Water Resources Management
Rebecca Wallace, Chief, Nonpoint Source & Land Management Section

Wisconsin Department of Agriculture, Trade and Consumer Protection

Alan Tracy, Secretary
Nicholas Neher, Administrator, Division of Agriculture Resource Management
Dave Jelinski, Director, Bureau of Land and Water Resources
Keith Foye, Chief, Soil and Water Resource Management Section

NONPOINT SOURCE CONTROL PLAN FOR THE SHEBOYGAN RIVER PRIORITY WATERSHED PROJECT

The Wisconsin Nonpoint Source Water Pollution Abatement Program

July 1993

This Plan Was Cooperatively Prepared By:

The Wisconsin Department of Natural Resources;
The Wisconsin Department of Agriculture, Trade, and Consumer Protection;
The Calumet, Fond du Lac, Manitowoc, and
Sheboygan County Land Conservation Departments;
The University of Wisconsin Extension Service;
The cities of Sheboygan, Sheboygan Falls, and Kiel;
The villages of Kohler and Elkhart Lake; and
The Sheboygan River Watershed Citizen's Advisory Committee.

Publication WR-265-93

For copies of this document please contact:

Wisconsin Department of Natural Resources
Bureau of Water Resources Management
Nonpoint Source and Land Management Section
P.O. Box 7291
Madison, WI 53707

The Wisconsin 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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Sheboygan River Priority Watershed Citizen Advisory Committee
Southeast District staff, DNR
Land Conservation Department staff of Calumet, Fond du Lac, Manitowoc, and Sheboygan Counties

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny, Secretary
Box 7921
Madison, Wisconsin 53707
TELEFAX NO. 608-267-3579
TDD NO. 608-267-6897

January 29, 1991

IN REPLY REFER TO: 2600

Mr. James Gilligan, Chair
Sheboygan Co. Board of Supervisors
615 N. Sixth Street
Sheboygan, WI 53081

Mr. Wilbert Halbach, Chair
Fond du Lac Co. Board of Supervisors
City-County Government Center
160 S. Macy St.
Fond du Lac, WI 54093

Ms. Wilma Springer, Chair
Calumet Co. Board of Supervisors
Administrator Coord. Office
206 Court Street
Chilton, WI 53014

Mr. John Hockhammer, Chair
Manitowoc Co. Board of Supervisors
1010 South 8th Street
Manitowoc WI 54220

It is my pleasure to approve A Nonpoint Source Control Plan for the Sheboygan River Priority Watershed. This plan meets the intent and conditions of s. 144.25, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. This plan has been approved by Sheboygan, Fond du Lac, Manitowoc, and Calumet, Counties, as well as by the Wisconsin Department of Agriculture, Trade, and Consumer Protection. This completes the plan approval process as set forth in Wisconsin Statutes and allows the granting of funds through the Nonpoint Source Water Pollution Abate Program necessary to support the project.

This approval letter also amends the nonpoint source control plan to the Sheboygan River Basin Areawide Water Quality Management Plan.

I appreciate the high degree of cooperation on this project with the County Land Conservation Departments. Protection of the lakes, streams, and the Sheboygan Harbor are important goals for the county and the entire State of Wisconsin.

I look forward to our working together in carrying out the recommendations of the Sheboygan River Priority Watershed Plan.

Sincerely,

C. D. Besadny
Secretary

cc: Raymond Karsteadt, Chair Sheboygan Co. LCC
Leonard Rosenbaum, Chair Fond du Lac Co. LCC
Robert Wenzel, Chair Manitowoc Co. LCC
William Barribeau, Chair Calumet Co. LCC
Mr. Edward Strauss, Chair Sheboygan R. Watershed Advisory Committee
Gloria McCutcheon - DNR, SED
James Huntoon - DNR, SD

State of Wisconsin
Department of Agriculture, Trade & Consumer Protection

Alan T. Tracy
Secretary

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

January 11, 1990

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

Dear Mr. Baker:

The Department has had the opportunity to thoroughly review the Nonpoint Source Control Plan for the Sheboygan River Priority Watershed Project. We hereby approve this watershed plan and look forward to assisting the Department of Natural Resources and Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties in implementing this project. It is our understanding that the County Boards in the affected counties are approving of the plan at their December 1990 or January 1991 meetings.

The Sheboygan River Watershed marks the initial efforts by the State of Wisconsin to include landowner eligibility criteria for the restoration of wetlands and the use of easements in the Nonpoint Source Program. These items were an important component of the administrative rule changes to the program in 1988. The use of easements has the potential to improve participation and increase success of the installation of best management practices, especially on riparian lands. Jim Bachhuber and other members of your staff which worked on this criteria should be congratulated on this effort.

If I or any members of my staff can be of any further assistance please let me know.

Sincerely,

James A. Johnson, Director
Land and Water Resources Bureau
AGRICULTURAL RESOURCE MANAGEMENT DIVISION
(608) 267-9788

JAJ:KWF

cc: Nicholas Neher
Dave Jelinski
Charles Burney

No. 90/91-113

RESOLUTION APPROVING THE SHEBOYGAN RIVER WATERSHED PLAN

TO THE CHAIRPERSON AND BOARD OF SUPERVISORS
OF MANITOWOC COUNTY, WISCONSIN

Supervisors:

WHEREAS, the Sheboygan River Watershed was designated a priority watershed in 1985 in the four counties of Sheboygan, Fond du Lac, Manitowoc and Calumet, under the Wisconsin Non-point Source Pollution Abatement Program to improve and protect the water quality of streams, lakes, wetlands, and groundwater by reducing pollutants from urban and rural nonpoint sources; and

WHEREAS, the inventory and planning phases of the project have been completed under the direction of the Manitowoc County Land Conservation Committee in cooperation with the Wisconsin Department of Natural Resources and the Sheboygan County Land Conservation Committee; and

WHEREAS, a priority watershed plan has been prepared which assesses the existing water quality and watershed conditions, and identifies the management practices and cost sharing assistance of over $300,000 to landowners to improve water quality; and

WHEREAS, the implementation of this plan will provide an estimated $202,000 to Manitowoc County for technical assistance to eligible landowners within the priority watershed for installation of practices designed to reduce non-point pollution and protect or improve the quality of Manitowoc and Sheboygan Counties' water resources; and

WHEREAS, a draft of the plan has been available for review, and comments were accepted at a public hearing held September 27, 1990 at the Kiel High School.

NOW, THEREFORE, BE IT RESOLVED, by the Manitowoc County Board of Supervisors, that the "Plan for the Control of Non-point Source Pollution in the Sheboygan River Watershed" be approved and that the Land Conservation Committee be given the authority and responsibility to act on behalf of Manitowoc County to administer this Priority Watershed Project as outlined in the Plan.

Dated this 15th day of January, 1991.

Respectfully submitted,

Manitowoc County Land Conservation Committee

FISCAL IMPACT: Estimated $300,000 cost sharing assistance to landowners and $202,000 to Manitowoc County for technical assistance to landowners

Adopted this 15th day of January, 1991.
27 Ayes 0 Noes 4 Absent

ATTEST:
Daniel R. Fischer
County Clerk

RESOLUTION ADOPTING THE SHEBOYGAN RIVER
NONPOINT SOURCE PRIORITY WATERSHED PLAN

WHEREAS, the Sheboygan River Watershed was designated a "Priority Watershed" in 1985 under the Wisconsin Nonpoint Source Water Pollution Abatement Program, and

WHEREAS, the County Land Conservation Department in cooperation with the Wisconsin Department of Natural Resources conducted a detailed inventory of the land use within the watershed in 1987 and 1988, and

WHEREAS, this inventory resulted in the development of a detailed Nonpoint Source Control Plan for the watershed, and

WHEREAS, a number of public information meetings have been conducted throughout the watershed, and an official public hearing was conducted on October 29 and October 30, 1990, and

WHEREAS, pertinent public comments have been incorporated into the plan, and

WHEREAS, each county within the watershed, wishing to receive cost-sharing grants for landowners in the watershed, must first adopt the Sheboygan River Watershed Plan.

NOW, THEREFORE, BE IT RESOLVED by the Fond du Lac County Board of Supervisors that the Sheboygan River Nonpoint Source Priority Watershed Plan be adopted and that implementation of the plan begin as soon as possible.

Dated December 18, 1990

LAND CONSERVATION COMMITTEE

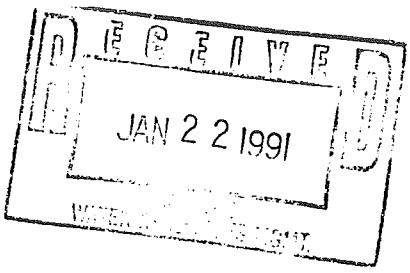
FISCAL NOTE: Costs to the County for implementation of the Sheboygan River Watershed plan are reimbursed 100%, except for office supplies and equipment which is reimbursed at 70%. The County's share for supplies and equipment has been included in the 1991 budget.

APPROVED BY:

M. Anita Anderegg
COUNTY EXECUTIVE

APPROVED BY:

Thomas L. Storm
CORPORATION COUNSEL



RESOLUTION 1990-51

RESOLUTION ADOPTING THE SHEBOYGAN RIVER
NONPOINT SOURCE PRIORITY WATERSHED PLAN

To the Honorable Chairperson and Board of Supervisors of Calumet County, Wisconsin:

WHEREAS, The Sheboygan River Watershed was designated a "Priority Watershed" in 1985 under the Wisconsin Nonpoint Source Water Pollution Abatement Program, and

WHEREAS, A detailed inventory of the land use within the watershed was conducted in 1987 and 1988, and

WHEREAS, This inventory resulted in the development of a detailed Nonpoint Source Control Plan for the watershed, and

WHEREAS, A number of public information meetings have been conducted throughout the watershed, and an official public hearing was conducted on October 29, and October 30, 1990, and

WHEREAS, Pertinent public comments have been incorporated into the Plan, and

WHEREAS, Each county within the watershed, wishing to receive cost-sharing grants for landowners in the watershed, must first adopt the Sheboygan River Watershed Plan, and

WHEREAS, Costs to the County for implementation of the Sheboygan River Watershed Plan are reimbursed 100%, except for office supplies and equipment which is reimbursed at 70% and the County's share for supplies and equipment has been included in the 1991 budget.

NOW, THEREFORE, BE IT RESOLVED By the Board of Supervisors of Calumet County herein assembled, that the Sheboygan River Nonpoint Source Priority Watershed Plan be adopted and that implementation of the Plan begin as soon as possible.

Dated this 15th Day of January, 1991.

Countersigned by:

Wilma Springer, Chairperson
COUNTY BOARD OF SUPERVISORS

INTRODUCED BY THE
LAND CONSERVATION COMMITTEE

William Barribeau, Chairperson

Alvin Ott

Donald Schwobe

Charles Lisowe

Peter Dorn

This resolution was approved by the County Board at their meeting held on January 15, 1991.

Donna Schreiber
County Clerk

RESOLUTION NO. 42 (1990/91) RE: SHEBOYGAN WATERSHED PLAN

WHEREAS, the Sheboygan River Watershed has been selected as a priority watershed by the Wisconsin Department of Natural Resources for priority funding to control non-point sources of water pollution; and

WHEREAS, the Sheboygan River Basin area-wide water quality plan designates Sheboygan County and the Sheboygan County Land Conservation Committee as designated management agencies in unincorporated areas of Sheboygan County and cities and villages as designated management agencies within their boundaries; and

WHEREAS, the Sheboygan County Board of Supervisors, through the Sheboygan County Land Conservation Committee, has the broad powers necessary to carry out the non-point source water quality program, and the Land Conservation Committee is responsible for providing technical assistance and administration cost sharing agreements for land management practices and project administration; and

WHEREAS, the Land Conservation Committee has reviewed the final draft of the Sheboygan River Plan and recommends approval of the Plan by the Board; and

WHEREAS, the County will be reimbursed for all costs incurred, including indirect costs, from state funds,

NOW, THEREFORE, BE IT RESOLVED, that the Sheboygan County Land Conservation Committee be authorized to cooperate in the planning, development, and administration of all portions of the Sheboygan River Priority Watershed Plan within Sheboygan County, including administration of state funds that will be provided to implement this program, and a copy thereof be filed in the Office of the County Clerk.

BE IT FURTHER RESOLVED that Sheboygan County reserves the right to request future amendments to the watershed plan in order to incorporate new cost sharing opportunities for landowners, to facilitate needed changes in technical standards and specifications, to extend sign-up periods, or to include other changes currently proposed in the Administrative Rules NR-120.

BE IT FURTHER RESOLVED that the Sheboygan County Land Conservation Committee be authorized, at no cost to the County, to set up a separate Sheboygan River Watershed account and to receive state watershed funds to cover project costs and personnel hired to plan and implement the program.

Respectfully submitted this 15th day of January, 1991.

LAND CONSERVATION COMMITTEE

Raymond Karsteadt
Raymond Karsteadt, Chairman

Elmer C. Grahl
Elmer C. Grahl, Vice-Chairman

William O. Hand
William O. Hand, Secretary

Elmer R. Gumm

William T. Jens
William T. Jens

(Summary of Plan is being circulated with this Resolution. Text of complete Plan is on file with the County Clerk's Office.)

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SUMMARY

Introduction

The Sheboygan River Priority Watershed Project Plan assesses the rural and urban nonpoint sources of pollutants in the Sheboygan River Watershed and guides the implementation of nonpoint source control measures. These control measures are needed to meet specific water resources objectives for the Sheboygan River, its tributaries and lakes in the watershed, and to improve the quality of the near shore waters of Lake Michigan. This summary document provides an overview of the information contained in the watershed plan.

Rural nonpoint sources of pollutants most commonly found in this watershed include:

- sediment from cropland erosion
- polluted runoff from barnyards and feedlots
- sediment from eroding streambanks
- runoff from areas winter-spread with livestock manure.

Urban nonpoint pollutant sources include:

- construction sites
- freeways
- industrial areas
- commercial areas
- residential areas

Major pollutants from urban sources are sediment, phosphorus and heavy metals. The purpose of this project is to reduce the amount of pollutants originating from both rural and urban nonpoint sources that reach the surface waters and groundwater within the Sheboygan River Priority Watershed Project area.

The plan was prepared by the Wisconsin Department of Natural Resources (DNR) and the Department of Agriculture, Trade, and Consumer Protection (DATCP); and the following:

- The Land Conservation Departments of Sheboygan, Fond du Lac, Manitowoc and Calumet counties
- The cities of Sheboygan, Sheboygan Falls, and Viel
- The villages of Kohler and Elkhart Lake
- The University of Wisconsin Extension Service
- The Sheboygan River Watershed Citizen's Advisory Committee

The DNR selected the Sheboygan River Watershed as a priority watershed project through the Wisconsin Nonpoint Source Water Pollution Abatement Program. It joins 40 similar watershed projects statewide where nonpoint source control measures are being planned and implemented. The Nonpoint Source Water Pollution Abatement Program was created in 1978 by the State Legislature. The program provides financial and technical assistance to landowners and local governments to reduce nonpoint source pollution.

The project is administered on the state level by DNR and DATCP. Each county land conservation department (LCD) will administer the appropriate rural portions of the project on the local level with assistance from UW-Extension and the Soil Conservation Service (U.S. Department of Agriculture). The urban portions of the project will be administered by the respective municipalities.

General Watershed Characteristics

The Sheboygan River Watershed is located in east-central Wisconsin and drains an area of land situated between Lake Winnebago and Lake Michigan. The watershed is a sub-basin of the larger Sheboygan River drainage basin which includes, along with the Sheboygan River, the Pigeon River, Mullet River, Onion River, Black River, and direct tributaries to Lake Michigan. The Sheboygan River Watershed drains approximately 245 square miles or about 157,100 acres. Surface water in the watershed drains via the Sheboygan River in an easterly direction into Sheboygan Harbor and Lake Michigan.

The watershed lies in portions of four counties: Sheboygan, Fond du Lac, Calumet, and Manitowoc. Table 1 shows the distribution of land area and population among these counties.

Sheboygan County has the largest contributing drainage area with 52 percent of the watershed (127 square miles). Thirty percent of the watershed lies in Fond du Lac County

(74 square miles), eleven percent (27 square miles) in Manitowoc County, and 7 percent (17 square miles) in Calumet County make up the remainder of the watershed.

The population of the Sheboygan River Watershed is estimated at 69,338 people. The majority (about 81 percent) reside in incorporated areas, with most concentrated in the metropolitan area containing the cities of Sheboygan, Sheboygan Falls, and Kiel, and the village of Kohler (table 2). The fastest growing urban areas in the watershed in the last decade were the villages of Kohler and Elkhart Lake, and the city of Sheboygan Falls.

Table 1. Distribution of the Sheboygan River Watershed Land Area and Population

	Land Area		Population	
County	Area Within Watershed (square miles)	Percent Watershed	Population Estimate	Percent Population
Calumet	17	7%	3,834	5%
Manitowoc	27	11%	1,228	2%
Fond du Lac	74	30%	5,616	8%
Sheboygan	127	52%	58,660	85%
Total	245	100%	69,338	100%

Source: DNR Sheboygan River Urban and Rural Inventories

Table 2. Watershed Population Estimates

	Population	Percentage of Watershed Populations
city of Sheboygan	43,646	63%
city of Sheboygan Falls	5,580	8%
city of Kiel	3,118	4%
village of Kohler	1,793	3%
village of Elkhart Lake	1,075	2%
village of Mt. Calvary	636	<1%
village of St. Cloud	568	<1%
Unincorporated areas	12,922	19%
Total	69,338	100%

Source: Department of Transportation Demographic Services Center, 1989 official estimates

The remainder of the watershed population (about 19 percent) live outside incorporated areas in small enclaves of residential development around lakes, or on farmsteads. Many of the rural townships have experienced slight population declines over the last decade. However, overall, populations in all four counties have remained stable or have increased slightly.

Land uses in the watershed are mostly rural. Agricultural uses and related open space account for 68 percent of the drainage area. Woodlands cover eight percent. The remaining rural land use includes wetlands and surface water, which comprises about 15 percent of the watershed area (table 3).

Table 3. Land Use in the Sheboygan River Watershed

Land Use	Percent of Watershed
Agricultural	
pasture, grazed woodlot	1%
cropland	61%
Grassland	5%
Woodland	8%
Urban and Developing	9%
Wetlands and Surface Water	15%

Urban land uses (including developing areas) occupy about nine percent of the watershed or approximately 13,946 acres. Most of the urban land (76 percent or 10,530 acres) consists of the Sheboygan metropolitan area. According to projections, the urbanized area population is expected to increase at an overall rate of approximately three percent per year in the next 20 yea). About one percent of the land in the watershed is currently under development.

Most of the land in the watershed is used for agricultural purposes, although the percentage of land in farms has declined over the past decade, a trend which is occurring throughout the state. Milk production and dairy products are the predominant industry in all four counties in the watershed. Manufacturing accounts for a large share of employment in the watershed (about 40 percent), but is limited for the most part to the cities of Sheboygan, Sheboygan Falls, and the village of Kohler.

The watershed may be divided into three distinct regions based on surface features formed by glacial drift deposits. Soil types vary within the watershed. Soils in the western portion tend to be loamy and light to medium textured, with patches of poorly drained areas. A narrow central band of steep hills is associated with the Kettle Moraine in this region. Poorly drained soils occur in low portions of this region where vast areas of peat and muck deposits are common. Soils in the eastern third of the watershed are "heavy" clay soils that tend to have poor infiltration and poor percolation, but are of high fertility. Following rainfall, the streams of the watershed exhibit a distinct red color from the suspended silts and clays.

Water Resources

For the purposes of this project, the watershed has been divided into 21 subwatersheds. All of the subwatersheds convey surface water directly or via tributaries into the Sheboygan River, except the Little Subwatershed which is internally drained. The Sheboygan River originates as a trout stream in Fond du Lac County and flows generally eastward before entering Lake Michigan at the city of Sheboygan Harbor.

Approximately 232 miles of streams drain the Sheboygan River Watershed. The Sheboygan River main stem accounts for approximately 81 miles. The Sheboygan River main stem and its tributaries exhibit wide variance in water quality. The overall water quality in the Sheboygan River Basin is described as fair to poor, and is not meeting its biological or recreational potential.

Water resource appraisals indicate there are currently 3.9 miles of Class I trout water (Millhome Creek, Schuett Creek, and a headwaters segment of the South Branch of the Sheboygan River), and about 1.8 miles of Class II trout water (Feldner's Creek and a headwaters segment of the South Branch of the Sheboygan) in the watershed. These streams are only partially meeting their potential. They suffer from sedimentation and altered flows that result from channelization, altered wetlands and spring sources, and streambank and habitat degradation from agricultural sources.

All main stem segments of the Sheboygan River are classified as warmwater sport fisheries, with diverse assemblages of both sport and forage fish species. The actual biological communities present in these segments vary according to natural and man-altered habitat conditions and by changes in water quality resulting from point and nonpoint source pollutants.

Segments from Sheboygan Falls to Lake Michigan experience seasonal runs of salmon and trout from Lake Michigan. A fish consumption advisory has been in effect since 1978 for the lower Sheboygan River and harbor, and a waterfowl advisory was placed on the lower Sheboygan River in 1987 because of PCBs (polychlorinated biphenyl) found in animal tissues.

Six natural lakes (larger than 20 acres) and 12 impoundments (ten on the Sheboygan River) are located in the Sheboygan River Watershed.

Approximately 24,000 acres of productive wetlands remain within the Sheboygan River watershed. The area covered by wetlands represents a significant portion of the watershed (15 percent) and amounts to roughly three percent of the total wetlands remaining in the state. Two major wetland complexes, Sheboygan Marsh (14,000 acres), and Kiel Marsh (approximately 800 acres) are present in the watershed. These are very important wildlife and fishery recreational areas.

Sources of Pollution

Rural Nonpoint Pollutant Sources

The land conservation departments collected data on all agricultural lands, barnyards, manure storage sites, and streambanks in the watershed. These data were used to estimate the pollutant potentials of these nonpoint sources. The amount of phosphorus carried in runoff from each barnyard to a receiving creek was calculated. The amount of sediment reaching streams from eroding agricultural lands and streambanks was also determined. In the Sheboygan River Watershed, 95 percent of the sediment deposited in streams annually is derived from agricultural upland erosion.

The results of the investigations of rural nonpoint sources are summarized below:

Barnyard Runoff Inventory Results:

- 286 barnyards were assessed, of which 217 have runoff that reaches streams.
- 67 barnyards were identified as being internally drained and will be further investigated for the potential to adversely impact groundwater.

Manure Spreading Inventory Results:

- 285 livestock operations produce 176,600 tons of manure.
- About 1,992 acres have high pollution potential.
- 7,000 acres of suitable land are needed to safely spread this manure.

Streambank Erosion Inventory Results:

- 220 miles were inventoried, excluding the mainstream in the Kohler and Oxbow subwatersheds.
- There are approximately eight miles of eroding sites, involving 175 sites.
- 619 tons of sediment reach streams from eroding sites.
- The Wilson, Maple Comer and Airport subwatersheds have the highest rates of erosion per stream mile.
- 76 percent of the sediment from streambank erosion is from Weeden's Creek (Wilson Subwatershed) and the Sheboygan River and its tributaries in Airport and South Branch subwatersheds.

- Sediment from streambank erosion constitutes only about four percent of that from upland sources.

- Stream-side and streambed degradation resulting from cattle access amounts to about seven miles of habitat, especially along the South Branch and North Branch of the Sheboygan River in Fond du Lac County.

Upland Sediment Inventory Results:

- 145,879 acres were inventoried.

- 13,575 tons of sediment are delivered to streams, of which 95 percent is from cropland.

- The highest sediment delivery rates are found in the Franklin, Wayside Park, Maple Comers and Airport subwatersheds.

Urban Nonpoint Pollutant Sources

Urban nonpoint sources include runoff from existing urban areas such as established commercial, industrial, institutional, freeways and residential land uses and runoff from areas where new urbanization is anticipated.

An inventory of existing 1988 and planned year 2010 conditions was conducted with the aid of land use inventory data gathered from the city of Kiel 50-year Comprehensive Plan, the city of Sheboygan future land use map, and the city of Sheboygan Falls and village of Kohler public works departments. The delivery of urban pollutants to streams from existing urban areas was calculated using an urban runoff model which uses information regarding landuses, stormwater conveyance, and urban housekeeping practices. Three pollutants (sediment, phosphorus, and lead) were chosen to characterize the sources and severity of urban nonpoint pollution. Although urban nonpoint modelling was not conducted, the village of Elkhart Lake was also investigated for the impacts of runoff on Elkhart Lake.

The results of the investigations of urban nonpoint sources are summarized below:

Combined Pollutant Results:

- The city of Sheboygan contributes more than 50 percent of the estimated urban sediment, phosphorus, and lead loads that originate in urban areas and are delivered annually to streams in the watershed and near shore waters of Lake Michigan. This is not surprising since the city of Sheboygan is the largest urban area in the watershed.

Sediment:

- The total sediment load from urban areas in the watershed is 3,924 tons/year (about 22 percent of the total sediment load from both rural and urban sources).

- The most important source of sediment reaching surface waters from urban areas in the watershed is erosion from construction sites (which make up less than one percent of the urban land in the watershed). It was estimated that construction erosion contributed 2,697 tons of sediment to surface waters in the watershed. This is nearly 70 percent of the total from all urban nonpoint sources.

Phosphorus and Lead:

- Overall, contributions of phosphorus and lead to the Sheboygan River from urban areas are relatively low. Freeways, industrial areas, commercial areas, and high density residential areas are the greatest contributors of lead (as well as sediment) on a per-acre basis. However, as these types of land uses increase, increased levels of lead and other heavy metals may be anticipated.

- Medium density residential areas can generate significant quantities of lead.

Other Urban Pollutants:

- Medium density residential areas are significant sources of pesticides and bacteria. In addition, data from other urban areas have often identified various household or automotive maintenance products which have been dumped into the storm sewer systems. These contaminants are delivered directly to streams and lakes.

Pollutant Reduction Levels

To improve water quality in the Sheboygan River system, and ultimately the near shore waters of Lake Michigan, this plan calls for:

- A 50 percent reduction in the sediment reaching streams.

- A 50 percent reduction in the phosphorus loading to the main stem segments of the river is needed to reduce the nutrients which cause excessive weed and algae growth.

- Varying amounts of needed sediment and nutrient reductions have been determined for water resources other than the main stem segments.

- For urban sources, the following reduction levels have been established:

  For the communities of Sheboygan, Sheboygan Falls, and Kohler (as a group) the urban nonpoint source control targets are:

  a. a 50 percent reduction of the 1988 sediment load from the incorporated area

  b. a 40 percent reduction of the 1988 heavy metal load (as measured in lead) to reduce the potential of violating the state water quality standards in the stormwater

  For the city of Kiel, the urban nonpoint source control targets are:

  a. a 50 percent reduction of the 1988 sediment load from the incorporated area

  b. a 50 percent reduction of the 1988 heavy metal load (as measured in lead) to reduce the potential of violating the state water quality standards in the stormwater

Management Actions

Management actions are carried out through the installation of practices called Best Management Practices (BMPs). In rural areas, these BMPs may range from alterations in farm management (changes in manure-spreading, crop rotations) to engineered structures (diversions, sediment basins, manure storage facilities), and they are generally tailored to specific landowner situations. The county land conservation departments will assist owners, managers, and renters of agricultural lands in constructing Best Management Practices. In urban areas, control practices may range from hydrologic alterations designed to detain pollutants or slow flows (wet detention ponds, grassed swales) to housekeeping practices (reducing sources of pet waste, road salts, lawn fertilizers and pesticides) to governmental controls (construction site erosion ordinances). The DNR and others will assist local units of government in the development of urban nonpoint pollutant source control measures.

Cost-share funds for installing pollutant control measures will be targeted at sources which contribute the greatest amounts of pollutants. Landowner and municipality eligibility for cost sharing of these practices will depend on whether pollutant loads from their lands fall into the established pollutant reduction ranges set for each nonpoint source category. Cost-share funds will be available through the Wisconsin Nonpoint Source Water Pollution Abatement Program for certain management actions. As shown in Table 4, cost-share rates for rural BMPs range from 50 percent to 70 percent. Cost-share rates for urban BMPs are shown in Table 5 and rates for other urban activities are shown in Table 6.

The following is a brief description of critical nonpoint pollutant sources, project eligibility criteria, and BNP design targets for the project.

Agricultural Lands:

Almost 16,500 of the most critical upland agricultural acres have been targeted for the highest level of pollutant control. When controlled, these acres will reduce the contribution of sediment from this source by 42 percent.

An additional 17,000 acres are also eligible under this project for sediment control. The installation of BMPs on these acres would control an additional ten percent of the sediment originating from upland sources.

The Best Management Practices identified by the county land conservation departments emphasize both improving farm management and controlling pollutants. Table 4 shows the eligible practices and cost-share rates.

Animal Lots:

Out of 286 barnyards inventoried, 219 were assessed for possible impacts on surface waters. Of the 219 barnyards, 116 lots have been identified as needing pollutant controls. Fifty-nine of these lots are considered the most critical and will receive the highest priority, and the 57 additional lots will be eligible to receive cost-share funds for control practice installation, although these are not as critical.

Sixty-seven internally drained barnyards will be evaluated for groundwater pollution potential and cost sharing eligibility during the implementation phase of the project.

Manure-spreading:

Sheboygan River project participants who winter-spread manure on more than 15 acres of "unsuitable" land will be targeted as the highest priority for control measures. Operators who winter-spread on seven to 15 acres will also be eligible. In this project "unsuitable" lands for winter manure spreading are those lands with greater than six percent slope or which are flood prone. The county LCDs will assist farm operators in preparing management plans for proper manure spreading. A manure management plan identifies the proper spreading periods, application rates, and acceptable fields for manure spreading. A small number of the manure management plans may identify needs for manure storage facilities to prevent winter manure spreading on unsuitable lands.

Table 4. State Cost-share Rates for Rural Best Management Practices	
Best Management Practice	State Cost-share Rate
Contour Farming	50% [1]
Contour Strip Cropping	50% [1]
Field Strip Cropping	50% [1]
Field Diversions and Terraces	70%
Grassed Waterways	70%
Reduced Tillage	50%
Critical Area Stabilization	70%[2]
Grade Stabilization Structures	70%
Agricultural Sediment Basins	70%
Shoreline and Streambank Stabilization	70%
Shoreline Buffers	70% [2]
Barnyard Runoff Management	70%
Animal Lot Relocation	70%
Manure Storage Facilities	70%[3]
Livestock Exclusion from Woodlots	50%
Wetland Restoration	70% [2]
Roofs for Barnyard Runoff Management and Manure Storage Facilities	70%
Nutrient and Pesticide Management	50% [4]

1. Flat rates for these BMPs can be found in table 7-2. Wildlife habitat restoration components of this practice are cost-shared at 70 percent.

2. Easements may be entered into with landowners identified in the watershed plan in conjunction with these BMPS. See Chapter 6 of the draft plan for where easements may apply.

3. Maximum cost-share amount is $10,000 including no more than $5,000 for manure transfer equipment.

4. Spill control basins have a state cost-share rate of 70 percent.

Table 5. State Cost-share Rates for Urban Management Practices	
Best Management Practice	State Cost-share Rate
Critical Area Stabilization	70%[1]
Grade Stabilization Structures	70%
Shoreline and Streambank Stabilization	70%
Shoreline Buffers	70% [1]
Wetland Restoration	70% [1]
Structural Urban Practices	70% [2]
Upgraded Street Cleaning[3]	50%

1. Easements may be available in conjunction with these practices.
2. Applies only to structures for established urban areas.
3. Described in Appendix C of draft plan.

Source: Wisconsin Department of Natural Resources.

Table 6. Urban Implementation Activities Eligible for State Funding	
Activity	State Funding Rate
Develop Construction Erosion Control Ordinances	100%
Develop Stormwater Management Ordinances	100%
Engineering Feasibility Studies (Existing Urban Area)	100%[1]
Stormwater Management Studies (Planned Urban Area)	100%[1]
Design and Engineering for Structural BMPs	100%
Staff for Enforcing Construction Erosion and Stormwater Management Ordinances	100%[2]

1. Funding not available for drainage or flood control
2. Funding limited to 5 years. Staffing level based on approved work plan

Source: Wisconsin Department of Natural Resources.

Streambanks:

All project participants must restrict livestock access to perennial creeks in the watershed where there is evidence of trampling along the bank, damaged streambeds, or eroded streambanks from livestock. An estimated 44,000 feet of streambank in the watershed will require restricted cattle access.

In addition, all participants with identified eroding sites in the Maple Corner, South Branch Sheboygan, Wayside Park and Wilson subwatersheds must reduce streambank erosion by 75 percent. Participants in all other subwatersheds must reduce streambank erosion by 50 percent. Overall, approximately 400 tons per year of sediment must be controlled in the Sheboygan River Watershed. The restriction of livestock access may achieve all or part of this goal. Land acquisition in the form of easements may be used along the riparian lands of Cedar Lake, Wolf Lake, Wilke Lake, Elkhart Lake, South Branch Sheboygan River, Schuette Creek, Millhome Creek and Otter Creek.

Urban Practices:

The following two-step approach to controlling urban pollutant sources has been devised.

Adopting "Core" Elements

The "core" elements of the urban nonpoint source control program applicable to local units of government include basic measures that can be adopted without further technical study. Communities are eligible to receive technical and/or financial assistance through the priority watershed project provided they commit to implementing a core program consistent with attaining pollutant reduction goals and water resource objectives for existing urban land uses within the first three years of the project. Sites that are currently undeveloped are expected to be controlled as part of the cost of development and thus are not eligible for cost sharing.

The basic elements of the "core" program include:

- Developing, adopting, and enforcing a construction erosion control ordinance consistent with the "model" developed jointly by the Wisconsin League of Municipalities and the DNR. Construction erosion control practices should be consistent with the standards and specifications in the *Wisconsin Construction Site Best Management Practice Handbook.*

- Developing and implementing a community-specific program of urban "housekeeping" practices which reduce urban nonpoint source pollutants. This may include a combination of information and education efforts, adoption of ordinances regulating pet wastes, or changes in the timing and scheduling of leaf and brush collection.

- Implementing an information and education program.

Adopting "Segmented" Elements

The "segmented" elements of the urban nonpoint source program include those requiring site-specific investigations prior to implementation (for example: the construction of detention ponds following the completion of an engineering feasibility study). Communities are eligible to receive cost sharing for "segmented" elements provided "core" elements have been developed and implementation has begun. Cost sharing will be limited to those elements of the segmented program completed within the eight-year implementation period of the project.

The higher costs of implementing this portion of the urban management program will require communities to budget expenditures over the course of several years. Best Management Practices implemented under this portion of the program may include detention ponds, infiltration devices, streambank erosion controls and other structural means for reducing urban nonpoint source pollutants. This element also includes changes in street sweeping schedules and equipment.

Eligible components of the "segmented" program include:

- Conducting detailed engineering studies to determine the best means of implementing community-specific nonpoint source control measures for identified existing land uses.

- Designing and installing structural urban Best Management Practices for existing urban areas.

- Developing management plans for planned future urban development. These plans will identify types and locations of structural urban Best Management Practices.

- Adopting and enforcing a comprehensive stormwater management ordinance encompassing current and planned future areas.

In order to reach the goals targeted for urban areas, the key land uses in all of the communities which will need controls were identified. These land uses are industrial, commercial, multi-family residential and medium density residential. These land uses currently total 5,400 acres, with an additional 1,200 acres to be added by the year 2010.

Funds Needed for Cost Sharing, Staffing, and Educational Activities

Grants will be awarded to each county or municipality by the DNR for cost sharing, staff support and educational activities. Table 7 includes estimates of the financial assistance needed to implement needed nonpoint source controls in the Sheboygan River Watershed, assuming a 75 percent participation rate of eligible landowners.

Table 7. Cost Estimates for the Sheboygan River Project

		Total Cost	State Share
Rural:	Management Practices	$2,455,500	$1,055,800
	Easements	306,700	306,700
	Information/Education	39,100	39,100
	Staff Needs	1,206,000	1,206,000
	Other Direct Costs	160,000	160,000
	Subtotal	$4,167,300	2,767,600
Urban:	Management Practices*	$2,252,700	$1,144,800
	Staff Needs & Other Costs	- unknown at this time -	
	Total	$6,420,000	$3,912,400

* Does not include costs of land or storm sewer rerouting.

Project Implementation Schedule

Project implementation is scheduled to begin in January, 1991. The first three years of implementation is the period for participants to sign cost-share agreements. There is a five year period for practice installation. While an eligible landowner or operator has three years to determine whether to participate in the program, the installation of practices can begin as soon as a landowner has signed a cost-share agreement with the appropriate local governmental unit.

Information and Education

An information and education (I&E) program will be conducted throughout the project period with Sheboygan and Fond du Lac counties serving as leaders for the multi-county educational activities in the rural areas. In urban areas, each city will conduct an I&E program.

University of Wisconsin-Extension staff will provide assistance. This program will be most intensive during the first four years of the project and the activities will taper of during the rest of the project. The activities will include Best Management Practice demonstrations, tours, newsletters, and public meetings.

Further Information

If you want more information about the Sheboygan Priority Watershed Project, or a copy of the watershed plan, contact:

Ruth Johnson, Nonpoint Pollution Coordinator
Wisconsin Department of Natural Resources
2300 North Martin Luther King Drive
Milwaukee, WI 53212

Project Evaluation

The evaluation strategy for the project involves the collection, analysis, and reporting of information so that progress may be tracked in three areas:

1. **Administrative** - This category includes the progress in providing technical and financial assistance to eligible landowners, and carrying out education activities identified in the plan. Progress in this area will be tracked by the LCD or municipality and reported to the DNR and DATCP quarterly.

2. **Pollutant Reduction Levels** - Reductions in nonpoint source pollutant loadings resulting from changes in land use practices will be calculated by the LCD or municipality and reported to DNR and DATCP at an annual review meeting.

3. **Water Resources** - Changes in water quality, habitat, and water resource characteristics will be monitored by the DNR during the first two years of implementation and at the end of the project period.

CHAPTER ONE
INTRODUCTION

Nonpoint Source Water Pollution Abatement Program

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

Nonpoint sources of pollutants include eroding agricultural lands, streambanks, roadsides developing urban areas, runoff from livestock wastes, and runoff from established urban areas. Pollutants from nonpoint sources are carried to the surface water or groundwater through the action of rainfall runoff or snowmelt, and seepage.

The following is an overview of the program:

- The NPS Program is administered by the Wisconsin Department of Natural Resources (DNR) and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). It focuses on critical hydrologic units called priority watersheds. The program is implemented through priority watershed projects.

- A priority watershed project is guided by a plan which is prepared cooperatively by the DNR, DATCP and local units of government with input from a local citizen's advisory committee. The nonpoint source pollution control plan assesses nonpoint and other sources of water pollutants and identifies the best management practices (BMPs) needed to meet specific water resource objectives. The plan guides the implementation of these practices in the effort to improve water quality in the watershed.

- Local units of government, usually one or more counties, carries out the implementation of a nonpoint source pollution control plan. Water quality improvement is achieved through the voluntary installation of nonpoint source pollution controls called best management practices (BMPs) and the adoption of ordinances. Landowners, land renters, counties, cities, villages, towns, sanitary districts, and lake districts are eligible to participate.

- Technical assistance is provided to aid in the design of BMPs. State level, cost-share assistance is available to participants to help offset the cost of installing these practices.

- Informational and educational activities are offered to encourage project participation.

Priority Watershed Selection

The Sheboygan River Watershed, located within the four counties of Sheboygan, Fond du Lac, Manitowoc, and Calumet, was designated a priority watershed in 1985. The Sheboygan River Watershed is shown in relation to the four counties and the state of Wisconsin in Map 1-1. It joined 32 other priority watershed projects in the state, encompassing more than three million acres, in which the cleanup and protection of water resources through control of nonpoint pollution sources is a priority of the DNR.

Priority watersheds are identified based on the following criteria:

- The severity of water pollution

- The relative importance of the contribution of nonpoint sources to pollution

- The willingness and capability of local units of government to carry out the necessary planning and plan implementation

- The public interest shown in nonpoint source water pollution abatement

The Phases of a Priority Watershed Project

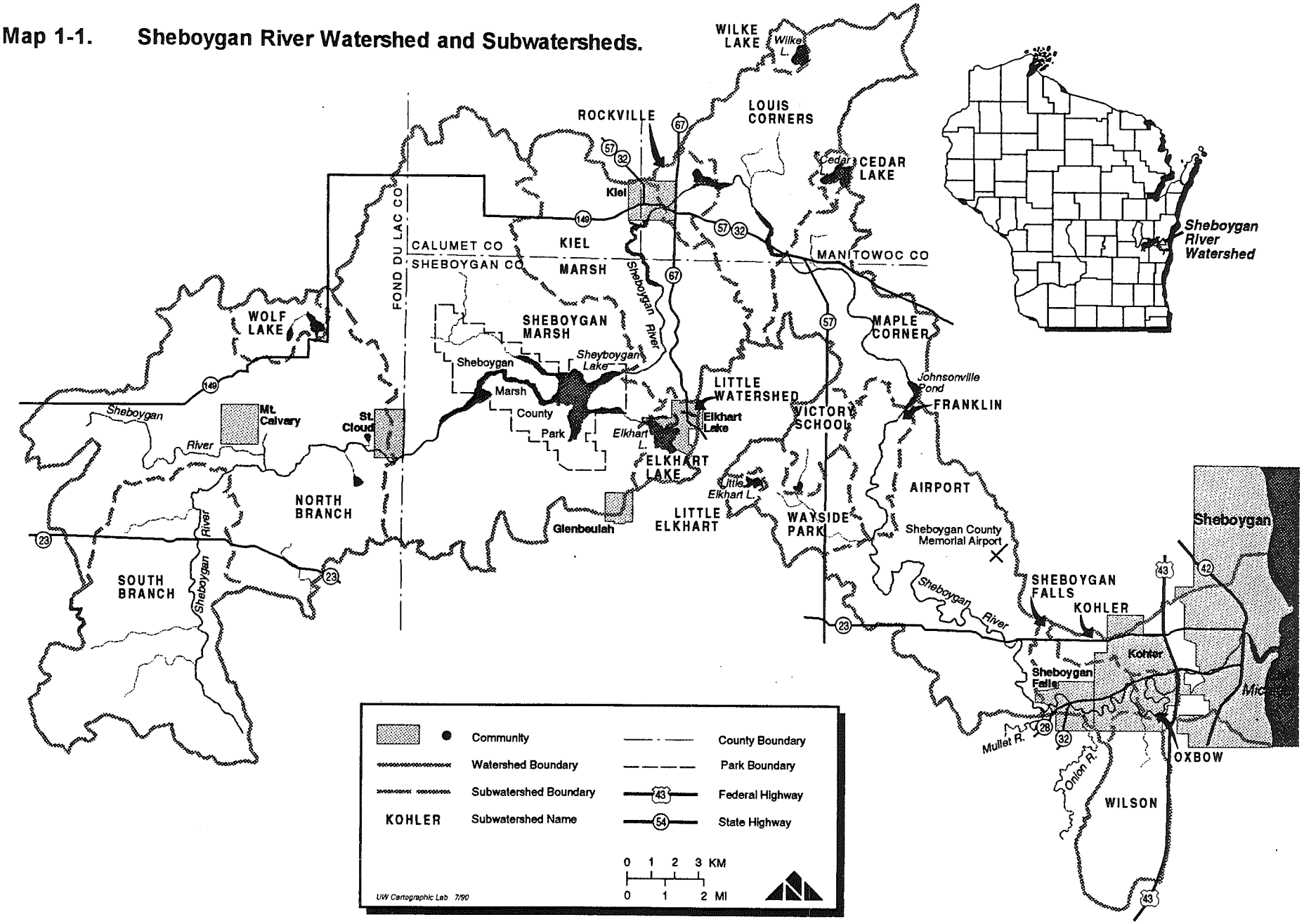
A priority watershed project involves three phases—planning, implementation, and evaluation.

Project planning, the first phase of this project, included the following information-gathering and evaluation steps:

1. Determination of the conditions and uses of streams, lakes and groundwater in the Sheboygan River Watershed.

2. Inventory of land uses and the severity of nonpoint source pollution which affect streams, lakes and groundwater.

Map 1-1. Sheboygan River Watershed and Subwatersheds.



3. Evaluation of the types and severity of other factors which may be affecting water quality. Examples include discharges from municipal wastewater treatment plants, and natural or endemic stream and groundwater conditions.

4. Determination of the levels of nonpoint source pollution control and in-field measures necessary to improve and/or protect water quality.

5. Preparation and approval of a priority watershed plan documenting the above evaluations, implementation procedures, and costs.

This publication is a summary of planning phase findings and management implications.

Project implementation, the second phase, began in the Summer 1990 following a public hearing and the approval of this plan by the DNR, DATCP, and the boards of supervisors for Sheboygan, Fond du Lac, Calumet, and Manitowoc Counties. The following steps are being utilized:

1. The DNR will enter into local assistance agreements with the counties and other local units of government identified as having implementation responsibilities. These agreements provide necessary funding to maintain the resources and staff required for plan implementation.

2. Eligible landowners will be contacted by the staffs of Sheboygan, Fond du Lac, Calumet, and Manitowoc County Land Conservation Departments to determine their interest in voluntarily installing the best management practices identified in the plan. The Land Conservation Department staffs will work with local units of government to develop cost-effective measures to reduce urban nonpoint pollution sources.

3. The landowner and county or other implementing body will sign cost-share agreements that outline the practices, costs, cost-share amounts, and schedules for installation of BMPs. The practices are scheduled for installation up to five years from the date of signing.

4. The DNR and DATCP will review the progress of the counties and other involved units of government, and will provide assistance throughout the life of the project (eight years). The DNR will monitor improvements in water quality resulting from control of nonpoint sources of pollution.

Legal Status of the Nonpoint Source Control Plan

The Sheboygan River Priority Watershed Plan was prepared under the authority of the Wisconsin Nonpoint Source Water Pollution Abatement Program (NPS 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 the DNR, DATCP, and Sheboygan County, Fond du Lac County, Calumet County, and Manitowoc County.

This watershed plan is the basis for the DNR to enter into cost-share and local assistance grants with participants, and will be used as a guide to implement measures to achieve desired water quality conditions. In the event that a discrepancy occurs between the 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.

Other Planning Activities the Watershed

Currently, the Sheboygan River Watershed and harbor area are the focus of several water resource planning efforts which are summarized below.

- *The Sheboygan River Water Quality Management Plan* (1988), prepared by the DNR, identifies water quality goals, problems, improvements, and management needs for the lakes and streams in the entire Sheboygan River Basin. *The Nonpoint Source Control Plan for the Sheboygan River Priority Watershed* is considered an amendment to the water quality management plan.

- The International Joint Commission (IJC), the U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office, and the DNR have targeted the lower Sheboygan River and harbor, and near-shore area of Lake Michigan as an Area of Concern (AOC) for remedial action. The Sheboygan River Remedial Action Plan (RAP), prepared by the DNR (1988), identifies specific management strategies to control and abate contamination due to the presence of toxic substances located in bottom sediments of the Sheboygan River Area of Concern.

- Two federal Superfund sites are located in the Sheboygan River Watershed. They are the lower Sheboygan River and harbor, and the Kohler Company landfill. Both sites are considered contaminated with toxic substances and are in the remedial investigation phase. The lower Sheboygan River and harbor project, and the Sheboygan RAP are addressing essentially the same geographic area; therefore, the RAP will guide management efforts for both projects. The Kohler landfill study will be summarized in an independent EPA document containing remedial action recommendations.

- Two main tributaries to the Sheboygan River, the Onion River and the Mullet River, are the focus of two separate priority watershed projects and will not be addressed in this plan.

Plan Organization

Following this chapter, chapters two through six assess the Sheboygan River Watershed. Chapter two, "General Watershed Characteristics," examines the cultural and natural resource features pertinent to planning and implementing priority watershed project efforts. Chapter three, "Evaluation of Pollution Sources," discusses nonpoint and other sources of pollution identified as problems in the watershed, and their impacts on the Sheboygan River, its tributaries and lakes. Chapter four, "Establishing Water Resources Objectives and Pollution Reduction Levels," describes the process used to define the condition of the surface water resources in relation to the nonpoint pollution sources that affect them. It also describes the process that establishes target levels to accomplish the water resource objectives. Chapter five, "Water Resource Conditions and Objectives," provides a detailed discussion of water resource conditions and objectives. Chapter six, "Management Actions," describes how to implement pollution reduction goals. It also translates pollution reduction goals into the acres of upland, feet of streambank or barnyard operations, as well as urban land area that will require pollution control measures. The chapter identifies eligible nonpoint pollution sources for funding under the priority watershed project.

Chapters seven, eight and nine discuss a detailed implementation program. Chapters seven and eight describe how the four counties and urban municipalities responsible for implementation will administer the project, estimate local assistance and cost-share budgets for BMPs, and specify a project tracking system. Chapter nine, provides an information and education strategy and budget estimate.

Chapter ten, describes the evaluation and monitoring strategy used to determine the effectiveness of the project in achieving the water resource objectives.

CHAPTER TWO
GENERAL WATERSHED CHARACTERISTICS

Location

The Sheboygan River Watershed is located in east-central Wisconsin and drains an area of land situated between Lake Winnebago and Lake Michigan (map 1-1.). The watershed is a sub-basin of the larger Sheboygan River drainage basin which includes, along with the Sheboygan River, the Pigeon River, Mullet River, Onion River, Black River, and direct tributaries to Lake Michigan. The Sheboygan River Watershed drains approximately 245 square miles or about 157,100 acres. Surface water in the watershed drains via the Sheboygan River in an easterly direction into the Sheboygan harbor and Lake Michigan.

The watershed lies in portions of four counties: Sheboygan, Fond du Lac, Calumet, and Manitowoc. Table 2-1 shows the distribution of land area and population among these counties.

Table 2-1. Distribution of Watershed Land Area and Population

	Land Area		Population	
County	Area Within Watershed (Square miles)	Percent of Watershed	Population Estimate	Percent Population
Calumet	17	7%	3,834	5%
Manitowoc	27	11%	1,228	2%
Fond du Lac	74	30%	5,616	8%
Sheboygan	127	52%	58,660	85%
Total	245	100%	69,338	100%

Source: DNR Sheboygan River Urban and Rural Inventories

Sheboygan County has the largest contributing drainage area with 52 percent of the watershed (127 square miles). Thirty percent of the watershed lies in Fond du Lac County (74 square miles); 11 percent (27 square miles) in Manitowoc County, and the remaining seven percent (17 square miles) is in Calumet County.

Cultural Features

Over one-half the land area in the watershed lies within Sheboygan County (127 square miles). Incorporated areas of the watershed include three cities and four villages, all located along the main stem of the Sheboygan River, except for the village of Elkhart Lake. Unincorporated areas include all or portions of 18 surrounding townships.

Major public lands within the watershed include Sheboygan Marsh County Park (14,000 acres managed by Sheboygan County and the DNR), and Kiel Marsh Wildlife Area (totalling 1,079 acres when planned acquisition is complete). Both contain large wetlands, with important fish, wildlife and recreation potential, surrounding the main stem of the Sheboygan River. Numerous urban parks are located in and around the city of Sheboygan.

The population of the Sheboygan River Watershed is estimated at 69,338 people. The majority (about 81 percent) reside in incorporated areas, with most concentrated in the metropolitan area containing the cities of Sheboygan and Sheboygan Falls, Kiel, and the village of Kohler (table 2-1 and 2-2). The fastest growing urban areas in the watershed in the last decade were the villages of Kohler and Elkhart Lake, and the city of Sheboygan Falls. This trend toward decentralization of urban growth areas is expected to continue around the city of Sheboygan.

The remainder of the watershed population (about 19 percent) lives outside incorporated areas in small enclaves of residential development, or on farmsteads. Many of the rural townships have experienced slight population declines over the last decade; however, overall the populations of all four counties have remained stable or have increased slightly.

Land uses in the watershed are mostly rural. Agricultural uses and related open space account for 68 percent of the drainage area. Woodlands cover eight percent. The remaining rural land use includes wetlands and surface water, which comprises about 15 percent of the watershed area. Virtually all of this area consists of wetlands (table 2-3).

Urban land uses (including developing areas) occupy about nine percent of the watershed or approximately 13,946 acres. Most of the urban land (76 percent or 10,530 acres) consists of the Sheboygan metropolitan area. According to projections, the urbanized area population is expected to increase at an overall rate of approximately three percent per year in the next 20 years (Kaiser, 1989). Approximately one percent of the land in the watershed is currently under development.

Table 2-2. Watershed Population Estimates		
	Population	Percent of Watershed Population
city of Sheboygan	43,646	63%
city of Sheboygan Falls	5,580	8%
city of Kiel	3,118	4%
village of Kohler	1,793	3%
village of Elkhart Lake	1,075	2%
village of Mt. Calvary	636	<1%
village of St. Cloud	568	<1%
Unincorporated areas	12,922	19%
Total	69,338	100%
Source: Wisconsin Department of Administration Demographic Services Center, 1989 official estimates		

Table 2-3. Land Use in the Sheboygan River Watershed.	
Land Use	Percent of Watershed
Agricultural	
pasture, grazed woodlot	1%
cropland	61%
grassland	5%
Woodland	8%
Urban and developing	9%
Wetlands and surface water	15%

Most of the land in the watershed is used for agricultural purposes, although the percentage of land in farms has declined over the past decade, a trend which is occurring throughout the state. Milk production and dairy products are the predominant industries in all four counties. Manufacturing accounts for a large share of employment in the watershed (about 40 percent), but is limited for the most part to the cities of Sheboygan and Sheboygan Falls, and the village of Kohler.

Groundwater is the source of potable water in the watershed outside the Sheboygan/Kohler/ Sheboygan Falls metropolitan area. The communities of Kiel, Elkhart Lake, Mt. Calvary,

and St. Cloud operate municipal water systems drawing from the deep limestone aquifer. The city of Sheboygan treats water from Lake Michigan and distributes it to its residents and surrounding communities in the metropolitan area (approximately 51,000 watershed residents) for domestic and industrial purposes.

The remainder of the watershed population relies upon individual, privately-owned well water systems. The depth of groundwater suitable for domestic use varies from approximately 100 feet along the eastern third to over 300 feet in the western third of the watershed.

Sanitary sewer service is mainly limited to incorporated areas in the watershed. The communities of St. Cloud, Mt. Calvary, and Kiel operate municipal sewage treatment plants. Sheboygan Falls, Kohler and the city of Sheboygan operate a regional sewage treatment system. The Sheboygan Urbanized Area Sewer Service System covers 182 square miles and serves an estimated 55,000 people within Sheboygan County. The sewer service planning area within the watershed project area includes the towns of Lima, Wilson, Sheboygan, Sheboygan Falls, and Herman. Sewer services are projected to extend mainly to the urbanizing portions of these jurisdictions within the next 20 years. The remainder of watershed residents treat waste with private on-site septic systems. The site-suitability and operating efficiency of these systems is not evaluated in this plan. Sanitary districts have been formed in the town of Rhine (Elkhart and Little Elkhart Lakes), and by residents around Cedar and Wilke lakes.

Physical Setting

The Sheboygan River Watershed lies in the temperate continental zone characterized by very cold, snowy winters and hot, humid summers. Temperatures in the eastern portion of the watershed are moderated by Lake Michigan, which extends the growing season in regions near the lake shore. Temperatures in the extreme western portion of the watershed are moderated somewhat by Lake Winnebago.

The frequency, duration, and quantity of precipitation influences surface water and groundwater, soil moisture content, runoff characteristics and the physical condition of waterways. The average annual precipitation for the basin is approximately 29 inches; about one-half falls in the form of rain during the growing season (May-September). About 42 inches of snow (approximately five inches of rain when melted) falls during a typical winter. During March and April, spring rains coincide with melting snow draining over frozen ground. This combined runoff contributes to peak discharge rates and high water levels in streams.

The topography of the Sheboygan River Watershed is generally rolling and hilly, reflecting the influence of glacial processes. Valleys and uplands are broad and gently sloping, extending in a northeast-southwest direction parallel to the Lake Michigan shore. In general there is a uniform gradient across the watershed sloping down toward Lake Michigan, due to the tilt of the underlying Niagara dolomite bedrock.

The watershed may be divided into three distinct regions based on surface features formed by glacial drift deposits. The western third (located in Fond du Lac County) is characterized by irregular ridges, drumlin (elongated hills) fields, and drift hills left by the glacier. Infiltration of the coarse drift is generally good and springs are common in this area. The middle region (portions of Calumet and Sheboygan Counties) is fairly broad and flat, with vast areas of wetlands; a central band of the moraine bisects the region with a belt of drift hills. The eastern third of the watershed exhibits low sloping surface relief. In this area of thinner drift, soils are heavier and infiltration and percolation are poor. Springs are not common here and streams are greatly influenced by rainfall, subjecting them to considerable variations in flow.

The first layer of rock underlying the glacial drift deposits is Niagara dolomite. The thickness of the Niagara formation at Sheboygan is apparently greater than in any other part of Wisconsin (719 feet). Underlying formations, in descending order, are as follows: Maquoketa shale, Galena and Trenton dolomite, St. Peter sandstone, Lower Magnesian dolomite, and Potsdam sandstone. Basement rock formations and surface drift are the dominant source materials for soils and rock in the watershed; both affect the water characteristics.

Soil types vary within the watershed. Soils to the west tend to be loamy and light to medium textured. The steepest slopes of the watershed (12 percent and more) occur here in the drumlin fields that contribute to the headwaters of the Sheboygan River. Patches of poorly drained and very poorly drained areas are scattered throughout these generally well-drained soils. Western soils grade into shallow, gravelly soils in the central morainic portion of the basin. A narrow central band of steep hills is associated with the Kettle Moraine in this region. Poorly drained soils occur in low portions of this region where vast areas of peat and muck deposits are common. Soils in the eastern third of the watershed are "heavy" clay soils that tend to have poor infiltration and poor percolation, but are of high fertility. The majority of the heavy soils consist of the clay loams or silty clay loams from the Kewaunee series. They are located on a nearly level, undulating plain, with erratic cobbles and boulders of basement rock and dolomite. Few wetlands are present in the eastern third of the watershed.

Soil types affect the water regime of the watershed. Increased rates of surface water runoff are characteristic of heavy surface soils. Additionally, the fine texture soils are very susceptible to erosion on the uplands, and have poor drainage on level areas. Following a rainfall, streams in the watershed exhibit a distinct red color from suspended silts and clays.

Regions with porous sandy soils generally have higher groundwater discharge to streams, accounting for a constant water supply. The eastern portions of the watershed which have heavy soils have fluctuating stream levels and greater problems with siltation and sedimentation.

Water Resources

Lakes, Streams, and Wetlands

Twenty-one subwatersheds drain the land area within the Sheboygan River Watershed. All convey surface water directly or via tributaries into the Sheboygan River, except Little Subwatershed which is internally drained. The Sheboygan River originates as a trout stream in Fond du Lac County and flows generally eastward before entering Lake Michigan at the city of Sheboygan's harbor. The Onion and Mullet Rivers are two main tributaries to the Sheboygan that enter the river at Sheboygan Falls. Major tributaries, associated streams, lakes, wetlands, and subwatershed divides within the Sheboygan River Watershed are shown in map 1-1.

Approximately 232 miles of stream drain the Sheboygan River Watershed. The Sheboygan River main stem accounts for approximately 81 miles, and the remaining 151 miles represent named and unnamed perennial tributaries. Stream gradients are generally low to moderate. The Sheboygan River main stem and its tributaries exhibit wide variance in water quality. In general, waters of the region are categorized as hard or alkaline and are moderately fertile to very fertile. Overall water quality in the Sheboygan River Basin is described as fair to poor (DNR, 1988), and is not meeting its biological or recreational potential.

Water resource appraisals indicate there are currently 3.9 miles of Class I trout water (Millhome Creek, Schuett Creek, and a headwaters segment of the South Branch of the Sheboygan River), and about 1.8 miles of Class II trout water (Feldner's Creek and a headwaters segment of the South Branch of the Sheboygan) in the watershed. These streams are only partially meeting their potential. They suffer from sedimentation and altered flows that result from channelization, altered wetlands and spring sources, and streambank and habitat degradation from agricultural sources. See table 5-1, in chapter five, which summarizes water resource objectives.

All main stem segments of the Sheboygan River are classified as warm water sport fisheries, with diverse assemblages of both sport and forage fish species. The actual biological communities present in these segments vary according to natural and human-altered habitat conditions and by water quality changes resulting from point and nonpoint source pollutants.

The western headwater reaches exhibit high oxygen levels, cool water temperatures and relatively low turbidity, despite areas of streambank degradation. They support several intolerant fish species which are indicative of such conditions. The middle reaches that flow through large marshes experience naturally low dissolved oxygen levels and winter fishkills. Segments that flow through the Rockville impoundment suffer severe oxygen depletion and winterkills, and have problems with carp. Segments from the Rockville dam to the Sheboygan Falls dams lack fish diversity due to migration barriers, and over the years have suffered from organic enrichment evidenced by excessive aquatic weeds. The Sheboygan Falls segment is influenced by discharges from the Onion and Mullet Rivers. Segments from Sheboygan Falls to Lake Michigan experience seasonal runs of salmon and trout from Lake Michigan.

These segments have relatively good bottom substrate (sands and gravel) but at the same time suffer from high turbidity and suspended solids, migration barriers, and in-place contaminants. A fish consumption advisory has been in effect since 1978 for the lower Sheboygan River and harbor, and a waterfowl advisory was placed on the lower Sheboygan River in 1987 due to the presence of polychlorinated biphenyls (PCBs) in animal tissues.

In general, major alterations in in-stream habitat have resulted from dams, and stream channelization (ditching), streambank erosion, the deposition of sediments, and the deposition of contaminants. These actions in turn influence nutrient availability, stream base flows and temperatures, dissolved oxygen levels, suspended solids, and fish and aquatic insect species diversity and abundance. Also, water quality and recreational use have been impaired by high levels of bacteria documented in many portions of the river and its tributaries. Many reaches of streams throughout the watershed are not meeting their biological or recreational potential because of these conditions. Ultimately, many of the problems of the Sheboygan River are inherited by Lake Michigan at the mouth of the river, contributing to the degradation and eutrophication of the Great Lakes system.

The natural lakes and surface depressions in the watershed are of glacial origin, and are concentrated in the west-central portion of the watershed along the margins of, or within, terminal ground moraines. By virtue of their origin, these lakes are fairly regular in shape with their deepest points typically located near the center of the lake basin. There are also 12 impoundments (ten on the Sheboygan River) in the watershed.

The six natural lakes, which are larger than 20 acres and located in the Sheboygan River Watershed, were assessed for this project. Several smaller lakes, which are less than 20 acres, are located in the northeastern portion of the watershed, however these smaller lakes were not included in the Water Resource Appraisal Study. Elkhart Lake (300 acres), Little Elkhart Lake (48 acres), and Wolf Lake (77 acres) are the largest natural lakes in the watershed and are fairly deep; and all three lakes stratify in the summer season. Little Elkhart Lake, the Rockville impoundment, and Sheboygan Lake suffer from winter oxygen depletion. Due to the scarcity of lakes of significant size in the region, Elkhart, Little Elkhart, Wolf, Wilke, and Cedar Lakes all receive considerable recreational pressure. The shorelines of Cedar and Little Elkhart Lakes are currently undergoing rapid development.

Wetlands play an important role as groundwater recharge and discharge areas; spawning, rearing, and over-wintering areas for fish and wildlife; flood water storage; and the removal and retention of sediment and nutrients contained in upland runoff. An abundance of organic material present in marshlands can also create naturally low dissolved oxygen conditions which may influence downstream river segments.

The original acreage of wetlands throughout Wisconsin have been vastly reduced by hydrologic modifications aimed at draining, and/or filling lowland areas to render them more suitable for agricultural purposes and urban development. Approximately 24,000 acres of productive wetlands remain within the Sheboygan River Watershed. The area covered by wetlands represents a significant portion of the watershed (15 percent) and amounts to roughly three percent of the total wetlands remaining in the state.

Two major wetland complexes are present in the watershed. The largest, Sheboygan Marsh, is located in the northwest part of Sheboygan County. It encompasses approximately 14,000 acres, or about 35 percent of the Sheboygan Marsh Subwatershed. Kiel Marsh (approximately 800 acres in the Kiel Marsh Subwatershed) is located in north-central Sheboygan County, with portions lying in southwestern Manitowoc County and southeastern Calumet County. Other smaller wetlands in the watershed are located next to or near streams and lakes in the western half of the watershed. In some areas of the watershed (such as the North Branch, Sheboygan Marsh, and Kiel Marsh Subwatersheds), wetlands adjoining main stem and tributary segments of the Sheboygan River play important roles as sediment and nutrient traps, thus protecting these waters from severe impacts of agricultural nonpoint source pollutants. Their capacity to function as sediment catch basins, however, is limited. The greatest threat to wetlands in the watershed is from agricultural drainage (ditching, tile drains) and development.

Groundwater

An underground rock or soil formation that contains water is called an aquifer. Groundwater occurs in fractures in dolomite formations and in the pore spaces between loosely cemented grains of sand (sandstone formations).

Groundwater in the Sheboygan River Watershed moves within two principal systems: the water table system and the artesian system. The artesian system is made up of those parts of aquifers lying beneath the relatively impermeable Maquoketa shale. Most groundwater recharge to this system is from the area just to the west of this formation (that is, along Lake Winnebago and west of Lake Winnebago). The water table system is present in all parts of the watershed and is recharged locally by precipitation and infiltration.

Four principal aquifers provide groundwater for the Sheboygan River Watershed. They are, in order from deepest to nearest the surface, the Precambrian or crystalline bedrock aquifer; the sandstone aquifer, which includes sandstone and dolomite formations of the Cambrian and Ordovician periods; the Silurian or Niagara dolomite aquifer; and the sand and gravel aquifer.

The sandstone aquifer is the source of most potable municipal groundwater, and extends throughout the Sheboygan River Watershed. The regional groundwater flow is generally towards the east in this aquifer. The sandstone aquifer is generally affected less by surface contaminants because it is overlain by the relatively impermeable Maquoketa shale layer.

The Silurian dolomite aquifer lies above the sandstone aquifer, separated from the sandstone aquifer by the Maquoketa shale layer. This aquifer is relatively close to the ground surface and is the source of non-municipal groundwater in the Sheboygan River Watershed.

Located above the Silurian dolomite is the sand and gravel aquifer, a relatively shallow aquifer consisting of permeable sediments of unconsolidated glacial deposits. The water in this aquifer is recharged locally by precipitation, and is often discharged to surface drainage systems within a few miles of the point of recharge. The sand and gravel aquifer is locally

important as a source of groundwater where there are relatively thick, saturated, and unconsolidated deposits in the basin.

The sand and gravel aquifer and the dolomite aquifer are the most at-risk environmentally in the Sheboygan River Basin, due to the shallow depth to groundwater and the permeability of the bedrock and subsurface materials. These factors increase the possibility of contaminants at the surface percolating through the ground to contaminate groundwater. In contrast, aquifers that are overlain by finer soil particles (clays, silt and loams) are less permeable to infiltrating water.

Most of the literature values available that describe groundwater quality are not specific to the watershed area. The values presented are from various sources and describe the groundwater quality in each county in the Sheboygan River Watershed.

A general description of the quality of the sand and gravel, Silurian dolomite, and sandstone aquifers in the eastern part of the state can be found in the United States Geological Survey Water Resources Investigations Report titled *An Overview of Ground-water Quality Data in Wisconsin* (Kammerer, 1984). Water in the eastern groundwater province aquifers is generally quite hard. Chloride levels in most wells sampled in this region were below the state's drinking water standards. Concentrations of dissolved solids exceeding the state standard were found in water from more than 25 percent of the wells sampled in the Silurian dolomite aquifer. Sulfate concentrations exceeding the standard were found in water from approximately 10 percent of the wells in this aquifer. Iron concentrations can be an aesthetic problem in all three aquifers. The standard for iron was equalled or exceeded in water from half or more of the 764 wells sampled in all three geologic units. Nitrate concentrations exceeding the 10 milligrams per liter (mg/l) state standard were found in relatively few wells.

The data referenced above indicate that nitrate contamination of the groundwater may not be a widespread problem in the Sheboygan River Watershed. Caution should be used when arriving at this conclusion. First, sampling in the Sheboygan River Watershed area has been sparse and there is not a good data base to make a determination on the current condition of the groundwater. Second, nitrogen-containing materials from waste-disposal sites, livestock, septic systems and agricultural fertilizers have been implicated in a general study of nitrate contamination of private rural wells (Delfino, 1977). A DNR study of Ozaukee and Sheboygan Counties showed areas where some wells were found to have nitrate levels in excess of the state drinking water standard (DNR, 1988).

In 1985, low level, volatile organic compounds (VOCs) were detected in over 150 private wells in the town of Sheboygan, in association with landfills in the area. These wells were later replaced with public water supplies from the Sheboygan regional system. In general, however, the heavy soils common in most of the Sheboygan River Watershed are not conducive to the migration of contaminants from surface to groundwater.

A discussion of critical sites with the potential of affecting groundwater in the Sheboygan River Watershed and the eligibility for project cost-share funding is included in Chapter Eight, "Detailed Program for Implementation".

Endangered and Threatened Resources

Information on rare and endangered resources was obtained from the DNR Bureau of Endangered Resources. It should be noted that comprehensive endangered resource surveys have not been completed for the entire Sheboygan River Priority Watershed project area. Data files may be incomplete, therefore, the absence of known occurrences does not preclude the possibility of their presence in the project area.

Several species which are designated as "endangered", or whose continued existence is in jeopardy in the state of Wisconsin, are known to occur in the Sheboygan River Watershed. Endangered species of the state have been identified in four subwatersheds: Wayside Park, Kohler, Sheboygan Falls, and Sheboygan Marsh.

Endangered Species

One endangered fish species, the striped shiner (*Notropis chrysocephalus*), has been observed in Otter Creek within the Wayside Park Subwatershed. Seaside crowfoot (*Ranunculus cymbalaria*) is known to occur along the Lake Michigan shoreline; therefore, the seaside crowfoot could be present in the Kohler Subwatershed. (The last observation of this plant in the Sheboygan area was made in 1909.) The queen snake (*Regina septemvittata*) has been observed in the Sheboygan River in the vicinity of the Kohler dam. The Sheboygan Marsh Subwatershed is known to support the prairie white-fringed orchid (*Platanthera leucophaea*), which is also a federally threatened species, and two Wisconsin species, the loggerhead shrike (*Lanius ludovicianus*) and Hudson Bay anemone (*Anemone multifida*).

Threatened Species

Several state-designated threatened species of plants are known to occur in the Sheboygan Marsh Subwatershed including rams-head lady's-slipper (*Cypripedium arietinum*), small round-leaved orchis (*Orchis rotundifolia*), and marsh valerian (*Valeriana sitchensis*). Ram's-head lady's-slipper may also occur in the Kiel Marsh Subwatershed. Forked aster (*Aster furcatus*) has been observed in the Kohler Subwatershed in the vicinity of the Greendale Cemetery ravine in the city of Sheboygan.

Species of Concern

Several "species of concern" in Wisconsin occur in or near the Sheboygan River Watershed. These are species which are suspected to have some problem of abundance or distribution but has not yet been proven. The purpose of this category is to focus attention on certain species before they become endangered or threatened. The following are known to occur in the vicinity of the Sheboygan Marsh and Kiel Marsh:

- White adder's-mouth (*Malaxis brachypoda*)
- Dragon sagewort (*Artemisia dracunculus*)

- American gromwell (*Lithospermum latifolium*)
- Purple false oats (*Trisetum melicoides*)
- Yellow gentian (*Gentiana alba*)
- Cooper's hawk (*Accipiter cooperii*)

Elkhart Lake is known to support the lake herring (*Coregonus artedii*), which is partially protected through administrative regulatory controls, and the least darter (*Etheostoma microperca*). White adder's-mouth is also found in the vicinity of Elkhart Lake. One plant species of special concern, the hairy beardtongue (*Penstemmon hirsutus*), has been observed in the Kohler Subwatershed in the city of Sheboygan.

Natural Communities

Many natural communities of state significance have been identified in the Sheboygan River Watershed, specifically in or near the Wilson, Kohler, North Branch, Kiel Marsh, Maple Corner, and Louis Corners Subwatersheds. Muehles Springs Natural Area contains a southern sedge meadow, shrub-carr, and springs and runs which are considered natural communities of statewide significance. Schuett Creek in the Maple Corner Subwatershed has been designated a "fast, hard, and cold water stream" of statewide significance. The woods surrounding the creek support a southern mesic forest natural community.

CHAPTER THREE
EVALUATION OF NONPOINT POLLUTANT SOURCES

Introduction

The first portion of this chapter presents a general overview of nonpoint sources of pollutants and their potential impacts on water resource conditions in the Sheboygan River Watershed. The second portion of the chapter presents a discussion of the findings of the urban and rural nonpoint source inventories conducted in the Sheboygan River Watershed. These findings include the actual quantities of pollutants generated from each source. A discussion of nonpoint source pollution control needs and corresponding management actions follows in chapter six.

Nonpoint sources of pollutants are significant contributors of sediment, nutrients, and other pollutants to the streams and lakes in the Sheboygan River Watershed. These pollutants are contributing to the decline in water quality and degradation of aquatic habitats. Under certain conditions, they also potentially may have localized adverse impacts on groundwater quality. The nonpoint sources of pollution inventoried and the methods for evaluating their impacts on surface and groundwater resources are discussed in Appendix A, "Watershed Assessment Methods".

A number of activities in the watershed other than nonpoint pollution sources have the potential of affecting surface or groundwaters. These activities include industrial and municipal wastewater treatment facilities, active and abandoned landfills, private septic systems, and toxic or hazardous waste spills. All of these activities are regulated by the State of Wisconsin, through the Department of Natural Resources or other governmental agencies. Unlike nonpoint sources of pollutants, conditions for point sources that must be met are defined in a permit for each facility that contributes pollutants. These regulations are established so that the water quality impacts from each operation are minimized. If the permit conditions are met, it is likely that there are no significant water quality concerns at the site. These other potential sources of pollution are described in detail for the watershed in the *Sheboygan River Basin Water Quality Management Plan* (DNR, 1988).

Overview of Nonpoint Sources of Pollutants

Rural Sources

The rural nonpoint pollution sources investigated through this inventory included barnyard manure runoff, upland delivery of sediment, streambank erosion, and runoff from areas winterspread with livestock manure. From the inventory the relative amount of sediment and phosphorus which enter surface waters from these sources was determined. Sediment was identified as having the most widespread and significant impact on water resources in the watershed. Phosphorus delivery is a useful indicator of organic and oxygen-demanding substances entering surface waters. When the quantity of these pollutants reaching surface and groundwater are reduced, the amounts of other substances which degrade water quality (heavy metals, pesticides, bacteria) are also reduced.

Most creeks in the Sheboygan River Watershed suffer from sedimentation delivered primarily from upland erosion. These sediments have blanketed the streambeds, filling in pools and riffles, and degraded reproductive habitat for cold and warm water fish species and associated fauna. Cattle have extensively trampled streambanks and stream bottoms along many of the streams in the watershed. Creeks are also locally affected by organic loads from livestock waste runoff. It is suspected that the loss of cover and vegetation, along with a shallower streambank, and the input of oxygen-demanding organic substances have caused in-stream temperatures to increase and dissolved oxygen levels to fall. Most of the lakes in the watershed suffer from excessive nutrients causing nuisance growths of aquatic weeds and algae.

These conditions indicate that rural nonpoint source pollutants are significantly affecting stream and lake water quality in the Sheboygan River Watershed. Streambank erosion and degradation of the stream corridor are suspected to have an adverse impact on riparian wildlife habitat as well.

Urban Sources

Urban runoff carries a wide array of pollutants to surface water; some pollutants 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 (PCBs, aromatic hydrocarbons, esters and many others). Substances in urban runoff that are also contained in runoff from rural areas include sediment (especially from construction sites), nutrients, bacteria and other pathogens, and pesticides. While acres of urban land may be small in comparison to rural sources of pollutants, urban areas can contribute more pollutants on a per-acre basis because they are often connected to storm sewers which convey runoff directly to lakes and/or streams. The urban nonpoint source pollutants investigated in this project include sediment, phosphorus, and lead.

Runoff from urban areas also adversely affects stream hydrology. As the landscape becomes urbanized, runoff volume increases in magnitude and is also produced over a short period of

time creating large increases in peak stream flows. In some areas, groundwater recharge is significantly reduced as concrete and other impervious surfaces prevent rainwater and snowmelt from soaking into the ground. This can reduce the base stream flows which are needed to sustain fish and aquatic life during periods of low rainfall.

Uncontrolled urban runoff can produce "flashy" streams with temperatures and chemical characteristics that limit animal life and recreational uses. Streambank erosion may increase as the stream attempts to cut a channel in equilibrium with widely variable stream flows. Flooding of adjacent property may also occur, sometimes requiring channel modifications to accommodate flood flows or to prevent flood damage. This often destroys the natural stream system and speeds the transport of pollutants downstream.

Runoff from new urban development, which is anticipated to occur approximately over the next 20 years, has the potential to affect stream water quality in several ways. First, constructing roads, utilities, and buildings disturbs large areas, exposing large amounts of soil to erosive forces. This type of runoff can easily carry sediment to drainageways, storm sewers, and ultimately to streams. Without adequate controls, construction site erosion can catastrophically impact urban rivers and streams, clog storm sewers causing local flooding, and accumulate on road surfaces and sidewalks. Second, newly established urban surfaces accumulate pollutants until they are carried in runoff to streams. Consequently, as new areas become urbanized, water quality problems caused by urban pollutants and excessive stormwater runoff can worsen. These additional pollutant sources can negate the water quality improvements that resulted from nonpoint source control practices in existing urban areas. The urban inventory for the Sheboygan River Priority Watershed Project included a computer-generated prediction of future urban land uses and pollutant loadings. Appendix A describes the modeling process.

Rural Inventory Results

Barnyard Runoff

Runoff that carries a variety of pollutants from livestock feeding, pasturing areas and barnyards is a significant source of pollutants in the creeks of the Sheboygan River Watershed. In the watershed, 219 livestock operations were identified as having runoff delivered to surface waters. These livestock lots were estimated to produce 1,012 pounds of phosphorus during a four-inch rainfall (Note: this storm has a 10-year reoccurrence period). The phosphorus value is used to compare the impact from the barnyards in the project.

An additional 67 livestock lots are internally drained. The runoff waters from these lots do not reach a stream or lake. These sites will require further investigation to determine their susceptibility for contaminating groundwater under these circumstances. The results of the barnyard inventory are listed in table 3-1.

Table 3-1. Inventory Results: Barnyard Summary*					
	Subwatershed	Yards with Surface Runoff			Yards Internally Drained
		Total # of Yards	Phosphorus Load (lbs)	% Total of Watershed Load	
1	Airport	32	246.7	24%	10
2	Cedar Lake	0	0.0	0%	0
3	Elkhart Lake	0	0.0	0%	0
4	Franklin	5	37.9	4%	0
5	Kiel Marsh	15	71.3	7%	8
6	Kohler	5	40.3	4%	0
7	Louis Corners	13	49.7	5%	8
8	Little Elkhart	0	0.0	0%	0
9	Little Watershed	0	0.0	0%	0
10	Maple Corner	15	39.6	4%	3
11	No. Branch Sheboygan	41	87.7	9%	17
12	Oxbow	0	0.0	0%	0
13	Rockville	2	6.5	1%	0
14	Sheboygan Falls	1	3.8	0%	9
15	Sheboygan Marsh	50	175.3	17%	0
16	So. Branch Sheboygan	15	40.0	4%	11
17	Victory School	1	19.1	2%	1
18	Wayside Park	7	52.2	5%	0
19	Wilke Lake	2	8.3	1%	0
20	Wilson	11	122.0	12%	0
21	Wolf Lake	4	12.0	1%	0
	Totals:	219	1012.4	100%	36

*Based on the modified ARS Barnyard Runoff Model (10yr, 24hr event).

Manure-Spreading Runoff

The 285 livestock operations inventoried in the Sheboygan River Watershed produced an estimated 176,600 tons of manure during the six-month period from late fall through mid-spring. Croplands spread with manure during this time of year produce a greater potential for runoff to cause water quality impacts because of the frozen soil.

The most significant water quality problems associated with landspreading of livestock manure occur when wastes are spread on "critical" areas such as steeply sloped frozen ground, land in floodplains, and/or areas with shallow depth to groundwater. For the purposes of this analysis, "critical lands" were defined as lands with slope greater than six percent, a soil type rated as flood prone, and soils with less than a 24-inch depth to bedrock. Estimates indicate livestock manure is spread on 1,992 "critical" acres from which runoff has a high potential to convey pollutants to surface and groundwater.

It was estimated that approximately 7,000 acres in the watershed are needed to safely spread the manure generated from late fall through mid-spring. Together, the operators of livestock operations own enough suitable land (13,500 acres) to safely spread animal wastes. However, a combination of factors, including climate, soil condition, and proximity of croplands suitable for spreading, result in manure-spreading on unsuitable (critical) areas. In addition, individual landowners may not have enough suitable land to properly spread livestock wastes.

Upland Sediment

Intensive agricultural practices have allowed considerable amounts of eroded soil to reach streams, lakes and wetlands in the Sheboygan River Watershed. Chemical fertilizers, herbicides, and pesticides are also carried along with runoff. Sediment transported in the runoff from the uplands was quantified during the inventory. Upland erosion is the major source of sediments carried to surface waters.

Upland sediment sources were evaluated for the entire watershed, with the exception of major urban areas (228 square miles). The results of this inventory are summarized in table 3-2. An estimated 302,069 tons of soil erode annually from croplands, pastures, woodlots, grassland, and other rural lands. Only about four percent of this amount (13,575 tons per year) actually reach wetlands, streams, or lakes in the watershed. The rest of the sediment settles out on fields or dry channels before reaching surface waters.

Croplands are the major source of sediment to reache surface waters. Although this land use accounts for 65 percent of watershed land cover, it contributes 95 percent of the sediment.

The highest sediment delivery rates are found in the Franklin, Wayside Park, Maple Corners, and Airport Subwatersheds. These are located in Sheboygan County in the eastern portion of the watershed. This area of the watershed has the highest portion of land in cropland and also is dominated by heavy clay soils. These two factors most likely account for the relatively high sediment delivery rates.

Table 3-2. Summary of Upland Sediment Loading by Land Use

Subwatershed		Cropland*	(%)	Farmstead	(%)	Grassland	(%)	Pasture	(%)	Woodlot	(%)	Grazed Woodlot	(%)	Commercial Residential	(%)	Developing	(%)	Wetland	(%)	Totals
Airport	Acres	10,402	74%	415	3%	841	6%	125	1%	1,370	10%	0	0	61	0%	157	1%	646	5%	14,019
	Soil Loss*	29,495	99%	0	0%	0	0%	434	1%	0	0%	0	0	0	0%	0	0%	0	0%	29,929
	Sediment*	2,665	94%	69	2%	4	0%	32	1%	11	0%	0	0	7	0%	38	1%	1	0%	2,827
Cedar Lake	Acres	133	32%	3	1%	22	5%	0	0%	171	41%	0	0	0	0%	80	19%	9	2%	418
	Soil Loss	414	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	413
	Sediment	12	38%	0	1%	0	0%	0	0%	0	0%	0	0	0	0%	19	62%	0	0%	31
Elkhart Lake	Acres	447	36%	11	1%	262	21%	0	0%	236	19%	0	0	225	18%	0	0%	62	5%	1,245
	Soil Loss	1,977	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	1,977
	Sediment	77	84%	0	0%	0	0%	0	0%	0	0%	0	0	14	15%	0	0%	0	0%	91
Franklin	Acres	2,158	76%	62	2%	175	6%	6	0%	343	12%	0	0	54	2%	7	0%	42	1%	2,850
	Soil Loss	11,827	100%	0	0%	0	0%	42	0%	0	0%	0	0	0	0%	0	0%	0	0%	11,870
	Sediment	1,062	98%	12	1%	1	0%	2	0%	3	0%	0	0	8	1%	1	0%	0	0%	1,088
Kiel Marsh	Acres	7,857	62%	157	1%	1,186	9%	35	0%	1,275	10%	0	0	96	1%	133	1%	1,948	15%	12,689
	Soil Loss	25,350	99%	0	0%	0	0%	182	1%	0	0%	0	0	0	0%	0	0%	0	0%	25,533
	Sediment	536	96%	4	1%	1	0%	5	1%	1	0%	0	0	1	0%	10	2%	2	0%	560
Kohler	Acres	995	55%	31	2%	370	20%	7	0%	171	9%	0	0	75	4%	133	7%	22	1%	1,806
	Soil Loss	2,503	98%	0	0%	0	0%	60	2%	0	0%	0	0	0	0%	0	0%	0	0%	2,563
	Sediment	129	83%	4	2%	0	0%	5	3%	1	0%	0	0	1	1%	15	10%	0	0%	155
Little Elkhart	Acres	59	12%0	8	2%	102	21%	0	0%	209	44%	0	0	68	14%	17	4%	15	3%	478
	Soil Loss	127	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	127
	Sediment	0	0%	0	4%	0	0%	0	0%	0	0%	0	0	3	41%	4	54%	0	0%	8
Little Watershed	Acres	46	13%	4	1%	100	28%	0	0%	119	33%	0	0	59	16%	30	8%	0	0%	358
	Soil Loss	72	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	72
	Sediment	0	0%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0	0	0%	0
Louis Corner	Acres	8,740	63%	297	2%	892	6%	153	1%	2,286	16%	0	0	17	0%	315	2%	1,218	9%	13,930
	Soil Loss	29,394	98%	0	0%	0	0%	491	2%	0	0%	0	0	0	0%	0	0%	0	0%	29,886
	Sediment	964	89%	15	1%	1	0%	26	2%	2	0%	0	0	5	0%	65	6%	0	0%	1,078
Maple Corner	Acres	4,396	64%	142	2%	431	6%	1	0%	1,375	20%	0	0	9	0%	133	2%	421	6%	6,908
	Soil Loss	24,060	100%	0	0%	0	0%	3	0%	0	0%	0	0	0	0%	0	1%	0	0%	24,062
	Sediment	1,477	97%	16	1%	1	0%	0	0%	2	0%	0	0	0	0%	18	1%	1	0%	1,516
North Branch Sheboygan	Acres	16,846	68%	473	2%	505	2%	123	0%	2,262	9%	0	0	338	1%	0	0%	4,078	17%	24,626
	Soil Loss	43,241	100%	0	0%	0	0%	149	0%	0	0%	0	0	0	0%	0	0%	0	0%	43,390
	Sediment	1,013	95%	22	2%	1	0%	0	0%	7	1%	0	0	6	1%	0	0%	19	2%	1,068

Table 3-2. Summary of Upland Sediment Loading by Land Use

Subwatershed		Cropland*	(%)	Farmstead	(%)	Grassland	(%)	Pasture	(%)	Woodlot	(%)	Grazed Woodlot	(%)	Commercial Residential	(%)	Developing	(%)	Wetland	(%)	Totals
Oxbo	Acres	254	57%	0	0%	60	13%	0	0%	113	25%	0	0	0	0%	4	1%	17	4%	448
	Soil Loss	369	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	370
	Sediment	24	93%	0	0%	0	0%	0	0%	0	2%	0	0	0	0%	1	5%	0	0%	26
Rockville	Acres	857	61%	58	4%	173	12%	15	1%	55	4%	0	0	43	3%	144	10%	55	4%	1,400
	Soil Loss	2,361	98%	0	0%	0	0%	35	1%	0	0%	0	0	0%	0%	0	0%	0	0%	2,397
	Sediment	127	78%	4	2%	0	0%	0	0%	0	0%	0	0	8	5%	24	15%	0	0%	163
Sheboygan Falls	Acres	743	56%	7	1%	199	15%	53	4%	250	19%	0	0	25	2%	4	0%	34	3%	1,319
	Soil Loss	2,191	99%	0	0%	0	0%	13	1%	0	0%	0	0	0	0%	0	0%	0	0%	2,204
	Sediment	87	97%	0	0%	0	0%	1	2%	1	1%	0	0	0	0%	0	0%	0	0%	90
Sheboygan Marsh	Acres	19,465	56%	557	2%	849	2%	143	0%	1,300	4%	0	0	149	0%	79	0%	12,017	35%	34,562
	Soil Loss	53,839	99%	0	0%	0	0%	322	1%	0	0%	0	0	0	0%	0	0%	0	0%	54,160
	Sediment	1,627	95%	25	1%	1	0%	6	0%	2	0%	0	0	0	0%	24	1%	30	2%	1,714
South Branch Sheboygan R.	Acres	12,354	75%	334	2%	466	3%	86	1%	758	5%	16	0	86	1%	0	0%	2,213	14%	16,313
	Soil Loss	44,388	99%	0	0%	0	0%	128	0%	0	0%	139	0	0	0%	0	0%	0	0%	44,655
	Sediment	1,138	98%	15	1%	1	0%	0	0%	0	0%	1	0	1	0%	0	0%	2	0%	1,159
Victory	Acres	1,140	62%	42	2%	183	10%	8	0%	289	16%	0	0	6	0%	13	1%	156	8%	1,837
	Soil Loss	4,316	99%	0	0%	0	0%	22	1%	0	0%	0	0	0	0%	0	0%	0	0%	4,338
	Sediment	253	97%	3	1%	1	0%	1	0%	0	0%	0	0	0	0%	3	1%	1	0%	262
Wayside Park	Acres	2,687	75%	104	3%	293	8%	3	0%	250	7%	0	0	6	0%	11	0%	174	5%	3,528
	Soil Loss	10,906	100%	0	0%	0	0%	38	0%	0	0%	0	0	0	0%	0	0%	0	0%	10,944
	Sediment	795	98%	14	2%	1	0%	1	0%	1	0%	0	0	1	0%	2	0%	0	0%	814
Wilke Lake	Acres	277	59%	10	2%	73	16%	1	0%	0	0%	0	0	22	5%	5	1%	79	17%	467
	Soil Loss	1,505	100%	0	0%	0	0%	2	0%	0	0%	0	0	0	0%	0	0%	0	0%	1,506
	Sediment	41	90%	0	1%	0	0%	0	0%	0	0%	0	0	2	5%	2	4%	0	0%	45
Wilson	Acres	3,807	77%	135	3%	301	6%	134	3%	135	3%	35	1	10	0%	91	2%	277	6%	4,925
	Soil Loss	8,712	98%	0	0%	0	0%	170	2%	0	0%	18	0	0	0%	0	0%	0	0%	8,900
	Sediment	752	91%	18	2%	1	0%	15	2%	2	0%	3	0	0	0%	33	4%	1	0%	824
Wolf Lake	Acres	1,368	78%	24	1%	22	1%	0	0%	26	1%	0	0	11	1%	0	0%	302	17%	1,753
	Soil Loss	2,774	100%	0	0%	0	0%	0	0%	0	0%	0	0	0	0%	0	0%	0	0%	2,773
	Sediment	56	97%	1	1%	0	0%	0	0%	0	0%	0	0	1	2%	0	0%	0	0%	58
Total	Acres	95,031	65%	2,874	2%	7,505	5%	893	1%	12,993	9%	51	0	1,360	1%	1,356	1%	23,785	16%	145,879
	Soil Loss	299,822	99%	0	0%	0	0%	2,090	1%	0	0%	157	0	0	0%	0	0%	0	0%	302,069
	Sediment	12,835	95%	221	2%	14	0%	95	1%	33	0%	3	0	59	0%	260	2%	57	0%	13,575

Streambank Erosion

Approximately 220 miles of streams were evaluated for eroding sites and degraded streambank habitat. The investigations showed that streambank erosion is not a large source of sediment to surface waters in the project. Sediment from streambank erosion is only about four percent of the sediment from the upland sources. Of greater concern are the number of sites where the streambanks are trampled from cattle which has caused significant streambank habitat and streambed degradation. However, the degradation is limited because of the extensive marshy areas along many streams.

Most (76 percent) of the sediment from eroding streambanks originated from Weeden's Creek (located in the Wilson Subwatershed), and the Sheboygan River and its tributaries in the Airport and South Branch Subwatersheds. Stream-side and streambed habitat degradation resulting from cattle access were most prevalent along the south and north branches of the Sheboygan River in Fond du Lac County. Approximately seven miles of degraded habitat were inventoried along these reaches (table 3-3). The main stem of the Sheboygan River was not inventoried for streambank conditions in the Kohler and Oxbow Subwatersheds.

Urban Inventory Results

An inventory of existing 1988 and planned year 2010 conditions was conducted with the aid of land use inventory data gathered from the city of Kiel's 50-year comprehensive plan, the city of Sheboygan's future land use map, and the city of Sheboygan Falls' and village of Kohler's planning departments. The delivery of urban pollutants to streams from existing urban areas was calculated using an urban runoff model. Three major factors which affect the model results are the type of urban land use, the type of stormwater conveyance system, and urban housekeeping practices including, but not limited to, street sweeping and leaf collection. Each factor is discussed below.

The village of Elkhart Lake was also investigated for the impacts of runoff on Elkhart Lake, although urban nonpoint modelling was not conducted. Approximately 22 acres of commercial residential lands drain from the village to a public beach on the lake via a storm pipe. Most likely, this situation is not critical for the lake's overall water quality; however, there have been elevated bacteria counts in the vicinity of the storm pipe outfall after rain events. It is also likely that there is an increase in turbidity in the area after runoff events. Based on this information, recommendations for the village are discussed in chapter six, "Recommended Management Actions: Control Needs and Eligibility for Cost-Share Funding".

Table 3-3. Inventory Results: Streambank Erosion and Habitat Degradation						
Subwatershed	Segment Length * (ft)	# of Eroding Sites	Total Length Eroding Sites (ft)	Total Sediment Loss (tons/yr)	Sediment Loss (tons/stream mile/year)	Banks With Cattle Access (ft)
Airport	164,380	62	10,805	205.2	6.6	3,350
Cedar Lake	2,500	0	0	0.0	0.0	0
Elkhart Lake	5,300	0	0	0.0	0.0	0
Franklin	34,100	15	1,500	19.5	3.0	0
Kiel Marsh	79,100	2	250	0.4	0.0	100
Kohler **	49,000	0	0	0.0	0.0	0
Little Elkhart	2,000	0	0	0.0	0.0	0
Little Watershed	No Perennial Streams Present					
Louis Corners	77,400	3	550	1.0	0.1	0
Maple Corner	60,160	36	4,900	60.9	5.3	2,200
No. Branch Sheboygan	253,280	4	4,180	27.8	0.6	8,360
Oxbow **	20,400	0	0	0.0	0.0	0
Rockville	12,600	1	150	2.1	0.9	0
Sheboygan Falls	40,600	12	1,750	10.1	1.3	0
Sheboygan Marsh	55,970	1	1,200	1.4	0.1	1,200
So. Branch Sheboygan	196,550	8	11,300	135.2	3.6	22,100
Victory School	18,700	2	400	0.3	0.1	400
Wayside Park	30,600	3	3,100	23.3	4.0	6,200
Wilke Lake	1,500	0	0	0.0	0.0	0
Wilson	48,900	26	2,025	131.7	14.2	0
Wolf Lake	20,000	0	0	0.0	0.0	0
Totals:	1,173,040	175	42,110	618.9	2.2	43,910

* This is the total length of stream inventoried

** The main stem of the Sheboygan River was not inventoried in Kohler or Oxbow subwatershed

Urban Land Uses

According to the 1988 urban land use inventory, approximately 17.6 square miles (or 11,278 acres) of urban land exist in the Sheboygan River Watershed (table 3-4). This amounts to approximately seven percent of all land in the watershed. (An additional 2,700 acres of developed or developing land were identified in the rural upland inventory. This land is distributed among smaller municipalities and enclaves of development scattered throughout the watershed. These lands were not included in the urban analysis, however, if they qualify, they will be eligible to receive cost sharing for control measures.)

Table 3-4 shows the distribution of urban land in the watershed based on the urban inventory. As might be expected, the greatest amount of urban land in the watershed (94 percent) is located in the Sheboygan metropolitan area in Sheboygan County. This includes the village of Kohler, and the cities of Sheboygan Falls and Sheboygan. The city of Kiel in Manitowoc and Calumet Counties covers an additional six percent of urban land. Table 3-6 summarizes the type and extent of urban land uses in these four communities. The predominant lands uses in the combined urban areas are open space (41 percent) and residential (35 percent).

Table 3-4. Inventoried Urban Areas in the Watershed

Municipality	Current (1988) Area	
	Acres	percent*
city of Kiel	703	6%
city of Sheboygan Falls	1,655	15%
village of Kohler	2,555	23%
city of Sheboygan (within the watershed)		
Drainage to Sheboygan R.	2,864	34%
Drainage to Lake Michigan	2,502	22%
Total	11,279	100%

* percent of total urban area within the watershed

Stormwater Conveyance

Urban 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 surface waters (streams and lakes). Properly designed grassed swales generally transport lesser amounts of runoff; both infiltration and vegetation serve 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 depend on the extent to which pollutant-producing surfaces are hydrologically "connected" to the storm sewer system. For

The types and amounts of pollutants transported by runoff depend 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 which may transport runoff directly to streams, lakes or wetlands. Developing sites in urban areas are often already connected to storm sewers before construction is begun. Stormwater conveyance systems were identified as part of the Sheboygan River urban inventory process.

Urban Housekeeping Practices

In addition to land uses and conveyance systems, street sweeping practices were inventoried in the watershed's major urban areas. These practices affect the portion of pollutants accumulated on urban surfaces that will be 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 weekly sweeping of commercial and industrial areas throughout the spring, summer, and fall. The benefits of street sweeping in other areas are primarily cosmetic and play a minimal role in reducing urban pollutant loads.

Current Urban Loads

Information regarding land uses, stormwater conveyance, and urban housekeeping practices was used to predict the delivery of current nonpoint source pollutant loads from urban areas in the Sheboygan River Watershed. Three pollutants (sediment, phosphorus, and lead) were chosen to characterize the sources and severity of urban nonpoint pollution. Urban nonpoint pollution sources described below include runoff from existing urban areas including established commercial, industrial, institutional, freeways and residential land uses; and runoff from areas where new urbanization is anticipated.

The analysis addresses urban nonpoint pollution sources in the four largest municipalities in the Sheboygan River Watershed: Kiel, Sheboygan Falls, Kohler, and Sheboygan. Current annual pollutant loads for each municipality are shown in table 3-5. Estimates shown include drainage areas in the Sheboygan River Watershed that are located within the city of Sheboygan but deliver nonpoint source pollutants directly to Lake Michigan.

The sources of sediment found in urban runoff and associated loads for the four urban areas are shown in table 3-6 and table 3-7. The city of Sheboygan contributes more than 50 percent of the estimated urban sediment, phosphorus, and lead loads delivered annually to streams and the near-shore waters of Lake Michigan in the watershed. This is to be expected, since the city of Sheboygan is the largest urban area in the watershed. The total annual sediment load from urban areas in the watershed is 3,924 tons. This is about 22 percent of the total sediment load from both rural and urban sources.

Table 3-5. Urban Inventory: Current (1988) Land Use and Pollutant Loads

Municipality	Current Area		Sediment Load*		Phosphorus Load		Lead Load	
	Acres	%	Tons/Yr	%	Tons/Yr	%	Tons/Yr	%
city of Kiel	703	6%	218	6%	0.14	6%	0.14	5%
city of Sheboygan Falls	1,655	15%	901	23%	0.28	11%	0.23	8%
village of Kohler	2,555	23%	703	18%	0.26	10%	0.37	13%
city of Sheboygan								
Drainage to Sheboygan R.	3,864	34%	1,461	37%	1.07	42%	1.44	52%
Drainage to L. Michigan	2,502	22%	659	17%	0.77	31%	0.59	21%
Total	11,279	100%	3,942	100%	2.52	100%	2.77	100%

* Includes construction site erosion

Table 3-6. Urban Inventory: Current (1988) Land Uses and Associated Sediment Pollution

	Kiel				Kohler				Sheboygan Falls				Sheboygan*			
	Area		Sediment		Area		Sediment		Area		Sediment		Area		Sediment	
Land Cover	acres	%	tons	%	acres	%	tons	%	acres	%	tons	%	acres	%	tons	%
Residential	194	28%	22	33%	202	8%	25	19%	567	35%	57	46%	2,992	47%	331	37%
Commercial	31	4%	15	22%	51	2%	17	13%	72	4%	22	18%	521	8%	142	16%
Industrial	46	7%	22	33%	223	9%	68	51%	159	10%	37	30%	747	12%	294	33%
Institutional	65	9%	8	12%	36	1%	4	3%	56	3%	7	6%	305	5%	37	4%
Open Space	338	48%	1	1%	1,973	78%	1	1%	772	47$	1	1%	1,563	25%	2	0%
Major Highways	0	0%	0	0%	37	1%	18	14%	0	0%	0	0%	196	3%	96	11%
Open Water	24	3%	0	0%	14	1%	0	0%	3	0%	0	0%	1	0%	0	0%
Total	698	100%	68	100%	2,536	100%	133	100%	1,629	100%	124	100%	6,325	100%	902	100%

* Includes drainage to Lake Michigan

Table 3-7. Urban Inventory: Current (1988) Areas Under Construction & Associated Sediment Pollution			
Urban Area	Area (acres)	Sediment (tons)	(%)[1]
Kiel	5	150	69%
Kohler	19	570	81%
Sheboygan Falls	26	777	86%
Sheboygan	40	1,200	57%
Total	90	2,697	68%[2]

1. Percent sediment contributed by construction site erosion compared to all other urban land uses
2. Average

Currently, construction site erosion is the most important source of sediment reaching surface waters from urban areas. A rate of 30 tons per acre per year was applied to estimate the sediment load from construction sites. Based on construction permits issued by each municipality, it was estimated that in 1988, construction erosion from the four urban areas contributed 2,697 tons of sediment to surface waters in the watershed. This significant contribution is nearly 70 percent of the total sediment load from urban nonpoint pollution sources; construction sites constitute less than one percent of the urban land in the watershed.

Overall, contributions of phosphorus and lead to the Sheboygan River from urban areas are relatively low. Freeways, industrial areas, commercial areas, and high density residential areas are the greatest contributors of sediment and lead on a per acre basis. The acreage for these uses is relatively low, even in the city of Sheboygan. (All four land use types together comprise approximately 24 percent of the city's land, and contribute 25 percent of the urban sediment.) However, as these types of land uses increase, increased levels of lead and other heavy metals may be anticipated.

Medium density residential areas are less important sources of sediment and lead per acre. However, these areas can generate significant quantities of lead because of the extensive areas the land uses often occupy. (For example, 32 percent of the urban area is in medium density residential land use and generates about 15 percent of the urban lead load.) Medium density residential areas are also significant sources of pesticides, bacteria, and household or automotive maintenance products that are 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.

Future Urban Development

Table 3-8 displays the increase in urban land use estimated to occur by the year 2010 for the four urban areas in the watershed. Estimated planned urban land use is expected to increase by nearly 1,294 acres, or about 11 percent by about the year 2010. The largest increase (25 percent) is anticipated to occur in the city of Sheboygan Falls. This amounts to a 414 acre increase in the city's current developed area and includes the subwatersheds of Sheboygan Falls and Airport. Most of the growth in the watershed is expected to occur in the development of additional residential areas (690 acres), with significant additions of industrial and commercial areas (537 acres).

Runoff from new urban areas can potentially further the degradation of stream water quality unless stormwater management controls are incorporated during development. Table 3-9 also shows the increase in urban nonpoint source sediment loading that will occur in the watershed in the year 2010 if new urban source areas are not controlled. Annual sediment loads are anticipated to increase by more than 58 percent per year over 1988 levels. Apart from developing areas, most of the increase in sediment in established urban areas will be derived from industrial lands (an additional 144 tons per year), followed by commercial areas (an additional 111 tons per year), and residential (an additional 66 tons per year).

In the four urban areas inventoried, an estimated 90 acres of new urban land uses were constructed in 1988, and approximately 60 acres are predicted to be developed annually until the year 2010. The two areas with the greatest percentage increase in planned development and accompanying sediment increase are the cities of Kiel and Sheboygan Falls. This is attributed to large relative increases in the acreage that will be under construction over the next 20 years. Sediment loading to streams from construction erosion under existing 1988 and year 2010 conditions was determined by multiplying the amount of land under development by an average of 30 tons per acre per year. The rate of erosion assumes no on-site erosion controls and is based on measured data normalized for local climatic conditions and land development patterns.

It was estimated that in 1988 construction erosion from the four urban areas contributed 2,697 tons of sediment to surface waters in the watershed. The impact of this source of sediment increases in the year 2010, when an estimated additional 1,848 tons (81 percent of total from urban nonpoint pollution sources) are projected to be delivered annually to streams.

Existing Urban Controls

The city of Sheboygan is in the process of developing and adopting a construction site erosion ordinance. The other urban areas inventoried have no provisions in place for controlling urban construction erosion. The city of Sheboygan has also experimented with other urban control practices such as grass swales in selected developing residential areas.

Table 3-8. Predicted Increase in Development and Sediment Pollution (1988 to 2010)

	Kiel				Kohler				Sheboygan Falls				Sheboygan[3]			
	Planned Increase		Added Sediment		Planned Increase		Added Sediment		Planned Increase		Added Sediment		Planned Increase		Added Sediment	
Land Cover	acres[1]	%[2]	tons	%	acres	%	tons	%	acres	%	tons	%	acres	%	tons	%
Residential	96	49%	13	59%	80	40%	0	2%	134	24%	14	25%	380	13%	39	12%
Commercial	13	42%	7	41%	14	27%	7	39%	140	194%	67	304%	70	13%	31	22%
Industrial	146	317%	70	318%	14	6%	7	10%	140	88%	67	181%	0	0%	0	0%
Institutional	0		0		0		0		0		0		0		0	
Open Space	0		0		0		0		0		0		0		0	
Major Highways	0		0		0		0		0		0		0		0	
Open Water	0		0		0		0		0		0		0		0	
Overall Increase	255	36%	89	41%	108	4%	14	2%	414	25%	148	16%	450	7%	70	3%

1 "Planned Acres" are the increases in developments predicted over the next 20 years
2 "% increase" compares the year 2010 land use with the 1988 land use
3 Includes drainage to Lake Michigan

Table 3-9. Predicted Annual Rate of Construction and Sediment Pollution (Yr: 2010)

Urban Area	Rate of Development * (acres/year)	Sediment Load (tons/year)
Kiel	13	390
Kohler	5	162
Sheboygan Falls	22	651
Sheboygan	23	675
Total	153	1,878

*Based on Average of 1985-1990

CHAPTER FOUR
ESTABLISHING WATER RESOURCE OBJECTIVES AND POLLUTANT REDUCTION LEVELS

Water Quality and Resource Objectives

Site-specific surface water quality objectives are the basis for determining the levels of pollutant control to achieve within the priority watershed project. Groundwater objectives are also used to set pollutant reduction goals. These groundwater objectives for the watershed are established in compliance with the state of Wisconsin's groundwater standards. Surface water standards exist for selected parameters such as dissolved oxygen and temperature, however, standards for pollutants such as sediment, nutrient loadings, and habitat conditions have not formally been established. Because these parameters are not as well-defined, this chapter will discuss the process of setting water resource objectives for surface waters.

Water quality and resource use objectives were developed by the Department of Natural Resources' (DNR) staff with assistance from the county Land Conservation Departments (LCDs), and the Department of Agriculture, Trade and Consumer Protection (DATCP). The following steps were used to establish the water resource objectives. This information is based on the water resource appraisal information (see Appendix A) and the general knowledge of watershed resources:

1. The current condition of each stream or lake in the project area was determined. Factors considered for this step included water quality and aquatic habitat, types of recreational use, and wildlife habitat. The current condition of the water resource was described in terms of the type of fishery, recreational use, or wildlife use currently supported. (See Appendix B for explanations of fishery and recreational use classifications.)

2. Factors threatening or degrading the water resource were identified. Examples of the factors include sedimentation, low dissolved oxygen levels, bacteria, nuisance aquatic plants, high water temperatures and lack of habitat.

3. The "new" condition or "potential" use of each water resource when pollutants and/or threats were removed or reduced was determined. An example of potential use is when sediments are sufficiently reduced, conditions may improve to the extent that a stream which supported a forage fishery may change classification to a Class III coldwater trout fishery. The extent to which pollutants are controllable was also considered in making the potential use determinations.

Water resource objectives were then developed for surface water resources in the watershed based on the "new" or "potential" condition identified for each stream or lake. Where the condition of a creek has the potential for substantial improvement, water resource objectives were set to change the existing fishery or recreational use in a positive direction. Where substantial improvement over present conditions is not possible, water resource objectives aim to maintain and enhance existing uses supported by the stream or lake. In chapter five, see table 5-1 for preliminary objectives for each stream or river segment, and table 5-2 for preliminary objectives for lakes.

Nonpoint Source Pollutant Reduction Levels

After setting the water resource objectives, the necessary level of pollutant reduction was determined to attain the "new" or desirable resource condition or use. Preliminary levels for pollutant control were established based on the current conditions of the streams, rivers, or lakes. The more severe the water quality conditions, the greater the reduction in pollutant loading that is required to reach the objective. The *Water Resources Appraisal and Stream Classifications for the Sheboygan River Watershed* (DNR, 1989a, unpubl.) indicated that significant reductions were needed in the amounts of both sediment and nutrients (phosphorus) that currently reach streams and lakes in order to achieve the water quality objectives for the watershed. Therefore, the pollutant reduction goals for this project target the control of sediment and phosphorus for streams and lakes. Tables 5-1 and 5-2, in chapter five, list the preliminary reduction goals for rivers, streams and lakes.

Overall, a 50 percent reduction in the existing sediment loading is needed to improve the water quality and aquatic habitat in all segments of the Sheboygan River. This level of control will eventually reduce the amount of sediment on the river bottom and will improve the river's ability to support a more diverse aquatic community.

In addition, a 50 percent reduction in the phosphorous loading to the river's main stem segments is needed to diminish the nutrients that cause excessive weed and algae growth. This plant growth can lead to low dissolved oxygen conditions in the streams. For water resources other than those of the main stem of the Sheboygan River, varying levels of nutrient and sediment reductions were proposed. These levels are shown in tables 5-1 and 5-2 in chapter five. A secondary benefit of controlling nonpoint sources of pollution to the Sheboygan River will be the improvement of the near-shore water quality in Lake Michigan.

Final pollutant reduction levels were determined based on the proposed preliminary goals. These goals reflect water quality conditions and the feasibility of attaining the reduction levels given the parent soil types, the practicality of applying best management practices (BMPs), and the cooperation of landowners. The pollutant reduction levels were determined for each of the five inventoried categories of nonpoint sources of pollution:

- Sediment eroded from rural uplands.
- Sediment eroded from streambanks.

- Runoff from barnyards.
- Runoff from areas winterspread with livestock manure
- Runoff from urban areas.

The final pollutant reduction levels, and corresponding management actions for each of the five pollutant sources, are shown in tables 6-1 through 6-7, chapter six.

Heavy metals and other toxic materials in urban runoff were evaluated, but were not identified as having a measurable impact on the water quality in the watershed. However, reductions in heavy metals may be necessary for communities to meet the toxicity standards set in Chapter NR 105 of the Wisconsin Administrative Rules for stormwater pipes. Significant amounts of polychlorinated biphenyls (PCBs) were deposited in the lower reaches of the Sheboygan River and harbor as a result of discharges from industrial processing. The PCBs were not a result of urban or rural nonpoint source pollution. The reduction of these in-place pollutants is being addressed by state and federal programs other than the Wisconsin Nonpoint Source Water Pollution Abatement Program.

CHAPTER FIVE
WATER RESOURCE CONDITIONS AND OBJECTIVES

Introduction

Lakes, rivers and streams with similar water resource objectives have been grouped within this chapter. Uniform pollutant reduction goals have been applied to each of the groupings to meet water resource objectives. The main stem of the Sheboygan River is considered one unit; each natural lake is a unit; and specifically identified resources, such as degraded fisheries that require more stringent controls to achieve water resource objectives, are grouped into units. This chapter presents the following items for each water resource unit in the Sheboygan River Watershed.

- A description of the water resource unit and the drainage areas contributing to it.
- A discussion of water resource conditions including water quality, habitat, and species diversity. (See Appendix A for a discussion regarding the methods in which the Sheboygan River, streams, and lakes in the watershed were inventoried and the methods in which watershed conditions were assessed.)
- A statement of water resource objectives (or potential for improvement) for each river segment, perennial stream, or lake. Refer to table 5-1 and table 5-2 for a summary of the objectives and preliminary pollution reduction goals set for each subwatershed. The water quality conditions which are necessary to reach these surface water objectives are the basis for determining the type and level of nonpoint source pollution control to be implemented under the priority watershed project.

Table 5-1 and 5-2 present an overview of the watershed's lakes and streams along with their water resource objectives and preliminary reduction goals. This chapter also contains detailed discussions of each water resource.

In chapter six, tables 6-1 through 6-7 present pollutant reduction levels and management actions needed to meet the water resource objectives of each water resource.

Table 5-1. Sheboygan River Watershed: Water Resource Objectives for Major Rivers and Streams

Stream/River	Sub-Watershed	Preliminary Water Resource Objective	Prelim. Reduction Goals	
			Sediment	Phosphorus
North Branch Sheboygan River (CTH W to CTH G)	North Branch	1. Maintain warm water sport fishery classification. Increase diversity & number of sport fish. 2. Improve potential for waterfowl production and pheasant habitat. 3. Reduce pollutant loading to Sheboygan Marsh	50%	25%
Feldners Creek	North Branch	1. Maintain cold water sport and forage fishery classification. Increase diversity & number of cold water sport and endemic forage fish. 2. Protect clean water inflow to main stem. 3. Protect spring and adjoining wetland areas.	25%	50%
South Branch Sheboygan River (CTH W to Headwaters)	South Branch	1. Maintain cold and warm water fishery classification. Increase diversity & number of sport fish. 2. Improve water quality entering Sheboygan Marsh. 3. Enhance waterfowl reproduction and turkey/pheasant habitat. 4. Maintain human recreational use classification.	75%	50%
Sheboygan River Main stem	Sheboygan Marsh Kiel Marsh	1. Maintain warm water sport and forage fishery classification. Increase diversity and number of fish. 2. Protect wetlands and natural communities of state significance (Muehles Springs).	50%	50%
Sheboygan River Main stem	Rockville	1. Maintain warm water sport fishery classification. Increase diversity and number of sport fish. 2. Reduce effect on/improve downstream reaches of Sheboygan River.	50%	50%
Sheboygan River Main stem	Louis Corners	1. Maintain warm water sport & forage fishery classification. Increase number & diversity of sport and forage fish. 2. Maintain human health classification and improve recreational uses.	50%	50%
Gooseville Creek	Louis Corners	1. Maintain forage fishery classification. Increase diversity and number of forage fish. 2. Protect overall quality of main stem by maintaining water quality of creek. Protect spring and adjoining wetland areas.	75%	50%
Sheboygan River Main stem	Maple Corner	1. Maintain warm water sport & forage fishery classification. Enhance numbers and size of sport fish. 2. Maintain human recreational use classification.	50%	50%
Millhome Creek	Maple Corner	1. Maintain Class I trout fishery classification. Improve carryover and reproduction. 2. Maintain human recreational use classification. 3. Protect corridor and headwater wetlands.	75%	50%
Schuett Creek	Maple Corner	1. Maintain Class I trout fishery classification. Improve carryover & reproduction. 2. Maintain human recreational use.	75%	50%
Sheboygan River Main stem	Franklin	1. Maintain warm water sport fishery classification. Enhance number and size of sport fish. 2. Maintain human recreational use classification.	50%	50%

Table 5-1. Sheboygan River Watershed: Water Resource Objectives for Major Rivers and Streams

Stream/River	Sub-Watershed	Preliminary Water Resource Objective	Prelim. Reduction Goals	
			Sediment	Phosphorus
Otter Creek	Wayside Park	1. Maintain forage fishery classification. Enhance number and size of forage fish. 2. Maintain human recreational use classification. 3. Protect stream corridor and adjoining wetlands to enhance quality of water reaching Sheboygan R. 4. Protect endangered fish species. 5. Improve wildlife habitat.	75%	50%
Gerber Lake Outlet	Wayside Park	1. Maintain warm water forage fishery classification. 2. Protect quality of water delivered to Gerber lakes.	75%	50%
Sheboygan River	Airport	1. Maintain current warm water sport fishery classification. Enhance number and size of sport fish. 2. Maintain human recreational use classification. 3. Protect stream corridor and adjoining wetlands.	50%	50%
Sheboygan River	Sheboygan Falls	1. Maintain current warm water sport fishery. Enhance number and size of sport fish. 2. Maintain human recreational use.	50%	50%
Weedens Creek (Lower segment)	Wilson	1. Maintain forage fishery classification. Enhance number and size of sport fish. 2. Protect stream corridor and adjoining wetlands. 3. Maintain human recreational use classification.	75%	50%
Weedens Creek (Upper segment)	Wilson	1. CHANGE to intolerant forage fishery classification. 2. Maintain human recreational use classification. 3. Protect stream corridor and adjoining wetlands.	75%	50%
Sheboygan River	Oxbow Kohler Sheboygan Harbor	1. Maintain warm water sport fishery classification. Enhance number and size of sport fish. 2. Maintain human recreational use classification. 3. Maintain commercial & recreational navigation. 4. Maintain quality of near shore waters of Lake Michigan. 5. Reduce lead content in sediment in lower stretches of river and harbor.	50%	50%

Table 5-2. Sheboygan River Watershed: Water Resource Objectives for Major Lakes

Lake	Sub-Watershed	Preliminary Water Resource Objective	Prelim. Reduction Goals Phosphorus
Wolf	Wolf Lake	1. IMPROVE the lake's trophic status. Reduce spring phosphorus concentration to 20 µg/L. Increase average summer secchi depth. 2. Protect surrounding wetlands. Restore wetlands around Giltner Lake. 3. Enhance species richness and abundance of sport and forage fish. 4. Enhance waterfowl communities associated with the lake. 5. Protect human health and recreational values.	50%
Gerber	Victory School	1. Maintain the lake's trophic status. Reduce spring phosphorus concentration to 20 µg/L. Increase average summer secchi depth. 2. Protect surrounding wetlands. 3. Enhance species richness and abundance of sport and forage fish. 4. Enhance waterfowl communities associated with the lake. 5. Protect human health and recreational values. 6. More accurate assessment of current conditions.	50%
Cedar	Cedar Lake	1. IMPROVE the lake's trophic status. Reduce spring phosphorus concentration to 20 µg/L. Increase average summer secchi depth. 2. Enhance species richness and abundance of sport and forage fish. 3. Enhance waterfowl communities associated with the lake. 4. Protect human health and recreational values. 5. More accurate assessment of current conditions.	50%
Elkhart	Elkhart Lake	1. Maintain the lake's trophic status. Reduce spring phosphorus concentration to 45 µg/L. Increase average summer secchi depth. 2. Enhance species richness and abundance of sport and forage fish. 3. Enhance waterfowl communities associated with the lake. 4. Protect human health and recreational values. Reduce bacterial loadings at city beach.	50%
Wilke	Wilke Lake	1. Maintain the lake's trophic status. Reduce spring phosphorus concentration to 20 µg/L. Increase average summer secchi depth. 2. Enhance species richness and abundance of sport and forage fish. 3. Enhance waterfowl communities associated with the lake. 4. Protect human health and recreational values. 5. More accurate assessment of current conditions.	50%
Little Elkhart	Little Elkhart	1. IMPROVE the lake's trophic status. Reduce spring phosphorus concentration to 30 µg/L. Increase average summer secchi depth. 2. Enhance species richness and abundance of sport and forage fish. 3. Enhance waterfowl communities associated with the lake. 4. Protect human health and recreational values. 5. More accurate assessment of current conditions.	75%

Rivers and Streams

Main Stem of the Sheboygan River

Description: The main stem of the Sheboygan River receives nonpoint source loads from the 11 subwatersheds that drain directly to it. This includes the North Branch, Sheboygan Marsh, Kiel Marsh, Rockville, Louis Corners, Maple Corner, Franklin, Airport, Sheboygan Falls, Oxbow, and Kohler Subwatersheds. The drainage area covers 125,787 acres (including urban areas) or about 80 percent of the entire Sheboygan River Watershed.

The main stem of the Sheboygan River includes all of the main channel (about 72 miles), beginning in the western headwaters (North Branch Subwatershed, map 5-5), and continuing eastward through the watershed to the river's mouth at Lake Michigan in the Kohler Subwatershed (see map 5-3.) (Note: The South Branch segment will be considered as a separate water resource unit.) The main stem of the Sheboygan River receives flow from numerous perennial and intermittent tributaries, from direct runoff, and from groundwater discharge. The river cuts its way through diverse topography and land uses, from the drumlins and glacial drift hills of the west, to the expansive marshes of the middle region, to the developing and urban landscape and industrial outfalls of the lower eastern reaches and harbor.

Water Resource Conditions: The entire main stem of the Sheboygan River is classified as FAL-B in that it is capable of supporting full fish and aquatic life communities. These communities consist of warmwater sport fish, such as northern pike, bullheads, crappie, largemouth bass, smallmouth bass, and assorted panfish. The water quality of feeder tributaries varies. The biological use classifications for these streams range from forage fisheries to Class I (see Appendix B) coldwater trout fisheries. The water quality of the main stem of the Sheboygan River is described as good to fair, in terms of nutrient enrichment and disturbance, with reaches of poor water quality (DNR, 1980).

In most areas, the river is only partially meeting its biological use classification due to the loss of fish and invertebrate habitat, low dissolved oxygen levels, and winterkills in the Sheboygan Marsh. These conditions result from cultural changes occurring on the landscape including channelization, streambank degradation, erosion and delivery of nutrients and sediment, and fish migration barriers. It is estimated that all segments of the Sheboygan River are 50 to 75 percent embedded or "silted-in"(DNR, 1989a, unpubl.).

Past municipal and industrial wastewater discharges have contributed heavy organic matter loads to virtually the entire main stem of the Sheboygan River. Low dissolved oxygen levels, and excessive weed and algae growth (especially behind impoundments) have resulted. Currently, upgrades of wastewater treatment facilities and the capability for recommended screening for toxins in wastewater are progressing under the Wisconsin Pollutant Discharge Elimination System (WPDES) process. All industrial wastewater discharges appear to be in compliance with current permit regulations.

Spills of toxic materials from industrial accidents or intentional disposal continue to degrade water quality. Contaminants in sediment and high bacteria levels present problems in the lower reaches.

Wildlife habitat has been degraded throughout the watershed due to the loss of riparian and floodplain vegetation and the alteration of wetland water levels.

The main stem may be divided into three major sections for a more detailed description of water resource conditions.

Section One: The North Branch, Sheboygan Marsh, Kiel Marsh, and Rockville Subwatersheds: This section includes the main stem of the Sheboygan River from the headwaters in the North Branch Subwatershed to the Rockville impoundment. Numerous small marshes, shallow lakes, and two vast wetland areas provide diverse terrestrial and aquatic habitat in these subwatersheds. Three impoundments are located on this stretch of river at Sheboygan Lake, Kiel Marsh, and Rockville. Primarily, the land uses include undeveloped wetland and dairy agriculture. This section includes the municipalities of Mt. Calvary, St. Cloud, and Kiel—all of which discharge treated effluent from permitted municipal wastewater treatment facilities into the Sheboygan River.

In these subwatersheds, the main stem segments of the river exhibit better water quality than the perennial and intermittent tributaries that contribute to the main stem. The wetlands and tributaries that adjoin the river function as a nutrient and sediment storage system, filtering out nonpoint source pollutants before severely affecting the main stem of the Sheboygan River. The effects of this action on wetland functions and values were not assessed in this plan. It is likely that the effectiveness of the wetlands as "pollutant sinks" will decrease over time. The tributaries in general suffer from sedimentation, nutrient loading, streambank habitat degradation, and spring source alteration.

Water quality in the pools behind impoundments is poorer than free-flowing reaches. Fish diversity shows a gradual decline downstream from Sheboygan Lake, the point after which impoundments become a regular feature of the river. The Rockville flowage exhibits the poorest water quality in this reach, due to significant nutrient enrichment and disturbance. Carp and nuisance aquatic plants dominate the impoundment.

High bacteria levels in the Sheboygan River below Kiel were recorded in the past (DNR, 1980). The Kiel wastewater treatment plant was cited as a potential source of bacterial loading. However, since the installation of a new treatment facility in 1983, the Kiel facility has regularly met its effluent limits. No recent bacteriological data have been collected, although 1987 and 1988 biotic index sampling indicated poor and fairly poor water quality in terms of the organic enrichment which still exists downstream of the Kiel dam.

Continuous low dissolved oxygen levels were measured in this segment indicating organic enrichment of the surface water. This condition may actually reflect a naturally occurring situation that results from marshy areas located upstream draining into shallow lakes. However, septic systems and nonpoint pollution sources, such as urban and barnyard runoff, should not be ruled out as contributing factors.

Three outstanding water resources in this segment were identified in the subwatersheds. Feldners Creek is a Class II trout fishery that originates in the springs southwest of St. Cloud in the North Branch Subwatershed. The creek is very close to meeting its biological potential and appears to be well buffered by adjoining woodlands and wetlands. It shows little evidence of nutrient and sediment impacts. Pauly's Lake is a small seepage lake located west of St. Cloud in the North Branch Subwatershed (see map 5-5). The lake and surrounding lands support several natural communities of regional significance including emergent aquatic vegetation, northern wet forest, and shrub-carr plant communities. The area is valuable for wildlife uses.

Finally, the Muehles Springs are located in the Kiel Marsh Subwatershed and flow into a tributary of the Sheboygan River classified as a forage fishery. The stream is limited by size, depth, and siltation, but the area surrounding the springs shows very little sign of human disturbance and supports several rare species of plants. The DNR's Bureau of Endangered Resources has identified the Muehles Springs area as a natural plant community of statewide significance. The Nature Conservancy owns much of the surrounding land.

Section Two: The Louis Corners, Maple Corner, Franklin, and Airport Subwatersheds: This section includes the main stem of the Sheboygan River from below the Rockville dam (the Louis Corners Subwatershed) continuing in a southeast direction to within the city limits of Sheboygan Falls (the Airport Subwatershed). Following the river downstream, land uses change from agricultural to developing and residential. This section includes the small communities of Franklin and Johnsonville in the upper reaches, and a few acres of the city of Sheboygan Falls in the lower portion. Two impoundments are located in this section of the Sheboygan River at Millhome and Franklin.

Unlike the main stem segments, described in Section One, these middle segments cut through relatively flat landscape which is characterized by clay soils of low permeability and high runoff. In this segment of the watershed, flow levels in streams are very dependent upon precipitation. Wetlands are not common. Perennial tributaries and intermittent channels serve as direct conveyances of nonpoint source pollution to the Sheboygan River.

Water quality in this middle segment of the Sheboygan River shows moderate enrichment or disturbance and is generally described as fair to good (DNR, 1989a, unpubl.). The segments that have been impounded show wide temperature variations and low dissolved oxygen concentrations. Nuisance algae and carp are problems in these flowages. In the past, bacteria levels which exceed the state recreational standards were recorded for all river segments in this section (DNR, 1980). However, recent surveys conducted since the upstream wastewater treatment facilities were upgraded are lacking.

The dams interfere with fish migration. Fish populations in the Louis Corners and Maple Corner segments lack diversity. Although instream habitat is poor, historical data indicates a diverse assemblage of sport and forage fish exists in the river between the Rockville dam and Sheboygan Falls. The Franklin Subwatershed is the only segment with an instream habitat ranked as "good", the other segments range from "poor" to "fair". The bottom substrate in the Franklin Subwatershed is mostly stable, and consists of rubble and gravel. Better than average water depth exists within the riffles, pools, and runs (DNR, 1989a, unpubl.). Other

river segments suffer from sediment deposition, turbidity, and prolific macrophyte or aquatic plant beds.

This section of the main stem includes the tributaries of Millhome and Schuett Creeks (Louis Corners Subwatershed), both of which are trout streams, and Otter Creek (Wayside Park Subwatershed). Otter Creek supports the striped shiner, an endangered species of fish. Based on their current water resource conditions, these creeks will require more stringent pollutant controls to reach the water quality objectives. These creeks are discussed later in this chapter as specific water resource units.

Section Three: The Lower Sheboygan River and Harbor. This section of the Sheboygan River includes segments that flow through the Sheboygan Falls, Oxbow, and Kohler Subwatersheds. It ends at the mouth of the river in Lake Michigan. The river's hydrologic characteristics change dramatically in this lower section, first as it receives drainage from two major tributaries, the Mullet and the Onion Rivers, in the vicinity of the city of Sheboygan Falls, and again in the sluggish harbor reaches. (Note: Weedens Creek in the Wilson Subwatershed is a tributary of the Sheboygan River below the Kohler dam. It is discussed as a separate water resource unit). The waters of Lake Michigan also back up into the river at times, reversing the river's flow in the area of the city of Sheboygan. Three impoundments in this section slow the flow of the river and also prohibit the upstream migration of Lake Michigan fish, including trout and salmon.

Unlike the upstream sections, the lower Sheboygan River's immediate drainage area has high runoff characteristics a result of clay soils and extensive urban area use. Despite the metropolitan nature of this drainage area, riparian habitat consists primarily of trees and grasses directly adjacent to the river, especially in the Sheboygan Falls and Oxbow Subwatersheds. The lower Kohler Subwatershed is more developed with approximately 19 permitted industrial facilities that discharge directly or via storm sewers into the Kohler Subwatershed (DNR, 1989a, unpubl.).

Water quality in this lower section of the river is described as fair to good, with the potential to support an excellent fishery. Currently, the presence of high levels of in-place contaminants (polychlorinated biphenyl compounds PCBs and heavy metals) and bacterial levels which exceed state recreational standards are limiting the utilization of the resource. Presently, there are consumption advisories (based on PCB concentrations in animal tissues) for fish and waterfowl taken from the lower reaches of the Sheboygan River. Historical data indicate that values for suspended solids, nitrogen, and phosphorus were elevated above the U.S. Environmental Protection Agency's (EPA) suggested water quality criteria levels. Recent data (collected after more stringent wastewater treatment plan effluent controls were instituted) are lacking for these parameters.

For Great Lakes harbors, the EPA's guidelines consider sediments with lead levels above 60 parts per million (ppm) to be "heavily contaminated". Sediments found in the lower Sheboygan Harbor area were heavily contaminated with lead (Maack, 1988). Significantly elevated levels of heavy metals have not been observed in the water column or in animal tissues.

The habitat in the streams varies within the three subwatersheds. The Sheboygan Falls Subwatershed has fairly good habitat which is mainly limited by its three dams. Its flowing reaches demonstrated good depth and a stable bottom composed of gravel and rubble. The habitat behind the dams is much more degraded and sedimentation is a problem. Streambank erosion is moderate. The lower subwatersheds (Oxbow and Kohler) exhibit poorer instream habitat with extensive embeddedness (See Glossary for definition of embeddedness).

Water Resource Objectives: The following water resource objectives were established for the Sheboygan River main stem:

- Maintain the warmwater sport fishery classification in all main stem segments. Improve the physical, chemical and biological conditions of the river in order to enhance the fishery and to meet its full biological potential.

- Improve the water quality of tributaries which supply the main stem. Preserve the wetland system from further degradation.

- Improve the potential for waterfowl production and pheasant habitat in the upper reaches (North Branch, Sheboygan Marsh, and Kiel Marsh) by protecting the river corridor and eliminating wetland ditching.

- Maintain water quality for full body contact recreational use and improve recreational use by reducing fecal bacteria levels.

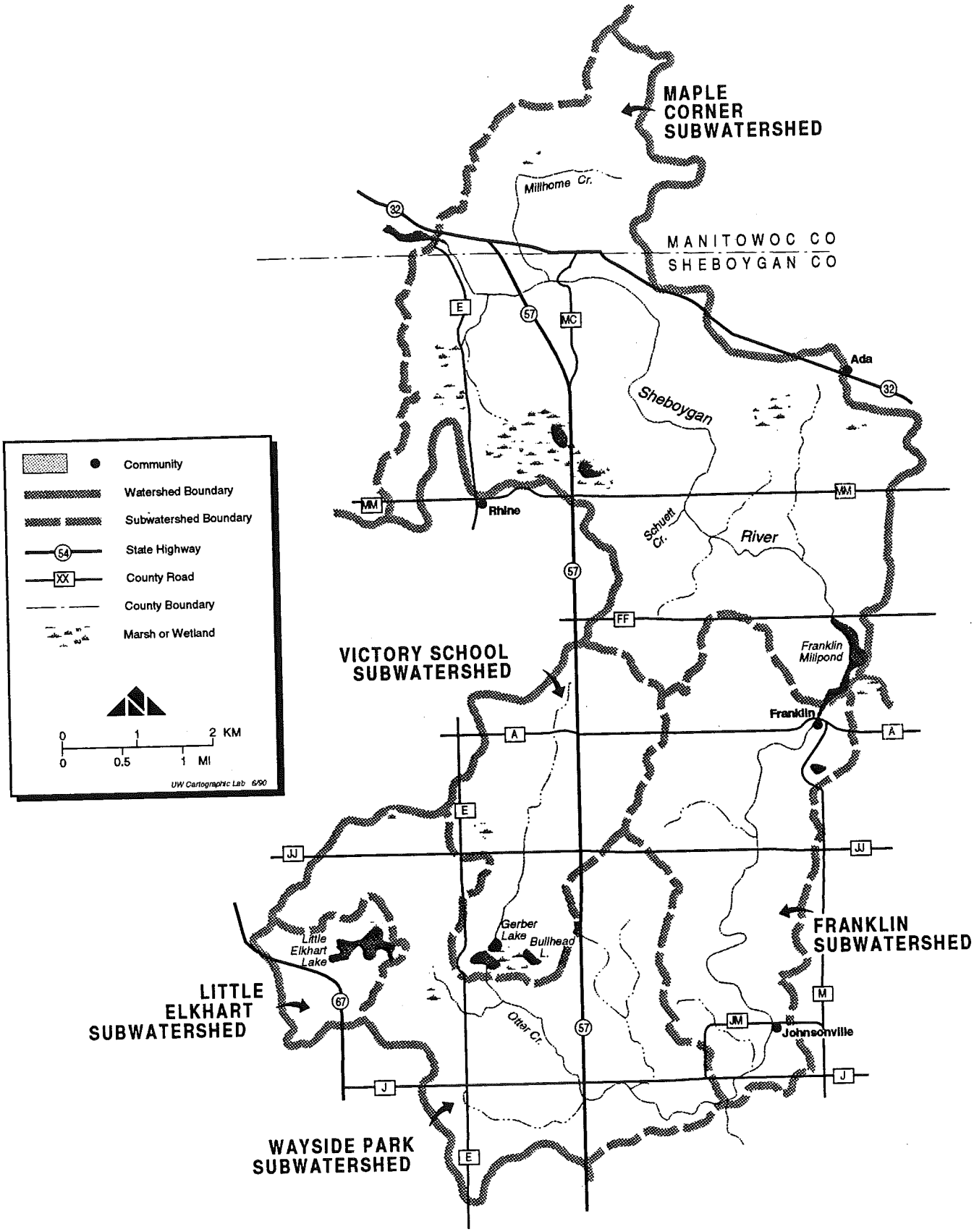
- Improve the quality of the water reaching Lake Michigan so that it is consistent with the International Joint Commission's (IJC), federal and state objectives. Reduce lead content in sediments of the lower stretches of the river and harbor.

- Protect rare and endangered species and natural communities (Muehles Springs).

Millhome and Schuett Creeks

Description: Millhome Creek and Schuett Creek are perennial waters located in the Maple Corner Subwatershed (map 5-1). Millhome Creek flows into the Sheboygan River approximately 0.2 miles downstream (east) of the State Highway 57 bridge. The creek flows approximately two miles from its headwater springs in the northern part of the subwatershed in Walla Hi County Park. Schuett Creek joins the Sheboygan River approximately 0.1 miles downstream (south) of County Highway MM. The stream originates in the springs, and flows through a steep gradient area approximately one-half mile to its confluence with the Sheboygan River. Part of the land adjacent to the stream is in state ownership.

Map 5-1. **Maple Corner, Victory School, Wayside Park, Little Elkhart, and Franklin Subwatersheds.**



Water Resource Conditions: Both streams have a good cubic foot per second (cfs) or greater, and are classified as Class I (see Appendix B) brook trout (i.e., FAL-A Coldwater Community Classification). These streams are only partially meeting their biological use classifications. The recreational use for these streams is classified for partial body contact due to insufficient depth, width, and water volume. Recreational uses include sport fishing, baitfishing, trapping, wading, wildlife habitat, and additionally for Schuett Creek, sight-seeing.

The sedimentation and nutrient conditions mainly limit biological uses of the streams. Toxicity associated with pesticides or herbicides is suspected (DNR, 1989a, unpubl.). Recent macroinvertebrate samples rated Millhome Creek "very good" in terms of organic enrichment, indicating only slight organic pollution. Samples collected on upstream segments of Schuett Creek showed no evidence of organic pollution; however, those samples collected further downstream below a barnyard showed values indicative of organic enrichment, and were rated "very poor" and "poor".

Streambed disturbance and habitat destruction are problems; both creeks received, overall, poor instream habitat ratings. Fast-flowing reaches consist of rubble, gravel and sand, with extensive silt deposits in slow-moving reaches. Floodplain pasturing and wetland dredging in the headwaters are suspected as the major causes of these conditions in Millhome Creek. The upper wooded reaches of Schuett Creek provide good instream and riparian habitat, while the lower reaches are influenced by a barnyard/feedlot that is adjacent to the stream.

The dominant fish population in both streams is brook trout, along with other sport fish and forage fish species. No bacteriological data is available on these creeks.

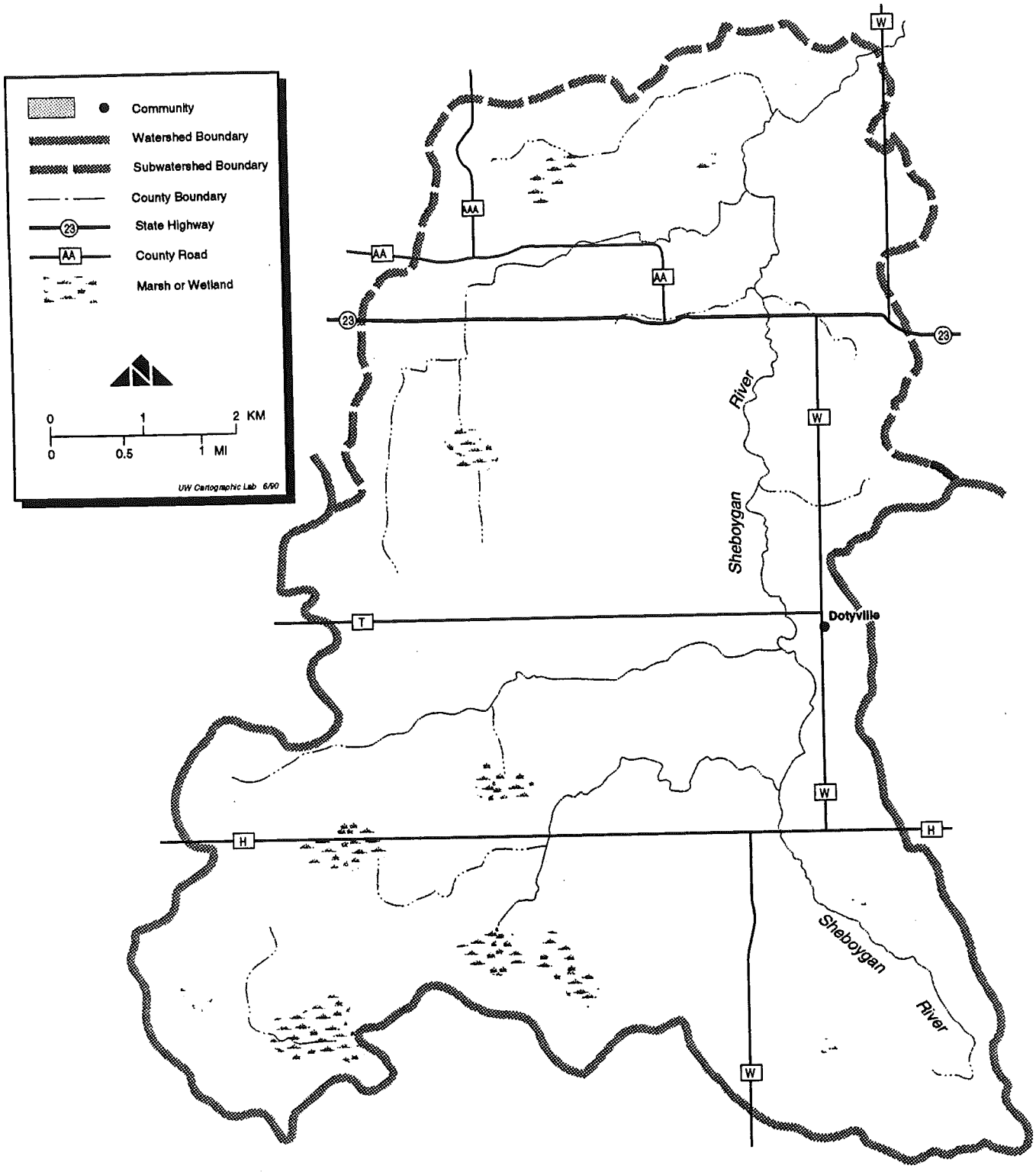
Water Resource Objectives: The following objectives were set for Millhome Creek and Schuett Creek:

- Maintain the current Class I trout fishery classification on both creeks. Improve the physical and biotic conditions of the creeks to enhance the fisheries and to meet the full biological potential.
- Maintain the human recreational use classification.
- Protect the stream corridor and headwater wetlands.

South Branch Sheboygan River

Description: The South Branch of the Sheboygan River originates in springs west of Mullet Lake in Fond du Lac County (map 5-2). It flows as a tributary in a northerly direction approximately 1.9 miles and becomes the Sheboygan River proper north of County Trunk Highway H. Over the next ten miles, four other perennial tributaries join the South Branch before its confluence with the North Branch near Mt. Calvary. Land use along the headwaters is mainly woodland and wetlands, with pasturing along the lower reaches. Much of the riparian vegetation and adjacent wetlands has been converted to cropland or is grazed, and wildlife habitat has been significantly impaired.

Map 5-2. South Branch Subwatershed



Water Resource Conditions:

Trout waters. The upstream portion of the river (1.8 miles) is classified as FAL-A. The stream was managed for brook trout in the past with approximately 1.1 miles of Class I and 0.8 miles of Class II trout waters. Water quality is fairly good with only slight organic pollution. The upper portions of this 1.9 mile stretch are surrounded by dense riparian cover. This is one of the few reaches in the South Branch Subwatershed minimally affected by agricultural development and nonpoint source pollution.

Main Stem. The main stem portion of the South Branch Sheboygan River is classified as FAL-B with the potential to support a warmwater sport fishery. The recreational stream use classification of partial body contact was assigned due to the stream's limited depth. The river is only partially meeting its designated biological and recreational uses due to the deposition of sediment, streambed disruption, riparian habitat loss, nutrients, temperature extremes, high bacteria levels, and suspected contamination from agricultural chemical spills.

Macroinvertebrate sampling indicates water quality in the main stem is good to fair with respect to organic pollution. Instream habitat ranges from fair to severely degraded, depending mainly on the degree of streambank erosion and disruption caused by livestock access and channel straightening. Sedimentation or embeddedness ranges from 10 to 100 percent.

Water Resource Objectives: The following objectives were set for the South Branch Sheboygan River:

- Maintain the current warmwater and coldwater sport fishery classification. Improve the physical and biological conditions of the creek to enhance the fishery and to meet its biological potential.
- Improve the quality of the water entering the Sheboygan Marsh downstream.
- Enhance waterfowl reproduction, and turkey and pheasant habitat.
- Maintain the human use classification of partial body contact. Meet the recreational potential by reducing fecal bacteria levels.

Otter Creek

Description: Otter Creek is a perennial stream that flows for 4.2 miles and drains the central portion of the Wayside Park Subwatershed (map 5-1). The stream originates in a small spring lake owned by the YMCA. It flows through a white cedar and tamarack swamp and receives flow from the north branch of Otter Creek (Gerber Lake outlet) before joining the main stem of the Sheboygan River below County Trunk Highway J at the border of the Airport Subwatershed.

Water Resource Conditions: Otter Creek is characterized by a moderate gradient, with rapid flow in some portions. The stream is classified as FAL-C, a warmwater forage fishery, and is classified as partial body contact for recreational use. The stream is capable of supporting both a high quality fish community with diverse and abundant forage fish, and a macroinvertebrate community that is intolerant of poor water quality and degraded or naturally limited habitat. Presently the fish community is composed of "tolerant" and "very tolerant" forage fish and a number of "intolerant" forage species. (Note: "Tolerant" species are able to survive in poor water quality and "intolerant" species require better water quality.) Although warmwater sport fish have been observed, they are not likely present in fishable numbers.

An endangered species in Wisconsin, the striped shiner, has been found in this creek. This fish requires clear water and gravel-rubble stream bottoms for its habitat. The presence of this species indicates the quality of Otter Creek and the importance of protecting this creek.

Macroinvertebrate samples indicate that water quality is "good" and "fair" with respect to organic enrichment, with better water quality observed in the upper headwater reaches. Habitat was rated "fair" to "good" for forage fish species, and "fair" to "poor" for sport fish. Good substrate is present; however lower reaches are extensively embedded. The stream is not meeting its biological and recreational potential, and suffers from sedimentation, streambank degradation, and streambed disruption. This is especially true in reaches where the stream is extensively pastured or channelized.

Data for bacteria levels are not available for Otter Creek, however, the discharge of residential septic waste to a tributary of the creek, via a tile line, has been observed (DNR, 1989a, unpubl.)

Water Resource Objectives: The objectives for Otter Creek are to:

- Maintain the current forage fishery classification. Improve the physical and biological conditions of the stream to enhance the intolerant fishery and to meet the current biological use designation.
- Protect the endangered fish species.
- Maintain the recreational uses.
- Protect and/or enhance the quality of water delivered to the Sheboygan River.
- Improve wildlife habitat.

Weedens Creek

Description: Weedens Creek flows north and meets the Sheboygan River about one mile downstream from the Kohler dam. The stream flows approximately six miles through the

Wilson Subwatershed and is supplied by numerous intermittent tributaries (map 5-3). The headwaters segment (actually an intermittent tributary) originates in a large wetland at the south end of the subwatershed below County Trunk Highway V.

The predominant land use is currently agricultural; however, much of this subwatershed is included in the Sheboygan Sewer Service Planning Area. Wilson Township has the highest predicted population growth rate of the Sheboygan metropolitan townships over the next 20 years. Most of this growth will most likely be in the Lake Michigan shoreline corridor; however, portions of the headwaters area of Weedens Creek are included in the area outlined to be sewered by the year 2010 (Kaiser, 1989).

Water Resource Conditions: Weedens Creek is classified as FAL-C with the potential to support a warmwater forage fishery throughout its lower perennial reaches—approximately two miles in length. The stream experiences seasonal runs of salmon, trout, and northern pike from the Sheboygan River. The stream is only partially meeting its recreational designation of partial body contact. Bacterial contamination is suspected. The headwaters segment of the creek is classified as Intermediate-D, see Appendix B for definition (DNR, 1989a, unpubl.). According to water resource appraisals, this segment can potentialy support a warmwater forage fishery (i.e., classified as FAL-C), but is limited by alterations to the stream channel.

Water quality in the main stem of Weedens Creek is considered "fairly poor" to "good" and is affected by moderate amounts of organic pollution. The instream habitat was rated as "poor". The main habitat problems are streambank degradation and instream deposition of sediment which result in shallow depths and bar formation. No bacteriological data were available for this creek.

Water Resource Objectives: The objectives set for Weedens Creek are as follows:

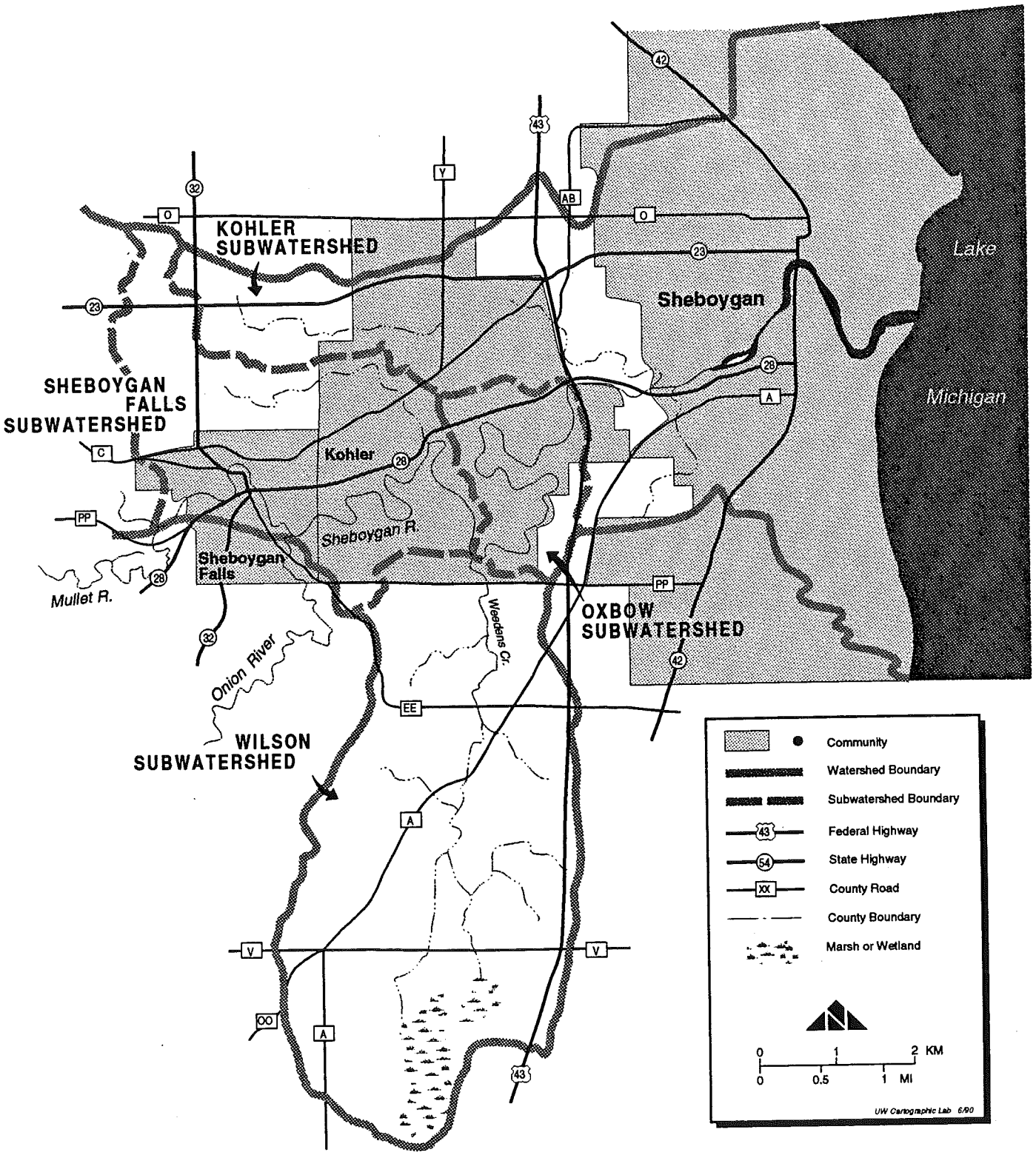
- **Lower Segment:** To maintain the warmwater forage fishery classification. Also to improve the physical and biotic condition of the stream to enhance the fishery and meet its biological potential, and also to improve wildlife habitat.
  Upper Segment: To change the classification to FAL-C, which is an intolerant forage fishery by improving the physical and biotic conditions of the stream.

- To maintain human recreational uses. This will involve an assessment of bacteria levels and a reduction of bacteria counts from nonpoint pollution sources to meet the partial body contact classification.

- To protect the quality and base flow of water supplied to the Sheboygan River and Lake Michigan.

- To protect headwaters area from impending impacts of urban development.

Map 5-3. Sheboygan Falls, Kohler, Wilson, and Oxbow Subwatersheds



Gooseville Creek

Description: The perennial portion of Gooseville Creek flows approximately 2.4 miles from the Sy Lake outlet to its confluence with the Sheboygan River below the Rockville dam. The stream drains most of the Louis Corners Subwatershed, and is fed by several intermittent tributaries, which originate both above and below Sy Lake (map 5-4).

Water Resource Conditions: Gooseville Creek is classified as capable of supporting a warmwater forage fish community (i.e., FAL-C); however, it is only partially meeting this biological designation. The stream suffers from sedimentation and streambank degradation. The recreational classification is for partial body contact, based on insufficient depth and water volume. The stream is fully meeting this use.

Water quality is rated "good" to "fair" based on recent macroinvertebrate data. Instream habitat, however, is rated "poor" based on 50 to 75 percent embeddedness resulting in shallow depths, and streambank habitat destruction. Recent surveys collected 11 species ranging from sport fish to very intolerant species. Bacteriological information is unavailable for Gooseville Creek.

Water Resource Objectives: The Gooseville Creek objectives are to:

- Maintain the existing warmwater forage fishery classification and improve the physical and biotic conditions of the stream to enhance the fishery and meet the biological use designation.

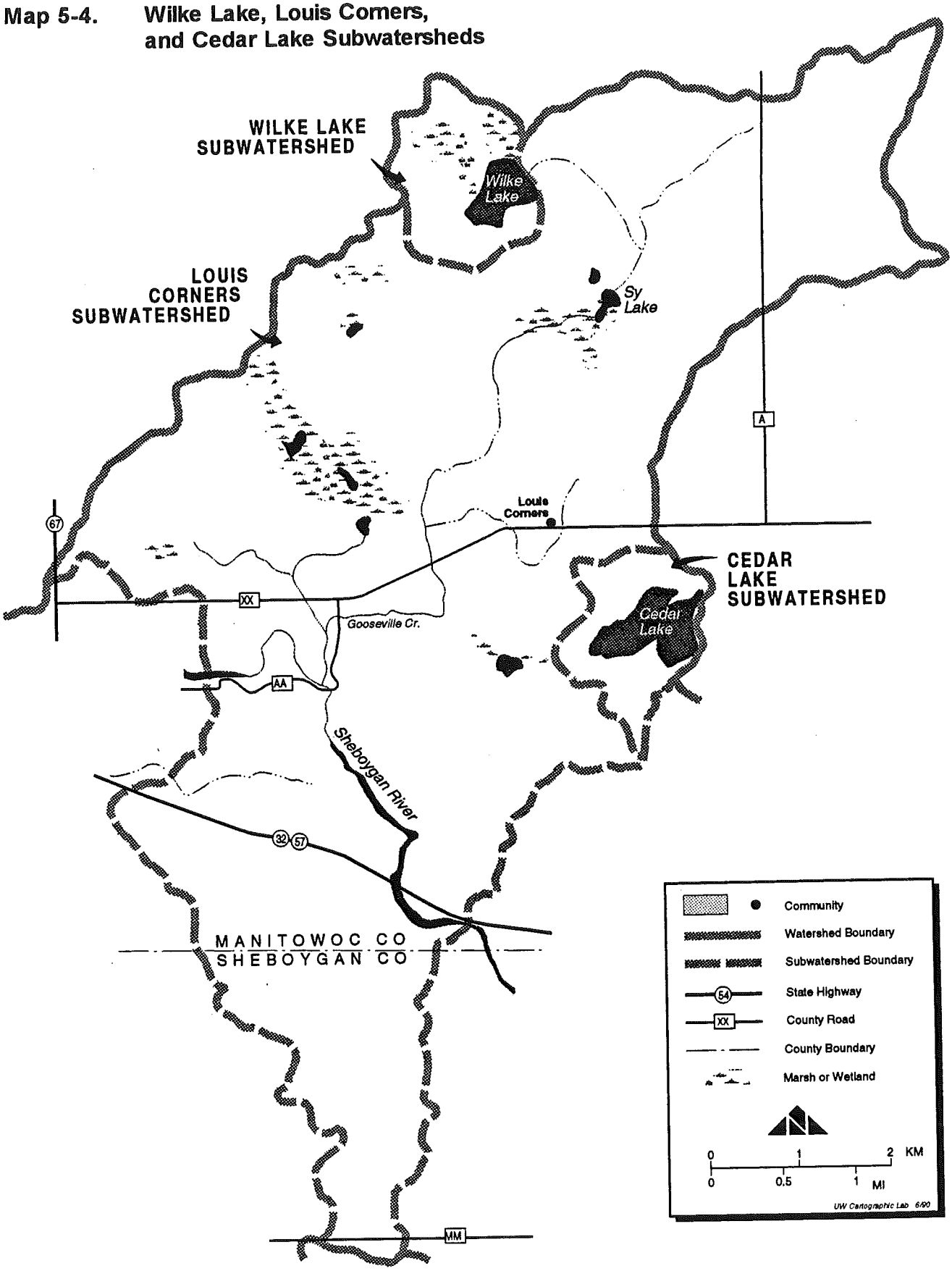
- Protect the quality of water delivered to the Sheboygan River. At this time, Gooseville Creek is more degraded than the Sheboygan River main stem.

Gerber Lake Inlet

Description: This unnamed perennial stream originates in the springs of a headwaters area north of Highway A. The stream flows approximately one mile through the Victory School Subwatershed, and discharges into Gerber Lake (Map 5-1).

Water Resource Conditions: The stream is classified as a warmwater forage fish community (i.e., FAL-C). It has the potential to contain a diverse coldwater, forage fish community (DNR, 1988). Presently, the stream primarily contains tolerant and very tolerant forage fish species. The stream's recreational classification is for partial body contact due to its narrow width, depth, and water volume. It is fully meeting this designation.

Map 5-4. Wilke Lake, Louis Corners, and Cedar Lake Subwatersheds



Instream habitat is considered "fair" to "good". The underlying substrate is coarse and stable; however, embeddedness has covered approximately 50 to 75 percent of the boulder, cobble, and gravel substrate with fine sand and silt. Channelization is estimated to involve approximately 75 percent of the total stream length. Macroinvertebrate studies indicate water quality is "good", with some organic pollution probable. The presence of intolerant species found in this stream indicate the stream has the potential to support a diverse intolerant forage fish community.

Water Resource Objectives:

- Maintain the existing warmwater forage fishery classification and improve the physical and biotic conditions of the stream to enhance the fishery and meet the biological use designation.

- Protect the quality of water delivered to Gerber Lakes.

Lakes

The water quality characteristics of the major lakes (20 acres or more) within the Sheboygan River Watershed were investigated. Water resource conditions will be discussed for the six major lakes within the watershed: Wolf Lake, the Gerber Lakes, Cedar Lake, Elkhart Lake, Wilke Lake, and Little Elkhart Lake.

Lakes are products of the surface and geological features of their watersheds. The lakes of the Sheboygan River Watershed are seepage lakes with generally moderately hard, alkaline, and fertile waters. A major factor in the high fertility or "eutrophication" of these waters is the addition of nutrients, especially nitrogen and phosphorus (DNR, 1988). Problems resulting from excessive fertilization of the lakes in the Sheboygan River Watershed include nuisance growths of rooted aquatic plants and algae, and reductions in water clarity and dissolved oxygen concentrations.

The Trophic State Index is a useful way of describing nutrient availability to macrophytes and planktonic plants in a lake system. Trophic State Index values for all of the major lakes in the watershed indicate they are in advanced stages of eutrophication. All of the lakes are classified in the mesotrophic (moderately rich) to eutrophic range; a common characteristic of lakes in southeastern Wisconsin.

Rooted aquatic plants are a continual nuisance in some lakes in the watershed. To control this problem, lake property owners on Cedar, Elkhart, Little Elkhart, and Wilke Lakes have, in the past, conducted chemical control programs under the guidelines of the Wisconsin Aquatic Nuisance Control Program. All four lakes were treated with sodium arsenite prior to 1970. Little Elkhart Lake still uses chemical herbicides to treat nuisance macrophytes.

Wolf Lake

Water Resource Conditions: Wolf Lake is a small seepage/drainage lake, but it is a significant resource in an area with few multiple use water bodies. Swimming, boating, and fishing are the most common activities on this 77-acre lake. Residents regularly monitor Wolf Lake during the summer months as part of the DNR's Self-Help Lake Monitoring Program.

The lake is described as mesotrophic or moderately rich in terms of nutrient availability for aquatic plants and algae. The mean depth is about 19 feet while the maximum depth is 47 feet. Walleye, perch, bluegill, and largemouth bass are common along with common forage fish species. Wildlife uses are moderate, since the shoreline is largely developed and contiguous wetlands are minimal.

Wolf Lake receives flow from the last remaining natural reach of stream remaining in its subwatershed, the Giltner Lake outlet. Giltner Lake is a small lake, less than 17 acres, ringed with wetlands. It is believed Giltner Lake and the nature of its outlet stream and surrounding wetlands help filter out pollutants, protecting the quality of water entering Wolf Lake (map 5-5).

Water Resource Objectives: The objectives for Wolf Lake are to:

- Improve the trophic status of Wolf Lake by reducing phosphorus loads to the lake in order to obtain an acceptable spring-turnover phosphorus concentration of 20 micrograms per liter (μg/L) (based on the Dillon-Rigler lake model predicted recovery values). Related objectives are to improve water clarity and reduce algal biomass to a degree that corresponds to potential trophic status.

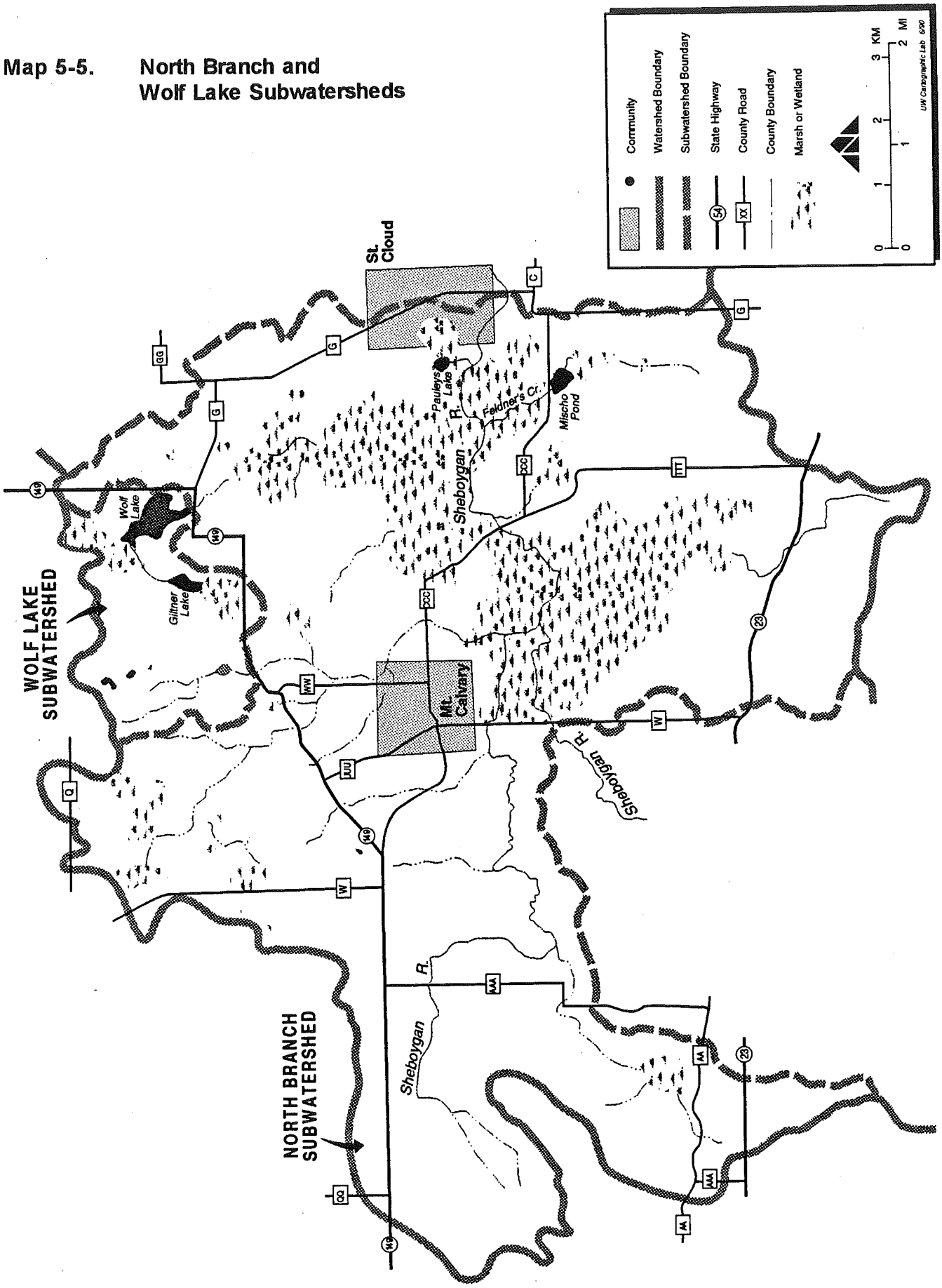
- Protect the filtering capacity of surrounding wetlands and the inlet stream to Wolf Lake. A related objective is to target the Giltner Lake inlet for wetland restoration efforts.

- Protect the human health and recreational values of Wolf Lake.

Gerber Lake

Water Resource Objectives: Gerber Lake is actually two basins connected by a navigable channel in the Victory School Subwatershed (map 5-1). The upper basin, called "Little Gerber", has a surface area of 6.8 acres, and the lower basin, "Big Gerber", has 15.2 acres. Their depths are 21 feet and 37 feet respectively. The outflow from Big Gerber Lake connects to Otter Creek. The lakes' shorelines are mainly undeveloped, which contributes to their "wilderness-like" nature. Some of the surrounding land is owned by Sheboygan County.

Map 5-5. **North Branch and Wolf Lake Subwatersheds**



It appears that the upper lake is functioning as a sediment trap for surface runoff from the Victory School Subwatershed. This protects the quality of outflow delivered to the lower lake. The water in the smaller basin is turbid compared to the relatively clear water in the larger lake. However, both lakes experience moderately heavy summer algal blooms. The lakes contain excellent largemouth bass and bluegill fisheries and contain numerous other species as well.

Water Resource Objectives: The objectives for the Gerber Lakes are to:

- Maintain the trophic status of the Gerber Lakes by reducing phosphorus loads to the lakes in order to obtain an acceptable spring-turnover phosphorus concentration of 20 μg/L (based on the Dillon-Rigler lake model predicted recovery values). Another objective is to improve the water clarity and reduce the algal biomass to a level which reflects the lakes' improved nutrient budget.

- Protect the filtering capacity of wetlands surrounding the Gerber Lakes.

- Protect the human health and recreational values of the Gerber Lakes.

Cedar Lake

Water Resource Conditions: Cedar Lake is a 139-acre landlocked seepage lake in southwestern Manitowoc County (map 5-4). The lake is shallow, with a maximum depth of 26 feet, and does not strongly stratify during the summer. Cedar Lake's fishery consists of largemouth bass, panfish, and northern pike. The lake's drainage area is less than one square mile and includes summer cottages, agricultural land and wetlands. According to the Upland Resource Inventory (DNR, 1989b, unpubl.), approximately 20 percent of the watershed is currently under development. Recreational uses include boating, swimming, and fishing.

Nutrient data collected on Cedar Lake over the past 15 years indicate that the lake may be classified as mesotrophic/meso-eutrophic. However this lake has not experienced any major problems over the years with nuisance vegetation, either rooted or planktonic. The calculated phosphorus loads based on average in-lake, spring-turnover phosphorus concentrations were significantly higher than phosphorus load calculations using the WIN model, which is based on upland sediment sources. This suggests the influence of the phosphorus that may be tied up in the lake sediments (internal loading). Septic systems may be another source.

Water Resource Objectives: The objectives for Cedar Lake are to:

- Improve the trophic status of Cedar Lake by reducing phosphorus loads to the lake in order to obtain an acceptable spring-turnover phosphorus concentration of 20 μg/L (based on the Dillon-Rigler lake model predicted recovery values). Related objectives are to improve water clarity and reduce algal biomass to a degree which corresponds to the potential trophic status.

- Assess current conditions more accurately for Cedar Lake to gain a better understanding of its phosphorus dynamics.

- Protect the human health and recreational values of Cedar Lake.

Elkhart Lake

Water Resource Conditions: The Elkhart Lake Subwatershed is located in northwestern Sheboygan County, south of the village of Elkhart Lake (map 5-6). The 300-acre lake is fed by two intermittent streams, and has an outflow draining into the Sheboygan Marsh. The lake has a maximum depth of 113 feet and supports an extensively managed fishery consisting of walleye, panfish, smallmouth bass, brown trout, and rainbow trout, and forage fish. Shoreline development is substantial as the lake is ringed with resorts and cottages. Elkhart Lake receives intense pressure from year-round recreational uses.

The lake is classified as meso-eutrophic, or moderately rich in terms of nutrient availability for aquatic plants and algae. The lake stratifies in the summer and dissolved oxygen levels in the bottom waters were measured at zero milligrams per liter (mg/L) in 1988. This indicates that there is sufficient biological activity (due to nutrient loadings) to deplete the water of oxygen in the deeper areas. Macrophyte growth has been a problem in the past and various chemical agents have been used to control this growth; however, it is believed that aquatic plants do not present a problem at this time (DNR, 1989a, unpubl.). Over the years the community around the lake has attempted to reduce nutrient input to the lake through the correction of faulty or inadequate septic systems.

The average spring-turnover phosphorus samples are limited in number, but those collected did indicate very high values (about 52 μg/L). The calculated phosphorus loads based on the W model inventories are much lower than the Dillon-Rigler lake model prediction of phosphorus loads that were based on the samples. It is likely that the phosphorus tied up in the sediments of the lake (internal loading) from years of cultural uses is having an effect on the lake's trophic state. Additional lake monitoring is needed to more accurately assess present and future lake conditions.

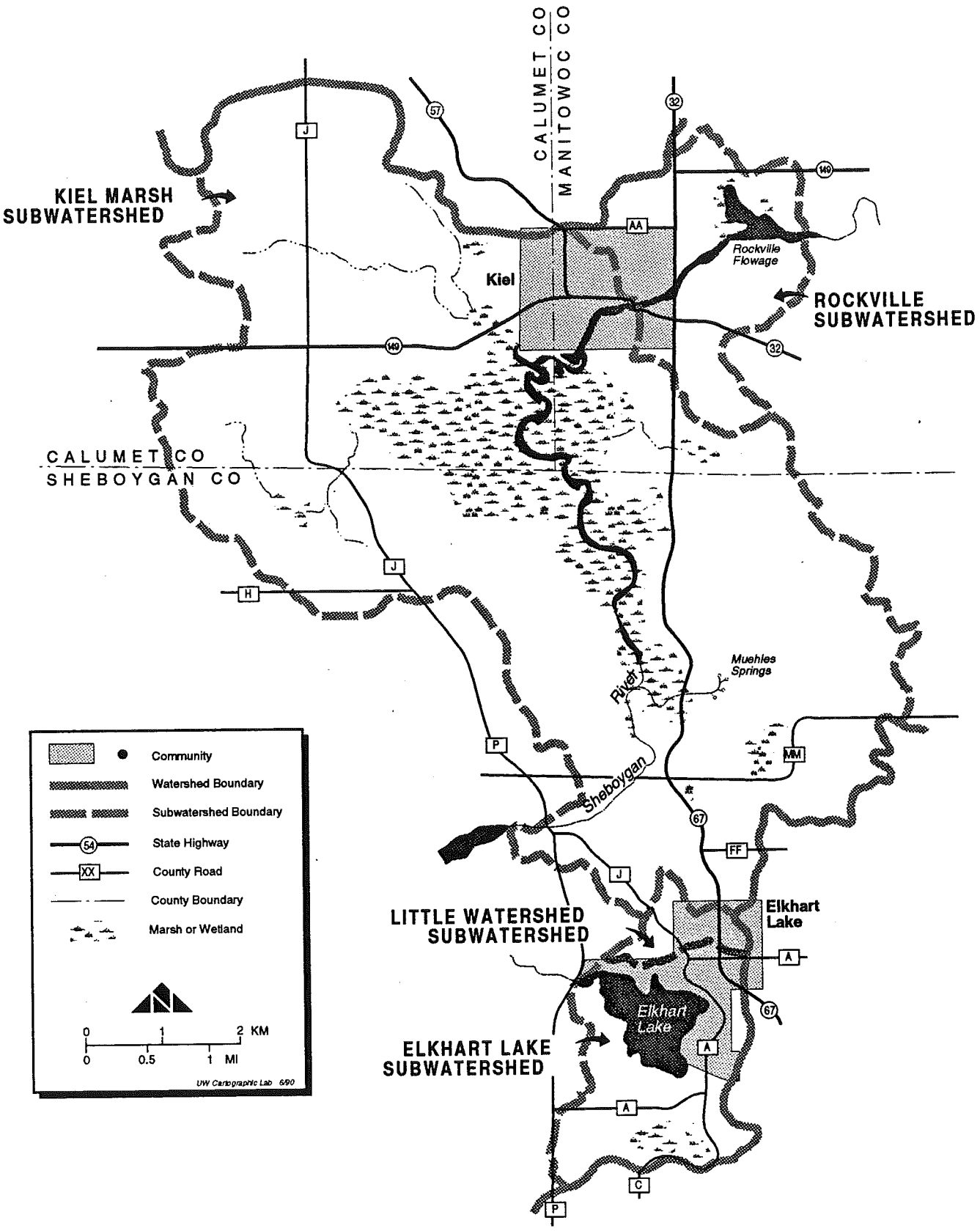
Water Resource Objectives for the Elkhart Lake area are to:

- Maintain the trophic status of Elkhart Lake by reducing phosphorus loads in order to obtain an acceptable spring-turnover phosphorus concentration of 45 μg/l (based on the Dillon-Rigler lake model predicted recovery values). Related objectives are to improve water clarity and reduce algal biomass to a level which reflects the lake's improved nutrient budget.

- Assess current conditions more accurately for Elkhart Lake in order to gain a better understanding of its phosphorus dynamics.

- Protect the human health and recreational values of Elkhart Lake.

Map 5-6. Rockville, Kiel, Elkhart Lake, and Little Watershed Subwatersheds



Wilke Lake

Water Resource Conditions: Wilke Lake is a shallow, land-locked seepage lake located on the northeastern border of the Sheboygan River Watershed, northeast of the city of Kiel in Manitowoc County (map 5-4). It has a maximum depth of 22 feet and a surface area of 97 acres. It is drained by a controlled outlet leading to Sy Lake in the Louis Corners Subwatershed. The shoreline is developed with cottages, with approximately 32 acres of wetland bordering its northern shore. Wilke Lake is one of the most heavily used lakes in Manitowoc County and supports a fish population of largemouth bass, panfish, northern pike, and assorted forage fish species, including carp.

The lake is too shallow to stratify during the summer and is classified as eutrophic. The bottom substrate is gravel overlain with muck. Historically, the lake has experienced problems with macrophytes and planktonic algae. Heavy boat traffic is considered the cause of turbid water conditions. Failing septic systems may still be a source of nutrients to the lake. Daily mechanical weed harvesting appears to be controlling macrophytes and algal mats in the lake at this timem (DNR, 1989a, unpubl.).

Water quality sampling found average summer chlorophyll a concentrations to be 9.33 μg/L, average summer secchi depths of 0.95 meters, and a spring-turnover phosphorus concentration of 27 μg/L; these values are indicative of "fair" water quality and a relatively high trophic status. Data are limited and these results were the average of only two sampling periods in 1975 and 1988.

Water Resource Objectives for Wilke Lake are to:

- Maintain the trophic status of Wilke Lake by reducing phosphorus loads to the lake to obtain an acceptable spring-turnover phosphorus concentration of 20 μg/L (based on the Dillon-Rigler lake model predicted recovery values). Related objectives are to improve water clarity and to reduce algal biomass to a level which reflects the lake's improved nutrient budget.

- Assess current conditions more accurately for Wilke Lake to gain a better understanding of its phosphorus dynamics.

- Protect the human health and recreational values of Wilke Lake by reducing bacterial loads to the lake.

Little Elkhart Lake

Water Resource Conditions: Little Elkhart Lake is a shallow seepage lake located in north central Sheboygan County, approximately two miles southeast of the larger Elkhart Lake (map 5-1). It has a maximum depth of 21 feet and a surface area of 47 acres. A controlled outlet on the lake's southeast corner flows into a bog located in the headwaters of Otter Creek. Little Elkhart Lake's 1.5 square mile watershed is covered mainly by low density residential development.

The trophic status of Little Elkhart Lake has been estimated at somewhere between mesotrophic and eutrophic. Macrophyte growth is very extensive and heavy. The productive, shallow lake is subject to periodic winterkills and therefore supports a relatively poor fishery characterized by stunted sport and panfish populations.

A comparison of the Dillon-Rigler lake model predictions of phosphorus loads, and the calculations of upland phosphorus sources, suggests possible contributions of nutrients to the lake from sources other than nonpoint sources of pollution, such as internal loading, groundwater, and/or failing septic systems.

Water Resource Objectives for Little Elkhart Lake are to:

- Improve the trophic status of Little Elkhart lake by reducing phosphorus loads to the lake in order to obtain an acceptable spring-turnover phosphorus concentration of 30 μg/L (based on the predicted recovery values using the Dillon-Rigler lake model). Related objectives are to improve water clarity and reduce algal biomass to a degree which corresponds to potential trophic status.

- Assess current conditions more accurately for Little Elkhart Lake in order to gain a better understanding of its phosphorus dynamics.

- Protect the human health and recreational values of Little Elkhart Lake.

CHAPTER SIX
RECOMMENDED MANAGEMENT ACTIONS: CONTROL NEEDS AND COST-SHARE FUNDING ELIGIBILITY

Introduction

Management actions were developed to meet the pollutant reduction levels established during the water resource appraisal process. These actions will obtain the levels of pollution control necessary to achieve the water resource objectives discussed in Chapter Five.

Tools for Carrying Out the Management Actions

Easement Eligibility

Although easements are not considered a best management practice (BMP), easements can help achieve desired levels of nonpoint source pollutant control in specified conditions. Easements are used to support BMPs, to enhance landowner cooperation, and to more accurately compensate landowners for the loss or altered usage of property. The benefits of using easements in conjunction with a management practice are:

- A riparian (shoreline) easement can provide fish and wildlife habitat along with the pollutant reduction function.
- Easements are generally perpetual, so the protection is longer-term than a management practice by itself.
- An easement may allow for limited public access (depending on the situation).

Three situations encountered when determining the use of easements are:

1. **Riparian Lands Along High Priority Water Resources.** These lands are determined to have the highest priority for receiving easements. High priority resources are these lakes and streams that are most sensitive to nonpoint source pollution. Easements in these areas provide an extra incentive for landowner participation in the program.

2. **Critical Lands Throughout The Watershed.** Where permanent vegetative cover provides a cost effective means of controlling a nonpoint pollutant source. There may be situations where taking a cropland out of production and providing an easement with permanent vegetative cover is less costly than constructing terraces, an agricultural sediment basin, or other high cost control measures.

3. **Wetland Restorations.** The criteria for the use of an easement under this circumstance is described on the following pages under the section titled "Wetland Restoration Eligibility".

The criteria for the use of easements in the Sheboygan River Priority Watershed Project are given in table 6-1.

Table 6-1. Criteria for Use of Easements

	Sources on Riparian Lands in "High Priority" Water Resources(1)	Other Sources
Low Cost Practices	Available(2)(4)	Not Available
High Cost &/or Non-Conventional Practices	Available(3)(4)	Available(3)(4)

Criteria:

1. Riparian lands include any field that is contiguous with a water resource and is identified as being a critical nonpoint source of pollutants (Management Category I on Table 6-3). The "high priority" water resources are: Cedar Lake, Wolf Lake, Wilke Lake, Elkhart Lake, Gerber Lakes, South Branch Sheboygan River, Schuette Creek, Millhome Creek, and Otter Creek, and perennial tributaries to these water resources.
2. Easements to allow the establishment of permanent vegetative cover may be used in these areas in place of a low cost management practice. Low cost practices include: changes in crop rotation, reduced tillage, contour plowing; and contour strips.
3. Easements to allow the establishment of permanent vegetative cover may be used in these areas in place of a high cost management practice. High cost practices include cropland terraces and agricultural sediment basins.
4. Easements are available under this condition if it is determined by the DNR that the added effectiveness justifies the costs.

Review and Approval

Easements may be held either by the local governmental unit or by the DNR. As landowners are contacted, and options for nonpoint pollutant source control measures are discussed, each proposal for an easement must be forwarded to the DNR central office for the review and approval of the easement (if the easement is to be held by the local government) or for the completion of the easement process (if the easement is to be held by DNR).

Wetland Restoration Eligibility

Wetland restoration is an eligible best management practice for the purpose of controlling nonpoint sources of pollution. The secondary benefit of wetland restoration may be for wildlife or fish habitat however the primary justification of the restoration must be for water quality improvement.

Wetland restoration includes the plugging or breaking up of existing tile drainage systems; the plugging of open channel drainage systems; other methods of restoring the pre-development water levels of an altered wetland; or the fencing of livestock out of a wetland.

Three situations in the Sheboygan River Watershed have been identified where wetland restoration is eligible:

1. Cultivated organic soils with tile or open channel drainage systems discharging to a lake, stream or tributary.

   Wetland restoration will reduce the amount of nutrients and pesticides draining from the altered wetland to a water resource. Establishing permanent vegetation and disabling the drainage system will control this pollutant source.

2. Pastured wetlands riparian to lakes, streams, or tributaries.

   Eliminating livestock grazing within wetlands will reduce the organic and sediment loading to the wetland and adjacent water resource, and will reduce the direct damage to the wetland from the livestock. Livestock exclusion by fencing will control the pollutants and restore the wetland.

3. Prior converted wetlands down slope or up slope from fields identified as critical upland sediment sources through the WIN model.

   Restoration of wetlands in these situations will do one of two things: create a wetland filter which reduces the pollutants from an up slope field to a water resource; or reduce the volume and/or velocity of water flowing from an up slope wetland to a downslope critical field. Two eligibility conditions must be met to use wetland restoration in this situation:

a. All upland fields draining to the wetland or below the wetland must be controlled to a USLE rate of 3.0 tons per acre per year (T/a/yr) or less.

b. One or more of these same fields must still have a sediment loss rate (after the application any erosion control measures) greater than the "sediment delivery rate" listed in table 6-4 for the appropriate subwatershed.

Easements may be used for the wetland for any one of these situations (see discussion below on easements). Any costs involved with the restoration of the water level or livestock exclusion will be handled through a cost-share agreement at a 70 percent state cost-share rate. if an easement is to be pursued, the LCD must first contact the DNR district nonpoint source coordinator to initiate the process. The nonpoint source coordinator will be responsible for obtaining review comments from the local wildlife fishery, water regulation and zoning staff, and from other appropriate staff. The nonpoint source coordinator will then forward the proposal to DNR Bureaus of Water Resources Management and Property Management, and other appropriate staff. Final approval of the easement will rest with the Bureau of Water Resources Management.

If wetland restoration does not involve the purchase of an easement, then the LCD may sign a cost-share agreement for the required costs and proceed to implement the practice.

Estimates on the number of sites where wetland restoration could be applied are shown on table 7-3. These estimates are based upon a preliminary investigation by DNR wildlife biologists. These estimates are subject to change based upon the conditions found during the implementation phase of this project.

Best Management Practices

Management actions are carried out through installation of practices, called best management practices (BMPs) which have been determined to be the most cost effective controls of nonpoint pollutants in the Sheboygan River Watershed. In rural areas, these BMPs may range from alterations in farm management (changes in manure-spreading, crop rotations) to engineered structures (diversions, sediment basins, manure storage facilities), and they are generally tailored to specific landowner situations. The county land conservation departments will assist owners, managers, and renters of agricultural lands in applying Best Management Practices. In urban areas, control practices may range from hydrologic alterations designed to detain pollutants or slow flows (wet detention ponds, grassed swales) to housekeeping practices (reducing sources of pet waste, road salts, lawn fertilizers and pesticides) to governmental controls (construction site erosion ordinances). The DNR and others will assist local units of government in the development of urban nonpoint pollutant source control measures.

Landowner and municipality eligibility for cost sharing of these practices will depend on whether pollutant loads from their lands fall into the established pollutant reduction ranges set for each nonpoint source category (as shown in the tables 6-2, 6-3, and 6-4). Not all

recommended practices are eligible for cost sharing. (See Chapters Seven and Eight for detailed information on implementation.)

Management actions are divided into two groups for the Sheboygan River Watershed: rural land management needs, and urban land management needs. The criteria defining the eligibility of nonpoint sources for cost-shared control measures on rural lands are shown in tables 6-2 through 6-6. Management alternatives for urban lands are shown in tables 6-8 to 6-11.

Rural Lands

Rural nonpoint pollutant source control needs are addressed by assigning management categories to each major nonpoint source of pollutant (barnyard runoff, manure-spreading, eroding uplands, streambank erosion or habitat degradation). Management categories define which nonpoint sources are eligible for financial and technical assistance under the priority watershed project. The categories are based on the amount of pollutants generated by a source, and the feasibility of controlling the pollutants. Management category eligibility criteria are expressed in terms of tons of sediment delivered to surface waters from eroding uplands and streambanks; pounds of phosphorus delivered to surface waters during a 10-year, 24-hour storm; the number of unsuitable acres winter-spread with manure annually; and whether or not cattle are permitted access to a surface water. The basic management categories used in this project and their implications for cost-share funding are described below.

Management Categories

Management Category I: Nonpoint sources included in this category contribute significant amounts of the pollutants which adversely affect surface waters. Reductions in their pollutant loads is essential for achieving the water quality objectives outlined in the priority watershed project. These are referred to as "critical" sources. Ideally, if all "critical" sources are controlled, water resource objectives for sediment and nutrient reductions will be met. It should be noted, however, that for upland sediment, there are instances where pollutant reduction goals cannot be met due to the practicality of applying management practices, the parent soil types, or where erosion levels have already been reduced to acceptable levels. In some watersheds, targeted reduction levels have been adjusted to reflect these conditions.

Nonpoint sources in Category I are eligible for funding and/or technical assistance under the priority watershed project. As a condition of funding, all sources in Management Category I must be controlled if a landowner wishes to participate in any aspect of the program. Tables 6-2 through 6-6 identify the sources which must be controlled in order to qualify for cost-share funds under Management Category I.

Management Category II: Nonpoint sources in this category collectively contribute less of the pollutant load than those in Management Category I. However their control may play an

important part in achieving water quality objectives. These nonpoint sources are identified and included in cost sharing eligibility to provide alternate means of sediment or nutrient reductions in the event that all sources in Management Category I are not controlled.

Nonpoint sources in this category are eligible for funding and/or technical assistance under the priority watershed project, however, the inclusion of sources in this category is not mandatory for participation in other aspects of the program. Tables 6-2 through 6-6 show which sources are eligible for cost-share funds under Management Category II.

Management Category III: Nonpoint sources of pollutants in this category do not contribute a significant amount of the pollutants which affect surface waters and therefore are not eligible for funding and/or technical assistance under the priority watershed project. Other departmental programs such as wildlife and fisheries management may, if warranted, assist county project staff in controlling these sources as part of the implementation of the integrated resource management plan for this watershed. Some federal programs may also be applicable to these lands.

Urban Lands

Three principal urban pollutant sources must be addressed in order to reduce the water quality impacts that result from urban runoff: established areas, including existing and planned (or even future areas); urban areas under development; eroding streambanks in urban areas.

The first source, established urban area runoff, occurs after development and construction have been completed. Developing areas are those during any phase of construction that involves soil disturbance from grading or excavation. Streambanks were not inventoried for the urban subwatersheds of Kohler and Oxbow, however, management actions for degraded streambanks in urban areas will be addressed under the same criteria specified for agricultural areas (tables 6-2 through 6-6).

Management practices and controls in this project apply to "critical" urban land uses or urban lands considered most critical to controlling nonpoint source pollutants. Critical lands were identified for each of the four inventoried urban areas based on:

- The unit area rate (pounds/acre) at which each type of land use generates pollutants.
- The portion of the total urban pollutant load (pounds/year) generated by each land use.

As part of the planning process, a range of urban management actions (or alternatives) were developed to control "critical" sources of urban nonpoint pollutants. The alternatives were evaluated and selected to form the basis for the "Recommended Urban Nonpoint Control Program" presented at the end of this chapter.

Table 6-2. Eligibility Criteria and Management Categories For Barnyards Affecting Surface Waters*

	Subwatershed	Phos. Control Goal (%)	Management Category I			Management Category II		
			Current Phos. Load (Lbs)	Phos. Control Target (Lbs)	# of Barnyards	Current Phos. Load (Lbs)	Phos. Control Target (Lbs)	# of Barnyards
1	Airport	50	>15.0	5.0	7	5.1-15.0	5.0	6
2	Cedar Lake	50	No Barnyards Present					
3	Elkhart Lake	50	No Barnyards Present					
4	Franklin	50	>9.0	5.0	2	5.1-9.0	5.0	2
5	Kiel marsh	50	>6.0	2.0	3	2.1-6.0	2.0	7
6	Kohler	50	>10.0	5.0	1	5.1-10.0	5.0	2
7	Little Watershed	50	No Barnyards Present					
8	Little Elkhart	50	No Barnyards Present					
9	Louis Corners	50	>7.0	3.0	4	3.1-7.0	3.0	2
10	Maple Corner	50	>4.0	3.0	5	3.1-4.0	3.0	2
11	North Branch Sheboygan	50	>3.0	2.0	11	2.1-3.0	2.0	9
12	Oxbow	50	No Barnyards Present					
13	Rockville	50	>5.0	3.0	1	3.1-5.0	3.0	0
14	Sheboygan Falls	50	>5.0	3.0	0	3.1-5.0	3.0	1
15	Sheboygan Marsh	50	>5.0	2.0	10	2.1-5.0	2.0	18
16	South Branch Sheboygan	50	>5.0	2.0	4	2.1-5.0	2.0	3
17	Victory School	50	>10.0	5.0	1	5.1-10.0	5.0	0
18	Wayside Park	50	>8.0	4.0	2	4.1-8.0	4.0	3
19	Wilke Lake	50	>1.0	1.0	2	No Mgmt. Cat. II Conditions		
20	Wilson	50	>15.0	10.0	3	10.1-15.0	10.0	2
21	Wolf Lake	50	>1.0	1.0	3	No. Mgmt. Cat. II Conditions		
	Totals:				59			57

* Eligibility for internally drained barnyards will be determined on site, during implementation by the County LCD, DATCP, and DNR.

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade, and Consumer Protection; and Land Conservation Departments of; Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties

Table 6-3. Eligibility Criteria and Management Categories for Winter Spread Manure

Number of Critical Acres Winter Spread*	Management Category	Estimated # of Operations	Estimated # of Critical Acres	% of Acres
15 acres or more	I	50	1,114	57%
7 to 15 acres	II	58	620	30%
0 to 7 acres	III	139	258	13%
Total		237	1,992	100%

* These acreages apply to individual landowners

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade, and Consumer Protection; and Land Conservation Departments of Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties

Table 6-4. Eligibility Criteria and Management Categories For Eroding Uplands

Subwatershed	Management Category	Criteria: Sediment Delivery (tn/ac/yr)			Criteria: Soil Loss (tn/ac/yr)	USLE Design Target (tn/ac/yr)
Airport	I	over	0.18	&	over 3	2.0
	II	over	0.18	&	under 3	
Cedar Lake	I	over	0.023	&	over 3	2.0
	II	over	0.023	&	under 3	
Elkhart Lake	I	over	0.10	&	over 3	2.0
	II	over	0.10	&	under 3	
Kiel Marsh	I	over	0.16	&	over 3	3.0
	II	over	0.16	&	under 3	
Kohler	I	over	0.075	&	over 3	2.5
	II	over	0.075	&	under 3	
Little Elkhart	I	over	0.10	&	over 3	2.0
	II	over	0.10	&	under 3	
Little Watershed	Internally Drained; Not Eligible					
Louis Corners	I	over	0.11	&	over 3	2.0
	II	over	0.11	&	under 3	
Maple Corner	I	over	0.09	&	over 3	2.0
	II	over	0.09	&	under 3	
North Branch Sheboygan	I	over	0.09	&	over 3	2.0
	II	over	0.09	&	under 3	
Oxbow	I	over	0.07	&	over 3	2.0
	II	over	0.07	&	under 3	
Rockville	I	over	0.09	&	over 3	2.0
	II	over	0.09	&	under 3	
Sheboygan Falls	I	over	0.14	&	over 3	2.0
	II	over	0.14	&	under 3	
Sheboygan Marsh	I	over	0.12	&	over 3	2.0
	II	over	0.12	&	under 3	
South Branch Sheboygan	I	over	0.05	&	over 3	2.0
	II	over	0.05	&	under 3	
Victory School	I	over	0.21	&	over 3	2.0
	II	over	0.21	&	under 3	
Wayside Park	I	over	0.20	&	over 3	2.0
	II	over	0.20	&	under 3	
Wilke Lake	I	over	0.08	&	over 3	2.0
	II	over	0.08	&	under 3	
Wilson	I	over	0.04	&	over 3	2.0
	II	over	0.04	&	under 3	
Wolf Lake	I	over	0.055	&	over 3	2.0
	II	over	0.055	&	under 3	

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade, and Consumer Protection; and Land Conservation Departments of: Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties

Table 6-5. Rural Uplands Targeted for Sediment Control

Subwatershed	Total Load (tons/yr)	Management Category I			Management Category II			Potential Control
		Acres	Control (tons/yr)	Control (%)	Acres	Control (tons/yr)	Control (%)	
Airport	2,826	2,421	1,024	36%	3,474	295	10%	47%
Cedar Lake	31	21	3	10%	46	7	23%	32%
Elkhart Lake	91	152	43	47%	34	2	2%	49%
Franklin	1,088	1,069	538	49%	0	0	0%	49%
Kiel Marsh	559	839	266	48%	205	10	2%	49%
Kohler	155	204	36	23%	361	32	21%	44%
Little Elkhart	8	0	0	0%	0	0	0%	0%
Little Watershed	0	Internally Drained Area - No Surface Water Runoff						
Louis Corners	1,077	1,571	412	38%	1,381	65	6%	44%
Maple Corner	1,516	2,150	906	60%	986	113	7%	67%
No. Branch Sheboygan	1,067	1,589	409	38%	1,961	117	11%	49%
Oxbow	26	0	0	0%	111	13	50%	50%
Rockville	163	279	63	39%	41	5	3%	42%
Sheboygan Falls	89	71	37	42%	121	6	7%	48%
Sheboygan Marsh	1,714	1,742	639	37%	2,337	187	11%	48%
So. Branch Sheboygan	1,159	2,461	668	58%	1,774	105	9%	67%
Victory School	262	298	131	50%	68	5	2%	52%
Wayside Park	814	553	303	37%	1,056	94	12%	49%
Wilke Lake	45	93	18	40%	105	6	13%	53%
Wilson	824	820	178	22%	2,555	340	41%	63%
Wolf Lake	58	86	16	28%	317	11	19%	47%
Totals:	13,572	16,419	5,690	42%	16,933	1,413	10%	52%

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade, and Consumer Protection; and Land Conservation Departments of Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties

Table 6-6. Eligibility Criteria and Management Categories for Streambank Erosion and Habitat Degradation

Subwatershed	% Control Goal [1]	Total Sediment Loss (tons/yr)	Control Goal (tons/yr)	Banks With Cattle Access[2] (ft)
Airport	50%	205.2	102.6	3,350
Cedar Lake	50%	0.0	0.0	0
Elkhart Lake	50%	0.0	0.0	0
Franklin	50%	19.5	9.8	0
Kiel Marsh	50%	0.4	0.2	100
Kohler[3]	50%	0.0	0.0	0
Little Elkhart	50%	0.0	0.0	0
Little Watershed	50%	0.0	0.0	0
Louis Corners	75%	1.0	0.5	0
Maple Corner	50%	60.9	45.6	2,200
No. Branch Sheboygan	50%	27.8	13.9	8,360
Oxbow[3]	50%	0.0	0.0	0
Rockville	50%	2.1	1.1	0
Sheboygan Falls	50%	10.1	5.1	0
Sheboygan Marsh	50%	1.4	0.7	1,200
So. Branch Sheboygan	75%	135.2	101.4	22,100
Victory School	50%	0.3	0.2	400
Wayside Park	75%	23.3	17.5	6,200
Wilke Lake	50%	0.0	0.0	0
Wilson	75%	131.7	98.8	0
Wolf Lake	50%	0.0	0.0	0
Totals:		618.9	397.2	43,910

1 % Control is applied on a landowner basis; each landowner must control the % sediment equal to the control goal for the subwatershed (this is a management category I requirement). Sites with erosion not due to cultural activities are excepted from this requirement. These sites are management category II.

2 Each participating landowner must restrict livestock access from any perennial creek in the watershed where there is evidence of trampling along the bank, streambed damage, or streambank erosion from livestock.

3 The main stem of the Sheboygan River was not inventoried in Kohler and Oxbow subwatershed

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade, and Consumer Protection; and Land Conservation Departments of: Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties

Urban Management Alternatives

Development of Alternatives: Management alternatives employing various urban Best Management Practices were developed for the four inventoried urban areas in the Sheboygan River Watershed: the city of Kiel, the village of Kohler, the city of Sheboygan Falls and the city of Sheboygan. These alternatives were formulated based on the land use inventories and the identification of critical acres, or the urban land uses contributing the greatest pollutant loads to the Sheboygan River and near-shore areas of Lake Michigan. Based on estimated planned acreage increases in urban areas of the watershed (as shown in table 3-8), construction sites, industrial, commercial, and selected residential land uses were targeted as "critical" to controlling sediment reaching surface waters in each community.

Nine management alternatives were identified. Each alternative applied controls to existing and future critical land uses (through the year 2010), spanning a range of management practices and pollutant control effectiveness. These were directed at pollutant source reduction, managing stormwater runoff, and encouraging the infiltration of water. Alternatives were applied separately to the city of Kiel and to the combined urban areas of Sheboygan, Sheboygan Falls, and Kohler.

The following alternatives were developed for urban areas of the Sheboygan River Watershed:

Existing Urban Lands:

- Do nothing to control existing runoff.
- Increase the frequency of street sweeping to once per week on critical land uses.
- Increase street sweeping to once per week on 50 percent of critical land uses, and detain runoff using wet detention ponds on the other 50 percent.
- Detain runoff using wet detention ponds on all existing critical land uses.

Planned Future Land Uses:

- Do nothing to control runoff from new development.
- Sweep streets once per week on 50 percent of all new development, and detain runoff with wet detention ponds on the other half.
- Install wet detention basins to detain runoff on all new development.

Developing Lands/Construction Sites:

- Manage construction sites assuming control practices are 75 percent effective in controlling sedimentation that is carried off-site to rivers, lakes and streams.

- Manage construction sites assuming control practices are 90 percent effective in controlling off-site sedimentation.

The alternatives were evaluated with regard to two factors: stormwater pollutant concentrations, and stormwater pollutant loads. The stormwater pollutant loadings predicted under the alternative scenarios provided the basis for designing a management program which attains pollutant reduction goals.

The concentration of pollutants in stormwater was estimated to indicate the toxicity of urban stormwater runoff. "Acute toxicity" is a way of describing concentrations of pollutants found in stormwater before the water is discharged to a lake, stream or wetland, and is often referred to as the "end of pipe" concentration. In order to meet the acute toxicity standards set forth by Chapter NR 105 of the Wisconsin Administrative Code for urban runoff, lead concentrations may not exceed 170 μg/L, assuming a water hardness of 100 mg/L. Therefore, the selected urban runoff management alternative must meet two goals: achieve state acute toxicity standards in the stormwater; and meet the sediment reduction goal as identified in the water resource appraisal.

Evaluating Alternatives

For the communities of Sheboygan, Sheboygan Falls, and Kohler (combined into a group) the urban nonpoint source control targets are:

- A 50 percent reduction of the 1988 sediment load from the incorporated area.

- A 40 percent reduction of the 1988 heavy metal load (as measured in lead) to reduce the frequency of the state water quality standards in the stormwater.

For the city of Kiel the urban nonpoint source control targets are:

- A 50 percent reduction of the 1988 sediment load from the incorporated area.

- A 50 percent reduction of the 1988 heavy metal load (as measured in lead) to reduce the frequency of the state water quality standards in the stormwater.

A comparison of the sediment control attainable under each management alternative is presented in tables 6-8 and 6-9. Each management alternative was evaluated based on its ability to control sediment loading, and cost-effectiveness. The alternatives were paired in various combinations so that the impacts of alternative management programs for existing urban areas could be considered in conjunction with those for planned future urban land needs (tables 6-8 through 6-11). The implementation of a program requiring the installation

of construction site erosion controls of 75 percent effectiveness was assumed for each alternative.

These same management alternatives were evaluated for their effectiveness in controlling heavy metal runoff from the existing and future planning urban areas of each community.

The analysis of management alternatives assumes that wet detention basins will trap all sediment particles five microns or larger in size. This is a high level that will result in controlling 90 percent of the suspended sediment, and about 70 percent of the heavy metals in urban runoff. Infiltration may be considered as an alternative to wet detention where conditions are suitable for providing an adequate level of control. The analysis assumes an infiltration rate of 0.25 inches per hour for infiltration basins and grassed swales. This is a moderate rate of infiltration that will provide less control of pollutants than wet detention ponds. Existing levels of street sweeping and grassed swale drainage were accounted for in the evaluation of alternatives for existing urban lands.

Alternatives Selection

Construction site erosion control is a cornerstone to achieving sediment reduction goals in the project. Annual construction activity is predicted to decrease over current rates for Sheboygan, Sheboygan Falls, and Kohler. However without adequate control, construction site erosion will remain the most significant source of sediment from all urban areas in the year 2010 (table 3-9). The effectiveness of all of the other alternative sediment control programs is dependent upon the efficiency of construction site erosion controls.

Table 6-7. Identified Critical Urban Land Uses Within the Urban Areas

Municipality	Industrial	Critical Land Uses Commercial	Multi-Family Residential	Medium Density Residential
city of Sheboygan	X	X	X	X
city of Sheboygan Falls	X	X	X	X
village of Kohler	X	X	X	X
city of Kiel	X	X	X	X

Sheboygan Urban Area: For the communities in the Sheboygan Urban Area, controlling sediment from areas under construction will be enough to achieve the 50 percent reduction goals for sediment (table 6-8). However, the control of construction site erosion will not allow the Sheboygan Urban Area to also reach its target for heavy metal concentration in the stormwater (table 6-9). About a 40 percent reduction in the lead load must also be attained to reach this target. Based on the results of the alternatives analysis; alternative "I" is recommended as the selected approach to achieve the necessary reduction in lead loads. This means that the communities will need to create sufficient detention or infiltration practices to control the runoff from one-half of the land currently under commercial, industrial, and high density residential land use (a total of about 2,470 acres for the three communities). The

other half of the critical land uses will need street sweeping conducted on at least a once-per-week basis. This alternative also assumes that all of the future lands developed will have the runoff controlled through a detention or infiltration device.

City of Kiel: For this community, controlling sediment from areas under construction will not be enough to achieve the 50 percent reduction goal for sediment (table 6-10). Additional controls on current and planned urban areas will be necessary to meet the sediment reduction goal. Alternative "I" is the recommended approach to achieve necessary reductions in lead loads (table 6-11). This means that communities will need to create sufficient detention or infiltration practices to control runoff from half of the land currently under commercial and industrial land use (about 135 acres). The other half of the critical land uses will need street sweeping conducted at least a once-per-week. This alternative also assumes that all the future lands developed will have the runoff controlled through a detention or infiltration device.

Recommended Urban Nonpoint Source Control Program

Urban Program Eligibility

Adopting "Core" Elements: The "core" elements of the urban nonpoint source control program applicable to local units of government include basic measures that can be adopted without further technical study. Communities are eligible to receive technical and/or financial assistance through the priority watershed project provided they commit to implementing a core program consistent with attaining pollution reduction goals and water resource objectives for existing urban land uses within the first three years of the project. Sites that are currently undeveloped are expected to be controlled as part of the cost of development and thus are not eligible for cost sharing.

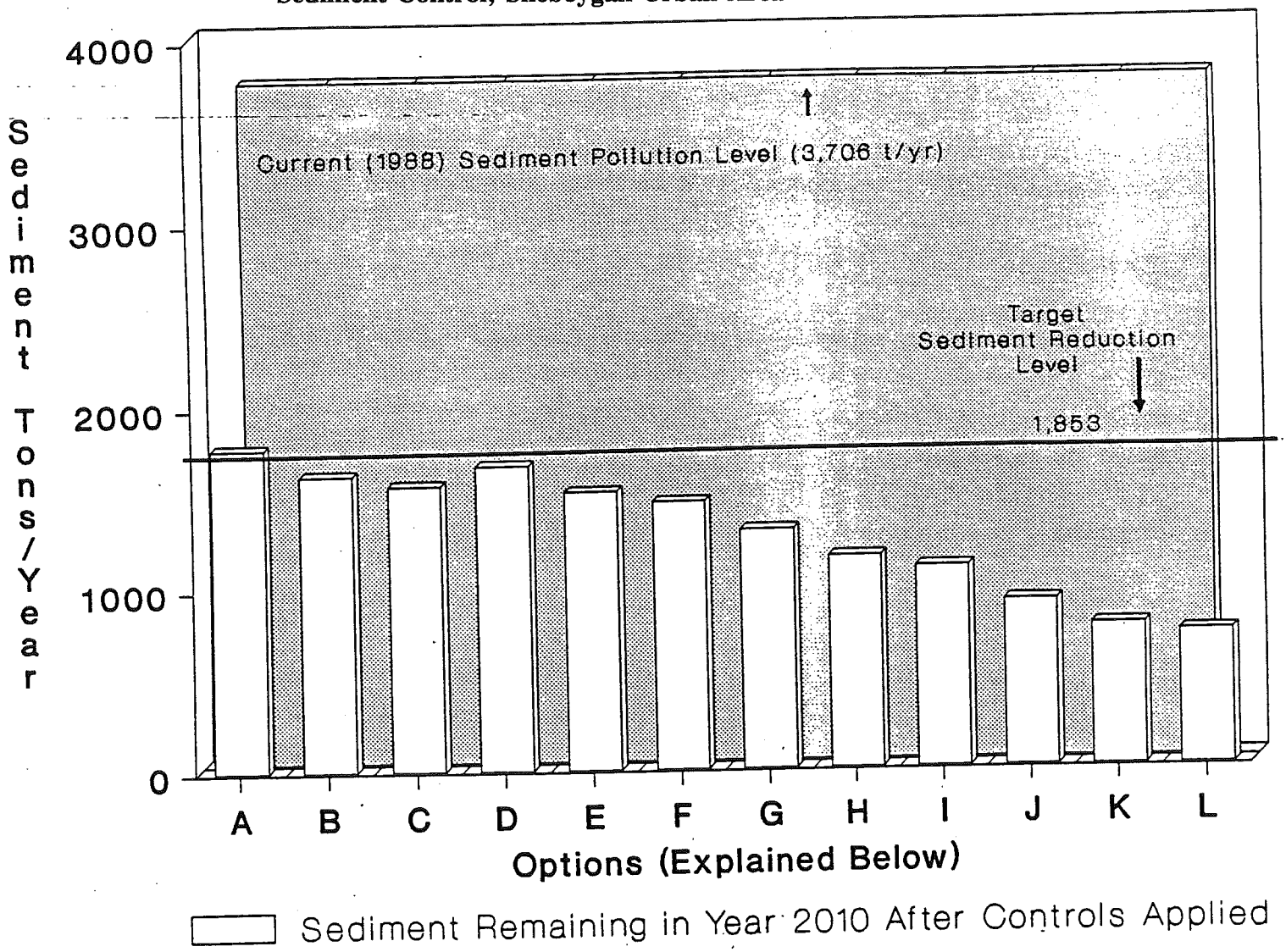
The basic elements of the "core" program include:

- Developing, adopting, and enforcing a construction erosion control ordinance consistent with the model ordinance developed jointly by the Wisconsin League of Municipalities and the DNR. Construction erosion control practices should be consistent with the standards and specifications in the "Wisconsin Construction Site Best Management Practice Handbook."

- Developing and implementing a community-specific program of urban "housekeeping" practices which reduce urban nonpoint source pollution. This may include a combination of information and education efforts, adopting ordinances to regulate pet wastes, or changing the timing and scheduling of leaf and brush collection.

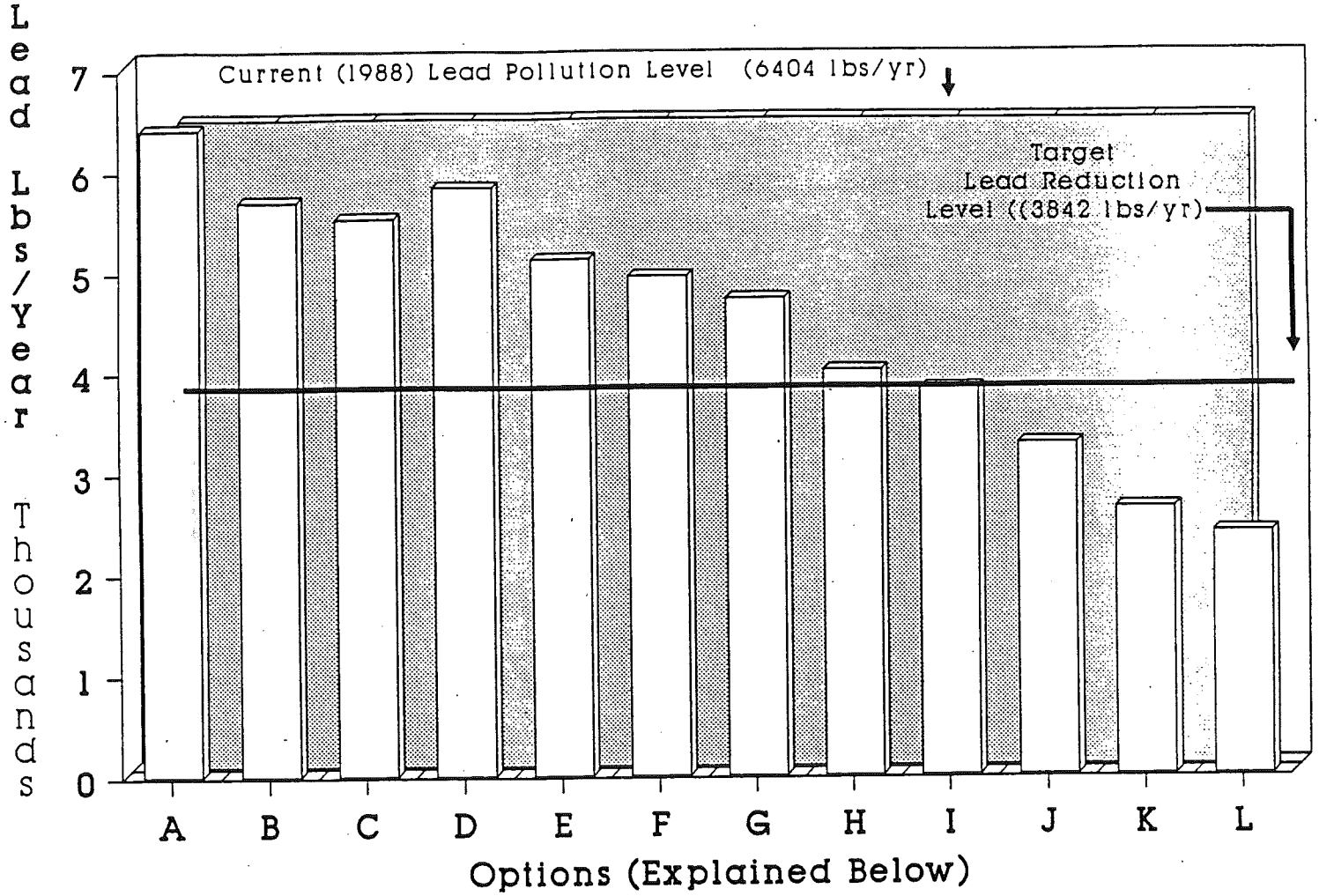
- Implementing an information and education program.

Table 6-8. Urban Management Alternatives: Sediment Control, Sheboygan Urban Area



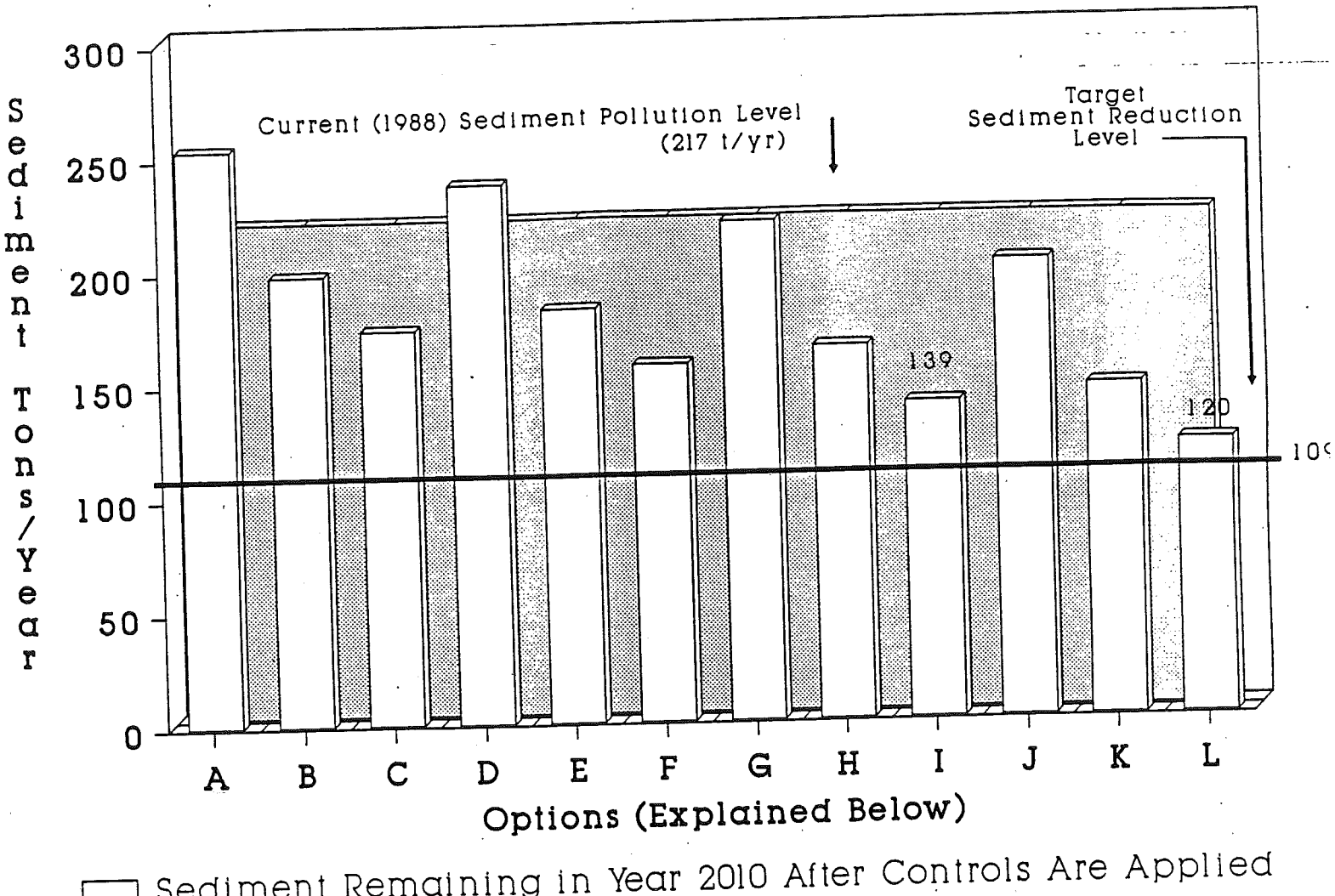
OPTION	EXISTING DEVELOPED LANDS	PLANNED DEVELOPMENT
A =	do nothing	do nothing
B =	do nothing	1/2 sweeping; 1/2 ponds
C =	do nothing	100% ponds
D =	sweeping 1/week	do nothing
E =	sweeping 1/week	1/2 sweeping; 1/2 pond
F =	sweeping 1/week	100% pond
G =	1/2 sweeping; 1/2 pond	do nothing
H =	1/2 sweeping; 1/2 pond	1/2 sweeping; 1/2 pond
I =	1/2 sweeping; 1/2 pond	100% pond
J =	all pond	do nothing
K =	all pond	1/2 sweeping; 1/2 pond
L =	all pond	all ponds

Table 6-9. Urban Management Alternatives: Lead Control, Sheboygan Urban Area



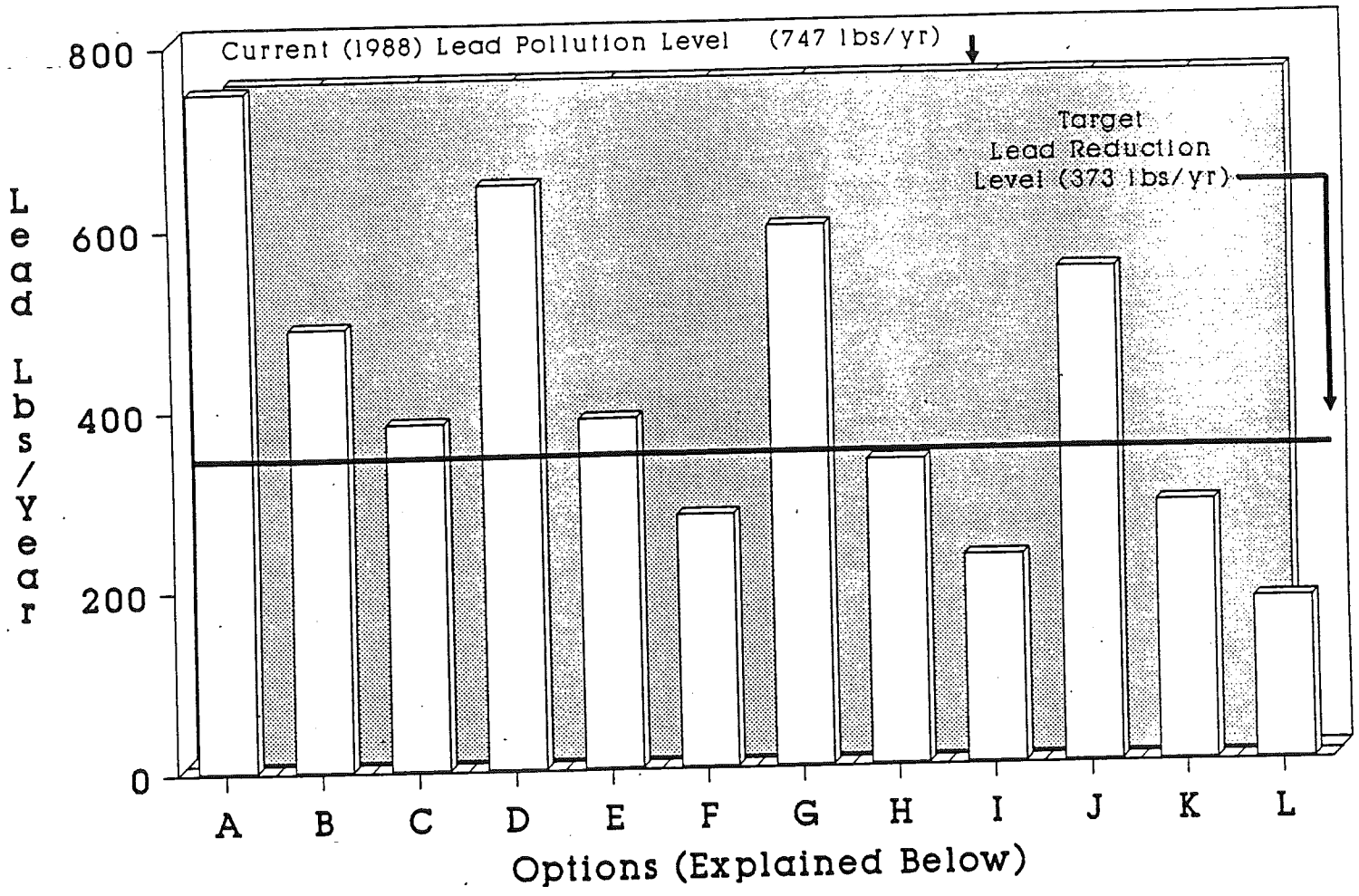
OPTION	EXISTING DEVELOPED LANDS	PLANNED DEVELOPMENT
A =	do nothing	do nothing
B =	do nothing	1/2 sweeping; 1/2 ponds
C =	do nothing	100% ponds
D =	sweeping 1/week	do nothing
E =	sweeping 1/week	1/2 sweeping; 1/2 pond
F =	sweeping 1/week	100% pond
G =	1/2 sweeping; 1/2 pond	do nothing
H =	1/2 sweeping; 1/2 pond	1/2 sweeping; 1/2 pond
I =	1/2 sweeping; 1/2 pond	100% pond
J =	all pond	do nothing
K =	all pond	1/2 sweeping; 1/2 pond
L =	all pond	all ponds

Table 6-10. Urban Management Alternatives: Sediment Control, City of Kiel



OPTION	EXISTING DEVELOPED LANDS	PLANNED DEVELOPMENT
A =	do nothing	do nothing
B =	do nothing	1/2 sweeping; 1/2 ponds
C =	do nothing	100% ponds
D =	sweeping 1/week	do nothing
E =	sweeping 1/week	1/2 sweeping; 1/2 pond
F =	sweeping 1/week	100% pond
G =	1/2 sweeping; 1/2 pond	do nothing
H =	1/2 sweeping; 1/2 pond	1/2 sweeping; 1/2 pond
I =	1/2 sweeping; 1/2 pond	100% pond
J =	all pond	do nothing
K =	all pond	1/2 sweeping; 1/2 pond
L =	all pond	all ponds

Table 6-11. Urban Management Alternatives: Lead Control, City of Kiel



OPTION	EXISTING DEVELOPED LANDS	PLANNED DEVELOPMENT
A =	do nothing	do nothing
B =	do nothing	1/2 sweeping; 1/2 ponds
C =	do nothing	100% ponds
D =	sweeping 1/week	do nothing
E =	sweeping 1/week	1/2 sweeping; 1/2 pond
F =	sweeping 1/week	100% pond
G =	1/2 sweeping; 1/2 pond	do nothing
H =	1/2 sweeping; 1/2 pond	1/2 sweeping; 1/2 pond
I =	1/2 sweeping; 1/2 pond	100% pond
J =	all pond	do nothing
K =	all pond	1/2 sweeping; 1/2 pond
L =	all pond	all ponds

Adopting "Segmented" Elements: The "segmented" elements of the urban nonpoint source program include those requiring site-specific investigations prior to implementation. An example would be the construction of detention ponds following the completion of an engineering feasibility study. Communities are eligible to receive cost-sharing for "segmented" elements provided "core" elements have been developed and implementation has begun. Cost sharing will be limited to those elements of the segmented program completed within the eight-year implementation period of the project.

The higher costs of implementing this portion of the urban management program will require communities to budget expenditures over the course of several years. Best management practices implemented under this portion of the program may include detention ponds, infiltration devices, streambank erosion controls and other structural means for reducing urban nonpoint source pollutants. This element also includes changes in street sweeping schedules and equipment.

Eligible components of the "segmented" program include:

- Conducting detailed engineering studies to determine the best means to implement community-specific nonpoint source control measures for identified existing land uses.

- The design and installation of structural urban best management practices for existing urban areas.

- The development of management plans for planned future urban development. These plans will identify the types and locations of structural urban Best Management Practices.

- The adoption and enforcement of a comprehensive stormwater management ordinance which encompasses both current and planned future areas.

CHAPTER SEVEN
RURAL IMPLEMENTATION STRATEGY

Introduction

This chapter identifies the methods to be used in implementing the rural portion of the nonpoint source control program described in chapter six.

More specifically, this chapter identifies:

- The agencies and units of government responsible for carrying out the identified tasks.
- The best management practices (BMPs) necessary to control pollutants on the critical sites previously identified in chapter six.
- The funding sources and the administrative procedures for carrying out the project.
- The schedule for the completion of the implementation tasks.
- The type and amount of staff needed by local units of government to carry out the project.
- The cost of installing BMPs, including cost sharing, technical assistance and administration.

Project Participants: Roles and Responsibilities

Landowners and Land Operators

Owners and operators of public and private lands are important participants in the Sheboygan River Priority Watershed Program. They will adopt the BMPs which will reduce the nonpoint sources of water pollutants and protect and enhance fish, wildlife and other resources. The landowners and land operators in the Sheboygan River Watershed who are eligible for cost-share assistance through the priority watershed program include: individuals;

Sheboygan County, Fond du Lac County, Manitowoc County, and Calumet County; other governmental units described in NR 120.02(19); corporations; and the state of Wisconsin.

Counties

Sheboygan, Fond du Lac, Manitowoc and Calumet counties are the primary units of government responsible for implementing this plan in rural areas. The Sheboygan, Fond du Lac, Manitowoc, and Calumet County Land Conservation Committees (LCC) will act for the respective County Boards and will be responsible contractually and financially to the state of Wisconsin for the management of the project in areas with rural land uses. The county LCCs will coordinate the activities of all other local agencies involved with the rural portion of the project.

The specific responsibilities for these counties are defined in the Wisconsin Administrative Rules, NR 120.04, and are summarized below:

- Identify in writing a person to represent the county during implementation of the project.
- Contact all owners or operators of lands identified as significant nonpoint sources within one year of signing the nonpoint source grant agreement. The counties' strategies for contacting landowners are included in this chapter.
- Develop farm conservation plans consistent with the needs of the project.
- Enter into nonpoint source cost-share agreements with eligible landowners and enforce the terms and conditions of cost-share agreements as defined in NR 120.13, Wisconsin Administrative Code.
- For lands the county owns or operates, enter into cost-share agreements with DNR to correct the identified nonpoint sources and thus fulfill their obligations as a cost-share recipient.
- Design Best Management Practices and verify proper practice installation.
- Reimburse cost-share recipients for the eligible costs of installing BMPs at the rates consistent with administrative rules and established in this plan.
- Prepare and submit annual work plans for activities necessary to implement the project. The Sheboygan, Fond du Lac, Manitowoc, and Calumet County LCDs shall submit a workload analysis and grant application to the Department of Agriculture, Trade and Consumer Protection (DATCP) as required in Ag. 166.50.
- Prepare and submit to the Department of Natural Resources and the Department of Agriculture, Trade and Consumer Protection the annual resource management

report required under NR 120.21(7) to monitor project implementation by tracking changes in the nonpoint source inventory, and quantifying pollutant load reductions which result from installing BMPs.

- Participate in the annual priority watershed project review meeting.

- Conduct the information and education activities identified in this plan for which they are responsible.

Department of Natural Resources

The role of the Department of Natural Resources (DNR) is identified in s. 144.24, Stats. and NR 120, Wisconsin Administrative Code. (NR 120) The Department has been statutorily assigned the overall administrative responsibility for the Wisconsin Nonpoint Source Water Pollution Abatement Program. The Department's role is summarized below.

Project Administration: Project administration includes working with the counties to ensure that work commitments required during the eight-year project implementation phase can be met. The DNR will participate in the annual work planning process with the county.

The Department reviews cost-share agreements signed by the county and the participating landowners for installing BMPs. The DNR provides guidance when questions arise concerning the conformance of proposed activities with the statutes, administrative rules, and the watershed plan.

Financial Support: Financial support for implementation of the priority watershed project is provided to each county in two ways: a local assistance grant agreement, and a nonpoint source grant agreement. These agreements are described later in this chapter.

The DNR may also enter into cost-share agreements directly with local or state units of government for the control of pollutant sources on land the governments own or operate.

Project Evaluation: The DNR has responsibility for priority watershed project monitoring and evaluation activities. These efforts determine if changes in water quality occur as Best Management Practices and other pollutant controls are installed or implemented. The water quality evaluation and monitoring strategy for the Sheboygan River Watershed are included in chapter ten. The DNR documents the results of monitoring and evaluation activities in interim and final priority watershed project reports.

Technical Assistance: The DNR provides technical assistance to the county on the design and application of Best Management Practices.

Other responsibilities include:

- Assisting county staff with site reviews to determine the impacts of nonpoint sources on wetlands and/or groundwater quality.

- Assisting county staff to integrate wildlife and fish management concerns into the selection and design of BMPs.

Department of Agriculture, Trade and Consumer Protection

The role of the Department of Agriculture, Trade and Consumer Protection (DATCP) is identified in s. 144.25, stats., ch. 92 stats., and NR 120. In summary, the DATCP will:

- Manage a training program for the staff involved with project implementation.
- Cooperate with the University of Wisconsin - Extension to act as a clearinghouse for information related to agricultural Best Management Practices, sustainable agriculture, and nutrient and pest management.
- Assist the counties to carry out the information and education activities or tasks described in this plan.
- Assist county staff to identify watershed participants subject to federal or state conservation compliance programs.
- Assist counties, if requested, to develop manure storage ordinances.
- Assist county staff to complete annual workload analyses and grant applications for work conducted under the priority watershed project.
- Participate in the annual project review meetings.
- If the need arises, assist in developing technical standards for agricultural BMPs, and provide technical assistance to county staff concerning the application of these practices.
- Assist county staff to evaluate the site-specific practicality of implementing rural BMPs.

Other Agencies

The Sheboygan River Watershed Project will receive assistance from the agencies listed below.

Soil Conservation Service (SCS): This federal agency (U.S. Department of Agriculture) works through the local LCC to provide technical assistance for planning and installing conservation practices. The local SCS personnel will work with the county staff to provide assistance with technical work. Personnel from the area SCS office may provide staff training and engineering assistance for Best Management Practices, especially where there is a lack of engineering job approval for particular practices. Efforts will be made by DATCP to assist SCS to coordinate the Sheboygan River Priority Watershed Project with the

conservation compliance and other conservation provisions of the 1985 and subsequent federal farm bills.

University of Wisconsin Extension (UWEX): County and Area Extension agents will provide support in developing and conducting a public information and education program aimed at increasing voluntary participation in the project. This effort will also include assistance to carry out the information and education activities identified in this plan.

Agricultural Stabilization and Conservation Service (ASCS): Besides administering most of the federal programs aimed at the stabilization of the prices paid producers for agricultural products, ASCS administers the federal funds for rural soil and water and other resource conservation activities. The Agricultural Conservation Program (ACP), which is administered by ASCS, will, to the extent possible, be coordinated with the Sheboygan River Priority Watershed Project. In addition other conservation incentives such as the Conservation Reserve Program (CRP) will be used whenever possible to control critical nonpoint sources of pollutants.

Best Management Practices (BMPs)

BMPs Eligible For Cost Sharing And Their Rates

Best management practices are those practices identified in NR 120 which are determined in this watershed plan to be the most effective controls of the nonpoint sources of pollutants. The practices eligible for cost-sharing and their cost-share rates under the Sheboygan River Priority Watershed Project are listed in table 7-1.

The design and installation of all BMPs must meet the conditions listed in NR 120. Generally these practices use specific standard specifications included in the SCS Field Office Technical Guide. In some cases additional specifications may apply. The applicable specifications for each BMP can be found in NR 120.14.

Following is a brief description of some of the most commonly used cost-shared BMPs included in table 7-1. A more detailed description of these practices can be found in NR 120.14.

Commonly used BMPs

Contour Farming: The farming of sloped land so that all operations from seed bed preparation to harvest are done on the contour.

Contour and Field Stripcropping: Growing crops in a systematic arrangement, usually on the contour, in alternate strips of close-grown crops, such as grasses or legumes, and tilled row crops.

Reduced Tillage: A system which leaves a roughened surface or substantial amounts of crop residue in or on the soil surface after crops are planted. The system consists of no more then one primary tillage pass in the fall or spring and no more than two passes with light or secondary tillage equipment prior to planting. It is utilized in two situations; one for continuous row crops or long corn rotations, the other for short crop rotations or for the establishment of forages and small grains.

Critical Area Stabilization: The planting of suitable vegetation on critical nonpoint source pollutant sites.

Grassed Waterways: Natural or constructed channels shaped, graded and established with suitable cover as needed to prevent erosion by runoff waters.

Grade Stabilization Structure: A structure used to reduce the grade in a channel to protect the channel from erosion or to prevent the formation or advance of gullies.

Livestock Exclusion from Woodlots: The exclusion of livestock from woodlots by fencing or other means in order to protect the woodlots from grazing.

Shoreline and Streambank Stabilization: The stabilization and protection of stream and lake banks against erosion and the protection of fish habitat and water quality from livestock access. This practice includes streambank fencing.

Terraces: A system of ridges and channels constructed on the contour with a suitable grade to prevent erosion in the channel.

Field Diversions: Practices constructed primarily to divert water from areas where it is in excess or is doing damage to areas where it can be transported safely.

Barnyard Runoff Management: Structural measures such as gutters, downspouts, or diversions to redirect surface runoff around the barnyard, and to collect, convey and temporarily store runoff from the barnyard.

Manure Storage Facility: A structure for the storage of manure for the period of time that is needed to reduce the impact of manure as a nonpoint source of pollution. Livestock operations where this practice applies are those where manure is winter-spread on fields that have high potentials for runoff to lakes, streams and groundwater. The facility is needed to store and later to properly spread manure according to a management plan.

Agricultural Sediment Basins: A structure designed to reduce the transport of sediment eroded from critical agricultural fields into surface waters and wetlands.

Shoreline Buffers: Permanently vegetated areas immediately adjacent to lakes, streams, and wetlands which are designed and constructed to manage critical nonpoint sources or to filter pollutants from nonpoint sources.

Animal Lot Relocation: The relocation of an animal lot from a critical site such as a floodway to a suitable site in order to minimize the amount of pollutants which are carried from the lot to surface or groundwater.

Wetland Restoration: The construction of berms or the destruction of the function of tile lines or drainage ditches in order to create conditions suitable for wetland vegetation. Fencing for the exclusion of livestock is also eligible under this practice.

Roofs for Barnyard Runoff Management and Manure Storage Facilities: Construction of roofs to prevent rain and snow from coming in contact with manure.

Nutrient Management: The management of the application of manure, legumes, and commercial fertilizers including the rate, method and timing of application, in order to minimize the amount of nutrients which enter surface or groundwater.

Pesticide Management: The management of the handling, disposal and application of pesticides, including the rate, method and timing of application, in order to minimize the amount of pesticides which enter surface and groundwater.

BMPs Not Cost-shared

BMPs not cost-shared, but which shall be included on the cost-share agreement if necessary to control the nonpoint pollutant sources, are listed in NR 120.17. Several examples are included below:

- Practices to be funded through other programs.
- Practices previously installed and necessary to support cost-shared practices.
- Changes in crop rotations and other activities normally and routinely used in growing crops or which have installation costs that can be passed on to potential consumers.
- Changes in location of unconfined manure stacks involving no capital cost.
- Manure spreading management.
- Other activities the DNR determines are necessary to achieve the objectives of the watershed project.

Table 7-1. State Cost-Share Rates for Best Management Practices	
Best Management Practice	State Cost-share Rate
Contour Farming	50%[1]
Contour Strip Cropping	50%[1]
Field Strip Cropping	50%[1]
Field Diversions and Terraces	70%
Grassed Waterways	70%
Reduced Tillage	50%
Critical Area Stabilization	70%[2]
Grade Stabilization Structures	70%
Agricultural Sediment Basins	70%
Shoreline and Streambank Stabilization	70%
Shoreline Buffers	70%[2]
Barnyard Runoff Management	70%
Animal Lot Relocation	70%
Manure Storage Facilities	70%[3]
Livestock Exclusion from Woodlots	50%
Wetland Restoration	70%[2]
Roofs for Barnyard Runoff Management and Manure Storage Facilities	70%
Facilities	70%
Nutrient and Pesticide Management	50%[4]

1. Flat rates for these BMPs can be found in table 7-2. Wildlife habitat restoration components of this practice are cost-shared at 70 percent.
2. Easements may be entered into with landowners identified in the watershed plan in conjunction with these BMPs. See chapter six for where easements may apply.
3. Maximum cost-share amount is $10,000, including no more than $5,000 for manure transfer equipment.
4. Spill control basins have a state cost-share rate of 70 percent.

Activities and Sources Of Pollution Not Eligible For Cost-share Assistance

Priority watershed cost-share funds cannot be used to control sources of pollutants and land management activities specifically listed in NR 120.10(2). The following is a partial list of ineligible activities most often inquired about for cost sharing in rural areas:

- operation and maintenance of cost-shared BMPs
- actions which have drainage of land or clearing of land as the primary objective
- practices already installed

- activities covered under the Wisconsin Pollution Discharge Elimination System (WPDES) Program or covered in other ways by Chapter 147 of Wis. Stats. (including livestock operations with more than 1,000 animal units, or livestock operations issued a notice of discharge under chapter NR 243)
- septic system controls or maintenance
- dredging activities
- silvicultural activities
- the bulk storage of fertilizers and pesticides
- activities and structures intended primarily for flood control
- practices required to control sources which were adequately controlled at the time the cost-share agreement was signed
- other practices or activities determined by DNR not to meet the objectives of the program

Nonpoint Source Grant Agreement and Administration

General Information

The Nonpoint Source Grant Agreement will be the means for transmitting funds from the DNR (through the nonpoint source program) to Sheboygan, Fond du Lac, Manitowoc and Calumet counties for use in funding the state's share of cost-share agreements. Cost-share agreements are the means to transmit funds from the counties to the landowners.

A portion of the Nonpoint Source Grant is forwarded to Sheboygan, Fond du Lac, Manitowoc and Calumet counties to allow the county to establish an "up front" account. Funds from this account are used by the counties to pay landowners after practices are installed under the project. As this account is drawn down, a county will request reimbursements from the DNR to replenish the account. The counties will submit reimbursement requests on a quarterly basis. This reimbursement schedule will insure that the "up front" account balance is maintained at an adequate level. The NPS grant agreement will be amended annually to provide funding needed for cost sharing for the year. The funds obligated under cost-share agreements must never exceed the total funds in the NPS grant agreement.

Fiscal Management Procedures, and Reporting Requirements

The project counties are required by NR 120 to maintain a financial management system that accurately tracks the disbursement of all funds used for the Sheboygan River Watershed Project. The records of all watershed transactions must be retained for three years after the date of final project settlement. A more detailed description of the fiscal management procedures can be found in NR 120.25 and NR 120.26.

Cost-Share Agreement and Administration

Purpose and Responsibilities

Consistent with s. 144.25, Stats. and NR 120, Wis. Adm. Code, cost-share funding is available to landowners for a percent of the costs of installing BMPs to meet the project objectives. Landowners have three years after the formal approval of the watershed plan to enter into cost-share agreements. Practices included on cost-share agreements must be installed within the schedule agreed to on the cost-share agreement. Unless otherwise approved, the schedule of installing BMPs will be within five years of signing of the cost-share agreement. Practices must be maintained for a minimum of ten years from the date of installing the final practice included in the cost-share agreement.

The cost-share agreement is a legal contract between the landowner and the county. The agreement includes the name and other information about the landowner and grant recipient, conditions of the agreement, the practices involved and their location, the quantities and units of measurement involved, the estimated total cost, the cost-share rate and amount, the timetable for installation, and number of years the practice must be maintained. The agreements also identify and provide information on practices not cost-shared through the nonpoint program but that are essential to controlling pollution sources, such as crop rotations. Once the agreement is signed by both parties, they are legally bound to carry out the provisions in it.

If landownership changes, the cost-share agreement remains with the property and the new owner is legally bound to carry out the provisions. NR 120.13(9) and (10) has more information on changes of landownership and the recording of cost-share agreements.

Local, state, or federal permits may be needed prior to installation of some BMPs. The areas most likely to need permits are zoned wetlands and the shoreline areas of lakes and streams. These permits are needed whether the activity is a part of the watershed project or not. Landowners should consult with the county planning and zoning department or the Land Conservation Department offices to determine if any permits are required. The landowner is responsible for acquiring the needed permits prior to installation of practices.

The cost-share agreement binds the county to provide the technical assistance needed for the planning, design, and verification of the practices on the agreement, and to provide the cost-share portion of the practice costs.

Counties are responsible for enforcing compliance of cost-share agreements to which they are a party. Where DNR serves as a party to an agreement with a unit of government, the DNR will take responsibility for monitoring compliance. The responsible party will insure that BMPs installed through the program are maintained in accordance with the operation and maintenance plan for the practice for the appropriate length of time. Sheboygan, Fond du Lac, Manitowoc and Calumet counties will check for compliance with practice maintenance provisions once every three years after the last practice has been installed. The county must check maintenance at its own expense after the Nonpoint Source Agreement has lapsed.

Landowner Contact Strategy

The following procedure will be used to make landowner contacts:

1. During the first three months of the implementation period, all landowners or operators with eligible nonpoint pollutant sources will receive from the county a mailing explaining the project and how they can become involved.

2. After the initial landowner mailings, county staff will make personal contacts with all landowners that have been identified as having critical nonpoint sources of pollution (Management Category I). These contacts will occur within a year of receiving the Nonpoint Source Agreement.

3. The county will continue to make contacts with eligible (Management Category I and II) landowners and operators until they have made a definite decision regarding participation in the program.

4. The county will contact all eligible landowners (as defined in c above) not signing cost-share agreements by personal letter six months prior to the end of the cost-share sign-up period.

Procedure for Developing a Cost-Share Agreement

Eligibility for cost sharing is verified following a site visit, using the criteria described in chapter six.

The development of farm conservation plans will be the primary method used to develop cost-share agreements. These plans are specific to a particular landowner and are a comprehensive approach to the control of the nonpoint pollutant sources, and the conservation of soil and other resources. The farm plan takes into consideration the sustainability of the agricultural resources and the management decisions of the owner or operator.

Landowners who spread livestock manure on critical acres (as defined in chapter three) during the winter period, and who are classified in Management Category I, will have a manure spreading plan developed for their livestock operation if they elect to participate in the program. Landowners in Management Category II may have a spreading plan developed.

Participants in the watershed project will be required to limit winter-spreading of livestock manure in accordance with the criteria listed in chapter six.

If manure storage facilities are cost-shared, a manure spreading plan is required. The plan will not allow winter-spreading of manure on critical acres for landowners receiving cost sharing for manure storage facilities.

The cost-share agreement specifies the items listed in the farm conservation plan that are necessary to reduce the nonpoint sources of pollutants. The conservation plan and cost-share agreement will document existing management which must be maintained to protect water quality.

The following procedure will be used by the county for developing and administering agreements. Below are the steps from the initial landowner contact through the completion of BMP maintenance.

1. The landowner and county staff meet to discus the watershed project, NPS control practice needs, and coordination with conservation compliance provisions if applicable.

2. The landowner agrees to participate with the watershed project.

3. A farm conservation plan is prepared by the county.

4. The landowner agrees with the plan, a cost-share agreement (CSA) is prepared and both documents are signed by the landowner and the county. Two copies of the CSA are sent to the DNR District Nonpoint Source Coordinator and a copy is given to the landowner. The CSA will be recorded by the county with the County Register of Deeds.

5. Practices are designed by the county, or their designee, and a copy of the design is provided to the landowner.

6. The landowner obtains the necessary bids or other information required in the cost containment policy.

7. Amendments to the CSA are made, if necessary.

8. The county staff oversees practice installation.

9. The county verifies the installation.

10. The landowner submits paid bills and proof of payment (canceled checks or receipts marked paid) to the county.

11. Land Conservation Committees, and if required, county boards, approve cost-share payments to landowners.

12. Checks are issued by the county to the respective landowners and project ledgers are updated.

13. The county records the check amount, number, and date.

14. The DNR reimburses the county for expended cost-share funds.

Identifying Wildlife and Fishery Needs

The Sheboygan, Fond du Lac, Manitowoc and Calumet County staffs will consult with the DNR district wildlife management and fisheries management staffs when completing cost-share agreements to optimize the wildlife and fish management benefits of nonpoint source control BMPs. Specifically, the county staff will contact DNR staff if:

- Streambank protection practices, agricultural sediment basins, or critical area stabilization practices are being considered.

- Fence rows, rock piles, wetlands, or other wildlife habitat components will be adversely affected by installation of the agricultural BMPs.

The DNR staff will assist county staff by:

- Identifying streambank protection practices that benefit fish and wildlife.

- Identifying wildlife habitat components that could be incorporated into vegetative filter strips along streams or in upland areas.

- Reviewing the placement of agricultural sediment basins to assure that negative impacts on stream fish and aquatic life do not occur and recommending wildlife habitat components.

- Providing technical assistance when the installation of BMPs will require the removal of obstructions or other wildlife habitat by proposing measures to minimize impact on wildlife habitat.

- Assisting to resolve questions concerning effects of agricultural nonpoint source BMPs on wetlands.

Submittal to the Department of Natural Resources

Cost-share agreements do not need prior approval from DNR, except in these instances:

- Where cost-share funds are to be used for practices on land owned or controlled by the county.

- agreements or amendments where the cost-share amount for all practices for a landowner exceeds $50,000 in state funds
- grade stabilization structures and agricultural sediment basins with embankment heights between 15 and 25 feet and impoundment capacities of 15 to 50 acre feet
- streambanks to be controlled using riprap or other materials with banks over six feet high
- animal lot relocation
- roofs over barnyards or manure storage facilities

Cost-Containment Procedures

Chapter NR 120 requires that cost-containment procedures be identified in this plan. The cost containment procedures to be used by Sheboygan, Fond du Lac, Manitowoc and Calumet Counties are described below.

Cost-share payments will be based on actual installation costs. If actual installation costs exceed the amount of cost sharing determined by the bidding, range of costs and average cost methods the amount paid the grantee may be increased with the approval of the appropriate land conservation committee. Appropriate documentation regarding the need for changes will be submitted to DNR.

Bids. Competitive bids will be required in Calumet and Fond du Lac Counties for all structural BMPs with estimated total costs, as determined by the project technicians, exceeding $5,000. The bidding process requires the cost-share recipient to receive a minimum of two bids from qualified contractors in lump sum bid. The cost-share recipient must provide copies of the bids to the county prior to initiating construction. In cases where the cost-share recipient provides proof that bids were requested from a minimum of three qualified contractors but only one bid was received, the county will determine if the bid constitutes an appropriate cost for the project. If no bids are received or if the lone bid is not deemed appropriate, Calumet and Fond du Lac Counties will limit cost sharing based on average costs.

Average Costs. Average costs will be used in Calumet and Fond du Lac Counties for all structural BMPs with an estimated cost equal to or less than $5,000 and for all non-structural BMPs not using a flat rate, unless the cost-share recipient decides, and the county agrees, to bid the installation of the BMPs. Manitowoc County will determine cost-share payments for installation of all BMPs based on the average cost method.

The average costs to be used will be sent to DNR and DATCP for approval prior to the counties signing cost-share agreements. This average cost list will be reviewed periodically and appropriate changes made. If changes are made the list will be forwarded to DNR and

DATCP for final approval before the changes are used for calculating cost-share agreements and payments.

Range of Costs. Sheboygan County will use a range of costs for all BMPs installed through cost-share agreements. The range of costs to be used will be sent to DNR and DATCP for approval prior to the counties signing cost-share agreements. This average cost list will be reviewed periodically and appropriate changes made. If changes are made the list will be forwarded to DNR and DATCP for final approval before the changes are used for calculating cost-share agreements and payments.

Flat Rates. BMPs using flat rates are shown in table 7-2. The rates shown are the state's share of the practice installation costs.

Local Assistance Grant Agreement Administration

General Information

The Local Assistance Grant Agreement (LAGA) is a grant from the DNR to Sheboygan, Fond du Lac, Manitowoc and Calumet counties for supporting their staffing and support costs of carrying out this watershed plan. Each county will have its own agreement. Consistent with NR 120, the counties will use funds from the LAGA for additional staff to implement the project and conduct information and education activities. Other items such as travel, training, and certain office supplies are also supported by the LAGA. Further clarification of eligible costs supported by this grant is given in NR 120.14(4) and (6). The estimated hours of staff needed can be found in table 7-4. The total estimated cost for staff and support costs can be found in table 7-5.

Grant Agreement Application Procedures

An annual review of the Local Assistance Grant Agreement is conducted through the development of an annual workload by the county. This workload estimates the work needed to be accomplished each year. The workload is provided to DATCP and DNR for review and clarification. Along with the workload analysis, a grant application form is sent. Funds needed to complete the agreed upon annual workload are amended to the local assistance grant agreement.

Fiscal Management Procedures, Reporting Requirements

Sheboygan, Fond du Lac, Manitowoc and Calumet counties are required by NR 120 to maintain a financial management system that accurately tracks the disbursement of all funds used for the Sheboygan River Watershed Project. The records of all watershed transactions must be retained for three years after the date of final project settlement. A more detailed

Table 7-2. Practices Using a Flat Rate for State Cost-Share Funding	
Best Management Practice	Flat Rate
Contour Farming	$6.00 /ac.
Strip Cropping	$12.00 /ac.
Field Strip Cropping	$10.00 /ac.
Reduced Tillage	$15.00 /ac[1]
Reduced Tillage	$45.00 /ac[2]

1. Reduced tillage systems for short crop rotations, and establishment of forages and small grains (includes no-till)
2. Reduced tillage systems for continuous row cropping or long rotations (does not include no-till)

description of the fiscal management procedures can be found in NR 120.25 and NR 120.26. NR 120 requires quarterly reports to DATCP from each county in accordance with s. Ag. 166.40(4) accounting for staff time, expenditures, and accomplishments regarding activities funded through the watershed project. Reimbursement requests may be included with the submittal of the quarterly project reports.

Budget and Staffing Needs

This section estimates the funding and staffing required to conduct the rural portion of this project. These estimates are based on needs identified for Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties.

Costs of Installing BMPs

The quantity and type of management practices that are required to meet this projects water quality objectives are listed in Tables 7-3, 7-3a, 7-3b, 7-3c, and 7-3d. The capital cost of installing the BMPs are listed in this table assuming landowner participation rates of 100 percent and 75 percent. Also included are the units of measurement and cost-share amount per unit for the various BMPs.

The capital cost of installing the BMPs in Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties is approximately $2.4 million, $1.8 million, $0.5 million, and $0.3 million, respectively, assuming 100 percent participation.

- State funds necessary to cost-share this level of control would be about $1,587,000, $1,127,000, $353,000, and $206,000 for Sheboygan, Fond du Lac, Manitowoc, and Calumet Counties, respectively.