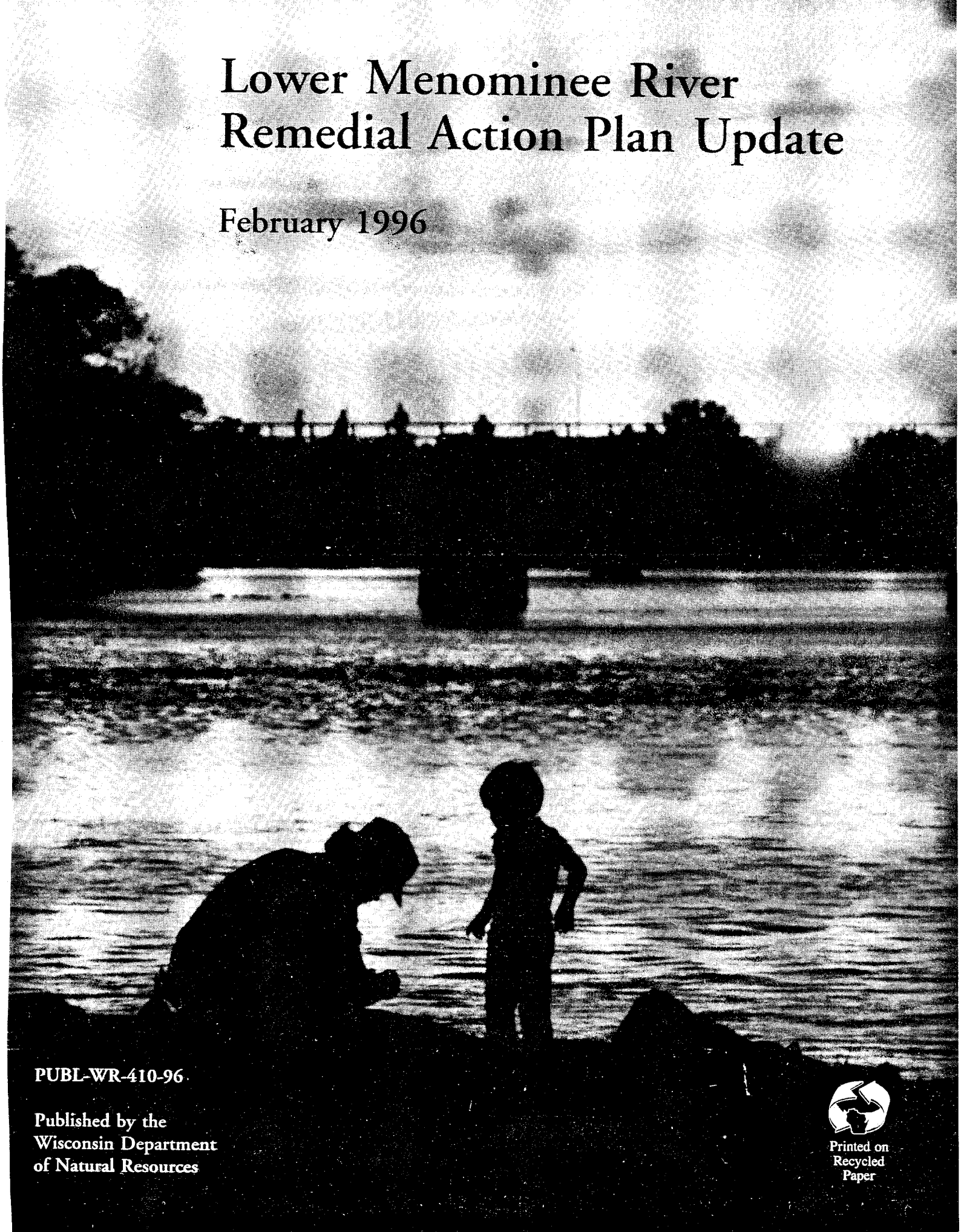
Lower Menominee River Remedial Action Plan Update

February 1996



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February 1, 1996

SUBJECT: 1996 Lower Menominee River RAP Update

Dear Interested Citizen:

The attached 1996 Lower Menominee River Remedial Action Plan (RAP) Update describes progress made in water quality restoration activities in the RAP area of concern since the stage one RAP was completed in 1991. Plan highlights include recommendations for continued restoration of historical contamination sites, protection of remaining environmentally sensitive areas, and monitoring the local ecosystem.

The sources of contaminants contributing to the use impairments are being addressed primarily through existing US Environmental Protection Agency, Wisconsin Department of Natural Resources (WDNR) and Michigan Department of Natural Resources and Department of Environmental Quality (MDNR/MDEQ) programs and enforcement actions. Upon completion of restoration activities, monitoring will be conducted to document restoration of the uses in order to delist the Lower Menominee River as a RAP area of concern.

Agency programs and community actions have been, and will continue to be, important in restoration and protection of water resources in the area of concern. Continuing commitment and cooperation between area residents and local, state and federal agencies is essential to coordinate and implement restoration and protection measures included in this update.

This plan was prepared by Terry Lohr, Wisconsin DNR Bureau of Water Resources Management, with contributions from many others within and outside of WDNR, including MDNR/MDEQ, and the Citizen and Technical Advisory Committees. This plan is part of the *Upper Green Bay Basin Water Quality Management Plan*, which guides water resources management activities in the basin.

Thank you for your interest, participation and continued involvement in managing our valuable water resources.

Sincerely,

Chuck Ledin

Chuck Ledin, Chief
Water Resources Policy and Planning Section
Bureau of Water Resources Management

ACKNOWLEDGEMENTS

Preparation of the Lower Menominee Remedial Action Plan 1996 (RAP) Update is being completed by the Wisconsin Department of Natural Resources (WDNR), Bureau of Water Resources Management, with support from the Michigan Departments of Natural Resources and Environmental Quality, the Citizens Advisory and Technical Advisory Committees, the WDNR Lake Michigan District and the WDNR Bureaus of Solid and Hazardous Waste, Wastewater Management, Fisheries Management and Wildlife Management. Many individuals from the area of concern contributed to the review of this plan.

Special thanks to Nancy Douglas, chair of the Citizens Advisory Committee and to Steve Zander for local staff support, and Dreux J. Watermolen and Cheryl Bougie of the WDNR Lake Michigan District.

Author: Terry Lohr

Editing/Design: Jordana Lenon

Photos: Steve Zander and Bill Kowalski; cover photo by Steve Zander

This publication was partially funded by a local water quality planning grant from the State of Wisconsin and the U.S. Environmental Protection Agency.

Steve Zander, RAP implementation specialist, demonstrates pollution prevention activities to a youth group during Environmental Field Days, sponsored by RAP participants.

TABLE OF CONTENTS

SUMMARY

Much progress has been, and continues to be made, to improve water quality in the Lower Menominee River. Actions have included contamination site investigations, restoration activities, and improvements in wastewater collection and treatment systems. Many of the remaining problems affecting water quality are being addressed through state and federal enforcement programs via corrective action measures. The success of the Lower Menominee River Remedial Action Plan in guiding the restoration of impaired river uses depends on the successful implementation of these programs and measures.

The Wisconsin Department of Natural Resources (WDNR) with assistance from the Michigan Departments of Natural Resources and Environmental Quality (MDNR/MDEQ), a Technical Advisory Committee, and the local Citizens Advisory Committee (CAC), have prepared this 1996 Lower Menominee River Remedial Action Plan Update in part to fulfill the reporting requirements of the 1990 Critical Programs Act. This plan is the first in a series of reports to be issued as remedial work on the river progresses. Reports may be amendments, site-specific project reports and/or updates that follow Wisconsin river basin planning schedules. Stage I of the RAP was accepted by the International Joint Commission in 1991.

Remedial action plans (RAPs) have been developed under the auspices of the Great Lakes Water Quality Agreement for 43 areas of concern (AOCs). They are long-range planning efforts developed and implemented with cooperation from community residents to address persistent water quality problems. Affected areas, typically harbors and industrial sites, fail to meet the objectives of the Agreement due to persistent water quality problems impairing beneficial uses, including the inability of area to fully support aquatic life.

Impaired uses identified in the Stage I Lower Menominee RAP included:

- Degraded benthos (bottom-dwelling organisms)
- Dredging restrictions
- Degraded fish populations
- Loss of fish and wildlife habitat
- Restrictions on fish consumption
- Total or partial body contact restrictions.

With the possible exception of degraded benthos, each of the uses is impaired only in isolated areas of the AOC, or as a result of pollution sources outside the AOC. For example, degraded fish populations are isolated to areas containing contaminated sediments or poor habitat. In addition, PCB and mercury fish consumption advisories appear to be larger bay and basin-wide problems.

Primary pollution problems in the AOC include:

> Marinette - arsenic contamination (shoreline, groundwater, sediment, surface water); coal tar contamination (soil, sediment).
>
> Menominee - paint sludge contamination site (shoreline, sediment); combined sewer overflows (surface water).

Pollution sources in the AOC include contaminated groundwater and sediment, municipal collection and treatment systems, industrial wastewater discharges, landfills and other disposal sites, and spills. Other potential pollution sources include bulk storage pile runoff, air emissions and atmospheric deposition, urban and rural polluted runoff, and pollution from adjacent water resources (i.e., Green Bay).

Recommendations in this update address aesthetics and the AOC shoreline, education and outreach activities, impaired uses including additional studies required to further assess and restore impaired uses, and surveillance and monitoring activities. Most of the impaired uses identified in the AOC are, or are anticipated to be addressed through existing enforcement programs. Recommendations applicable to enforcement programs and impaired uses include assessment, remediation and monitoring of arsenic, coal tar, and paint sludge contamination sites, and separation of combined sewers.

AOC DESCRIPTION

The Menominee River flows into Green Bay and forms the boundary between northeast Wisconsin and Michigan's Upper Peninsula. (See **Figure A**). The cities of Marinette, Wisconsin and Menominee, Michigan lie in the Area of Concern (AOC). An AOC is identified by the Great Lakes International Joint Commission as an area bordering the Great Lakes and having serious environmental problems requiring remedial action. The AOC includes the lower three miles of the Menominee River from the Upper Scott Paper Company Dam to the river's mouth. It extends several miles north and south of the adjacent Green Bay shoreline, from John Henes Park (Menominee) to Seagull Bar (Marinette). The AOC also includes Green Island, located in Green Bay approximately five miles southeast of Marinette (**Figure B**).

Water uses in the AOC include fishing, swimming, industrial production, fish and wildlife habitat, wastewater discharge, boating and shipping, and hydro-electric power generation. Municipal water supplies are obtained from Green Bay, north of the AOC. The Menominee River is designated as a warm water sport fishery in both Wisconsin and Michigan.

CONTENTS OF THIS PLAN

In addition to this summary, the 1996 Lower Menominee River RAP update includes the following:

- Recommendations: This section copies and places all the recommendations proposed throughout this plan in one place. For easy reference, headings and subheadings in this section correspond to those in subsequent chapters.

- Chapter I (and Appendix I): Describes participants and programs involved with the RAP, including information and recommendations concerning shoreline uses and stakeholder participation and support in the RAP implementation process. Education and outreach activities are also included.

- Chapter II: Includes background information defining the basic environmental problems. It also includes corrections and updates to the Stage I RAP

- Chapter III: Includes recommendations and related information addressing the impaired uses and other environmental quality concerns.

- Chapters V and VI: Describe surveillance and monitoring studies completed and additional studies needed. Additional recommendations will be developed and included as new data is collected and as cleanup and enforcement programs proceed.

PURPOSE OF THIS PLAN

The primary purpose of this plan is to guide restoration, where possible, of the impaired uses identified in Stage I of this strategy. The Lower Menominee River RAP's goals and objectives, as identified in Stage I, are to:

Long-term goals

A. Protect the aquatic ecosystem of the Menominee River and harbor from the effects of toxic and conventional pollutants.

B. Maintain a balanced aquatic and terrestrial community to ensure long term health of the ecosystem.

C. Maintain and enhance recreational and commercial uses of the Menominee River and harbor, consistent with long term maintenance of the natural resource base and a healthy economy.

D. Limit nutrient enrichment to protect the Menominee River and Lake Michigan from the effects of eutrophication.

E. Include and encourage public participation in the development and implementation of the Lower Menominee River Remedial Action Plan.

Objectives for meeting long-term goals

1. Evaluate the exposure risks to fish, aquatic life, wildlife and human health from in-place pollutants (contaminated sediments) to determine the need for remediation.

2. Eliminate all toxic effects to fish and aquatic life from industrial and municipal discharges.

3. Identify and eliminate all toxic effects to fish and aquatic life from polluted runoff.

4. Maintain the water quality in the river and bay as drinkable after standard treatment.

5. Maintain a balanced and productive fishery that produces fish everyone can safely eat.

6. Improve water and sediment databases to assist in evaluating environmental quality in the AOC.

7. Restore, protect, and enhance environmental corridors in the AOC.

8. Limit excess nutrients from entering the Menominee River and harbor area.

9. Promote public attitudes and perceptions of the waterfront as a valuable and aesthetic resource.

10. Develop, improve, and maintain shoreline access and recreational facilities for public use and enjoyment.

11. Protect wildlife and fish habitat in nearshore and wetland areas.

12. Reduce conflicts among different types of users.

13. Encourage commercial and industrial developments that build upon and enhance the value of the waterfront.

14. Improve the scenic beauty along the river and bay shorelines.

15. Remediate sediment contamination to protect human health, fish, aquatic life and wildlife.

16. Eliminate all raw sewage discharges and overflows and other known bacterial problems to meet water quality standards for total and partial body contact (including recreational uses) throughout the AOC.

17. Pursue all opportunities to reduce or eliminate all discharges of toxic substances into the AOC, including direct discharges to surface waters, runoff from land surfaces, and air emissions.

WHO'S INVOLVED?

Many agencies and programs at the federal, state and local levels are involved in restoring and protecting the Lower Menominee River AOC. Cooperation and coordination among them is essential to ensure success of this RAP. Inter-agency coordination between WDNR and MDNR/MDEQ is necessary for implementation in areas of overlap such as management of fishery and wildlife resources, promotion of pollution prevention activities, and remediation of contamination sites. WDNR, MDNR/MDEQ, federal agencies, counties, cities, public and private organizations, associations and individuals must all work together to implement the RAP. See *Chapter 2, RAP Participants and Programs*, for more information.

RAP APPROVAL

All Remedial Action Plans are formally reviewed by the states that prepare them (in this case, WDNR and MDNR/MDEQ. Copies of draft plans are produced and distributed for public review and submitted to U.S. Environmental Protection Agency for review and comment. Public meetings are scheduled to present draft reports and solicit comments. Final revisions are drafted and incorporated by the involved states.

Each state involved approves and incorporates the RAP into its statewide water quality management plans. Final reports are submitted to the International Joint Commission and the Environmental Protection Agency. Recommendations are cooperatively implemented between local stakeholders (citizens, interest groups, business, industry, community organizations), responsible parties, and local, regional, state and federal agencies.

The entire RAP - from planning, through implementation of approved recommendations, and finally to significant overall environmental improvement in the AOC - will be an ongoing process, initially comparable to a five year work plan.

For more information contact:

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Lansing, MI 48909
(517) 335-3313 or WWW.DNR.STATE.MI.US

The 3,200-foot Menekaunee Walkway runs from Ogden Street to Red Arrow Park in Marinette. Completed in fall 1993, the walkway allows joggers, pedestrians, bicyclists and others to enjoy the Menominee River. It was paid for by grants from WDNR and the Coastal Management Program.

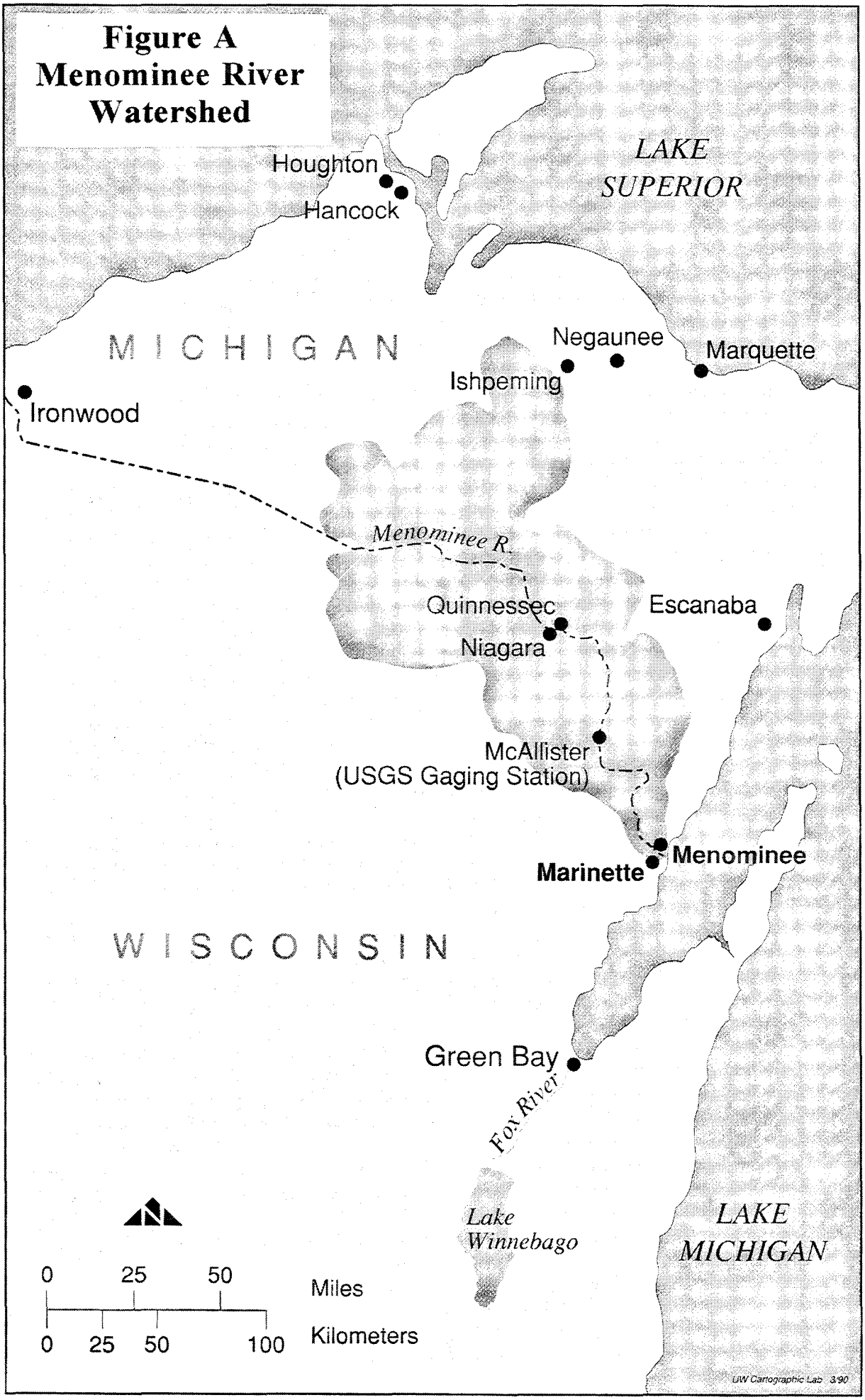
Figure A
Menominee River
Watershed
LAKE
SUPERIOR
Houghton
Hancock
MICHIGAN
Negaunee
Marquette
Ishpeming
Ironwood
Menominee R.
Quinnessec
Escanaba
Niagara
McAllister
(USGS Gaging Station)
Menominee
Marinette
WISCONSIN
Green Bay
Fox River
Lake
Winnebago
LAKE
MICHIGAN
0 25 50
Miles
0 25 50 100
Kilometers
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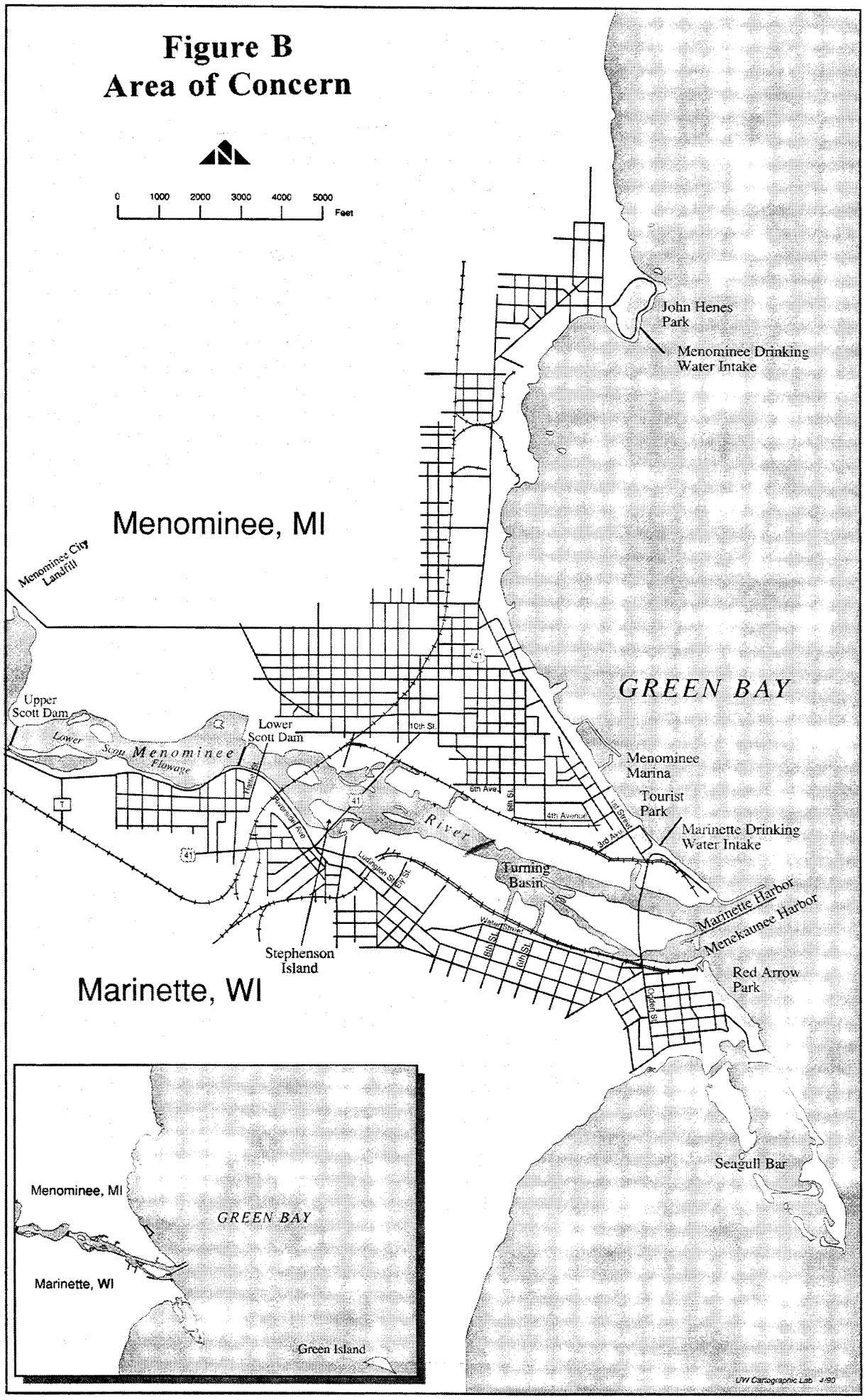
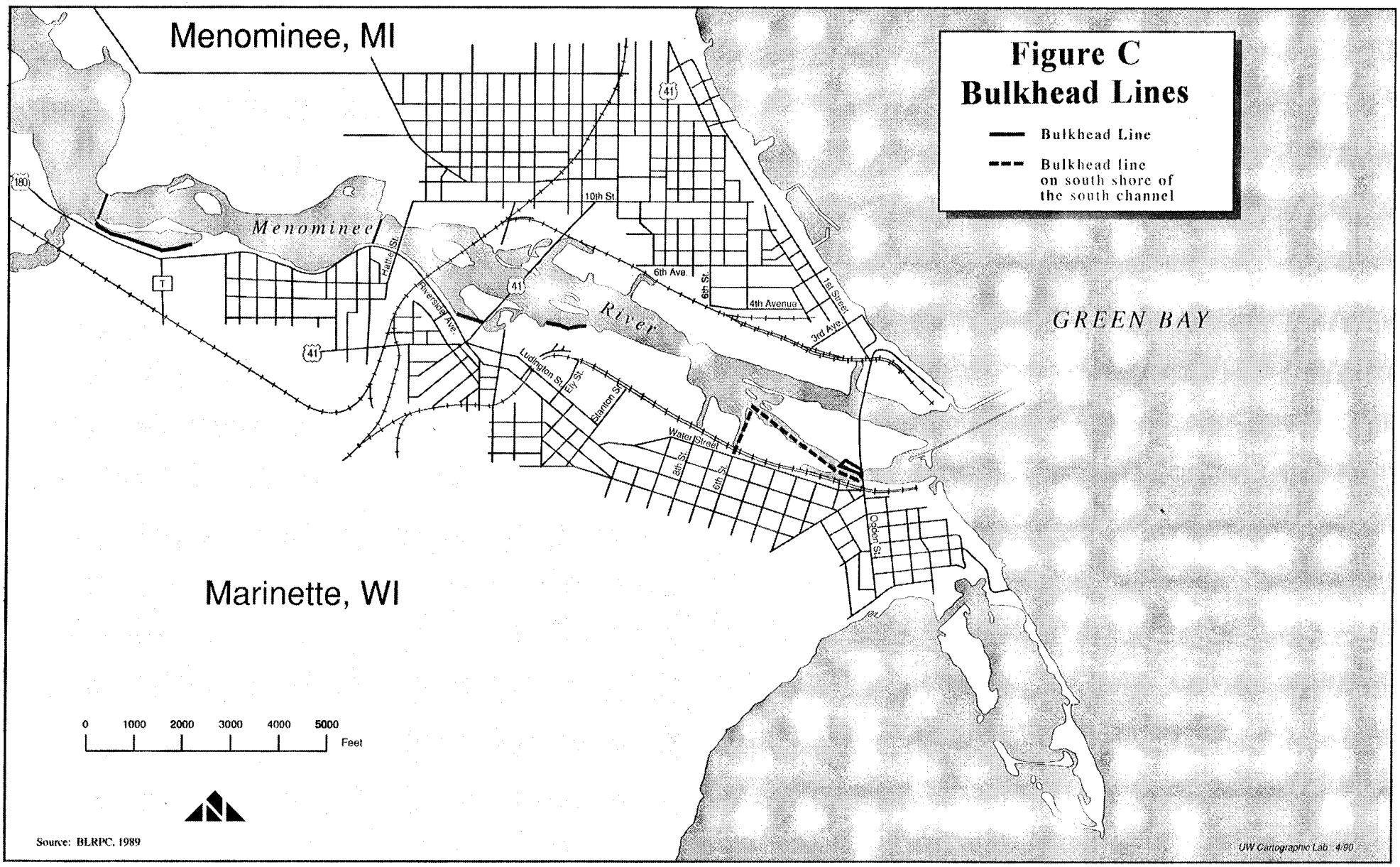
Figure B
Area of Concern




Menominee, MI
Figure C
Bulkhead Lines
Bulkhead Line
Bulkhead line on south shore of the south channel
Menominee
River
GREEN BAY
Marinette, WI
10th St
6th Ave.
6th St.
4th Avenue
1st Street
3rd Ave.
Pattison St.
Riverside Ave.
Ludington St.
Ely St.
Blanton St.
Water Street
8th St.
16th St.
Ogden St.
41
180
7
0 1000 2000 3000 4000 5000
Feet
Source: BLRPC, 1989
UW Cartographic Lab 4/90

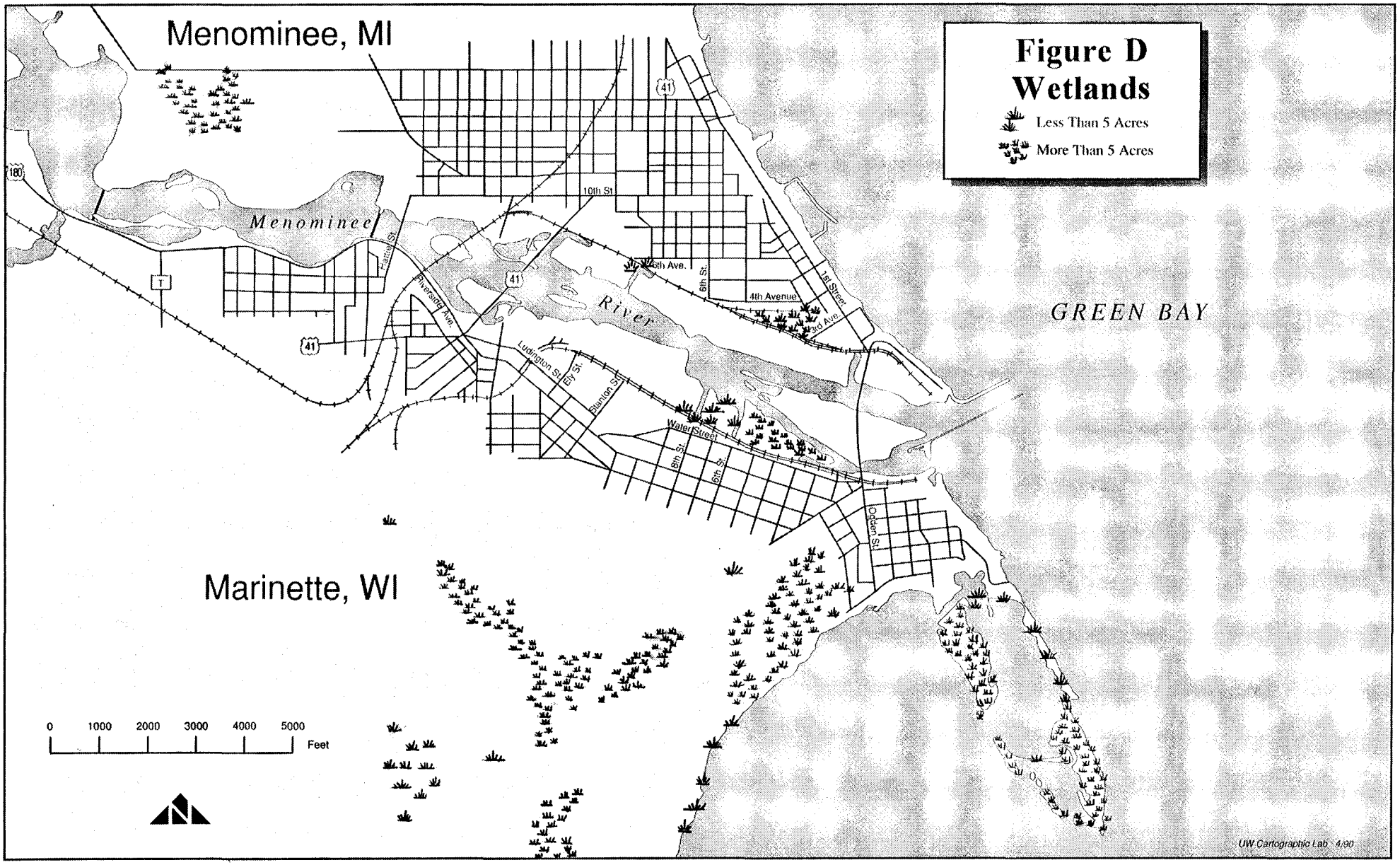


Figure D
Wetlands
Less Than 5 Acres
More Than 5 Acres
Menominee, MI
Marinette, WI
GREEN BAY
Menominee
River
10th St
8th Ave.
6th St.
4th Avenue
3rd Ave.
1st Street
Riverside Ave.
Ludington St.
Ely St.
Pierce St.
Water Street
8th St.
6th St.
Ogden St.
41
180
0 1000 2000 3000 4000 5000
Feet
UW Cartographic Lab 4/90

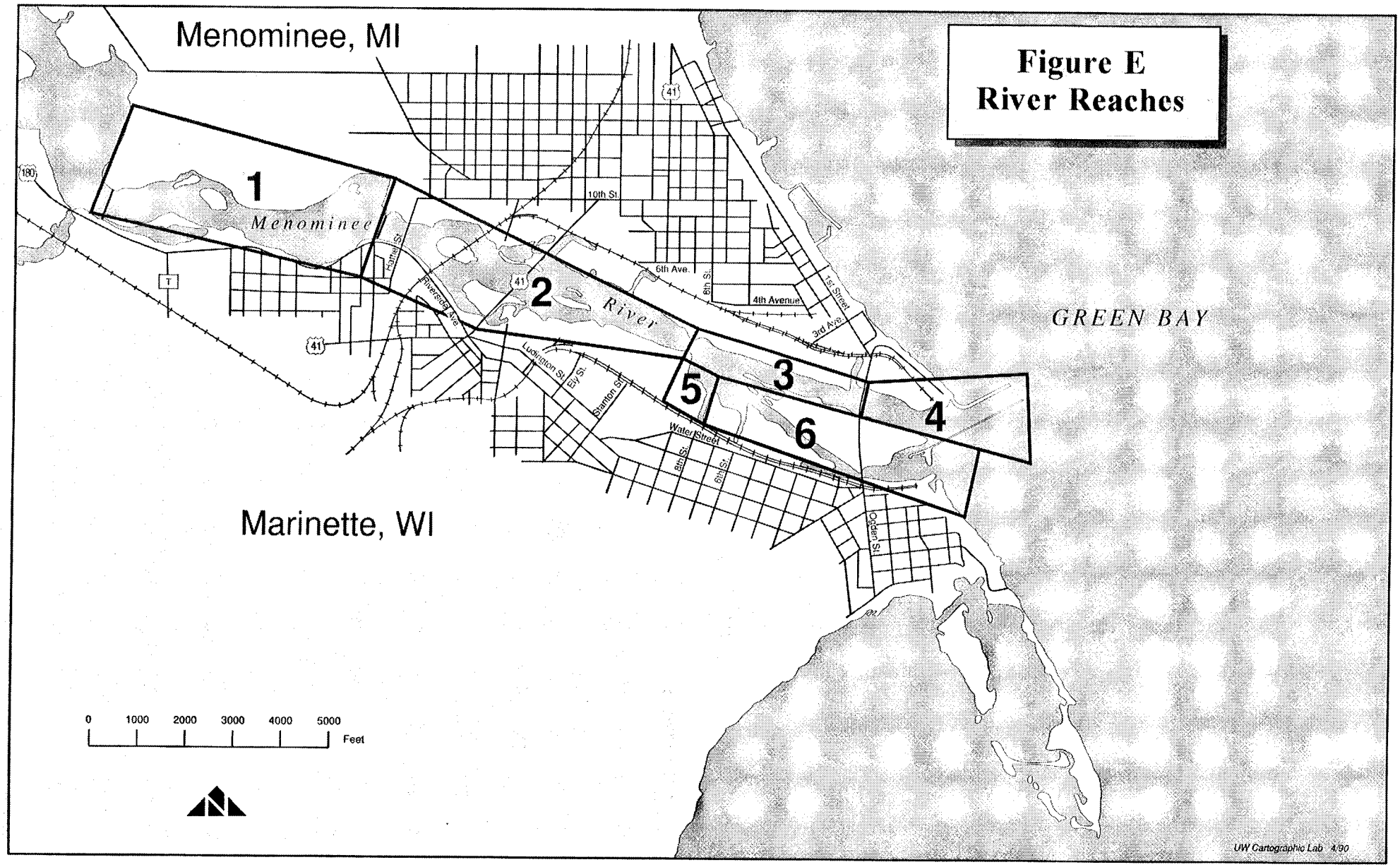


Figure E
River Reaches
Menominee, MI
Marinette, WI
GREEN BAY
Menominee River
1
2
3
4
5
6
10th St.
6th Ave.
4th Avenue
3rd Ave.
15th Street
Carnell St.
Riverside Ave.
Ludington St.
Ely St.
Stanton St.
Water Street
8th St.
6th St.
Golden St.
41
180
T
0 1000 2000 3000 4000 5000
Feet
UW Cartographic Lab 4/90

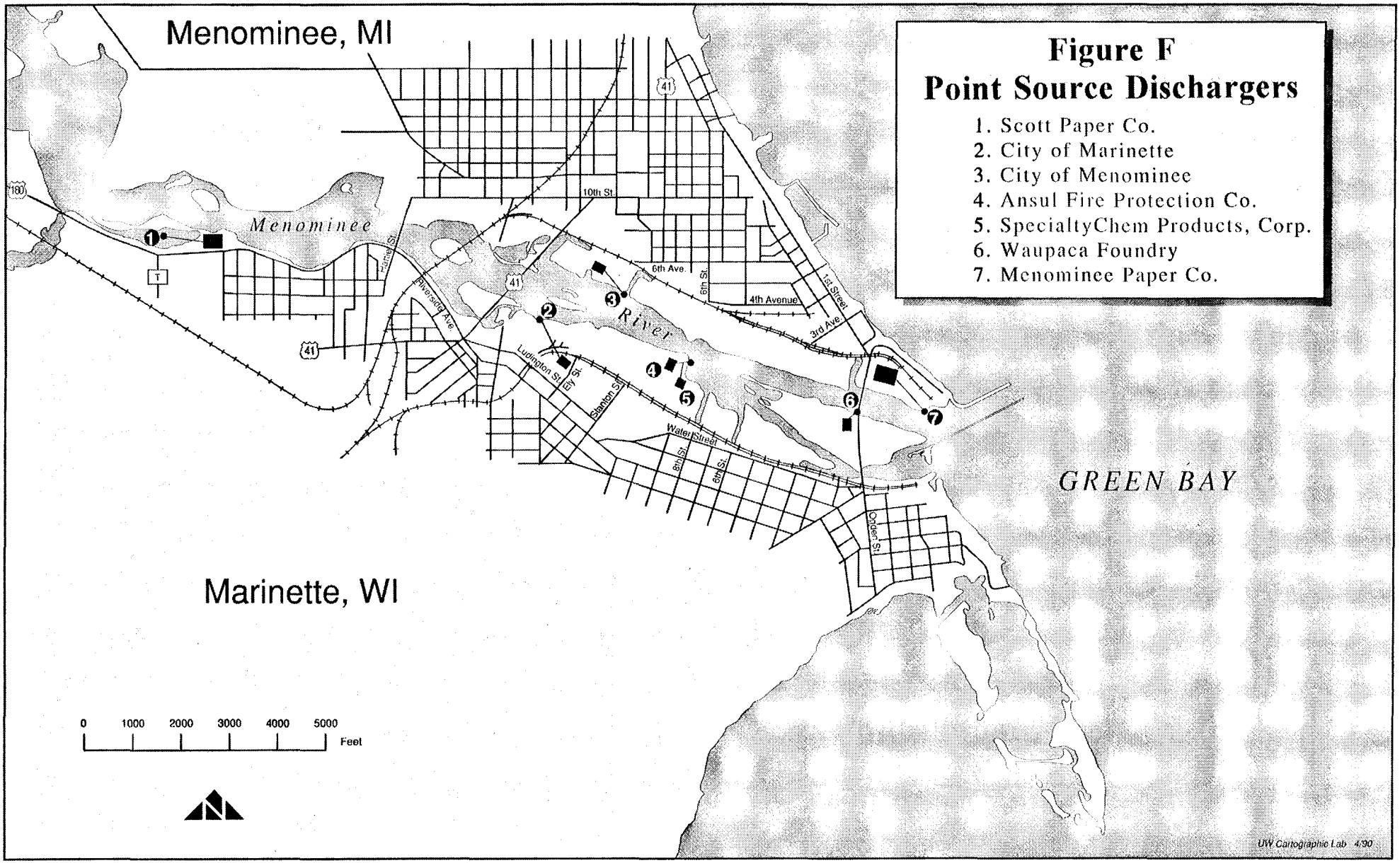

Menominee, MI
Figure F
Point Source Dischargers
1. Scott Paper Co.
2. City of Marinette
3. City of Menominee
4. Ansul Fire Protection Co.
5. SpecialtyChem Products, Corp.
6. Waupaca Foundry
7. Menominee Paper Co.
Menominee
Menominee River
GREEN BAY
Marinette, WI
10th St.
6th Ave.
6th St.
4th Avenue
1st Street
3rd Ave.
Riverside Ave.
Ludington St.
Ely St.
Stanton St.
Water Street
8th St.
6th St.
Order St.
41
180
0 1000 2000 3000 4000 5000
Feet
UW Cartographic Lab 4/90

Figure G
Secondary Sources

1. Scott Paper Co. - Former ash and debris area of disposal. Probably also wood, bark, etc. from pulp mill days (Scott Paper Co. property)
2. Wood, bark, sawdust from sawmill era, municipal solid waste from pre WWII era. (Ansul Co., Marinette Marine Property)
3. Ash, municipal solid waste from 1940's and 1950's (Waupaca Foundry property)
4. Menominee City Landfill
5. Green Bay Paint Sludge Disposal Site
6. Marinette Coal Tar Contamination
7. Former Arsenic Storage Area
8. Fill area above Menominee WWTP

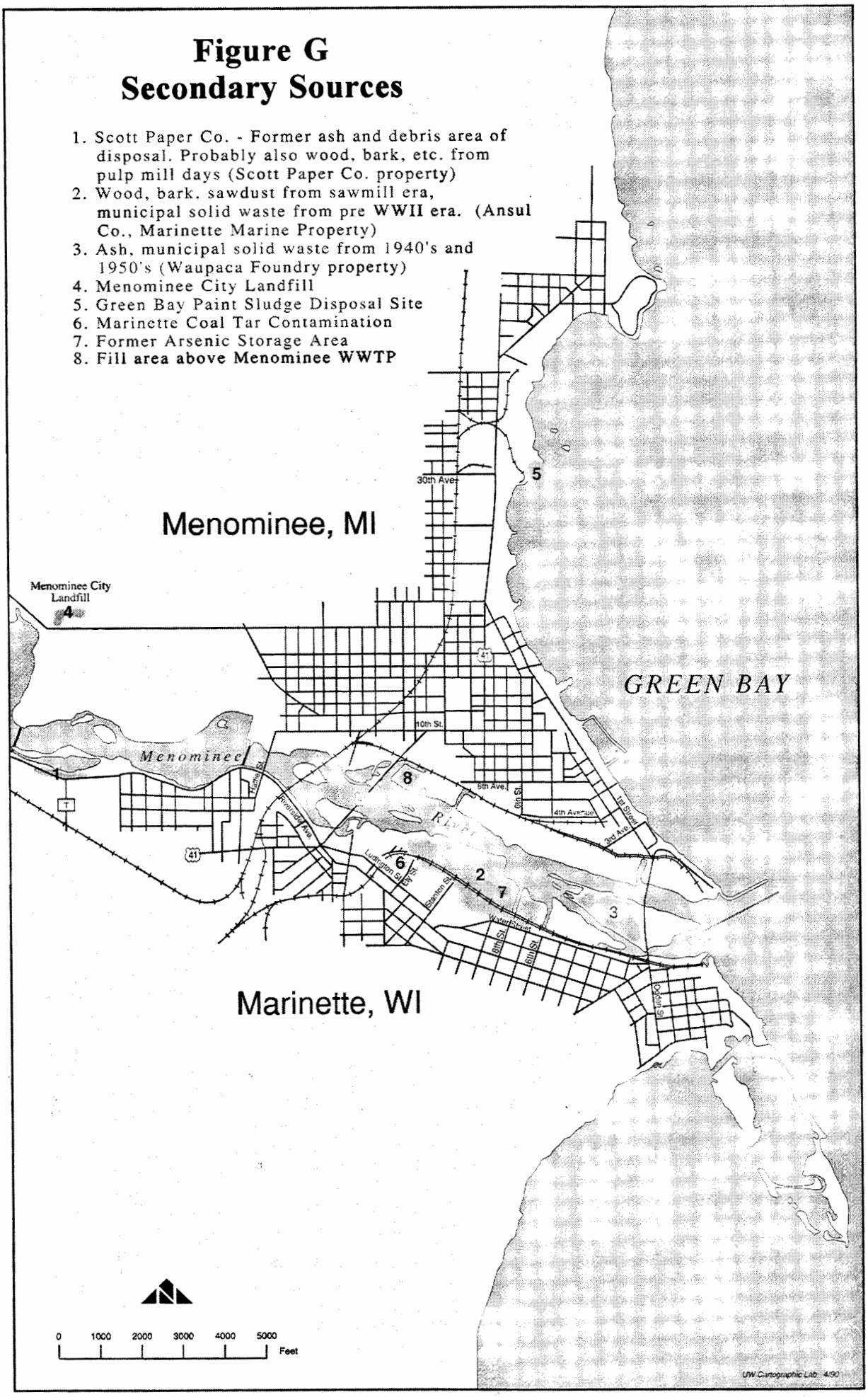
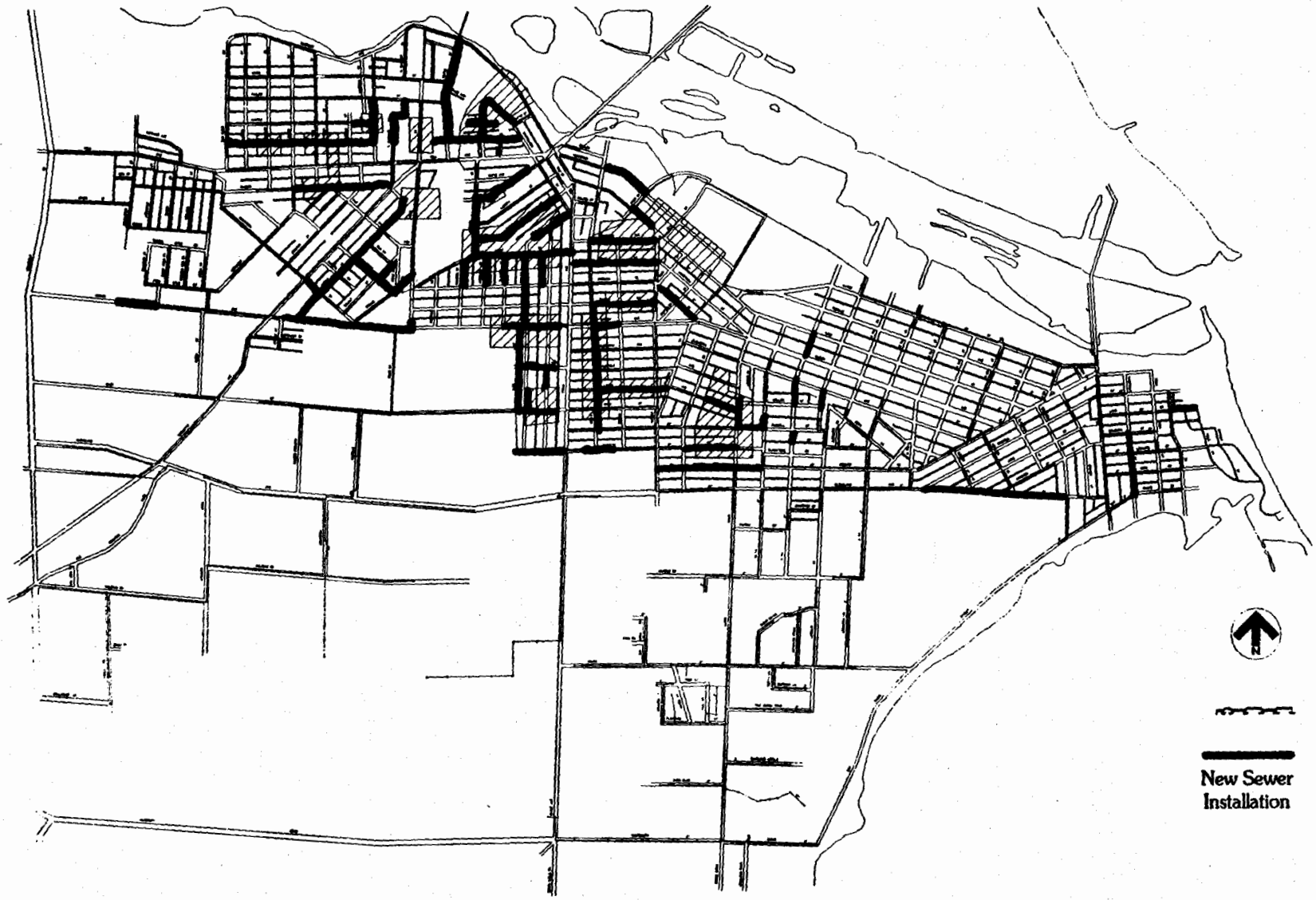


Figure H
City of Marinette, Wisconsin
New Sewer Lines



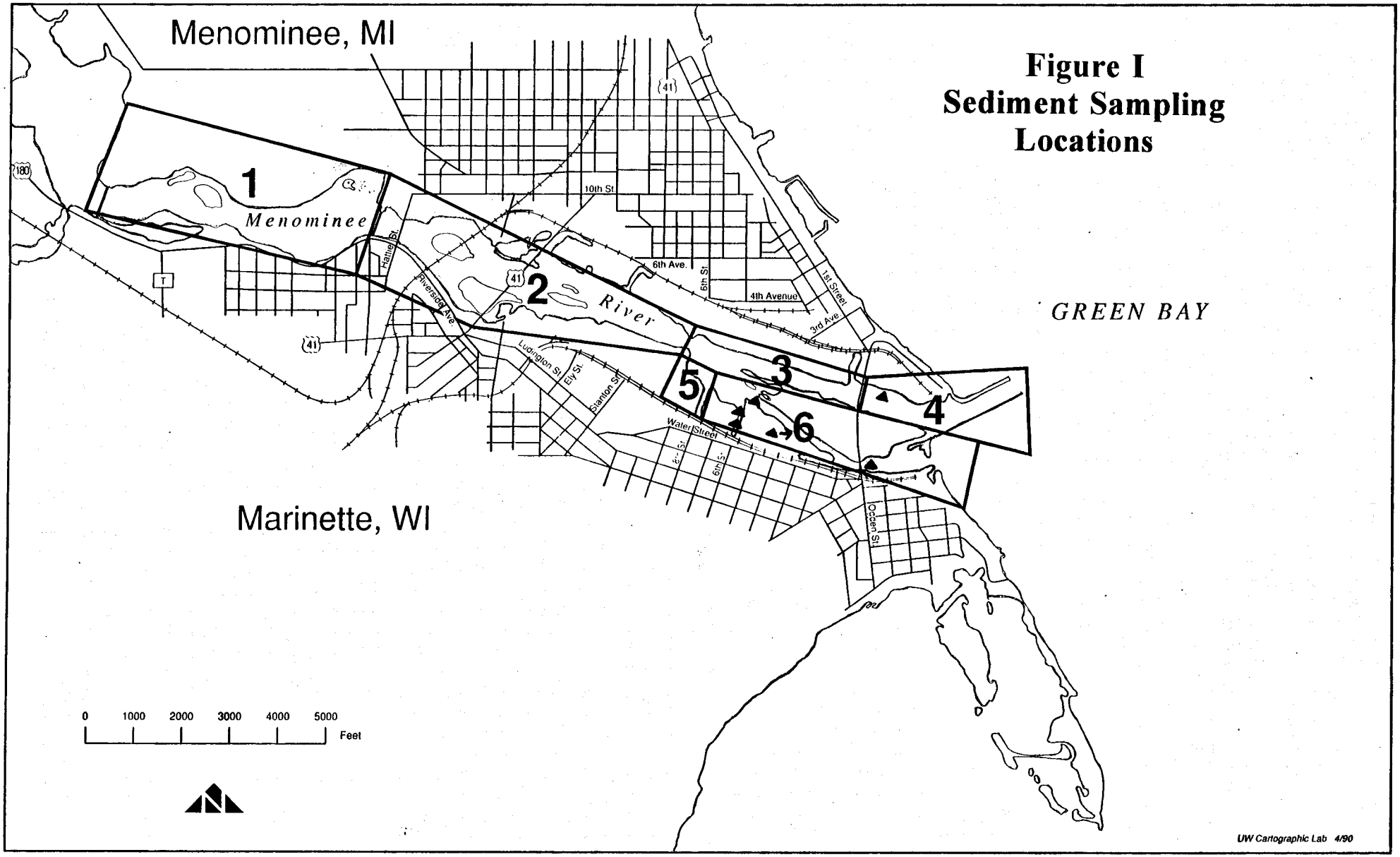
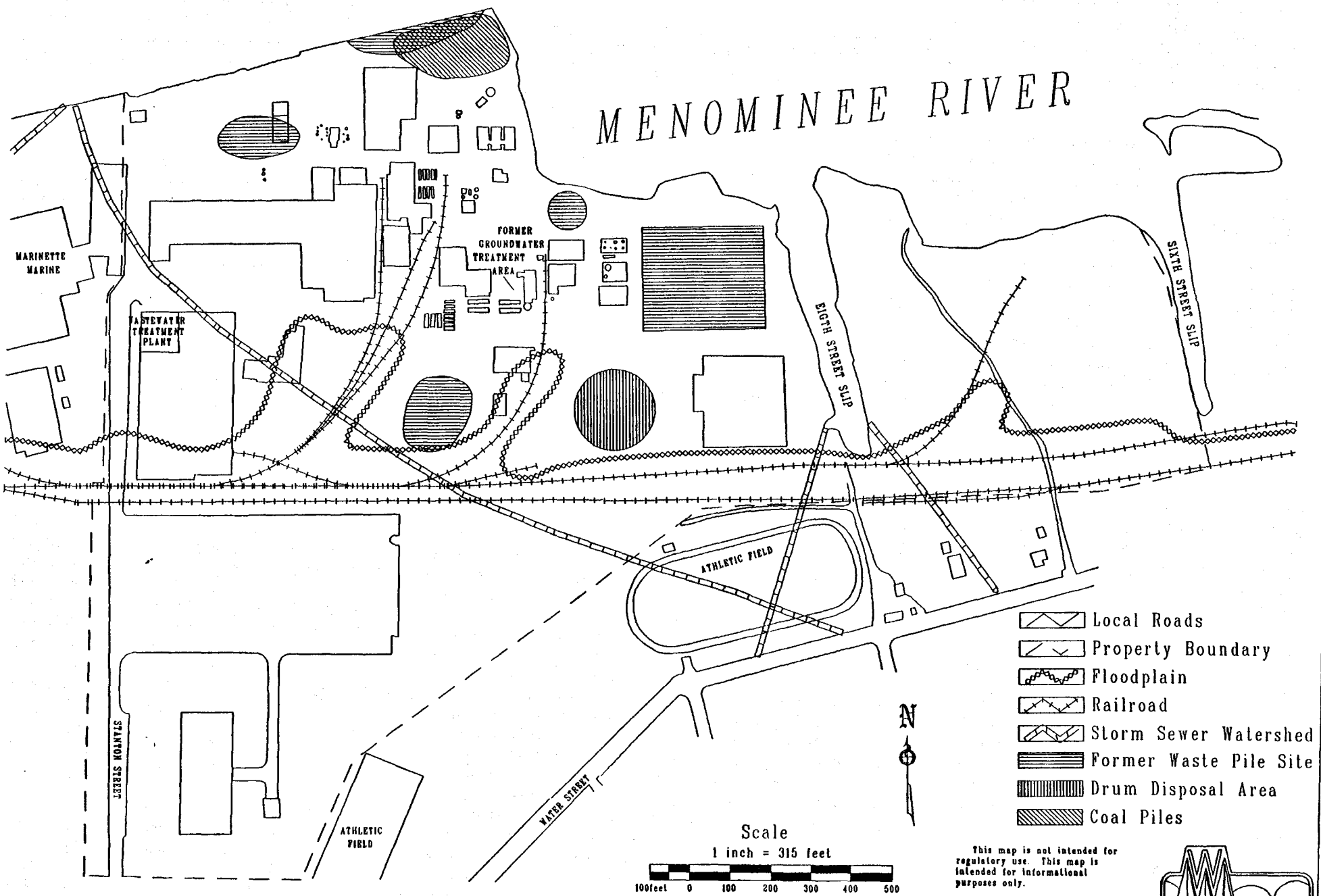

Menominee, MI
Figure I
Sediment Sampling
Locations
1
Menominee
2
River
3
4
5
6
GREEN BAY
Marinette, WI
10th St.
6th Ave.
4th Avenue
1st Street
3rd Ave
6th St.
Hattie St.
Riverside Ave
Ludington St.
Ely St.
Stanton St.
Water Street
Ogden St.
41
180
0 1000 2000 3000 4000 5000
Feet
UW Cartographic Lab 4/90

Figure J: Ansul Property



This map is not intended for regulatory use. This map is intended for informational purposes only.

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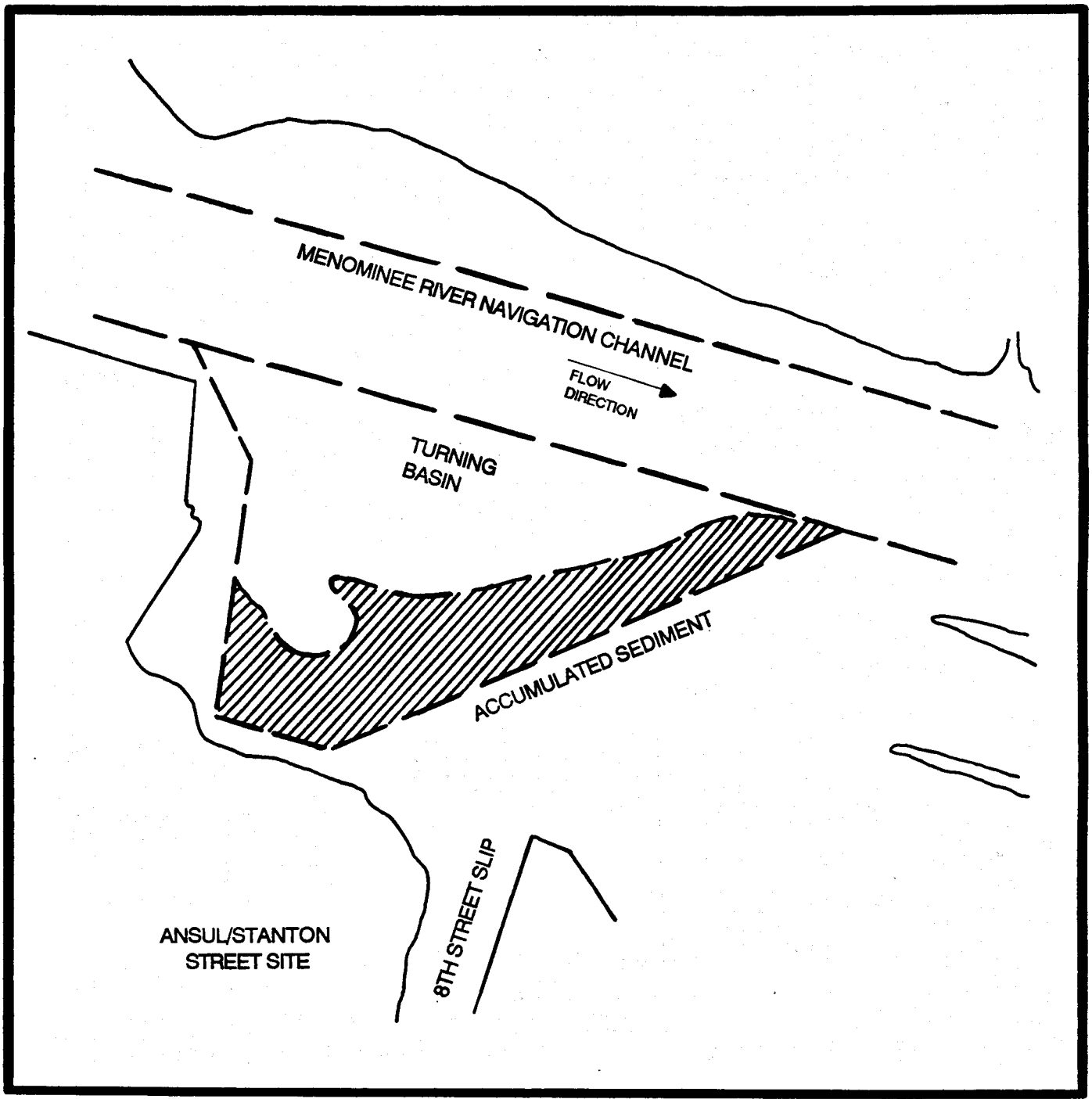
Source : Department of Natural Resources, 1993.



SOURCE: CORPORATION OF ENGINEERS, BAKER ENGINEERING, UNPUBLISHED

Figure K: Area of Arsenic-Impacted Sediment

SCALE: 1 INCH = 200 FEET
PROJECT DREDGING LIMIT — — —
EST. AREA OF CONCERN = 120,000 FT^2

Figure L
Storm Sewer Outfalls and Combined Sewer Overflows (CSO)

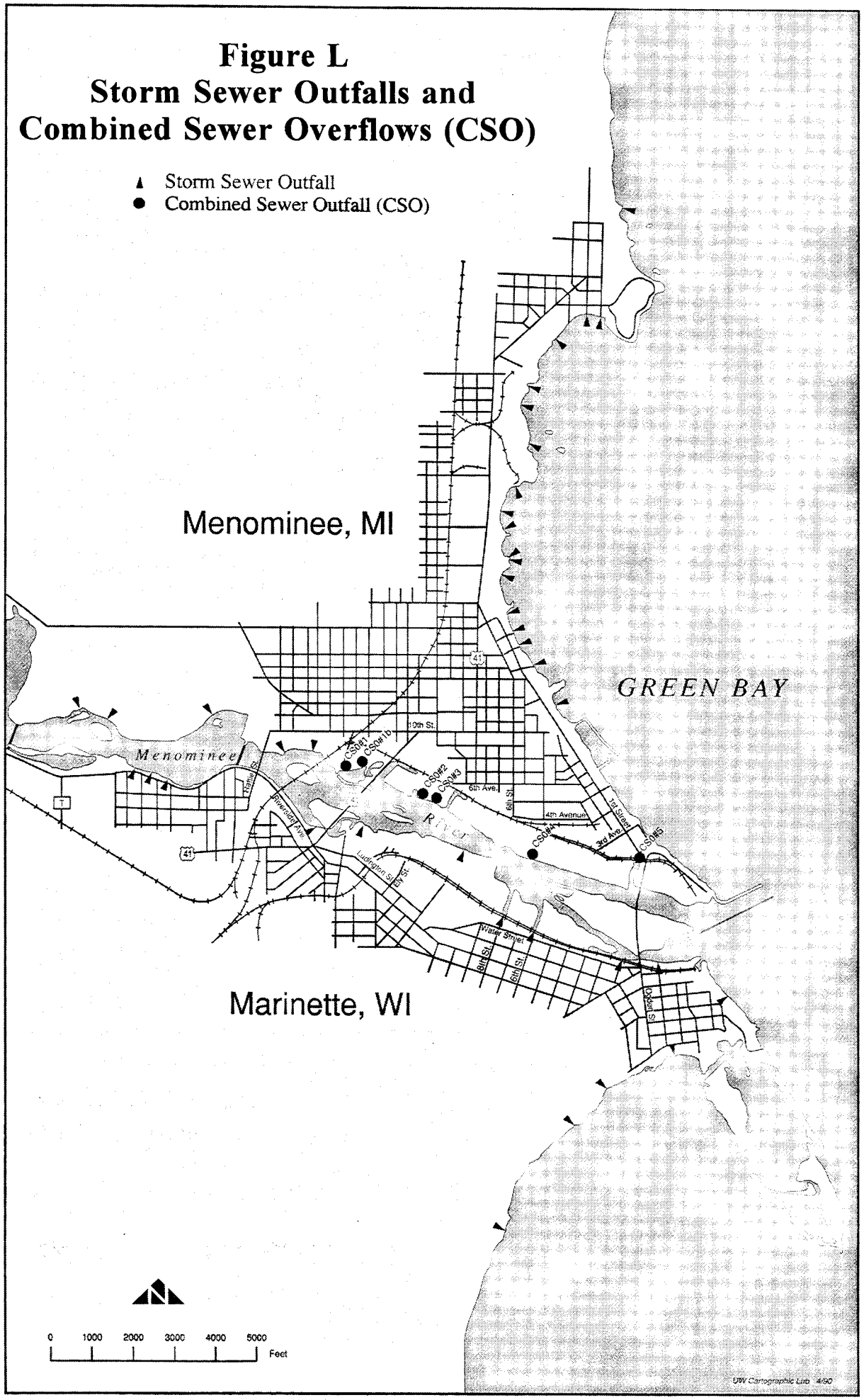
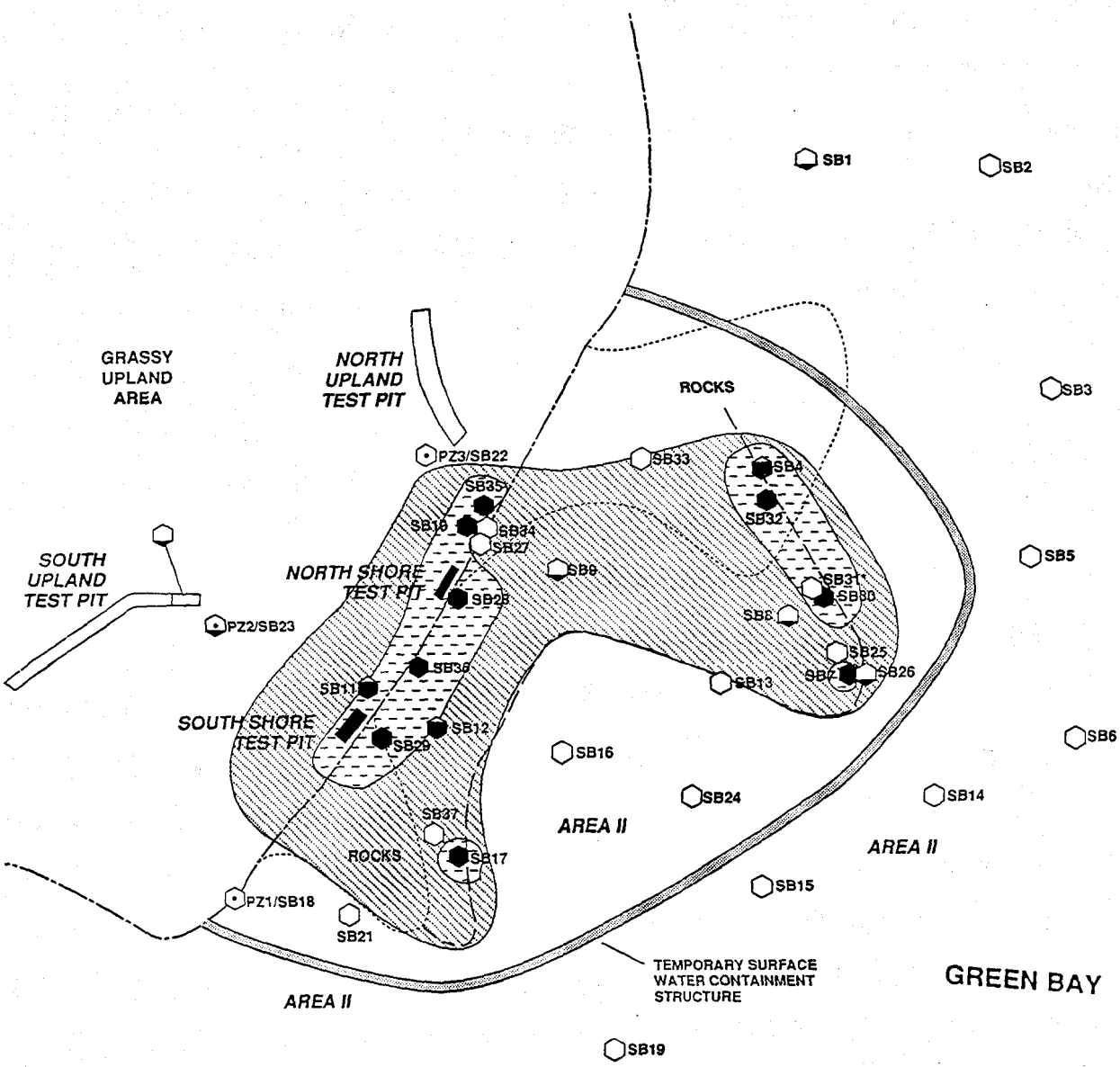


Figure M
Areas Containing Paint Sludge



LEGEND

- SB1 — SOIL BORING LOCATION
- PZ1 — PIEZOMETER LOCATION
- TEST PIT LOCATION
- APPROXIMATE SHORELINE (11-90)
- APPROXIMATE EXTENT OF ROCKS (11-90)
- APPROXIMATE EXTENT OF PAINT SLUDGE (G&M EST. /11-90)

CONCENTRATION

- NO PAINT SLUDGE FRAGMENTS ENCOUNTERED
- MINOR TRACES OF PAINT SLUDGE FRAGMENTS ENCOUNTERED IN ONE SPLIT-SPOON SAMPLE
- PAINT SLUDGE FRAGMENTS ENCOUNTERED IN AT LEAST TWO SPLIT-SPOON SAMPLES
- SIGNIFICANT THICKNESS OF PAINT SLUDGE ENCOUNTERED (FROM 0.5 FT TO POSSIBLY GREATER THAN 3.0 FT THICK)

AREA I - Areas containing major accumulations of paint sludge material.

AREA IIA - Area located adjacent to the major accumulation of paint sludge (AREA I). Paint sludge fragments were observed at the surface and in sediment samples collected within this area.

AREA II - Area surrounding Area IIA which likely contains minimal amounts of paint sludge fragments scattered around in offshore areas, the grassy upland area, and along the shoreline adjacent to and south of the site.

NOTE: * NO SAMPLE COLLECTED FROM 0-7 FEET BELOW GROUND SURFACE

N

0 25 50 100

APPROXIMATE SCALE IN FEET

GERAGHTY & MILLER, INC.
Environmental Services

FIGURE 2
AREAS CONTAINING PAINT SLUDGE
SUBMERGED WASTE REMOVAL ACTION WORK PLAN
GREEN BAY PAINT SLUDGE SITE
MENOMINEE, MICHIGAN
WI17401 - 0181.03.1

RECOMMENDATIONS

The following recommendations are numbered chronologically and identified by chapter and subheadings where any further information appears. Responsible parties, cooperating agencies and cost information, if available, are included in subsequent chapters. Some recommendations are cross-referenced, as they overlap topics. Additional recommendations and implementation strategies will be added to the RAP as studies and field work continue and progress is documented.

The process for identifying remedial options and selecting recommended actions included assessing alternative recommendations and developing final recommendations through the RAP Technical Advisory Committee and the RAP Citizens Advisory Committee (described in the next chapter). All recommendations are based on goals, impaired uses and RAP objectives identified in the Stage I RAP, and on new information obtained since Stage I was completed. Cost estimates for each of the recommendations and implementation schedules will be determined as agency work plans and enforcement actions proceed.

CHAPTER I: RAP PARTICIPANTS AND PROGRAMS

1 Citizens Advisory Committee (CAC) members, in cooperation with other state and local participants and stakeholders, should ensure that the shoreline and aesthetics recommendations (below) developed and approved by CAC are implemented.

Shoreline and Aesthetics

2 The CAC and community organizations, in cooperation with city governments, and public and private interests, should continue to organize annual summer or fall cleanup day(s) to remove litter and debris from the shoreline and to focus attention on the river's many potentials.

3 The City of Marinette should, in cooperation with other public and private sector groups and individuals, complete improvements by 1998 to the following recreational facilities:

a. Red Arrow Park - Continue to improve and maintain existing facilities.

b. Sixth St. Slip - Improve as boat launch area or picnic area, clean up debris, landscape, enhance shoreline, develop boardwalk.

c. Boom Landing - Upgrade boat launch area and connect with proposed riverway nature trail.

d. Government Pier - Work with the U.S. Army Corps of Engineers (COE) to provide safe access and pier improvements.

4 The City of Menominee, in cooperation with MDNR and other appropriate public and private sector groups and individuals should:

a. Improve access to Lighthouse Pier.

b. Complete fish-cleaning station at River Park Campground.

c. Maintain Ann Arbor Boat Launch.

d. Continue local support for marina improvements.

e. Continue development of Veterans Memorial Park including Hinkers Dock.

f. Upgrade public facilities at Henes Park.

g. Protect lagoon area west of Interstate 41 Bridge.

5 The Cities of Menominee and Marinette, in cooperation with the Michigan and Wisconsin Departments of Transporation and local Chambers of Commerce, should continue to enhance existing recreational and natural areas through an improved coordinated system of signs, lighting and facility design between Marinette and Menominee.

6 The Cities of Menominee and Marinette should continue to determine, develop and maintain an adequate number of swimming beaches that meet appropriate water quality and safety standards.

7 MDNR, WDNR, Cities of Menominee and Marinette should continue to maintain and improve boat launch facilities.

8 Municipalities, in cooperation with chambers of commerce, private developers, harbor commissions, should continue to encourage marina development where it is environmentally sound.

9 Regional and local planning agencies should continue to encourage resolution of riverfront aesthetics conflicts among commercial uses, industrial uses (i.e., setbacks), wetland preservation and habitat protection and recreational uses.

10 WDNR, MDNR/MDEQ, in cooperation with U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (COE), environmental and conservation organizations,

should continue to protect and enhance wildlife habitat in wetland areas for habitat protection and public enjoyment.

11 The Cities of Menominee and Marinette, States of Michigan and Wisconsin should continue to encourage and fund public acquisition of vacant properties along shoreline when available for enhanced waterfront uses.

12 Property owners should continue to encourage improved aesthetics by planting native vegetation and encouraging appropriate screening (e.g., berm and fencing).

13 WDNR, MDEQ and the U.S. Army Corps of Engineers, in cooperation with property owners, should continue to coordinate and promote the use of environmentally sound shoreline protection along all sections of unprotected shoreline in Area of Concern

14 (**Partially completed**) Local governments, in cooperation with state agencies and private landowners, should develop facilities for passive recreation (e.g., walking, biking, cross-country skiing) through development of boardwalks and public trails where feasible). WDNR and Wisconsin Coastal Management grants totaling $56,000 were awarded to the City of Marinette to start financing some of these improvements.

15 The Cities of Marinette and Menominee, Area Planning Commissions and Chambers of Commerce, in cooperation with local conservation, fishing, hunting, and environmental groups, should continue to promote buffer strips, green spaces, and aesthetics for new development.

16 State and local historical societies and educational institutions should continue to identify and protect historical areas.

17 The City of Menominee should map existing status of the Menominee shoreline area including transportation routes, land ownership, floodplain, wetland, and recreational areas as part of an updated land use plan.

18 WDNR and MDNR/MDEQ should assess and protect Menominee River islands.

19 Chambers of Commerce and economic development interests should continue to encourage commercial and industrial development where environmentally sound.

Land Use Planning

20 (**Completed**) The Lower Menominee River Remedial Action Plan Citizens Advisory Committee (CAC) should go on record in support of the City of Marinette in using the May 1990 Menominee River Waterfront Plan for long range waterfront planning.

21 (**Completed**) The City of Marinette should remove the bulkhead line designation on city-owned property along the south channel. The CAC recommends that this area be protected and managed as a wildlife habitat area by the Wisconsin Department of Natural Resources. The CAC recognizes that the south shore of the south channel of the Menominee River between the Sixth Street Slip and Ogden Street contains one of the few remaining wetlands in the RAP area of concern (See **Figures C** and **D**).

APPROVED - The Marinette City Council approved a resolution (April 7, 1993) to remove the designated bulkhead line in this area.

22 (**Completed**) The CAC should approve a recommendation to include Green Island as part of the RAP Area of Concern.

Education and Outreach

23 WDNR, MDNR/MDEQ, Citizen Advisory Committee (CAC) and Technical Advisory Committee (TAC) members, and local stakeholders should continue to monitor and provide leadership for the restoration, protection and management of the environmental quality and resource management initiatives embodied in this plan.

24 WDNR, MDNR/MDEQ and the CAC should continue to provide information to the public through the use of general media (TV, radio, newspaper), brochures and publications, and speaking engagements.

25 Michigan and Wisconsin Chambers of Commerce, in cooperation with MDNR/MDEQ, WDNR, local and regional planning commissions, environmental organizations, area schools and academic institutions should continue to develop and expand information and education programs that will:

a. Promote positive attitudes toward potential benefits and values of the waterfront.

b. Encourage the use of existing recreational, cultural and natural resource areas and waterfront activities.

c. Use a variety of approaches to educate local and state decision makers, area community leaders, and the general public about the Menominee River RAP. Potential funding sources should include the Coastal Management program.

26 WDNR, MDNR/MDEQ, local schools, area academic institutions and Departments of Public Instruction should continue to work with area school administrators and curriculum coordinators to incorporate activities on the river and Great Lakes into school curriculum.

27 Chambers of commerce, civic, conservation and environmental organizations should continue to promote clean-up and rehabilitation activities that encourage individual and group participation (e.g., clean-up days, annual wildlife surveys, clean sweep efforts).

28 WDNR and MDNR/MDEQ should continue to monitor and periodically report to local stakeholders on progress of RAP implementation.

CHAPTER III: ENVIRONMENTAL QUALITY RECOMMENDATIONS

Degradation of the benthos

29 Ansul Fire Protection Company (as part of RCRA Consent Order signed with EPA and WDNR), WDNR (and responsible party at coal tar contamination site), MDEQ and Lloyd Flanders Company should conduct site-specific benthic surveys (diversity and density) at several control sites and in areas known to be contaminated with high concentrations of arsenic (Turning Basin, the Sixth and Eighth Street Slips, south channel of river), coal tar (Boom Landing), and paint sludge (Green Bay shoreline adjacent to Lloyd Flanders Company.

Degraded Fish Habitat

30 Same as Recommendation No. 21.

Total And Partial Body Contact Restrictions

31 MDEQ should conduct selective water quality monitoring for *Escherichia coli* (*E. coli*) until all combined sewers in the City of Menominee are eliminated.

Water quality

Dissolved oxygen

32 WDNR and MDEQ should use continuous meters to monitor dissolved oxygen (DO) levels below the Upper and Lower Scott Paper Co. dams and near the Menekaunee Bridge during June through September. Flow data should be analyzed in conjunction with DO data to examine how DO levels are affected by river flows.

Urban polluted runoff

33 WDNR, MDEQ and the cities of Marinette and Menominee should sample storm sewers in the AOC to assess the concentration and loading contributions

of urban polluted runoff to the river and bay during storms. All remaining combined sewer overflows in the City of Menominee should be eliminated. (Note: Starting in 1996 Wisconsin statutes will require the City of Marinette to monitor stormwater as part of statewide stormwater management permit requirements.)

Biota and habitat

Wetlands

34 Responsible parties through existing programs and authorities* should assess and protect all remaining wetlands in the AOC. Marginal wetland areas in the AOC should be considered for potential remediation projects.

* Cities of Menominee and Marinette (land use zoning, shore-land/wetland ordinances, Sewer Service Planning), WDNR and MDNR/MDEQ environmental quality and resource management programs (water quality/surface water quality, shore land wetland zoning, solid and hazardous waste disposal, pollution discharge); U.S. EPA [SWIS, Section 404 (dredge disposal) program]; and U.S. Army COE (Section 404 Program).

Green Island

35 The Natural Areas Preservation Council in conjunction with the WDNR Bureau of Endangered Resources should purchase and protect Green Island as a State Natural Area if and when the land becomes available.

Snapping turtle contaminant data

36 WDNR Lake Michigan District staff and MDNR staff should collect additional snapping turtles from throughout the AOC for PCB and mercury analyses. Both fat and muscle tissue samples should be analyzed.

Mussels

37 Hydroelectric dam operators should conduct a survey of unionid mussels in river reaches 1 and 2 in conjunction with the Federal Energy Regulatory Commission (FERC) relicensing process.

Air quality

38 MDEQ and WDNR should obtain measurements to support determination of atmospheric deposition of toxic substances found in the Menominee River by

monitoring ambient air quality for toxicants of concern, using state of the art sampling and analytical techniques.

39 MDEQ and WDNR should utilize air emissions inventories, additional air monitoring, and air quality modeling techniques to work towards quantifying local deposition of contaminants of concern.

Sediment quality

Sediment Characterization

40 WDNR Bureau of Water Resources Management should design and implement sediment mapping surveys to better characterize the physical properties and location of depositional areas within the AOC.

Partially Completed: WDNR staff began the collection and digitization of this information in 1994. This deposit information, along with existing sediment quality data, is being used to determine where additional sediment samples will be collected and analyzed.

41 WDNR Bureau of Water Resources Management and MDEQ should conduct a sediment quality triad assessment of Lower Menominee River sediment deposition zones, based on the sediment deposit survey results. In addition, WDNR should conduct toxicity tests at the two sites previously showing toxicity (Tusler/Masnado sites) to verify toxicity. Additional toxicity testing should identify the primary causes, delineate the area of toxicity and serve as a baseline for evaluating remedial actions.

Coal Tar Contamination (polycyclic aromatic hydrocarbons - PAHs)

42 The potentially responsible parties (Wisconsin Public Service and/or the City of Marinette) should:

- Assess the horizontal and vertical extent of PAH contamination in soils and adjacent river sediments from the site adjacent to the Marinette wastewater treatment plant.
- Conduct additional soil, sediment and groundwater sampling and monitoring, as necessary, to further assess contamination and contaminant mobility.
- Develop a remediation strategy to assess and implement potential remedial actions.

Note: A site assessment took place in summer 1995. Results are not yet available.

Harbor Dredging Maintenance And Deepening Project

43 The City of Menominee should complete sediment analyses to determine if contaminants in the materials are acceptable for dredging and for disposal in open water as part of the harbor deepening project.

Arsenic Contamination

Toxicity Assessments

44 Ansul Fire Protection Company, through the EPA RCRA Consent Order cosigned by WDNR September, 1990, should conduct an environmental assessment for each RCRA site targeted for corrective action. Actions must include a comprehensive assessment of ecological impacts of toxic substances to the environment, including groundwater, surface water, soils and sediments. Assessment methods and characterizations should be compatible with current science as including, but not limited to, the following guidelines and documents:

a. U.S. EPA Office of Water Regulations and Standards Sediment Oversight Technical Committee and Tiered Testing Workgroup;

b. Regional and National U.S. EPA and US Army COE Workgroups developing guidance for implementing Section 404 (b)(l) of the Clean Water Act as it applies to disposal of sediment in open water;

c. EPA Region V Waste Management Division Policy Directive on performing Ecological Assessments;

d. ASTM guidelines for performing sediment toxicity testing;

e. State of Wisconsin assessment methodologies for evaluating contaminated sediments.

45 Ansul, through the EPA RCRA consent order cosigned by WDNR September, 1990, should use current assessment methods to facilitate technically defensible and publicly acceptable decisions based on chemical and biological assessment of contaminated sediment. Below are guidelines and recommendations for assessments:

a. For each environmental medium potentially affected by the release of toxic substances to a surface water, consideration should be given to

using the results of appropriate bioassays conducted on sediment and sediment pore water and overlying site surface waters. Bioassay results should be considered along with the numeric state standards applicable to groundwater and surface water quality criteria. Numeric state standards for groundwater quality and surface water quality should be used for protecting biota in the surface waters and benthic habitats.

b. The horizontal and vertical extent of contamination in the sediments and pore water should be included on Isopleth maps, based on existing data and additional sampling as necessary.

c. Present loading of contaminants moving off site should be quantified to assess existing conditions and monitor site changes.

d. Bioassays should be used in conjunction with collected sediments and pore water samples that represent a gradient of contamination. Bioassays would assist in establishing site specific levels of contaminants for acute and chronic toxicological effects and other biological effects.

46 Ansul, through EPA RCRA Consent Order cosigned by WDNR September, 1990, should consider the following factors (noted by Eisler, 1988) when assessing the impacts of arsenic on aquatic ecosystems:

a. Little work has been done on the long-term effects of arsenic on organisms at chronic concentrations (blocking or depressing enzyme systems, pathological changes in tissues and limiting development of growth, reproduction, metabolism and other physiologic processes).

b. Additional long-term studies and studies involving sensitive life stages such as embryos, larvae, or early juveniles are needed to more accurately access the toxicity of arsenic forms to fish and other aquatic organisms.

c. While there is not enough data to allow derivation of numerical criteria for aquatic organisms for pentavalent arsenic (As (V)) or any organic arsenic compound, indications are that some organisms are more sensitive or at least as sensitive to As (V) and organic arsenic as they are to exposure to As (III) for which water quality criteria have been developed.

d. Exposure to low levels of arsenic by organisms at certain trophic levels may have significant ecosystem implications. For example, Eisler (1988) indicates that chronic studies with mass cultures of natural phytoplankton communities exposed to low levels of arsenate (As (V))

of 1.0 to 15 µg/l showed that As (V) differentially inhibits certain plants, causing a marked change in species composition, succession and predator-prey relations. The significance of these changes on carbon transfer between trophic levels is unknown.

Remediation approaches

47 The RCRA enforcement process should proceed with a site investigation and remediation program until impaired uses associated with arsenic contamination are restored. Requirements addressing the investigation, remediation and restoration of the Ansul site will be determined through the RCRA corrective action enforcement program, involving both WDNR and the U.S. EPA.

Note: If impaired uses associated with arsenic contamination are not restored through the RCRA enforcement program, WDNR will consider using other authorities, resources and programs to address this site.

48 A cooperative effort between Ansul, EPA and WDNR should be *considered* to eliminate or reduce the flow of groundwater through arsenic-contaminated soils and sediments, while negotiations and additional assessments take place as part of the RCRA Corrective Action Enforcement Program.

49 Cleanup of the submerged paint sludge site in Green Bay should continue until impaired uses associated with this site (degradation of benthos, loss of fish and wildlife habitat) are restored.

Plans and Studies

Menominee River Fisheries Plan

50 WDNR and MDNR should continue to evaluate stocking efforts in and around the Area of Concern.

51 WDNR, MDNR and Scott Paper Company should assess and, if necessary, implement techniques to reduce dam entrainment fish mortality in the Lower Scott Flowage.

CHAPTER IV: SURVEILLANCE AND MONITORING

Water Quality Assessment

River Flow Model

52 WDNR should develop and maintain a computer simulation flow model for Menominee River reaches 1 - 6 (**Figure E**).

Stormwater

53 Same as Recommendation No. 33.

South Channel Dissolved Oxygen Studies

54 **(Completed)** WDNR Lake Michigan District Water Resources Management personnel should assess dissolved oxygen levels in river reach 6 of the South Channel, using continuous dissolved oxygen meters and/or hydrolab monitoring units.

Note: Dissolved oxygen data was collected in the South Channel by WDNR in 1993 (Appendix IV). Daily fluctuations in dissolved oxygen levels were within an acceptable and expected level. Additional monitoring is not recommended at this time. However, dissolved oxygen measurements should be taken in conjunction with any future water chemistry or macroinvertebrate work conducted in the river.

Sediment Mapping

55 Same as Rec. No. 40.

56 Same as Rec. No. 41.

Fisheries Data Acquisition And Monitoring

The following four recommendations are based on guidance developed for WDNR fish managers and water quality planners when determining fish community attributes in areas of concern. More detail on this guidance is included in the body of this report.

57 *Long-term trends in general fish community composition:* Information on the composition of the fish community in the area of concern should be obtained through WDNR and MDNR fisheries management programs to develop specific goals for remediation efforts.

58 *Population trends of one or two indicator species:* WDNR and MDNR fish managers should monitor population trends on one or two indicator species in the AOC identified as important or critical to restorations of impaired uses.

59 *Fish habitat types, quantity, and quality:*WDNR and MDNR fish management programs should include identification of habitat parcels important to restoring or maintaining a healthy fish community.

60 *General health condition of one or two indicator species and indicators of exposure and response to contaminants:* WDNR and MDNR fish managers should obtain necessary information to describe the population and physiological conditions of one or more fish species chosen to indicate the exposure and response to contaminants in the system.

Wildlife Baseline Data Acquisition

Habitat Inventory and Assessment

61 WDNR and MDNR Wildlife Management personnel should identify necessary and available habitat for meeting wildlife management objectives in the AOC, including identifying potential sites for wildlife habitat improvement projects.

62 WDNR and MDNR Wildlife Management personnel should delineate available habitat, including critical wildlife habitats on river reaches 1-6 within the AOC.

Wildlife Health Assessment

63 WDNR and MDNR Wildlife Management personnel should capture resident avian, amphibian, reptilian and mammalian species from river reaches 1-6 for gross health exams, necropsy and contaminant analysis.

Wildlife Health Assessment and Contaminant Monitoring

64 WDNR and MDNR staff should assess the reproductive performance (egg production, viability and hatchling survival) of a representative piscivorous bird, such as the common merganser, above and within the AOC. Contaminant concentrations should be determined in eggs, adult and hatchling serum, and in adult and hatchling feathers and livers.

65 WDNR and MDNR staff should assess the PAH exposure and immune status of waterfowl near the Marinette wastewater treatment plant. Samples of food items and gastrointestinal tract contents can be analyzed to determine if waterfowl are being exposed to PAHs. Serial blood sampling of live-trapped birds will be used if immune system function has been supressed by PAHs.

66 WDNR and MDNR staff should identify any amphibian and reptile populations in the contaminated area. Tissue samples should be obtained above and below the site to determine arsenic concentration. Reproductive performance should be monitored, including egg production and viability, larval survival, growth and deformities. If amphibians are not present in sufficient numbers, the Frog Embryo Toxicity-Xenopus (FETAX) can be performed in a laboratory. There, the frogs would be exposed to water and sediments from the contamination sites to determine if arsenic concentrations are contributing to reduced amphibian populations.

Wildlife Contaminant Monitoring

67 WDNR Lake Michigan District staff should collect additional snapping turtles from throughout the AOC for PCB analyses in fat and mercury analyses in muscle tissues.

Endangered/Threatened And Nongame Resources Inventory

68 WDNR and MDNR should conduct an inventory to determine if flora and fauna on the endangered and threatened species lists are present in the AOC.

69 Same as Recommendation No. 37.

Water Quality Trend Monitoring

Dissolved Oxygen

70 WDNR and MDEQ should monitor dissolved oxygen levels below the Upper and Lower Scott dams and near the Menekaunee Bridge (river reaches 1 through 4) using continuous meters from June through September.

Benthic Macroinvertebrate Monitoring

71 **(Partially completed - data has been collected but not analyzed)** WDNR should conduct macroinvertebrate trend monitoring in the following locations: near the Hattie Street bridge, near Boom Landing, in the Turning Basin, at the upstream end of the South Channel, at the mouth of the South Channel and at a site upstream of the AOC (river reaches 2, 5, & 6). A minimum of three artificial substrates should be placed on

the river bottom at each site. Samplers should be retrieved after thirty days and invertebrates collected, identified and enumerated.

Fisheries Population Monitoring

72 WDNR and MDNR Fisheries Management personnel should monitor stocks of selected species and the magnitude of migrations to ascertain when population goals listed in **Table 7** are reached, or whether other actions, such as selected stocking, are needed.

Fish Contaminant Monitoring

73 WDNR Lake Michigan District Fisheries Management personnel should collect fish from river reaches 1-6 and upstream of the AOC every five years for contaminant analyses.

Air Quality Monitoring to Determine Deposition

74 WDNR and MDEQ Air Management programs should obtain measurements to support determination of atmospheric deposition of toxic substances found in the Menominee River by monitoring ambient air quality for toxicants of concern, using state-of-the-art sampling and analytical techniques.

75 WDNR and MDEQ Air Management programs should use air emissions inventories, additional air monitoring and air quality modeling techniques to quantify local deposition of contaminants of concern.

76 WDNR and MDEQ Air Management programs should use a technique such as back trajectory analysis to analyze data from the Green Bay urban toxics monitoring station, the Great Lakes regional monitoring stations and current studies to quantify long range contaminant transport and deposition.

CHAPTER V: ADDITIONAL STUDIES

Benthic Survey

77 WDNR Lake Michigan District staff should conduct a benthic invertebrate analysis of 1994 samples.

Restrictions On Fish Consumption

78 WDNR and MDEQ should continue contaminant monitoring in the AOC for toxic pollutants of concern (including PCBs, dioxin and mercury) in water, sediment, fish and wildlife as part of existing permit, surveillance and monitoring programs. WDNR should assess mercury concentrations and sources as part of the *Upper Green Bay Basin Areawide Water Quality Management Plan* and by EPA as part of the Lake Michigan Lakewide Management Plan. If significant sources of mercury, dioxin, PCBs, or other pollutants of concern are found originating from within the AOC, remedial recommendations should be developed and included in the RAP.

CHAPTER I: RAP PARTICIPANTS AND PROGRAMS

GOVERNMENT PARTICIPATION

Descriptions of applicable and potentially-applicable RAP programs and authorities are included Appendix I. Additional information on specific programs may be obtained from the identified program. **Table 1** summarizes pollution sources and applicable programs. **Figures F and G** show all industrial and municipal dischargers in the area as well as secondary sources of pollution described in the table.

Table 1: Summary of Pollution Sources and Applicable Regulatory Programs

Source of Pollution or Problem	Applicable Regulatory Program
Former arsenic salt storage areas	EPA RCRA program, WDNR Solid and Hazardous Waste Program;
Filled wetlands	WDNR Water Regulation and Zoning; County zoning regulations; City ordinances
Storm sewers/Urban nonpoint sources	WDNR and MDEQ NPDES (Wastewater) and Nonpoint Source Water Pollution Programs.
In-place pollutants	WDNR and MDEQ: Assessments and criteria currently developed on a site- specific basis, taking into consideration existing water quality standards
Buildup of wood fibers in sediments	Surveillance, Monitoring and research programs, WDNR and MDNR
Point source discharges -Marinette WWTP -Ansul Company -Specialty Chem Products, Inc. -Scott Paper Co. -Menominee WWTP -Menominee Paper Co. -Combined Sewer Overflows	 WDNR NPDES program MDEQ NPDES program
Regional pollution sources outside, but affecting AOC	Pending implementation of EPA Lake Michigan Lakewide Management Plan

Source of Pollution or Problem	Applicable Regulatory Program
Undetermined source of fecal coliform	MDEQ Water Quality Standards, NPDES program, Nonpoint Source program, Michigan Dept. of Public Health, Delta-Menominee Public Health Dept., WDNR Water Quality Standards, WPDES program, Nonpoint Source program
Atmospheric deposition	WDNR Air Management program MDEQ Air Quality Management program
Menominee City Landfill	MDEQ Environmental Response Division
Menominee/Marinette spills and leaking underground storage tanks	WDILHR and WDNR Solid and Hazardous Waste programs; MDEQ Environmental Response and Surface Water Quality Division
Green Bay paint sludge disposal site	MDEQ Environmental Response Division
Marinette Coal Tar contamination	WDNR Solid and Hazardous Waste program
Riverfront filled areas	WDNR Solid and Hazardous Waste program; MDNR Land and Water Management Programs; County shoreland zoning regulations
Rural nonpoint pollution sources	WDNR Nonpoint Source program; MDEQ Nonpoint Source program; County subdivision regulations and zoning regulations
Coal and salt pile runoff	WDNR Wastewater program; Wisconsin Department of Transportation, MDEQ Wastewater program, Surface Water Quality Division

PUBLIC PARTICIPATION

The Parties, in cooperation with the State and Provincial Governments, shall ensure that the public is consulted in all actions undertaken pursuant to this Annex. [Annex 2.2 (e), Great Lakes Water Quality Agreement]

A primary goal of the Lower Menominee River RAP is to include and encourage public participation in RAP development and implementation. Public participation has focused on:

- Community recognition
- Public meetings
- RAP advisory committees
- Education and outreach
- Community clean-up days
- School presentations
- Stakeholder survey

Community Recognition

Two local organizations have recognized the RAP process for making positive contributions to the community. The Chappee Rapids Audubon Society and the Marinette Area Chamber of Commerce have singled out the RAP process for making environmental and leadership contributions in the communities of Marinette and Menominee.

Public Meetings

To date, there have been two larger public meetings (separate from CAC meetings) to solicit input from stakeholders in the Area of Concern. A third public meeting will be scheduled as part of this update. The first public meeting (described next) was held at the beginning of the RAP process to gauge community concerns and goals as they relate to the RAP. The second meeting was held before completion of Stage I. Both meetings served as opportunities to disseminate and to receive information.

Technical Advisory Committee

A RAP Technical Advisory Committee (TAC), with representation from local stakeholders and local, state and federal agencies assisted with developing the RAP. Three TAC subcommittees (sediment, water, and biota) developed preliminary recommendations included in this update. TAC members included the following:

Dan Amundson
Brian Belonger
Tim Doelger
Larry Hanrahan
Tom Janisch
Wendel Johnson
Terry Lohr
Rick Lundgren
Janet Marron
Ron Martin*
Mike Netzer
Stanley Nogalski
Bruce Oman
George Rogers
Jack Rydquist
Greg Sevener
Mark Tusler
Jim Wiersma
Bill Ziegler

**Committee Chair*

Citizens Advisory Committee

As part of the RAP process, WDNR and the Michigan Departments of Natural Resources and Environmental Quality formed a RAP Citizens Advisory Committee (CAC). The CAC has included area residents, local government officials, educators, recreation specialists, environmentalists, and business and industry representatives from Marinette, Wisconsin and Menominee, Michigan area. CAC community education and outreach activities were also begun and will continue throughout the RAP process.

The CAC's purpose has been to advise WDNR and MDNR/MDEQ by:

1. Representing the interests, organizations and constituencies involved in developing the RAP.

2. Assisting with dissemination of information concerning water quality-related environmental issues identified in the RAP.

3. Mobilizing citizen participation in RAP planning and implementation.

4. Reviewing RAP chapters and technical advisory subcommittee reports.

5. Developing a "desired future state" for the Area of Concern.

<u>CAC membership</u>

The CAC established the following membership policy:

- Membership shall remain at 25 persons, including one student from each high school in the AOC.

- Committee members may designate alternatives who will have voting privileges in the absence of the member they are representing.

- Vacancies will be filled by committee consensus.

The 20 to 25 members who have served on the CAC have met intermittently since 1988 to provide advice to WDNR and MDR/MDEQ concerning RAP development and implementation. Since inception, the CAC Committee Chair has been Nancy Douglas; the Committee Vice Chair is Trygve Rhude. Past and present members are:

Bob Angwall	Pamela Malicoat
John Baker	Len Moore
Charles Boyle	Don Neverman
Bob Brisson	Michael Piasecki
Henry Campbell	Edward Poquette
Tom Crowley	Tina Poquette
Anita Doepke	**Trygve Rhude**(2)
Nancy Douglas(1)	George Robbins
Mary Eickman	George Rogers
Martin Holden	Barb Schaal
John Janowitz	Robert Schacht
Bruce Johnson	Ervin Sengstock
Wendel Johnson	Doug Sheraski
Bill Kowalski	Ken Sweet
Thomas Kuber	Jim Van Laanen
Dave Larson	John Wachholz
Rebecca Leighton-Caters	Jill Wiese-Martin
	Gary Whipp
Darryl Leroy	Steve Zander
John Magney	Jeffery Zeratsky

(1) Committee Chair
(2) Committee Vice Chair

Information on RAP process, Great Lakes and local environmental and resource management issues has regularly been disseminated and discussed by CAC members. Guest speakers (from WDNR, MDNR/MDEQ, U.S Environmental Protection Agency, International Joint Commission, U.S. Army Corp of Engineers, Soil Conservation Service (now Natural Resources Conservation Service), Bay Lake Regional Planning Commission) have addressed the CAC and tours of the Area of Concern have familiarized committee members with the issues.

Desired Future State

The Citizens Advisory Committee developed a "desired future state" for the Area of Concern. This served as the basis for goals and objectives identified in the Stage I RAP. Based on the desired future state, the CAC developed and approved the following recommendations. Implementation of the recommendations will require action by one or more state or local agencies, entities or affected parties.

Recommendations

1 Citizens Advisory Committee (CAC) members, in cooperation with other state and local participants and stakeholders, should ensure that the shoreline and aesthetics recommendations (below) developed and approved by CAC are implemented.

Shoreline and Aesthetics

2 The CAC and community organizations, in cooperation with city governments, and public and private interests, should continue to organize annual summer or fall cleanup day(s) to remove litter and debris from the shoreline and to focus attention on the river's many potentials.

3 The City of Marinette should, in cooperation with other public and private sector groups and individuals, complete improvements by 1998 to the following recreational facilities:

a. Red Arrow Park - Continue to improve and maintain existing facilities.

b. Sixth St. Slip - Improve as boat launch area or picnic area, clean up debris, landscape, enhance shoreline, develop boardwalk.

c. Boom Landing - Upgrade boat launch area and connect with proposed riverway nature trail.

d. Government Pier - Work with the COE to provide safe access and pier improvements.

4 The City of Menominee, in cooperation with MDNR and other appropriate public and private sector groups and individuals should:

a. Improve access to Lighthouse Pier.

b. Complete fish-cleaning station at River Park Campground.

c. Maintain Ann Arbor Boat Launch.

d. Continue local support for marina improvements.

e. Continue development of Veterans Memorial Park including Hinkers Dock.

f. Upgrade public facilities at Henes Park.

g. Protect lagoon area west of Interstate 41 Bridge.

5 The Cities of Menominee and Marinette, in cooperation with the Michigan and Wisconsin Departments of Transporation and local Chambers of Commerce, should continue to enhance existing recreational and natural areas through an improved coordinated system of signs, lighting and facility design between Marinette and Menominee.

6 The Cities of Menominee and Marinette should continue to determine, develop and maintain an adequate number of swimming beaches that meet appropriate water quality and safety standards.

7 MDNR, WDNR, Cities of Menominee and Marinette should continue to maintain and improve boat launch facilities.

8 Municipalities, in cooperation with chambers of commerce, private developers, harbor commissions, should continue to encourage marina development where it is environmentally sound.

9 Regional and local planning agencies should continue to encourage resolution of riverfront aesthetics conflicts among commercial uses, industrial uses (i.e., setbacks), wetland preservation and habitat protection and recreational uses.

10 WDNR, MDNR/MDEQ, in cooperation with the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers (COE), environmental and conservation organizations, should continue to protect and enhance wildlife habitat in wetland areas for habitat protection and public enjoyment.

11 The Cities of Menominee and Marinette, States of Michigan and Wisconsin should continue to encourage and fund public acquisition of vacant properties along shoreline when available for enhanced waterfront uses.

12 Property owners should continue to encourage improved aesthetics by planting native vegetation and encouraging appropriate screening (e.g., berm and fencing).

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15 The Cities of Marinette and Menominee, Area Planning Commissions and Chambers of Commerce, in cooperation with local conservation, fishing, hunting, and environmental groups, should continue to promote buffer strips, green spaces, and aesthetics for new development.

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17 The City of Menominee should map existing status of the Menominee shoreline area including transportation routes, land ownership, floodplain, wetland, and recreational areas as part of an updated land use plan.

18 WDNR and MDNR/MDEQ should assess and protect Menominee River islands.

19 Chambers of Commerce and economic development interests should continue to encourage commercial and industrial development where environmentally sound.

Land Use Planning

20 (**Completed**) The Lower Menominee River Remedial Action Plan Citizens Advisory Committee (CAC) should go on record in support of the City of Marinette in using the May 1990 Menominee River Waterfront Plan for long range waterfront planning.

21 (**Completed**) The City of Marinette should remove the bulkhead line designation on city-owned property along the south channel. The CAC recommends that this area be protected and managed as a wildlife habitat area by the Wisconsin Department of Natural Resources. The CAC recognizes that the south shore of the south channel of the Menominee River between the Sixth Street Slip and Ogden Street contains one of the few remaining wetlands in the RAP area of concern (See **Figures C** and **D**).

APPROVED - The Marinette City Council approved a resolution (April 7, 1993) to remove the designated bulkhead line in this area.

22 (**Completed**) The CAC should approve a recommendation to include Green Island as part of the RAP Area of Concern.

Education and Outreach

Education and outreach activities support the ninth objective of the RAP, which is to:

- Promote public attitudes and perceptions of the waterfront as a valuable aesthetic resource.

These activities have included:

- Public meetings.
- Annual community river/bay clean-up days.
- Informational presentations to government agencies, area schools and colleges, environmental and civic organizations.
- Community questionnaire.
- Development and use of a RAP sturgeon logo on all project materials.
- Development and distribution of RAP fliers ("You can help protect our river; here are some tips") at an annual Waterfront Festival.
- Printing and distributing the following RAP fact sheets:

  1. "What is a RAP?"
  2. "Fish and Wildlife in the Area of Concern"
  3. "What are Contaminated Sediments?"

- Statewide RAP newsletter - Approximately 100 area residents were placed on a mailing list to receive the Wisconsin statewide RAP newsletter *Synergy*. (Note: Publication of *Synergy* was suspended in 1995 due to funding constraints.)
- Development and display of a mobile RAP informational display board.
- Development and use of slide presentations.
- Youth educational activities - adopt a stream; environmental field days, wastewater treatment plant tours.
- Stormwater sewer stenciling project.
- Development and distribution of promotional items with RAP logo.
- Development and distribution of annual progress and summary reports.

- Local media coverage (TV, radio, newspaper).
- Use of information booth at annual waterfront festival.
- Development and distribution of 10,000 copies of the household pollution prevention guide, "Simple Solutions to Water Pollution" (Zander, 1995).

Recommendations

23 WDNR, MDNR/MDEQ, Citizen Advisory Committee (CAC) and Technical Advisory Committee (TAC) members, and local stakeholders should continue to monitor and provide leadership for the restoration, protection and management of the environmental quality and resource management initiatives embodied in this plan.

Discussion: Solving complex ecosystem problems is beyond the scope of any single agency or group. It will be necessary to involve stakeholders from the AOC in the RAP implementation. One of the expectations of CAC members is interaction with others involved in the RAP process, as well as other stakeholders and interest groups.

24 WDNR, MDNR/MDEQ and the CAC should continue to provide information to the public through the use of general media (TV, radio, newspaper), brochures and publications, and speaking engagements.

Discussion: Media exposure is a cost-effective and efficient means of updating the public on RAP implementation progress. Local media have been supportive and cooperative in the RAP development process.

25 Michigan and Wisconsin Chambers of Commerce, in cooperation with MDNR/MDEQ, WDNR, regional planning commissions, environmental organizations, local schools and academic institutions should continue to develop information and education programs that will:

a. Promote positive attitudes toward potential benefits and values of the waterfront.

b. Encourage the use of existing recreational, cultural and natural resource areas and waterfront activities.

c. Use a variety of approaches to educate local and state decision makers, area community leaders, and the general public about the Menominee River RAP. Potential funding sources should include the Coastal Management program.

26 WDNR, MDNR/MDEQ, local schools, area academic institutions and Departments of Public Instruction should continue to work with area school administrators and curriculum coordinators to incorporate activities on the river and Great Lakes into school curriculum.

Discussion: Working to see that students in the AOC develop an understanding and appreciation of the River and the Great Lakes can benefit long-term restoration efforts. Future

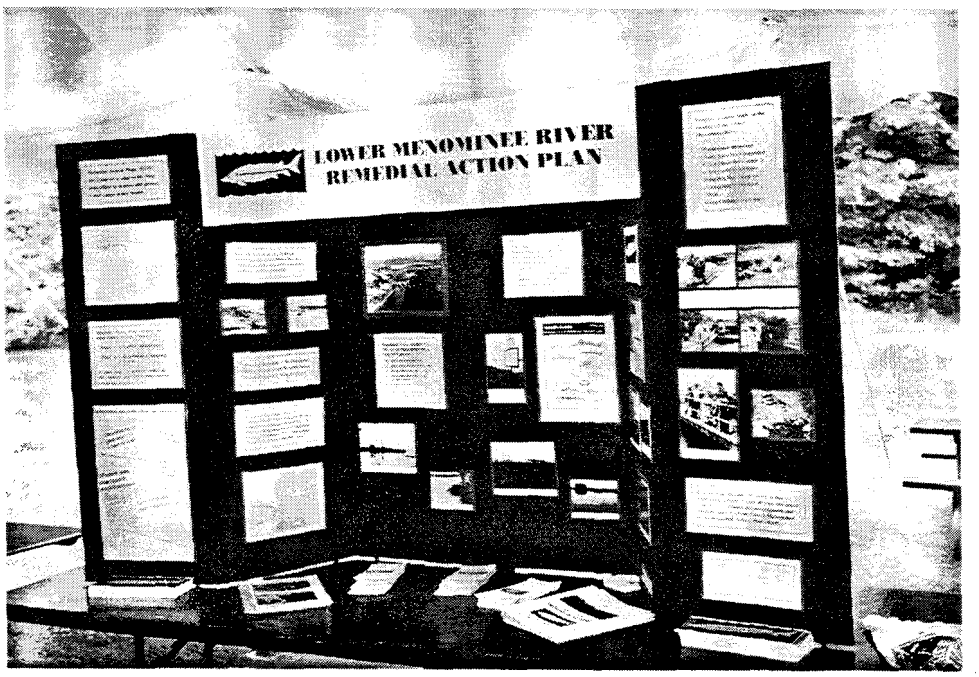
decision makers need to be kept informed of the problems and issues affecting area water resources.

27 Chambers of commerce, civic, conservation and environmental organizations should continue to promote clean-up and rehabilitation activities that encourage individual and group participation (e.g., clean-up days, annual wildlife surveys, clean sweep efforts).

Discussion: If people have the opportunity to participate, they will take ownership and pride in the RAP and associated efforts. Informed and involved citizens will likely support sound management decisions.

28 WDNR and MDNR/MDEQ should continue to monitor and periodically report to local stakeholders on progress of RAP implementation.

Discussion: To continue public involvement and nurture local support, citizens must be informed and updated. The implementation structure must allow for continuing contact and discussion with decision makers.



This mobile RAP display board has assisted with outreach and education efforts throughout the Area of Concern. Developed by Steve Zander, RAP implementation specialist, the display has been used at regional RAP conferences and the annual Menominee Waterfront Festival.

THANK YOU, RAPPERS! (*Special photo feature*)

Dreux Watermolen of the Wisconsin Department of Natural Resources Lake Michigan District unloads one of six truckfulls of trash collected during the third annual River Bay Cleanup Days, October 1992.

Volunteers pick up trash along the shore of the Menominee River, near Menekauknee Harbor. In the foreground are, from the left, Citizens Advisory Committee members and site leaders Dave Larson and Anita Doepke.

During River Bay Cleanup Days, RAP Citizens Advisory Committee Member Bill Kowalski and son Byron tackle the Stephenson Island area of the Menominee River.

Citizens Advisory Committee Chair Nancy Douglas serves pizza to cleanup volunteers at the M & M Yacht Club.

From the left, adults Dick Dubord and Steve Zander guide Menekaunee School fifth-graders through a tour of the Marinette wastewater treatment plant. The field trip was part of "Adopt-A-Class" RAP activities in spring 1993.

Teacher Joy Peterich, center, and the Menekaunee School fifth-graders show off their storm drain stenciling efforts in Marinette. The stenciling was done in spring, 1995.

CHAPTER II: BACKGROUND

DEFINITION OF THE PROBLEMS

This chapter includes information about impaired uses and contamination sites within the AOC. Combined sewer overflows (City of Menominee) and three contamination sites (arsenic, coal tar, paint sludge) are the primary causes of the impaired uses within the AOC; each are part of existing enforcement actions.

Arsenic Contamination

High levels of arsenic contamination continue to be detected on, adjacent to, and downstream of the Ansul Fire Protection Company property in Marinette (See **Figure J**). The contamination is present in soils, sediment, groundwater and surface water in the area. The source was a former herbicide manufacturing facility at the site.

Many of the impaired uses in the Lower Menominee River are totally or partially related to remaining arsenic contamination: dredging restrictions, localized degradation of fish populations and benthos, and loss of fish habitat. A federal RCRA Corrective Action Order on Consent (consent order) with Ansul was issued by EPA in 1990. As part of the RCRA Corrective Action Order, Ansul has submitted three facility investigation proposals to EPA, none of which have been accepted.

EPA became directly involved in the Ansul case in 1984 as a result of statuatory changes in the RCRA program that year. In 1990, EPA, WDNR and Ansul Fire Protection Company entered into an Administrative Order on Consent. The mutual objective of EPA, WDNR and Ansul in entering into this consent order was to protect public health and the environment to the greatest extent possible through the prevention or reduction of the release or migration of hazardous waste or hazardous constituents to the groundwater, surface water, sediment and soils in and around the Ansul facility. This objective would be achieved through the RCRA Facility Investigation and RCRA Corrective Measures Study. (RCRA Facility Investigation, or RFI, and Corrective Action Plan tasks and reporting requirements are listed in Appendix II.)

Ansul submitted a list of the first three facility investigation proposals to EPA on November 28, 1990. EPA returned comments in September 1991, noting that the workplan submitted was "extremely deficient and inadequate." Ansul submitted a revised RFI proposal in 1992. This was also unacceptable to WDNR and EPA.

Implementation of existing enforcement measures under RCRA will determine the final outcome of the Corrective Action Order. This process will establish the long range RAP strategy to restore impaired uses resulting from arsenic contamination.

While arsenic does not appear to biomagnify up the food chain, it does bioaccumulate in exposed fish and aquatic life. Testing by the WDNR in 1989 (surface water above contaminated sediments) and in 1991 (contaminated sediments) indicated toxicity to exposed aquatic test organisms. The toxicity test used for these analyses is the same test procedure that wastewater dischargers are required to pass. Chemical analyses of the river water detected arsenic concentrations of 3,900 ug/l and 18,000 ug/l in

the Turning Basin and Eighth Street slip, respectively. Analyses also revealed arsenic concentrations of 26 ug/l in the water column over sediment in Menedaunee Harbor, located one mile down stream from Ansul. Referring to these test results, Masnado (WDNR, 1990) noted the following:

> *"The observed lethality at the Turning Basin and Eighth Street Slip is alarming. This is especially important with regards to the very immediate response exhibited by both Ceriodaphnia dubia and Daphnia magna If these were effluent samples...whole effluent toxicity limitations would be imposed in their respective permits."*

1990 RCRA Corrective Action Order

High levels of arsenic were still leaching from sediments and groundwater near Ansul in 1988, at concentrations greatly exceeding groundwater and surface water quality standards, according to data submitted Baker Engineering to the U.S. Army Corps of Engineers. In addition, the Corps determined that a portion of the Turning Basin needed navigational dredging (**Figure K**) and that this project would include removing some 40,000 cubic yards of contaminated sediment. Of this total, some 28,900 cubic yards of sediment were estimated to contain arsenic concentrations three times greater than the 278 mg/kg classified by EPA as hazardous waste, or waste deemed to pose a health threat to humans and the environment. Handling this waste is therefore subject to the Federal Resource Conservation and Recovery Act's (RCRA) Corrective Action Program (CAP).

CAP objectives at the Ansul site are to:

- Evaluate the nature and extent of the release of hazardous waste and hazardous constituents to groundwater, surface water, soils and sediment (RCRA Facility Investigation), and gather necessary data to support a Corrective Measures Study (CMS).
- Develop and evaluate a corrective measure alternative or alternatives and recommend final corrective measures. (Corrective Measures Study).
- Design, construct, operate, maintain and monitor performance of the corrective measure or measures selected. (Corrective Measures Implementation).

The following steps will be taken to meet these objectives:

- Locate the source(s) of contaminant release.
- Characterize the nature and extent of contamination, both within the facility boundaries and migrating from the facility. This would include defining the pathways and methods of hazardous waste or constituent migration, including the media, extent, direction, speed and complicating factors influencing movement, concentration profiles, etc.
- Identify areas and populations threatened by releases from the facility.
- Determine short and long term, present and potential threats of releases from the facility on human health and the environment.

- Identify and implement an interim measure or measures to abate the further spread of contaminants, control the source of contamination or otherwise control the releases themselves.

- Evaluate the overall integrity of containment structure and activities at the site intended for long-term containment.

- Identify, develop and implement a corrective measure or measures to prevent and remediate releases of hazardous waste or constituents from the facility.

- Design a program to monitor the implementation, maintenance and performance of any interim or final corrective measure(s) to ensure that human health and the environment are being protected.

Background

Ansul produced arsenic-based herbicides from 1957 to 1977. Processed wastes, including arsenic salts, were stored next to and discharged directly into the river. At one time, an estimated 95,000 tons of waste salt were store on site. In 1966, Ansul had a waste recycling plant constructed to recover the arsenic, but abandoned it a year later. WDNR became involved with the arsenic contamination problem in 1971. Between 1971 and 1981, Ansul and WDNR entered into a series of mutually agreed-upon consent orders. In 1973, WDNR issued a consent decree to Ansul, which had three main provisions - a study, a long-term plan for managing arsenic salt wastes, and the installation of a trench to reduce groundwater flow through the contaminated area. That year, 7,500 tons of arsenic salt wastes were land-filled in Michigan. In 1979, under a modified consent order from WDNR, Ansul installed a groundwater control trench. The trench was designed to limit the movement of arsenic across the site by means of groundwater transport. In 1979, some 890 tons of arsenic salt were estimated to remain in the sand layer. In 1981, Ansul installed a groundwater extraction and treatment system licensed by the Resource Conservation Recovery Act (RCRA). From 1982 to 1986, Ansul treated over 16 million gallons of groundwater and removed 350 tons of elemental arsenic. Ansul was granted permission to halt extraction and treatment of the arsenic in 1986. However, in 1984 the U.S. Environmental Protection Agency (EPA) became directly involved in the Ansul case as a result of a statutory change concerning the federal RCRA program.

Sediment sampling

One hundred sediment samples taken in and below the Turning Basin (1986) contained arsenic levels as high as 1,953 µg/g, with a mean value of 152.83 µg/g. The sediment samples with the highest arsenic concentrations (> 1000 µg/g) were located primarily in 2 to 7 feet of sediment next to the Ansul property. However, arsenic concentrations as high as 1,075 µg/g have been detected 15 feet deep in sediment. Sediment samples taken in 1980 (Anderson 1981) detected arsenic concentrations as high as 399 (µg/g dry weight) between the main channel and the Turning Basin.

Arsenic concentrations in sediments (µg/g) and corresponding concentrations in pore water (µg/l) are listed on the next page (**Table 2**). Each sample exceeded the Wisconsin surface water acute arsenic criteria of 364 µg/l. Speculation based on this study indicated that 45 percent of the pore water was in the inorganic (As III) form.

Table 2: Arsenic concentrations in sediments and pore water (µg/g)

Site	Total Arsenic Concentration in Sediment (µg/g dry wt)	Arsenic Contaminated Pore Water (µg/l)
Turning Basin next to main river channel	24	391
	1,080	
"	135	
"	95	875
"	287	8,934
"	132	1,866
Inner Turning Basin next to Ansul property	171	1,093
Sixth Street Slip	59	506
"	500	39,300
"	32,300	45.6 (g/L)
Composite of Turning Basin excluding Sixth Street Slip	160	2,133

Source: Anderson, 1981

Groundwater

Groundwater flowing underneath the Ansul property toward the river greatly exceeds the Wisconsin groundwater protection standard for arsenic of 50 µg/l (parts per billion), which is also the federal drinking water standard. Groundwater monitoring records from the Ansul property in 1990 detected arsenic concentrations as high as 1,325,000 µg/l or 26,500 times greater than Wisconsin's groundwater protection standard. According to quarterly monitoring reports by Ansul, six monitoring wells with the highest arsenic concentrations in 1989 - 1990 on or adjacent to the Ansul property had an average arsenic concentration of 811,333 µg/l. Data submitted to the Army Corps of Engineers in 1988 (Baker Engineering) indicates that extremely high levels of arsenic are still leaching from sediments and groundwater at concentrations greatly exceeding groundwater and surface water quality standards.

Off-Site Transport of Arsenic

Schmitt and Brumbaugh (1990) identified the Ansul property as the greatest single source of arsenic to Lake Michigan (May and McKinney 1981; Christensen and Chien 1981). According to Schmitt and Brumbaugh declining concentrations noted in fish samples suggest that remedial activities at this site have reduced the flux of arsenic to Lake Michigan. However, these two scientists noted that the 85th percentile for arsenic has not, however, shown any clear trend; after declining from 1976-77 through 1980-81, arsenic concentrations started to increase in 1984.

There are other sources of arsenic in Green Bay, such as power plant emissions and runoff from agriculture areas treated with arsenical pesticides, but these sources are diffuse. Anderson (*et al.* 1978; Menominee-Marinette Sediment Investigation, Prepared for the U.S. Army Corp. of Engineers-Chicago District, Contract #144-K551) discussed possible arsenic sources that may have accounted for observed fluxes found in arsenic concentrations in the Menominee River downstream of the Turning Basin. These sources were:

- Arsenic in groundwater flowing through the Turning Basin sediments.
- The highly contaminated sediments in the Eighth Street Slip area.
- Releases from other Turning Basin sediments, some of which are saturated with arsenic.

Before the 1980s remediation activities Anderson et al. (1978) estimated that the input of arsenic deposited into Green Bay from the Menominee river was approximately 55 tons per year. Furthermore, the calculations indicated that all of the dissolved arsenic entering Green Bay from the Menominee River ends up in bay sediments. Christensen and Chien (1981) estimate that over 20 years, 477 tons of arsenic or 24 tons per year had been added to Green Bay sediments.

Paint Sludge Contamination

Paint sludge removal operations along Green Bay adjacent to the Lloyd Flanders furniture company in Menominee resulted in the excavation of more than 10 million pounds of hazardous waste from the bay (**Figure M**). An additional 20 million pounds of contaminated sediments were removed during this effort. The cleanup, part of an enforcement order issued to the company, was completed in 1995.

A nearby quarry supplied roughly 15,000 cubic yards of rock for the 900-foot dike. A series of membranes and liners were incorporated to hydraulically isolate the encolsed area. The paint sludge contained hazardous levels of lead, as well as high concentrations of other metals and various organic compounds. The waste was transported to a treatment and disposal

facility in Wisconsin. Now that excavation is complete, follow-up monitoring and site restoration activities will occur. In addition, a feasibility study and plan for a final remedy is scheduled for completion in 1996.

In 1992, Lloyd Flanders was ordered by MDNR to investigate and clean up this site. The order required the company to:

- Collect and remove paint sludge, bulk paint wastes and associated deposits from the shoreline and waters of Green Bay.
- Complete an investigation to delineate the nature, extent and impact of soil, sediment, groundwater and surface water contamination throughout the facility.
- Complete a feasibility study that evaluates final cleanup alternatives.
- Submit to MDNR a remedial action plan proposing a final remedy that will address environmental contamination at the site.

Background

In 1983, the Michigan Department of Environmental Quality discovered paint wastes on the property, along the shoreline. Discarded drums of paint sludge were observed in a wooded area along Green Bay and numerous paint sludge nodules were observed along the shoreline. Past waste disposal practices at the site included dumping and emptying drums of paint sludge laden with heavy metals into the bay and along the beach behind the plan site. Investigations identified an area of lake bed, about half an acre is size, that had substantial accumulations of paint sludge. Waste deposits in this area averaged three feet in thickness and typically contained percentage levels of lead, in addition to high concentrations of other metals and organic compounds. Nodules of paint sludge as large as three feet in diameter have washed up on beaches and submerged drums and paint cans have been spotted as far as 350 feet from the shoreline. High concentrations of lead and other heavy metals have been detected in the paint sludge in addition to several organic compounds including naphthalene, xylene, toluene and ethylbenzene.

Public Act 307 of the Michigan Environmental Response Act, as amended, grants MDEQ the authority to issue administrative orders to clean up sites of environmental contamination and provides the attorney general with enforcement authority in the event of noncompliance.

Wave and ice erosion have fragmented and dispersed paint sludge deposits over a large area. In accordance with the MDNR/MDEQ's order, Lloyd Flanders has placed warning signs along the shore and conducts daily patrols to collect washed-up waste.

Coal Tar Contamination (polycyclic aromatic hydrocarbons - PAHs)

One of the primary environmental quality problems in the AOC is coal tar contamination of river sediment adjacent to the Marinette wastewater treatment plant. A coal tar gasification operation at this site from 1900 to 1960 resulted in contamination that is currently being investigated.

As part of the investigation, the Wisconsin Public Service Corporation has proposed a sediment sampling work plan (Natural Resource Technology, Project No: 1033, April 28, 1995) to WDNR to accomplish the following objectives:

- Evaluate the presence or absence of environmental impairment of the sediments associated with the former site.
- Evaluate the characteristics of the river adjacent to the site.
- Evaluate the shoreline outline through time.
- Evaluate other industrial activities along the shoreline upstream and downstream from the site.

The proposal includes sediment sampling along eight transects from 250 feet west of the WWTP outfall to 450 east of the outfall. Transects will extend 200 feet from shore. Between one and four sample core samples are proposed for collection from the area, from the thickest sediments within each transect.

In April 1991, WDNR conducted solid-phase sediment toxicity tests using *Daphnia magna* with sediments collected near the plant's outfall and at several other locations. Acute toxicity was 100 percent (using a 48-hour acute test) at two sites: The Eighth Street Slip mouth (known to be contaminated with high levels of arsenic), and near the wastewater treatment plant's outfall. A chemical analysis of the sediment sample taken near the plant detected PAH compounds at 3,638 µg/g (ppm).

A June 1989 excavation at the Marinette Wastewater Treatment Plant expansion site had uncovered contaminated soil. Soils were tainted with various polycyclic aromatic hydrocarbon (PAH) compounds, which are created through the combustion of coal or petroleum. A coal gasification operation, or manufactured gas plant, was formerly on the site, ceasing its operations in 1960. The excavated soils were not classified as hazardous waste and were dumped in a Michigan (Environs) landfill.

PAHs are benzene-like compounds, some of which are known to induce cancer and cause chromosome damage in humans, often include toxic components that can harm aquatic organisms. Some PAHs are phototoxic (their toxicity to aquatic organisms is enhanced in the presence of sunlight). Elevated PAHs in waterbodies have been associated with liver cancer in

brown bullhead and English sole. U.S. Fish and Wildlife Service findings are consistent with growing evidence linking liver neoplasms in brown bullhead with elevated concentrations of PAH in sediment. PAHs enter the environment from petroleum spills, discharges from coking and creosote operations, atmospheric deposition from combustion or incineration of organic substances, and miscellaneous disposal, such as surface runoff.

Biological effects-based sediment quality guidelines developed by the Ontario Ministry of the Environment (D. Persaud, et al., 1990) indicate that a total PAH concentration of approximately 400 µg/g, is the "severe effect level" for the majority of benthic species. The "severe effect level" is defined as "the level (i.e., concentration level) at which pronounced disturbance of the sediment-dwelling community can be expected. This is the sediment concentration of a compound that would be detrimental to the majority of benthic species." The PAH concentration detected near the Marinette wastewater treatment plant outfall (3,638 µg/g) is nearly nine times greater that the total organic carbon (TOC) normalized "severe effect level" value of 400 µg/g. The average PAH concentration at the other three river sampling sites was 8 µg/g, well below the "severe effect level."

Documentation of contamination near the gas plant and sewage treatment plant has been recorded as far back as 1960 by the State of Wisconsin Committee on Water Pollution in *An Investigational Report On Floating Tars On The Menominee River In Marinette, Wisconsin:*

> *"A ditch, located in this general vicinity, collects wastes from both the gas plant and sewage treatment plant and discharges into the right side of Menominee River as one faces downstream. A short distance below the confluence of the ditch and the river, two sewer outfalls are located which can also carry wastes from the above mentioned sources. Complaints have been received that boats anchored downstream from this general area become coated with a tar like substance...."*
>
> *"...During recent surveys, within the ditch confines, floating tar droplets were numerous and the natural bottom was covered with a very thick and sticky tar-like material. This material extended into the river and downstream at least 200 feet. When the bottom was disturbed, tar bubbles rose to the surface and attached to the survey boat as well as to other pieces of equipment. Floating tar was seen 300 to 350 feet downstream from the ditch entrance."*

IMPAIRED USES

Dredging Restrictions

The U.S Army Corps of Engineers (COE) periodically dredges the Menominee River Harbor for navigational shipping. The dredged sediment has been disposed of in the Michigan waters of Green Bay.

The Turning Basin has not been dredged since 1965 because of sediment contamination. Much of the arsenic-contaminated sediment in the Turning Basin would be classified as a hazardous waste if removed without treatment. Harbor maintenance dredging in the main river channel occurred in 1991. Sediments were disposed of in open water east of the AOC.

Degradation of Fish Populations

Fish populations are believed to have declined in isolated areas of contamination within the AOC, based on habitat loss and alteration and demonstrated with the use of sediment toxicity tests. The effects of contaminants on Lower Menominee River fish would be difficult to quantify and have not been investigated. Consequently, this use is considered impaired only to the extent that contamination sites still exist in the AOC (arsenic, coal tar, paint sludge). This impaired use will be considered restored upon identification and implementation of remedial actions at the identified contamination sites. Degradation of fish populations is not considered an impaired use outside the known contamination sites. The overall fish population in the AOC is considered to be diverse and abundant.

Degradation of Benthos

Several studies have documented degraded communities of bottom-dwelling aquatic organisms (benthos) in and around the Turning Basin. Elevated levels of arsenic, cadmium and mercury were detected in subsequent benthic tissue analyses. Historical data indicate that the benthic population in other parts of the AOC may also be impaired. WDNR staff have initiated systematic collection of additional benthic and substrate data in the AOC, recommended as part of the RAP.

Fish Consumption Advisories

Consumption advisories exist for various fish species in the AOC because of PCB and mercury contamination. These pollutants degrade slowly and bioaccumulate, or build up in larger concentrations in organisms higher up on the food chain. Unlike these pollutants, arsenic does not biomagnify up the food chain and does not result in fish consumption advisories. Existing data indicate that primary sources of these contaminants are from outside the AOC.

In Wisconsin, a PCB advisory includes all tributaries to Green Bay, including the Menominee River, from the mouth of the river to the first dam. Recommendations in the fish advisory are listed by species and length of fish. Because of sampling conducted in the Stage I RAP, certain species of fish are included in a mercury advisory.

In Michigan, a fish consumption advisory exists because of PCB contamination in Green Bay south of Cedar River, which includes the Menominee River downstream of the first dam. Michigan also has an advisory for the Menominee River upstream of the first dam for walleye, redhorse sucker and sturgeon, due to mercury contamination, and for carp, due to PCB, mercury and dioxin contamination.

Loss of Habitat

Loss of fish and wildlife habitat in the AOC has resulted from past lumber and logging activities, urbanization, water fluctuations, waste disposal, and sediment and groundwater contamination.

Wetlands and other fish and wildlife habitats, once common on the river's edge, were largely eliminated by lumber industry practices from the mid-1800s to the early 1900s. Log jams clogged the river and wood chips, bark, and other saw mill wastes were dumped along the shoreline. The river bottom still contains remains of these wastes. The City of Marinette also used the river's edge as a municipal dump site. Many of these waterfront sites were eventually filled to provide land for industrial development.

Total and Partial Body Contact Restrictions

Past fecal coliform bacterial levels exceeding Michigan and Wisconsin water quality standards have occurred in the Lower Menominee River. The City of Menominee is currently under a court order to control all combined sewer overflow discharges by addressing both short-term and long-term conditions specified in the order, including a correction program. The City of Marinette completed a sanitary sewage rehabilitation and combined sewer separation program in 1989 to eliminate sewage bypassing.

Elevated levels of fecal coliform bacteria have been previously detected inside the Menominee Marina. Subsequent monitoring has indicated that the bacteria levels have been reduced to an acceptable level.

STAGE I RAP UPDATES

Clean Water Act Violations

In 1989, the Menominee Paper Company and the EPA reached a settlement concerning violations of the federal Clean Water Act. Past discharges from the Menominee Paper Company have caused disruptions in the city's wastewater treatment plant. The company has since constructed a wastewater treatment system and no longer discharges to the city's facility. Post-construction monitoring and NPDES permit records show that the facility is in

compliance with its limits. The City of Menominee has upgraded its wastewater treatment plant and is implementing a combined sewer overflow correction program as specified in its permit.

Following are updates on Stage I RAP activities. (Corrections to the Stage I RAP appear in *Appendix VI.*)

Harbor And Navigation Channel Dredging

In 1990, the U.S. Army Corps of Engineers began studying whether to improve the commercial navigation channel on the Lower Menominee River. Improvements would include deepening all portions of the commercial navigation channel on the Lower Menominee River by 3 feet. However, the Turning Basin would be excluded, due to arsenic contamination.

The navigation channel totals 2.3 miles, running from the naturally deep Marinette Harbor in Green Bay to the Marinette wastewater treatment plant just below the Hwy 41 bridge. (See **Figure B**). It is divided into three sections by depth: The 0.6-mile entrance channel in Marinette Harbor is maintained at 23 feet; a 1.5-mile section extending upstream to the Turning Basin is maintained at 21 feet (the upper 0.2 miles of this is maintained at 19 feet.); the 6-acre Turning Basin on the south side of the channel is maintained at 21 feet deep.

The Corps began conducting studies in two phases - *reconnaissance*, to define problems and opportunities, and *feasibility*, to formulate and analyze potential solutions with input from federal, state, local and other interests. Reconnaissance studies are federally funded, while feasibility studies must be cost-shared 50/50 with a non-federal sponsor(s). In this case, the City of Menominee, Michigan, considered cosponsorship. Local industry also supported improved navigation facilities. However, past contamination of the Menominee River, specifically in the Turning Basin, heightened concern over potential dredging.

By 1991, the Corps determined that navigation improvements would only be economically feasible if dredged sediments were disposed of in open water. During a reconnaissance phase review conference with interested parties, Corps representatives outlined three critical issues to be addressed before the project could move to feasibility. These issues were safety and ship maneuverability, sediment disposal acceptability and cost, and commodity confirmation.

Both MDNR/MDEQ and WDNR expressed concerns about open water disposal of dredged sediments. Wisconsin does not permit open water disposal of dredged materials in Wisconsin waters. For open water disposal in Michigan waters, it must be demonstrated that contaminants in dredge spoils will not bioaccumulate, that sediment particle size is compatible with sediments at the proposed disposal site, and that fish spawning sites and other aquatic habitat will not be disrupted. Although the Corps classified the sediments as "clean," both states expressed the need for additional assessments. EPA also has expressed concern over open water disposal of dredged materials.

The Corps slated both the ship simulation model study (to be done by its Detroit District) and additional sediment characterization to be part of the feasibility study's first year. The feasibility cost-sharing agreement was sent to the City of Menominee in August 1991, to determine whether Menominee would be willing to split the $958,000 cost. In late 1991, at the city's request, the Corps put the project on hold. Meanwhile, maintenance dredging of the shipping and entrance channels occurred in the summer of 1991. About 22,900 cubic yards of dredged material were disposed of in Michigan waters of Green Bay 2.14 miles east of the Menominee Lighthouse.

Great Lakes Pulp & Fibre Mill

The siting of a new pulp mill (Great Lakes Pulp & Fibre) along the lower Menominee River has renewed interest in improving the navigation channel. The pulp mill will require that a portion of the channel be deepened by 3 feet to accommodate ocean-going vessels.

The City of Menominee has withdrawn its request for the COE sponsored deepening project and has replaced it with a proposal for a smaller, locally funded dredging project. This city has applied for a permit to deepen the main channel of the river from the Menominee Lighthouse to the GLP&F site (west of the K&K Warehouse). Project financing would be handled by the City of Menominee through grant acquisitions. The city would also assume responsibility for future maintenance dredging in the deepened areas. Open water disposal of the dredge spoils, estimated at 90,000 cubic yards, is being considered.

WDNR submitted comments and requested additional information about the proposed project, including additional sediment sampling and analysis. Subsequently, the COE and MDEQ tentatively denied the permit request pending the resolution of disposal site and sediment sampling issues. The city has hired a consulting firm to acquire and analyze additional sediment samples. Processing of the permit request will continue after sediment sampling results are available.

Construction of the pulp mill began in 1995. When completed, the mill will be capable of processing some 750 tons of mixed office waste paper per day into reusable pulp. The $220 million pulp recycling plant, expected to be completed in 1996, should provide about 100 jobs. Company representatives briefed Citizens Advisory Committee members about details of the operation. They also answered questions about environmental quality concerns.

Fisheries

(See *Chapter III, Plans and Studies*)

Fish Tissue Contaminant Data

Mercury is either believed to be elevated in the AOC, due in part to local impoundments. Research indicates that impoundments tend to increase mercury concentrations in the food chain.

In 1993, Wisconsin sampled walleye, smallmouth bass, northern pike and white sucker from the Lower Scott Flowage and downstream to the mouth. Mercury in walleye from Lower Scott Flowage ranged from 0.47 to 1.7 ppm and confirmed the importance of the advisory in place for this stretch of river. PCB and smallmouth bass and walleye from this stretch ranged from < 0.04 to 0.11 ppm. Below Lower Scott Flowage mercury levels in all species were much lower, with levels ranging from 0.03 to 0.48 ppm. PCB concentrations varied widely. Northern pike ranged from 0.18 to 0.4 ppm while walleye ranged from 0.12 to 1.9 ppm. Carp ranged from 0.05 to 2.6, ppm. This is probably due to the migration of fish from the river to the bay of Green Bay.

In 1991, as part of Wisconsin's and Michigan's ongoing contaminant monitoring programs, carp, walleye, and panfish were collected from the AOC. Walleye and carp were also collected and analyzed from the Chalk Hills and White Rapids Flowages. Carp and sturgeon collected in the AOC were analyzed for PCB and dioxins. Walleye and panfish were analyzed for mercury contamination. Walleye from White Rapids and Chalk Hills Flowages showed elevated mercury concentrations with four fish testing over the fish advisory health criteria of 0.5 ppm. Three walleye from Lower Scott Flowage had mercury concentrations from 0.35 to 0.9 ppm while bluegill and rock bass ranged from 0.2 to 0.58 ppm and 0.28 to 0.55 ppm respectively.

In 1990, WDNR fisheries staff collected rock bass and walleye at several sites within the Area of Concern. MDNR/MDEQ staff analyzed the fish. Statistical analysis comparing mercury contaminant levels found in fish from the AOC with fish from upstream of the AOC showed no significant difference in contaminant levels (Belonger, 1991). For additional information see *Chapter III, Other Remedial Actions, Fish Consumption Advisories*. Carp collected in Lower Scott Flowage averaged 0.24 ppm PCB while sturgeon collected at the river mouth averaged PCB concentrations of 2.97 ppm. This value confirmed the advisory that is in place for sturgeon caught in Green Bay and its tributaries up to the first dams.

Fish Consumption Advisories

Wisconsin

WDNR made the following fish consumption advisory changes in the AOC since 1991:

- Fall 1992 - Sturgeon were added to the advisory for the entire Menominee River due to mercury contamination

- Spring 1993 - Sturgeon from Green Bay and tributaries up to the first dam were added to the advisory as banned from consumption because of high PCB levels. Sturgeon are probably exposed to PCBs in Green Bay and not in the tributaries (Amrhein, 1993).

- Spring 1993 - Walleye from the White Rapids Flowage were added to the advisory due to mercury contamination

- Spring 1993 - Rock bass from the Lower Scott Flowage were changed from a "category three" (no one should eat these fish) to a "category two" (woman and children should not eat these fish) due to additional sampling indicating that a 1.2 ppm mercury concentration detected in 1989 was probably an outlier.

Note: Anglers can check fish consumption advisories currently in effect for the area by consulting WDNR publication IE-019-95REV, ***Health Guide for People Who Eat Wisconsin Fish.***

Previous advisories issued by the WDNR for this area include: (1) Pregnant women should not eat more than one meal per month of walleye that are less than 15 inches, and (2) Walleye greater than 15 inches should not be eaten by pregnant women, women who are breast-feeding their infants, women who plan to have children, or children under 15 years old. Others should limit their consumption of large walleyes.

Michigan

Fish consumption advisories issued by the State of Michigan for the AOC, as part of the Lake Michigan Watershed, include the following:

Green Bay, including the Menominee River from the mouth to the first dam (PCB advisory before 1993)

- Restricted consumption (no more than one meal per week) of splake up to 16 inches for nursing mothers, pregnant women, women who intend to have children and children under 15.

- No consumption is recommended for any of the following fish: Rainbow trout over 22 ", chinook over 25", brown trout over 15", splake over 16", northern pike over 28", walleye over 20", and all white bass, sturgeon and carp. Consumption advisories for Sturgeon were added after 1991 due to elevated levels of PCBs.

The Menominee River upstream of the first dam (Spring of 1993)

- Mercury advisory:

  Restricted consumption of walleye, redhorse sucker over 17", sturgeon, and carp under 30" for nursing mothers, pregnant women, women who intend to have children and children under 15.

- Dioxin advisory:

  No consumption of carp over 30 inches is recommended.

Fish Contaminant Studies

The U.S. Fish and Wildlife Service (USFWS) completed a tumor and contaminant study in 1991. The study was *not* intended to correlate whole body burdens for specific contaminants to incidence of tumors in walleyes and bullheads as stated in the Stage I RAP. Rather, the objectives were to: 1) better define the extent of liver neoplasia in a benthic and a pelagic species widely distributed in the Great Lakes watershed, and to 2) test the association of neoplasms with different classes of toxicants by choosing study areas with different classes of known contaminants (Baumann et al., 1991). No correlations were made.

Study results showed that polychlorinated aromatics were highest in Fox and Menominee bullheads at five locations sampled. Bullheads from the Fox and Menominee Rivers had the highest concentrations of polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), and non-ortho polychlorinated biphenyls (PCB). Arsenic concentrations in sediment were significantly higher in the Menominee River than at other locations (175 µg/g dry weight in the Menominee compared to 4, 9, 14, & 21 µg/g dry weight in other sites, USFWS, 1991). Brown bullheads in the Menominee River had three to five times more arsenic in their tissues (average: 160 ng/g wet weight) than did bullheads from other sites (averages: 30, 40, 50 ng/g wet weight), (Baumann et al., Canada J. Fish. Aquat. Sci., Vol. 48, 1991).

No liver neoplasms were found in bullheads from the Menominee River, and only two walleye from the Menominee River had areas of hepatocellular alteration. The frequency of these lesions was low. Although this does not rule out the possibility of carcinogenic effects on bullheads by these compounds, it indicates that these organochlorines and arsenic are not a primary cause of precancerous growths in bullheads. (Baumann et al., Canada J. Fish. Aquat. Sci., Vol. 48, 1991).

Waterfowl Tissue Analyses

As indicated in the Stage I RAP (p. 54), some of the data on contaminants in waterfowl were unavailable at the time of publication. Results for waterfowl were not presented in Stage I Appendix IV.5 as indicated on p. 74. The analyses have been completed and results are presented below. Only one goldeneye (not two as indicated on p. 54) was collected. Additionally, a lesser scaup was collected.

Including the five mallards discussed in the Stage I RAP, waterfowl analyzed for PCB and mercury levels consisted of 10 mallards believed to be Menominee River residents and collected in 1988 and 1989; three transient mergansers, one transient lesser scaup, and one transient goldeneye collected in 1989 at Red Arrow Park. Skin-on muscle tissues were analyzed for contaminants. Results are presented in **Table 3.**

Table 3: Contaminants in Waterfowl from the Lower Menominee River AOC (based on skin-on muscle samples)

	PCBs (ppm)	PCB(ppm / % fat)	Mercury (ppm)
Red Arrow Park (1989)			
Common merganser	0.24	2.89	0.95
Common merganser	0.33	4.46	0.42
Common merganser	0.24	2.73	0.13
Goldeneye	< 0.20	<1.43	0.29
Lesser scaup	0.21	6.77	0.08
Menominee River			
Mallard (1988)	0.46	4.18	< 0.03
Mallard (1988)	< 0.20	<3.23	0.06
Mallard (1988)	< 0.20	<4.08	0.06
Mallard (1988)	0.21	2.39	< 0.03
Mallard (1988)	0.37	8.22	< 0.03
Mallard (1989)	0.22	1.00	< 0.03
Mallard (1989)	< 0.20	0.95	unknown
Mallard (1989)	< 0.20	<1.18	< 0.03
Mallard (1989)	0.59	2.68	< 0.03
Mallard (1989)	0.25	1.09	< 0.03

Mercury Concentrations

Mercury is a naturally occurring metallic element that is found in very low levels in air and water; it is also found in rocks, soil, plant, and animal matter. Mercury was widely used by industry as a slimicide. Inorganic mercury attaches to small sediment particles, where microorganisms convert it to methyl (organic) mercury. Organisms that ingest methyl mercury rapidly absorb it. Older, predatory animals or fish have higher mercury levels than do herbivores or omnivores. The state and federal mercury standard for commercial fish is 1.0 parts per million (ppm); the state standard for mercury in sport fish is 0.5 ppm.

Mercury levels in the transient duck species from Red Arrow Park ranged from 0.08 ppm to 0.95 ppm. Mercury concentrations in mallards from the Menominee River ranged from < than 0.03 to 0.06. The U.S. Food and Drug Administration (FDA) does not have an action level for *total* mercury in poultry, however, the FDA action level for *methyl mercury* in poultry is 0.1 ppm. Research on the chemical form of mercury in edible fish and marine invertebrate tissue indicates that virtually all (>95%) of the mercury present is monomethylmercury (Bloom, 1992). Consistent with this research, WDNR staff assume that total mercury in fish and wildlife is all in the more toxic methyl mercury form.

Results from 1989 duck tissue analyses indicated that all three samples of the fish-eating transient merganser species exceeded the FDA action level of 0.1 ppm for methyl mercury in poultry. The mean concentration of mercury in the five samples is .374 ppm, nearly four times the acceptable FDA level. However, these mercury concentrations may be common for mergansers sampled in Wisconsin. Wildlife contaminant monitoring in Wisconsin in 1984 (Sawyer and Oneida Counties) detected comparable mercury concentrations in mergansers (mean concentration of .63 ppm) than those analyzed in the Area of Concern. These values exceed acceptable FDA levels and warrant further assessment by WDNR and MDNR. The more resident mallards with a diet of less than 10 percent aquatic invertebrates and no fish showed mercury concentrations well below the FDA poultry consumption advisory level. Seven of nine samples had a mercury concentration below .03 ppm.

PCB Concentrations

PCB levels in the mallards ranged from less than 0.2 to 0.59 ppm. Transient mergansers, scaup and goldeneye had PCB levels from less than 0.02 to 0.33 ppm. The FDA "tolerance level" for PCBs in poultry is 3 ppm calculated on a fat basis (ppm fat basis = ppm wet weight x 100% / % fat). A health advisory has been issued for mallards from the Lower Fox River and extreme southern end of Green Bay, but not for the Menominee River. On a fat basis, only one of the five mallards collected in 1988 exceeded 3 ppm PCBs (8.22 ppm), which brought the mean value for the five ducks to 3.69 ppm. The five mallards collected in 1989 had a mean concentration of 1.17 ppm with a maximum concentration of 2.68 ppm. The transient ducks collected in 1989 had highly variable PCB concentrations on a fat basis. The common goldeneye had 0.71 ppm, while the three mergansers averaged 3.36 ppm and the lesser scaup had 6.77 ppm PCBs.

The Green Bay Mass Balance Study

In 1990, the EPA, WDNR, University of Wisconsin Sea Grant Institute and other agencies joined efforts in a multi-million dollar project to quantify the inputs, outputs and movements of four types of toxic substances and to predict their fate in the Green Bay ecosystem. Results from this study are guiding efforts to eliminate toxic effects in this and other large ecosystems.

The study found that, after leaving the Fox River, PCBs become widely distributed in Green Bay. The resulting sediment concentrations of PCBs, while lower than in the Fox, still provide a detrimental source of toxins that move up the food chain. In-place pollutants, especially in the Fox River, are seen as a major source of the overall problem. A three-phased computer modeling effort included the lower Fox River, contaminant transport, and food chain models for the Bay. The computer modeling effort allows for a better understanding of the relative loading, or input rates from various pollutant sources and allows for projection of the ultimate fate of the contaminants.

The four pollutants of concern assessed in the Green Bay/Fox River ecosystem were congener specific PCBs, dieldrin, lead, and cadmium. WDNR conducted extensive monitoring of pollutant loads to the bay and river from 1988 to 1990. This monitoring included point and nonpoint sources, groundwater sources such as landfills, the major tributaries (including the Menominee River), and the sediments and water column of the Fox River. Extensive samples of fish were collected from Green Bay. Water column samples were taken from Green Bay and the Lower Fox River. Physical and chemical models have been coupled with a food chain model to estimate body burdens in the target fish species of carp, brown trout and walleye. The integrated model has been used to predict concentrations in the water, sediment and biota in response to differing regulatory and remedial action scenarios.

WDNR staff have calculated PCB inputs to the Fox River from point and nonpoint sources. The extent and location of PCB deposits in Fox sediments have been mapped, and the modeled transport of PCBs for various periods of time and flow conditions has been determined. Tributary load data for the Menominee River are included in Chapter III of this report. Modeling projections are now available to assist in implementing future environmental quality and resource management decisions.

Water Quality Conditions

Additional water sampling data from within the AOC have been analyzed. These data are very similar to those reported in the Stage I report. **Table 4** summarizes data for several parameters of concern. As in Stage I, half the limit of detection was used in calculations. Results for several of the parameters are as follows:

- *Total lead:* The current concentration of lead in the Menominee River is about 1 µg/L, much lower than previous findings. Previous high levels may have resulted from a one-time event (e.g., floodwater from urban runoff) or from sampling or lab errors.

- *Total cyanide and hexavalent chromium:* The water quality criteria for these parameters are below levels of detection.

- *Total copper:* Copper concentration exceeded established criteria at the Upper Scott Flowage, but appears to be at background level.

- *Total mercury:* The seven detections of mercury at the Upper Scott Flowage averaged slightly below the Interntational Joint Commission (IJC) criteria of 0.2 µg/L. The levels were consistent with those found in area fish, however, quality assurance/quality control for field sampling methodology and laboratory analysis techniques for mercury have recently come under scrutiny. These data should be interpreted cautiously. There is also some indication that mercury concentrations may be elevated throughout the entire Menominee Basin, presumably from atmospheric deposition or from naturally occurring background concentrations. More data should be collected and analyzed from the Upper and Lower Scott Flowages, as well as from areas above the AOC.

- *Dissolved oxygen:* Dissolved oxygen levels recorded in the south channel of the river by WDNR in 1993 were in an acceptable or normal range.

- *Phosphorus:* Excessive phosphorus levels have *not* been identified as a problem in the Lower Menominee River. However, phosphorus has been identified as a priority pollutant in the Great Lakes basin, and Wisconsin is implementing a new state phosphorus control program (Chapter NR 217, Wis. Adm. Code) for municipal wastewater dischargers.

Chapter NR 217, Wisconsin Administrative Code, establishes effluent standards for phosphorus in wastewater discharged to surface waters. The rule is designed to control phosphorus discharges from the largest mass phosphorous dischargers in the state. It will affect approximately 35 to 40 percent of municipal and industrial permittees dischargers. This cutoff is based on the phosphorus removal experience with municipal wastewater sources. It translates into requirements that will affect municipal wastewater treatment facilities discharging wastewater containing more than 150 pounds of phosphorus per month and industries discharging wastewater containing more than 60 pounds of phosphorus per month. These dischargers would be required to meet a 1 mg/L effluent standard, which would be imposed through the WPDES permitting process. The rule allows for alternative effluent limitations to the 1 mg/L effluent standard in certain cases.

Table 4: Summary of water quality data

Parameter	MacAllister Gaging Sta. 1981-1986	Upper Scott Flowage 1989	Hattie St./ 26th. St. 1986-1991	River Mouth 1988-1990	Criteria/ Standards
Lab Ph (S.U.)		8.2 (7)[1]	8.0 (60)	8.1 (73)	6.5-9.0
Total Phosphorus (mg/L)	0.025 (34)	0.017 (7)	0.023 (60)	0.027 (64)	
Total Ammonia (mg/L)	0.04 (6)		0.03 (59)		0.02 (IJC)
Total Chloride (mg/L)		13.6 (7)	10.0 (60)	12.6 (70)	
Total Cyanide (µg/L)		<10.0 (7)	1.0 (5)	<10.0 (6)	5.2 (MI)
Total Arsenic (µg/L)	1.6 (7)	<10.0 (7)	1.0 (2)	<10.0 (6)	50.0 (IJC)
Total Cadmium (µg/L)	1.6 (7)	0.12 (6)	<0.2 (60)		0.2 (IJC)
Hexavalent Chromium (µg/L)		<20.0 (6)		<20.0 (5)	3.0 (MI)
Total Chromium (µg/L)		<3.0 (6)	<1.0 (14)[2]	<3.0 (6)	50.0 (IJC)
Total Rec. Chromium (µg/L)	11.0 (7)	<3.0 (1)			3.0 (IJC)
Total Copper (µg/L)		9.8 (6)	2.4 (60)	3.4 (10)	5.0 (IJC)
Total Iron (µg/L)		0.136 (5)	254.0 (11)		300.0 (IJC)
Total Lead (µg/L)		1.9 (6)	4.8 (60)[3]	0.15 (5)	25.0 (IJC)
Total Rec. Lead (µg/L)	2.6 (7)	<3.0 (1)			3.8 (MI)
Total Mercury (µg/L)		0.17 (7)	<0.5 (6)	0.02 (4)	0.2 (IJC)
Total Nickel (µg/L)		<10.0 (1)	<2.0 (15)[2]	<10.0 (6)	25.0 (IJC)
Total Selenium (µg/L)		<5.0 (1)		<5.0 (1)	10.0 (IJC)
Total Rec. Selenium (µg/L)	<1.0 (7)	<5.0 (6)			7.1 (WI)
Total Rec. Silver (µg/L)	<1.0 (7)	<0.5 (6)		0.3 (5)	0.1 (MI)
Total Zinc (µg/L)		7.2 (4)	14.0 (60)	<10.0 (1)	30.0 (IJC)

1. Number in parenthesis is the number of samples, which mean is based on.

2. During the past five years, more analyses for chromium and nickel were done than are indicated, but the L.O.D. was reduced and all recent analyses were below the L.O.D. Therefore, these data were felt to better represent concentrations in the river.

3. Removing one out-lying data point of 130 (µg/L) leaves an average lead concentration of 2.6 (µg/L).

Upper Green Bay Areawide Water Quality Management Plan

An update to the *Upper Green Bay Areawide Water Quality Management Plan*, including the Menominee River Basin, was completed in 1992. The plan includes actions the WDNR, industries, communities, counties and other agencies should take through 1997 and beyond to protect and improve water quality in the Upper Green Bay basin. The plan's goals are to:

- Identify water quality problems to set management priorities, and to provide guidance for specific lake and stream management activities.
- Guide and direct public management agencies, state and federal agencies, and local units of government in their efforts to protect and improve Wisconsin's water resources.
- Ensure appropriate water quality objectives and standards for significant or affected water bodies in the basin.
- Anticipate management activities necessary for water quality protection.
- Integrate and coordinate WDNR programs for managing both surface and groundwater resources in Wisconsin.

Marinette Sewer By-Passing Correction Program

Marinette's wastewater treatment plant and collection system was upgraded in 1990 and now complies with current state and federal regulations. The city separated its previously combined sewer system and installed 6.2 miles of sanitary sewer and 6.5 miles of storm sewer in the process. The sanitary sewer is polyvinyl chloride pipe and ranges from 8 to 27 inches in diameter. The storm sewer is concrete pipe and ranges from 12 to 27 inches in diameter. **Figure H** shows the locations of new lines (the darker lines on the map).

Major additions to the wastewater treatment plant included: a headwork building, a splinter box at the primary clarifiers, two primary clarifiers (85 feet in diameter), one of four cells in the aeration tank, two of four final clarifiers, an ultraviolet disinfection system, an effluent line, an outfall structure, two sludge digesters, a sludge storage tank and a new sludge spreading vehicle. Since the upgrade, spring rains have not caused basement backups or by-passing. Similar rains before the improvements would have caused by-passing (Mann 1991).

While installing sewers, the city also rehabilitated existing ones and replaced or repaired deteriorated and leaking manholes. In addition, three pumping stations were upgraded to increase capacity and the Marinette water utility replaced more than a mile of water main.

Menominee Combined Sewer Overflow Elimination/Correction Program

Since 1990, the City of Menominee has been under a U.S. EPA mandate to correct wastewater treatment problems including wastewater bypassing, which is the discharge of untreated sewage due to heavy rains or rapid snow melts.

Phase I of the corrective action plan was completed in summer 1992 when a major section of the sewer system servicing Thirteenth Street was upgraded (See **Figure L**). Phase II of the plan includes sewer system improvements that will eliminate the use of combined sewer overflow pipe No.2. During 1993, the City of Menominee installed almost 13 miles of new sewer pipe to separate the storm and sanitary sewer systems above outfall No. 2.

Progress reports must be submitted to MDEQ by November 1, 1995, and provide details of progress completed since the beginning of Phase 2 construction. Phase 2 of the plan must be completed and in operation by November 30, 1996. After that date, no discharge of combined sewage will be permitted from outfall No. 2 (except in accordance with the by-passing or accidental loss provision of the facility's NPDES permit).

Sediment Quality

Extremely high concentrations of arsenic were detected in sediment samples from two WDNR studies in 1992. In one study, sediment samples from six sites in the lower segment of the Menominee River were collected (**Figure I**). The Wisconsin State Lab of Hygiene analyzed the samples for seven metals (**Table 5**). Organics and particle size information for these samples are available through WDNR.

Table 5: Menominee River Sediment Sampling, 1992 (all values in mg/kg)

Sample Location	Arsenic	Cd	Cu	Hg	Ni	Pb	Zn
South Channel: at Ogden St. Bridge	3.96	<1.0	4.0	ND	<5	<5.0	23.0
S. Channel: mid-channel	169.0	4.0	47.0	0.8	15.0	56.0	190.0
S. Channel: west end	30.7	<1.0	5.0	0.14	5.0	5.0	33.0
Sixth St. Slip	287.0	<1.0	54.0	0.86	13.0	91.0	270.0
Sixth St. Slip	252.0	2.0	53.0	0.65	16.0	88.0	230.0
Main Channel at Menominee Paper	7.73	<1	11.0	0.11	<5	8.0	36.0

Amounts at or above the following severe biological effect levels for metals in sediment would likely cause a pronounced disturbance of the sediment-dwelling community (Ontario Provincial Sediment Quality Guidelines, Persaud et al., 1990):

Arsenic (As)	33
Cadmium (Cd)	10
Copper (Cu)	110
Lead (Pb)	250
Mercury (Hg)	2
Nickel (Ni)	90
Zinc (Zn)	820

The second study was a followup to a 1989 sediment water toxicity test in the Eighth Street Slip. Results showed complete mortality of the aquatic test organism *Daphnia magna* and significant reductions in growth and weight of the *Chironomus tentans*. Observations from the bioaccumulation assays using fathead minnows also suggested sediment toxicity. Minnows placed over sediment from the Eighth Street Slip sustained the highest mortality during the test (20%), exhibited sediment avoidance behavior and became relatively inactive compared to fish in other tanks (Smith, et al., 1992).

Acute toxicity (100%) was also evident from sediment samples taken near the Marinette wastewater treatment plant. Chemical sediment analysis from this site detected extremely high levels of PAH compounds (3,638 µg/g). For additional information see *Chapter II - Background, Coal Tar Contamination.* Bioassay and chemical analyses from this survey may be obtained from WDNR.

In 1993, 13 miles of new sewer pipe were installed as part of a sewer separation project in Menominee. (Sewer bypassing was also completed in Marinette.) Installation of the pipe eliminated a major combined sewer overflow problem in the area.

CHAPTER III: ENVIRONMENTAL QUALITY

This section provides supporting information on the recommendations listed at the beginning of this plan.

IMPAIRED USES

Degradation of Benthos

Recommendation

29 Ansul Fire Protection Company (as part of RCRA Consent Order signed with EPA and WDNR), WDNR (and responsible party at coal tar contamination site), and MDEQ and Lloyd Flanders should conduct site-specific benthic surveys (diversity and density) at several control sites and in areas known to be contaminated with high concentrations of arsenic (Turning Basin, the Sixth and Eighth Street Slips, south channel of river), coal tar (Boom Landing), and paint sludge (Green Bay shoreline adjacent to Lloyd Flanders Company).

Existing Activities Related to this Action

Existing benthic and sediment assessment information as well as new data to be collected.

Expected Benefits

The benthic and sediment information generated within the Area of Concern will assist (1) in the restoration and protection of an aquatic ecosystem presently contaminated, and (2) with trend monitoring. Specifically with:

- Monitoring compliance with surface and groundwater quality standards.

- Eliminating toxicity of contaminated sediment.

Rationale for Selection

Soil, groundwater, sediment, and surface water samples on and adjacent to Ansul property still contain high levels of arsenic. Degradation of the benthos from arsenic, coal tar and paint sludge contamination is an impaired use in the Lower Menominee River AOC, based on toxicity tests, previous benthic survey data, and contamination of benthic habitat, all explained in the Stage I RAP.

Bulk chemical analyses and toxicity bioassays can reveal whether there is a specific chemical pollutant problem or inherent toxicity to lab test organisms. However, the tests do not always reveal more subtle and sometimes more significant impact the ecosystem is enduring. Benthic or macroinvertebrate community assessment is a monitoring tool that can help close this gap by directly measuring the ecological impact on the benthic community, which can have subsequent effects on the whole aquatic-dependent ecosystem. Synergistic effects from low level contaminants or other anthropogenic activities can thus be unveiled even if they fail to become evident in bulk chemistry analyses or toxicity tests.

Estimated Cost and Funding Source(s)

Unknown.

Evidence of Commitment

Ansul signed a RCRA Consent Order with EPA and WDNR on September 28, 1990 to "protect public health and the environment to the greatest extent necessary through the prevention or reduction of the release or migration of hazardous waste or hazardous constituents to the groundwater, surface water, sediment and soils in and around the Ansul facility" (See Chapter VII).

Enforcement activities are taking place under the direction of WDNR and MDEQ at the coal tar and paint sludge contamination sites. WDNR has collected and recently analyzed benthic data from the coal tar contamination site.

Implementation Steps and Schedule

Dependent upon on ongoing enforcement and remediation activities.

Relative Priority

High

RAP Goals and Objectives Addressed (See Summary)

Goals: A, B
Objectives: 1, 3, 5, 7, 11, 15, 17

Restrictions on Dredging Activities

Turning Basin

As described in the Stage I RAP, dredging in the Turning Basin has not taken place since 1965 primarily because of arsenic contamination , which is being addressed in the RCRA enforcement. (Additional information and recommendations concerning sediment assessment, disposal, and the harbor deepening project are addressed under *Sediment Quality*, later in this chapter.

Degraded Fish Habitat

Recommendation

30 (**Completed**) The CAC should encourage the City of Marinette to remove the designation of the bulkhead line on city-owned property along the south channel. The CAC recommends that this area be protected and managed as a wildlife habitat area by the Wisconsin Department of Natural Resources. The CAC recognizes that the south shore of the south channel of the Menominee River between the Sixth Street Slip and Ogden Street contains one of the few remaining wetlands in the RAP area of concern (See **Figures C** and **D**).

Expected Benefits

- Protection of fish and aquatic life habitat.
- Protection of water quality from erosion and pollution that could potentially be associated with industrial or commercial development of the site.

Rationale for Selection

As described in Stage I, the City of Marinette obtained a bulkhead line in 1963 along the south shore of the south channel of the Menominee River between Sixth and Ogden Streets. Bulkhead lines allow filling between the designated line and the natural shoreline. The city's intention was to use the area behind the bulkhead line as a disposal site for fill obtained from dredging of the river channel by the U.S. Army Corps of Engineers and from excavation sites in the city. Once filled, the land would be sold as sites for industries requiring water access. The city did not apply for a lease in 1963, and no further action was taken on this proposal until 1973 when the city and the Waupaca Foundry (Division of Midwest Metalcast) renewed efforts to have the bulkhead line approved and a lease completed. Information reviewed to

date indicates that no lease was issued in 1973, and the status of the bulkhead line is the same today as it was in 1963.

Estimated Cost and Funding Source(s)

Nominal costs are anticipated.

Evidence of Commitment

- Development of (1) Marinette comprehensive (land use) plan (2) Menominee River Waterfront Plan (3) sewer service area plan. Each of these plans recognizes this area as an environmental corridor.
- Community involvement in the development and implementation of the Remedial Action Plan.

Implementation Steps and Schedule

- Development of brief issue paper.
- Briefing of city officials (mayor, planner(s), appropriate city council committees/members).
- Presentation to city council with resolution to remove the bulkhead line designation.

Relative Priority

Medium.

RAP Goals and Objectives Addressed

Goals: A, B, C
Objectives: 7, 9, 11,

Fish Consumption Advisories

Mercury

Recent fish tissue data analyzed for mercury indicates that the concentrations in fish from the Area of Concern might *not* be significantly different from mercury concentrations in fish sampled above the AOC. Fish samples throughout the Menominee River Basin appear to be elevated in mercury. Nevertheless, concentrations in some of the fish sampled in the AOC exceeded the Michigan and Wisconsin fish consumption advisory levels. Additional rock bass collected and analyzed from the AOC have had lower mercury detection levels than the 1.2 ppm sample collected in 1989. Subsequently, a less stringent consumption advisory has been issued for rock bass in the AOC.

PCBs

The mean PCB (total) value of 46 water column samples taken in the Lower Menominee River (1988 and 1990) was 1.2 ng/L (parts per trillion). Summary data of annual PCB loads of major tributaries entering Green Bay is listed in **Table 6.** This data was generated factoring PCB concentrations and flows of each tributary.

Table 6: Summary data of annual PCB loads of major tributaries entering Green Bay, 1990

Tributary	Annual PCB Load (grams per year)	Range of PCB concentrations (ng/L)	Average Flow (cubic ft./sec.)
Fox (mouth- Green Bay)	227,300	5 - 150	3,904
Fox (DePere)	158,757	5 - 115	3,904
Menominee	4,794	1 - 9	2,577
Peshtigo	2,390	1 - 19	746
Oconto	1,417	1 - 7	623
Escanaba	1,387	1 - 11	807

Source: US Geological Survey, Open File Report 93-132

Total And Partial Body Contact Restrictions

As described in *Chapter II, Stage I RAP Updates*, bacterial levels in the Menominee Marina are no longer considered to be a problem. Elevated levels of bacteria associated with combined sewer overflows in the city of Menominee remain as a potential pollutant source.

Combined sewer overflows in the City of Menominee are being corrected as part of an EPA consent agreement with the City. Water quality from the largest CSO (outfall #2), was monitored in 1994, after construction was completed in 1993. All construction and monitoring activities related to the separation of combined sewer overflows are required to be completed in 1996.

Phase I of the corrective action plan to eliminate CSO's in the Menominee River was completed during summer 1992 when a major section of the sewer system servicing Thirteenth Street was upgraded (See **Figure L**). Phase II of the plan includes sewer system improvements that will eliminate the use of combined sewer overflow pipe No.2. During 1993, the City of Menominee installed almost 13 miles of new sewer pipe to separate the storm and sanitary sewer systems above outfall No. 2.

Since 1990, the City of Menominee has been under a U.S. EPA mandate to correct wastewater treatment problems including wastewater bypassing, which is the discharge of untreated sewage due to heavy rains or rapid snow melts.

Recommendation

31 MDEQ should conduct selective water quality monitoring for *Escherichia coli* (*E. coli*) until all combined sewers in the City of Menominee are eliminated.

Existing Activities Related to this Action

Stormwater monitoring requirements for the City of Marinette will begin in 1996.

Expected Benefits

- Improvement of water quality.
- Elimination of total and partial body contact restrictions.

Rationale for Selection

Monitoring for *E. coli* in selected areas of the AOC will ensure that water quality contamination is no longer a problem. Elevated fecal coliform counts were identified as the cause of an impaired use (total and partial body contact restrictions) in the Stage I RAP. Trend monitoring is necessary for public health protection and to continue assessing water quality conditions.

Estimated Cost and Funding Source(s)

Nominal.

Evidence of Commitment

Compliance by City of Menominee with EPA consent agreement for corrective action on combined sewer overflow/wet weather discharges.

Implementation Steps and Schedule

To be determined.

Relative Priority

Medium.

RAP Goals and Objectives Addressed

Goals: A, C
Objectives: 16

WATER QUALITY

Dissolved Oxygen

Recommendation

32 WDNR and MDEQ should use continuous meters to monitor dissolved oxygen (DO) levels below the Upper and Lower Scott Paper Co. dams and near the Menekaunee Bridge during June through September. Flow data should be analyzed in conjunction with DO data to examine how DO levels are affected by river flows.

Existing Activities Related to this Action

WDNR and MDEQ water quality monitoring activities.

Expected Benefits

Maintain fish biodiversity.

Rationale for Selection

Adequate DO levels are critical to protecting fish and other aquatic life, especially during low river flows. Preliminary data collected on the south channel of the river indicates that DO levels are adequate.

Estimated Cost and Funding Source(s)

Minimal.

Evidence of Commitment

Inclusion of recommendation in the *Upper Green Bay Areawide Water Quality Management Plan.*

Implementation Steps and Schedule

Not determined.

Relative Priority

Medium.

RAP Goals and Objectives Addressed

Goals: A, B
Objectives: 5, 6, 11

Urban Polluted runoff

Recommendation

33 WDNR, MDEQ and the cities of Marinette and Menominee should sample storm sewers in the AOC to assess the concentration and loading contributions of urban polluted runoff to the river and bay during storms. All remaining combined sewer overflows in the City of Menominee should be eliminated. (Note: Starting in 1996 Wisconsin statutes will require the City of Marinette to monitor stormwater as part of statewide stormwater management permit requirements.)

The following parameters should be included in the analysis of stormwater samples:

Bacteria:	*E. coli* or current indicator species.
Metals (total (and dissolved):	lead, copper, zinc, cadmium, iron, mercury, nickel and cyanide.
Nutrients:	total phosphorus, dissolved phosphorus, nitrogen series (TKN, NH_3-N, NO_2-N, NO_3-N).
Water Chemistry:	dissolved solids, dissolved oxygen, total suspended solids.
Oil & Grease:	(and/or total petroleum hydrocarbons).

A more detailed proposal to implement this recommendation is included in Stage I Appendix V.2.

Existing Activities Related to this Action

Implementation of consent decree issued by EPA with the City of Menominee and conditions in the city's NPDES permit to correct combined sewer overflows.

Expected Benefits

- Assessment of urban NPS contaminants entering the river and bay.
- Enhancement of water quality trend monitoring database.
- Improved water quality through elimination of CSOs.

Rationale for Selection

Runoff from cities and farms has been recognized as a large source of pollution to the Great Lakes and to coastal waters nationwide. EPA data reveals that polluted runoff is responsible for approximately 76 percent of the pollution loadings to the nation's lakes, 65 percent to rivers and streams, and 45 percent to coastal bays and estuaries (Munson, Conklin 1990). Studies have confirmed that runoff from urban areas contains a variety of contaminants. These contaminants are washed into the aquatic ecosystem via stormwater discharges and combined sewer overflows. They impact not only the immediate receiving water but, because of their persistence, they can contribute to a lakewide contaminant burden (IJC, 1987).

Combined sewer overflows (CSOs) are intermittent, short-term discharges that occur during wet weather. Acute toxicity is more of a concern than chronic toxicity for these discharges. During very heavy storms (once or twice a year), CSO outfalls will continue to discharge a mix of residential and industrial wastewater and stormwater. The quality of this combined sewage is subject to extreme changes for any one outfall, depending on waste strength in the sanitary system during a storm, the storm's intensity, duration, location, and the preceding precipitation conditions. Characterizing the possible types of pollutants in the remaining CSO discharges will give a better understanding of associated receiving water quality impacts.

As indicated in the Stage I RAP, the extent of polluted runoff in the AOC is unknown. A total of 29 storm sewer outfalls are located in Menominee, and 15 are in Marinette. In Menominee, 11 storm sewers discharge into the river; four are combined sewer overflows. The Sixth Street Slip in Marinette receives stormwater discharge and contains sediment with elevated concentrations of lead, zinc, copper, cyanide, Kjeldahl nitrogen, and oil and grease.

Estimated Cost and Funding Source(s)

Unknown.

Evidence of Commitment

Implementation of consent decree issued by EPA with the City of Menominee, and conditions in the City's NPDES permit to correct combined sewer overflows.

WDNR and MDEQ stormwater sampling strategy (Stage I Appendix V.2).

Implementation Steps and Schedule

WDNR Marinette staff will be responsible for sampling. MDEQ staff conducted analyses in 1994 and 1995.

Relative Priority

High.

RAP Goals and Objectives Addressed

Goals: A
Objectives: 3, 5, 6, 8, 11, 16

BIOTA AND HABITAT

Wetlands

Recommendation

34 Responsible parties through existing programs and authorities* should assess and protect all remaining wetlands in the AOC. Marginal wetland areas in the AOC should be considered for potential remediation projects.

* Cities of Menominee and Marinette (land use zoning, shoreland/wetland ordinances, Sewer Service Planning), WDNR and MDNR/MDEQ environmental quality and resource management programs (water quality/surface water quality, shoreland wetland zoning, solid and hazardous waste disposal, ollution discharge); U.S. EPA [SWIS, Section 404 (dredge disposal) program]; and U.S. Army COE (Section 404 Program).

Also see CAC shoreline use and aesthetics recommendations in *Chapter I, RAP Participants and Programs.*

Existing Activities Related to this Action

Special Wetland Inventory Study (SWIS)

Recognizing the significant wetlands resources and the level of activity in the requests to fill wetlands, the EPA, in cooperation with other federal and state agencies, completed the Special Wetlands Inventory Study (SWIS) for the Green Bay, Lake Michigan watershed. Marinette County east of U.S. Highway 41 was included in the SWIS study area.

The objective of this program was to inventory and evaluate the wetlands resource and to identify those wetland sites that are generally unsuitable for fill disposal. SWIS results are informational and advisory, not regulatory. Updated Wisconsin Wetland Inventory maps and a computer database with site visit data and literature citations will be products of the SWIS.

Information for the maps will be prepared for computer storage, making it easier to update and produce specialized maps.

Anyone wishing to fill shoreline wetlands must submit an application for a Section 404 permit to the U.S. Army Corps of Engineers. SWIS designation of a site that is generally unsuitable for fill does not preclude obtaining a Section 404 permit, but does mean that EPA will recommend permit denial for most types of discharges in SWIS-designated areas. Conversely, areas not designated as being unsuitable in the SWIS still serve valuable wetlands functions. Thus, individuals applying for permits in areas not designated as generally unsuitable might still, in some circumstances, not receive a permit. The SWIS products will enable EPA and others to state to the public why given wetland areas should not be filled.

An additional step beyond the SWIS is the use of Section 404(c) of the Clean Water Act to prohibit or restrict filling of wetlands and other waterbodies that would cause an "unacceptable adverse effect" to, among other things, wildlife, fisheries or water supply resources. As part of the SWIS, certain areas may be designated for a more detailed survey for their 404(c) potential.

Expected Benefits

- Protection of existing wetlands for wildlife habitat.
- Improvement of water quality degraded by polluted runoff.

Rationale for Selection

Wetlands are among the most environmentally beneficial ecosystems in the nation. They include marshes, swamps, bogs and similar areas that have developed between water and dry land. Wetlands provide food and habitat for fish and wildlife. They also provide for groundwater purification, erosion control, flood control and recreation. Wetlands receive some protection at local, state and federal levels of government. WDNR has just recently developed and approved standards to provide additional protection for the state's wetlands.

As noted in the Stage I RAP, wetlands and other fish and wildlife habitat, once common on the river's edge, have been eliminated over time, primarily because of industrial and municipal filling and land disposal. Because existing wetlands in the AOC are scarce and their value and use are increased, they should be provided maximum protection. The protection of designated "high quality" wetlands as being pursued through the EPA SWIS program - while being helpful in protecting wetlands - is not considered adequate to address this impaired use. All remaining wetlands in the AOC should be preserved. Marginal wetlands should be assessed for potential restoration.

Estimated Cost and Funding Source(s)

Site-dependent.

Evidence of Commitment

Identification of environmental corridors in Marinette: Marinette Sewer Service Area Plan and Land Use Plan and the Menominee River Water Front Plan.

Implementation Steps and Schedule

Ongoing activity in land use planning.

Relative Priority

Medium.

RAP Goals and Objectives Addressed

Goals: A, B
Objectives: 7, 8, 9, 11, 13, 14, 17

Green Island

Green Island is an undeveloped 86-acre island located in Green Bay six miles offshore from the Menominee River. The Island is included in the Area of Concern.

Recommendation

35 The Natural Areas Preservation Council in conjunction with the WDNR Bureau of Endangered Resources should purchase and protect Green Island as a State Natural Area if and when the land becomes available.

Existing Activities Related to this Action

- Protection and management of Seagull Bar Natural Area.
- Protection of river and bay shoreline by the City of Marinette, including a proposal and support for a natural trail in this area.

Expected Benefits

Preservation and protection of wildlife habitat in the AOC.

Rationale for Selection

According to a WDNR site inspection in 1990, the island contains significant bird colonies (gulls, cormorants, black-crowned and great blue herons) and provides important wildlife habitat. Green Island and the Seagull Bar State Natural Area are biologically linked and should be considered part of the same area: Birds nesting on Green Island fly off the island to forage. Cormorants and herring gulls feed offshore. Herring gulls use Seagull Bar as a foraging area. The herons make flights daily to the mainland, primarily to Seagull Bar to forage.

WDNR staff conducted a site inspection of Green Island and Seagull Bar in 1990 to assess bird populations, vegetative habitat and human influence on the environment (Stage I Appendix XIII.3). Green Island still contains significant colonies of herring gulls; over 500 nests were counted. In addition there were at least 20 cormorants seen, at least 100 black-crowned night heron nests, and at least 20 great blue heron nests.

Estimated Cost and Funding Source(s)

Cost estimate is unknown; pending availability to purchase. Potential funding source: Stewardship Fund.

Evidence of Commitment

Approval by WDNR Bureau of Endangered Resources and the Natural Resources Council to include Green Island as part of Seagull Bar State Natural Area.

Implementation Steps and Schedule

Pending availability to purchase.

Relative Priority

Medium.

RAP Goals and Objectives Addressed

Goals: B
Objectives: 7, 11

Snapping Turtle Contaminant Data

Recommendation

36 WDNR Lake Michigan District and MDNR staff should collect additional snapping turtles from throughout the Area of Concern for PCB analyses in fat and mercury analyses in muscle tissue.

Existing Activities Related to this Action

Wisconsin and MDEQ fish contaminant monitoring programs, RAP sediment monitoring activities, proposed air sampling initiatives.

Expected Benefits

Recommended contaminant monitoring will provide a larger database on which to evaluate exposure risks.

Rationale for Selection

A large snapping turtle taken from the Menominee River had a total PCB concentration of 130 ppm in its abdominal fat. No age estimate or comparison data were available.

Snapping turtles, whose skeletal muscle, liver and eggs are used for human food, have been suggested as useful indicators of local contamination (Environment Canada, 1991). However, little research has been done on the accumulation of pesticides and industrial pollutants in reptiles (Stone, et al., 1980). It has been stated by some herpetologists that snapping turtles are relatively sedentary (Stone et al., 1980; Hammer, 1969). Yet others have demonstrated that some snapping turtles have large home ranges (Obbard & Brooks, 1981; Galbraith et al., 1986). The average home range of 10 snappers in Ontario, Canada was 3.44 ha (range: 0.95 - 8.38 ha) (Obbard & Brooks 1981). Some female snapping turtles undergo relatively long nesting migrations. Obbard & Brooks (1980) found that one snapper traveled 16 km round trip between nesting site and home range, and that some females traveled more than 0.5 km overland from one waterbody to another. Additionally, some turtles use different home ranges in different years. Statements about snapping turtles being sedentary have been based on

subjective observation and studies of pond turtles, not river-dwelling turtles. It cannot be assumed that snapping turtles in the riverine environment of the AOC are necessarily indicative of conditions in the AOC.

It is possible that elevated contaminant concentrations in large snapping turtles from industrial areas is common. Without data from other areas, it will be difficult to interpret local data. Therefore, snapping turtle data should be assessed in a larger ecological system.

Estimated Cost and Funding Source

Incorporate as part of the WDNR fish contaminant monitoring program.

Implementation Steps and Schedule

To be determined.

Relative Priority

Low.

RAP Goals and Objectives Addressed

Goal: 1
Objectives: 1, 6

Mussels

Recommendation

37 Hydroelectric dam operators should conduct a survey of unionid mussels in river reaches 1 and 2 in conjunction with the Federal Energy Regulatory Commission (FERC) relicensing process.

Existing Activities Related to this Action

Additional assessments of benthic, sediment and water quality data.

Expected Benefits

Site assessment and trend monitoring.

Rationale for Selection

Mussels are reliable pollution indicators. Being sedentary and occupying a low position in the food chain, they are rapidly affected when water quality deteriorates (Fuller, 1974; Forester 1980). Fuller (1974) wrote that mussels have extraordinary value as qualitative indicators of the presence of pesticides, radionuclides and trace elements in nature or waste materials.

Several studies have examined the effects of contaminants on mussels (Havlik and Marking, 1987). The most frequently studied contaminants are cadmium, copper, manganese, lead and zinc. Various common contaminants have been reported as toxic to mussels (Havlik and Marking, 1987).

Mathiak (1979) reported the fat mucket (*Lampsilis radiata siliquoidea*) and floater (*Anodonta frandis*) from the Menominee River in the AOC. These are probably the two most common and widely distributed mussels in the state. Several additional mussel species - at least a dozen - have been reported from the river upstream of the AOC (Mathiak 1979).

Estimated Cost and Funding Source(s)

Incorporate into existing monitoring programs of dam operators.

Evidence of Commitment

Increasing agency emphasis on biological diversity.

Implementation Steps and Schedule

To be determined.

Relative Priority

Low.

Fisheries Management

When detailed recommendations applicable to the AOC are developed as part of the Fisheries Management Plan, they will be included in RAP updates and progress reports. See *Plans and Studies, Menominee River Fisheries Management Plan*, later in this chapter.

AIR QUALITY

Recommendations

38 MDNR and WDNR should obtain measurements to support determination of atmospheric deposition of toxic substances found in the Menominee River by monitoring ambient air quality for toxicants of concern, using state-of-the-art sampling and analytical techniques.

39 MDEQ and WDNR should use air emissions inventories, additional air monitoring and air quality modeling techniques to work toward quantifying local deposition of contaminants of concern.

Existing Activities Related to this Action

The Green Bay Mass Balance Study (referred to in Chapter II), which quantified deposition of PCBs in Lake Michigan, may ultimately be useful in quantifying deposition of pollutants in the AOC. In addition, a Great Lakes regional air toxic emissions inventory project is being coordinated by the Great Lakes Commission with participation from each of the Great Lake states. A point and area source emissions inventory for 49 toxic pollutants for the Great Lakes region should be complete by the end of 1995.

Expected Benefits

Fish consumption advisories exist in the AOC due to mercury and PCB contamination. Atmospheric deposition may be a source of these compounds. Other parameters measured in the river have exceeded water quality standards and criteria and may also be related to atmospheric deposition. Air emissions inventories and monitoring projects can identify pollutant types, origins and quantities emitted from specific sources. Industries can use these inventories to ensure adequate controls of toxic air emissions.

Rationale for Selection

If the atmosphere is contributing toxic substances to the Menominee River, it will be necessary to identify the emission source of such substances. Efforts to determine deposition should first focus on the AOC.

The effects of air emissions on water quality in the Menominee River are unknown. There are several air emission sources in and around the AOC that may contribute contaminants to the river. However, local atmospheric deposition of substances emitted by these sources cannot be assumed, because the fate of air emissions is dependent on many factors. Short-range transport can be determined by applying air monitoring and emission inventory data to appropriate air quality models.

Estimated Cost and Funding Source(s)

The Great Lakes Protection Fund has already awarded money for Michigan projects. Additional money is necessary to continue monitoring efforts or add a monitor near the AOC. Since data interpretation would need to be contracted, implementation costs are unknown.

Evidence of Commitment

Money from the Great Lakes Protection Fund continues to support development and maintenance of a regional air toxics emission inventory. WDNR is also preparing an emissions inventory for more than 400 hazardous air compounds. This information is updated yearly. Wisconsin data is entered into EPA's regional and national air database.

Wisconsin's Hazardous Air Rules (NR 445) and the Federal Clean Air Act Amendments of 1990 support RAP objective No. 17. Additionally, many of MDEQ's and WDNR's existing programs will support implementation of this objective. The Great Lakes States Air Permitting Agreement, being carried out by Wisconsin and Michigan since 1988, commits air regulatory programs to require best available control technologies. Special focus is placed on emission sources of Great Lakes critical pollutants including mercury, alkylated lead compounds, total PCBs, hexachlorobenzenes, benzopyrene, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and 2,3,7,8-tetrachlorodibenzofuran.

Implementation Steps and Schedule

Ongoing.

Relative Priority

Low.

RAP Goals and Objectives Addressed

Goal: A
Objective: 17

SEDIMENT QUALITY

Researchers and regulators are using many approaches (field, laboratory and calculation-based) in various stages of development and application to assess sediment quality.

Sediment Characterization

Recommendations

40 WDNR Bureau of Water Resources Management should design and implement sediment mapping surveys to better characterize the physical properties and location of depositional areas within the AOC.

Partially Completed: The collection and digitization of this information was started by WDNR staff in 1994. This deposit information, along with existing sediment quality data, is being used to determine where additional sediment samples should be collected and analyzed.

41 WDNR Lake Michigan District and Central Office Water Resources Management staff, in conjunction with MDNR staff, should conduct sediment quality triad assessment of Lower Menominee River sediment deposition zones, including areas that previously exhibited toxicity conditions.

Project Description

These recommendations will help to project will assess the degree and potential effects of contamination in five depositional zones identified as having 1) potentially toxic conditions to aquatic life, 2) pollutants of concern significantly elevated above background levels, and 3) old or incomplete sediment data. This data will be collected and analyzed through a sediment quality triad assessment.

The triad approach combines data from sediment chemistry, bioassays and *in situ* biological variables. Chemistry and bioassay estimates are based on laboratory measurements of collected sediments. Analysis of *in situ* variables (benthic community structure) are integrated into the chemistry, physical and toxicity data and are analyzed against reference site data. The toxicity of a chemical substance varies with sediment conditions and other factors (Chapman

et al., 1992). Thus, the importance of any particular concentration of a sedimentary chemical or chemical suite cannot be determined solely from chemical measurements.

Environmental Results

The triad method will incorporate sediment chemistry, toxicity and benthic community structure measurements. It will qualitatively describe the five soft sediment deposits to help determine degradation. Integrating the three triad components in the Menominee AOC will help identify and rank degraded sites as well as predict where future degradation might occur.

Deliverables/Final Product

This project will produce a comprehensive triad assessment of the Lower Menominee River.

Implementation Steps and Schedule

Will be included as part of the *Upper Green Bay Areawide Water Quality Management Plan* update.

Related Activities and Commitment

Sediment analysis is recommended in the Lower Menominee River to complement several ongoing planning and enforcement initiatives: *The Upper Green Bay Areawide Water Quality Management Plan*, investigations of coal tar (PAH) contamination of river sediment adjacent to the Marinette Wastewater Treatment Plant, and EPA-WDNR Resource Conservation Recovery Act Corrective Action Enforcement Program with the Ansul Fire Protection Company. (The latter two are described in this chapter.) The proposed analysis will compliment water column and benthic survey analyses proposed by MDNR.

Collection and assessment of sediment samples is recommended to supplement existing AOC data based on the location of sediment deposition zones identified in 1994.

Relative Priority

High.

RAP Goals and Objectives Addressed

Goals: A, B
Objectives: 1, 3, 5, 6, 7, 11, 15, 17

Coal Tar Contamination (polycyclic aromatic hydrocarbons - PAHs)
(See *Chapter II - Background* for information on this site.)

Recommendation

42 The potentially responsible parties (Wisconsin Public Service Corporation and/or the City of Marinette) should:

- Assess the horizontal and vertical extent of PAH contamination in soils and adjacent river sediments from the site adjacent to the Marinette wastewater treatment plant.

- Conduct additional soil, sediment and groundwater sampling and monitoring, as necessary, to further assess contamination and contaminant mobility.

- Develop a remediation strategy to assess and implement potential remedial actions.

Note: An initial site assessment was started in summer 1995. Results are not yet available.

Existing Activities Related to this Action

Benthic and sediment assessments included as part of the Lower Menominee River RAP.

Expected Benefits

Reduction or elimination of PAH toxicity to the aquatic food chain.

Rationale for Selection

This recommendation is consistent with other ongoing coal tar investigation and remediation efforts in the state.

Estimated Cost

- Initial investigation - not available.
- Remediation - not available.

Evidence of Commitment

Wisconsin Public Service Corporation completed a revised site investigation work plan to WDNR in August 1995 to assess coal tar contamination within the Menominee River. The proposal includes using eight river transects from 250 feet west of the WWTP outfall to 450 feet east of the outfall, for a total study area length of 700 feet. The down gradient boundary of the study area is approximately 200 feet upgradient of the Ansul property. Proposed transects will extend out 200 feet. Results from the investigation are not yet available.

Implementation Steps and Schedule

To be determined.

Relative Priority

High.

RAP Goals and Objectives Addressed

Goals: A, B, C
Objectives: 1, 3, 6, 11, 15, 17

Harbor Deepening Project

A new pulp generating mill (Great Lakes Pulp and Fiber) is being developed along the river shoreline in Menominee. This facility will require deepening part of the shipping channel for larger ocean vessels. The City of Menominee is the project sponsor for the harbor deepening proposal. Feasibility studies will be conducted to assess potential dredging and sediment disposal options.

The facility, which is expected to be completed in 1996, will be able to process over 750 tons of mixed office waste paper into 520 tons of pulp per day. The facility is expected to create approximately 100 jobs.

Recommendation

43 The City of Menominee should complete sediment analyses to determine if contaminants in the materials are acceptable for dredging and for disposal in open water as part of the harbor deepening project.

Project description

Use of tiered evaluation that includes bioassay and bioaccumulation studies is recommended for all U.S. Army Corps of Engineers dredging permits within the Area of Concern. The general guide for the Corps would be its document, *Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters,* with substitution of appropriate freshwater test organisms. Other draft EPA or Corps guidance for assessing inland dredging projects should also be used.

The City of Menominee should investigate upland disposal alternatives for dredged material in its feasibility study for the channel deepening project and for future dredging operations.

Timing of dredging and disposal activity within the AOC should be done to:

- avoid major fish spawning and migratory periods.
- minimize disruption of aquatic biological activity .
- minimize and contain any suspended sediments and contaminants.

Existing Activities Related to this Action

Sediment assessments of the AOC.

Expected Benefits

Development and use of a long range navigational dredging strategy protective of the Lower Menominee River ecosystem.

Rationale for Selection

Arsenic, mercury and other contaminants in sediment within the proposed deepening project have previously been detected above background concentrations.

Estimated Cost and Funding Source(s)

The estimated cost to the City of Menominee is between $900,000 and $1,200,000. Potential funding sources include state and local government, the pulp facility, and the U.S. Army Corps of Engineers.

Evidence of Commitment

City is working with affected and interested parties.

Implementation Steps and Schedule

Pending.

Relative Priority

High.

RAP Goals and Objectives Addressed

Goals: C
Objectives: 13

Arsenic contamination

Background information on arsenic contamination in the Area of Concern appears in *Chapter II*, under *Definition of the Problems.* **Figure K** pictures the area of arsenic-impacted sediment at the Ansul Fire Protection Company property in Marinette.

RCRA Corrective Action Order

Any handling of hazardous waste, such as the arsenic contamination at the Ansul site, is subject to oversight by the Federal Resource Conservation and Recovery Act (RCRA). Under this Act, Ansul, WDNR and the Environmental Protection Agency (EPA) are working to protect public health and the environment around the Ansul site. Ansul must complete a required facility investigation and, upon approval of this investigation by EPA and WDNR, the company will have 90 days to submit a draft corrective measures study (CMS). Based on these efforts, if corrective measures are necessary, Ansul shall identify, screen and develop one or more alternatives for arsenic removal, containment and/or residual contamination treatment based on the objectives established by the CMS. The corrective action process provides for a 30-day public comment period after a corrective measure is selected.

Implementation of existing enforcement measures under RCRA will determine the outcome of the RCRA Corrective Action Order. The assessment and remediation of arsenic contamination

through the RCRA Corrective Action Program is included as part of the Lower Menominee River Remedial Action Plan's long-range strategy.

Note: RCRA procedures are further detailed in *Appendix II.*

Guidelines on Toxicity Assessments and Remediation Objectives

Below are EPA guidelines concerning toxicity assessments and remediation end points. Detailed work plans will be included as part of the RAP as they are established through the RCRA Corrective Action Program.

The purpose of a site investigation is to define the degree and extent of contamination in all media impacted and to provide a basis for choosing the most appropriate remedial action alternative(s). An accompanying work plan will state investigation objectives and present a proposal for field investigations that build upon available supporting background information.

Basic steps in developing a work plan include:

1. Identify the project objectives:
    a. Define the degree and extent of contamination
    b. Provide a basis for evaluating the most suitable remedial action alternatives
2. Collect and evaluate site background information
3. Determine information need
4. Determine how the necessary information is to be obtained
5. Propose a plan of action
6. Develop a schedule for the proposed plan.

The purpose of defining the degree and extent of contamination is to document the entire (i.e., three dimensional) extent of contamination. In determining whether the soil or water is a hazardous waste, applicable requirements of Ch. NR 600 - NR 685, Wis. Adm. Code, must be met.

Remediation Approaches

Remediation must take a statistical approach. Soil and sediment quality criteria are integral components of site assessments and development and assessment of remedial options. Acceptable concentration limits, or a series of tests that would indicate the recovery of an area, should be established for each site before remediation. Environmental and human health protection goals should be stated as numerical biological criteria. For example, the goal may be to attain sediment quality that is acutely non-lethal to benthic organisms prevalent in upstream or intake areas. More stringent criteria may include chronic non-lethality or absence of sublethal effects on growth and development. Without agreement on these goals, consistency in derivation of numerical chemical criteria cannot be expected (Fitchko, et al.)."

The options for remedial action to address a contamination problem will depend on the types and levels of contamination allowed following remedial action. The extent of arsenic-contaminated soil, groundwater, sediment and surface water near Ansul will be assessed as part of the pending RCRA consent order. According to EPA (Agency Policy on the Use of Quality Standards in Ground-Water Prevention and Remediation Activities), water quality standards set by the Clean Water Act will be used as reference points when groundwater is closely (i.e., hydrologically) connected to surface water. According to EPA's proposed contaminated sediment management strategy: (1) RCRA decisions on corrective action cannot consider costs; and (2) if a RCRA Facility Assessment indicates that a release to surface waters has occurred, extensive RCRA Facility Investigations will be required, including sediment considerations (*EPA's Contaminated Sediment Management Strategy: a proposal for discussion, March 4, 1992*).

EPA considers state-delegated environmental quality programs and standards when assessing and finalizing decisions concerning Corrective Action Programs. In Wisconsin, the level of remediation required for contaminated soils is based on the probability of the soil contamination's potential to:

- contaminate groundwater in exceedance of Chapter NR 140, Wis. Adm. Code standards,
- contaminate surface water in violation of Chapters NR 102 - 106, Wis. Adm. Code, or
- pose a threat to public health, safety, welfare or the environment.

Wisconsin cleanup standards for contaminated groundwater are found in Chapter NR 140, Wis. Adm. Code (Groundwater Quality). Standards for discharges to surface water or groundwater are identified in WPDES permits. Cleanup goals for soil are naturally-occurring background conditions. Cleanup goals for sediments are developed case by case, considering water quality standards, human health and aquatic toxicity. Chapter NR 140, Wis. Adm.

Code, requires that groundwater contamination be defined and remediated by those who caused it.

For substances with an established standard in Chapter NR 140, Wis. Admin. Code, groundwater must be restored and the source of contamination contained, treated or removed so that the preventive action limits (PALs) are not attained or exceeded. If WDNR determines that compliance with the PAL is either technically or economically not feasible, compliance with the lowest possible concentration that is technically or economically feasible must be achieved. The cleanup standard must not attain nor exceed the enforcement standard at the point of standards application. The groundwater enforcement standard for arsenic in Wisconsin (also the federal drinking water standard) is .05 mg/l (50 parts per billion).

For soil determined to contaminate or have the potential to contaminate groundwater in exceedance of Chapter NR 140 standards, remediation levels are regulated according to the Chapter NR 700 series of Wisconsin Administrative Code.

Recommendations

44 Ansul, through the EPA RCRA Consent Order cosigned by WDNR September, 1990, should conduct an environmental assessment for any RCRA site targeted for corrective action. Actions must include a comprehensive assessment of ecological impacts of toxic substances to the environment, including groundwater, surface water, soils and sediments. Assessment methods and characterizations should be compatible with current science as including, but not limited to, the following guidelines and documents:

a. U.S. EPA Office of Water Regulations and Standards Sediment Oversight Technical Committee and Tiered Testing Workgroup;

b. Regional and National U.S. EPA and US Army COE Workgroups developing guidance for implementing Section 404 (b)(1) of the Clean Water Act as it applies to disposal of sediment in open water;

c. EPA Region V Waste Management Division Policy Directive on performing Ecological Assessments;

d. ASTM guidelines for performing sediment toxicity testing;

e. State of Wisconsin assessment methodologies for evaluating contaminated sediments.

45 Ansul, through the EPA RCRA Consent Order cosigned by WDNR September, 1990, should use current assessment methods to facilitate technically defensible and publicly

acceptable decisions based on chemical and biological assessment of contaminated sediment. Below are guidelines and recommendations for assessments:

a. For each environmental medium potentially affected by the release of toxic substances to a surface water, consideration should be given to using the results of appropriate bioassays conducted on sediment and sediment pore water and overlying site surface waters. Bioassay results should be considered along with the numeric state standards applicable to groundwater and surface water quality criteria. Numeric state standards for groundwater quality and surface water quality should be used for protecting biota in the surface waters and benthic habitats.

b. The horizontal and vertical extent of contamination in the sediments and pore water should be included on Isopleth maps, based on existing data and additional sampling as necessary.

c. Present loading of contaminants moving off site should be quantified to assess existing conditions and monitor site changes.

d. Bioassays should be used in conjunction with collected sediments and pore water samples that represent a gradient of contamination. Bioassays would assist in establishing site specific levels of contaminants for acute and chronic toxicological effects and other biological effects.

46 Ansul, through EPA RCRA Consent Order cosigned by WDNR September, 1990, should consider the following factors (noted by Eisler, 1988) when assessing the impacts of arsenic on aquatic ecosystems:

a. Little work has been done on the long-term effects of arsenic on organisms at chronic concentrations (blocking or depressing enzyme systems, pathological changes in tissues and limiting development of growth, reproduction, metabolism and other physiologic processes).

b. Additional long-term studies and studies involving sensitive life stages such as embryos, larvae, or early juveniles are needed to accurately access the toxicity of arsenic forms to fish and other aquatic organisms.

c. While there is inadequate data to allow derivation of numerical criteria for aquatic organisms for pentavalent arsenic (As (V)) or any organic arsenic compound, indications are that some organisms are more sensitive or at least as sensitive to As (V) and organic arsenic as they are to As (III) for which water quality criteria have been developed.

d. Exposure to low levels of arsenic by organisms at certain trophic levels may have significant ecosystem implications. For example, Eisler (1988) indicates that chronic studies with mass cultures of natural phytoplankton communities exposed to low levels of arsenate (As (V)) of 1.0 to 15 µg/l showed that As (V) differentially inhibits certain plants, causing a marked change in species composition, succession and predator-prey relations. The significance of these changes on carbon transfer between trophic levels is unknown.

47 The RCRA enforcement process should proceed with a site investigation and remediation program until impaired uses associated with arsenic contamination are restored. Additional recommendations addressing the investigation, remediation and restoration of the Ansul site will be determined through the RCRA corrective action enforcement program, involving both WDNR and U.S. EPA.

Note: If impaired uses associated with arsenic contamination are not restored through the RCRA enforcement program, WDNR will consider using other authorities, resources and programs to address this site.

48 A cooperative effort between Ansul, EPA and WDNR should be *considered* to eliminate or reduce the flow of groundwater through arsenic-contaminated soils and sediments, while negotiations and additional assessments take place as part of the RCRA Corrective Action Enforcement Program.

Existing Activities Related to the above recommendations

Proposed and ongoing assessments of benthos, sediment and water quality in the Lower Menominee River as part of the RAP and the *Upper Green Bay Basin Areawide Water Quality Management Plan.*

Expected Benefits

- Determination of the current vertical and horizontal extent of arsenic contamination.
- Determination of biological effects associated with the arsenic contamination.
- Development and assessment of a long-range, ecosystem-based remediation strategy.

- Development and implementation of remedial alternatives that use an ecosystem assessment approach, incorporating the most stringent and applicable environmental standards.

- Elimination or significant reduction of arsenic-contaminated groundwater and surface water flowing into the Menominee River, Green Bay and Lake Michigan.

- Restoration of AOC impaired uses associated totally or partially with arsenic contamination: dredging restrictions, aquatic toxicity, localized degradation of fish populations and degraded fish habitat.

Rationale for Selection

The above recommendations support an ecosystem assessment of arsenic contamination in the AOC. The recommendations also support restoration of impaired uses associated with the arsenic contamination.

Estimated Cost

Unknown.

Evidence of Commitment

- Administrative Consent Order developed and signed by EPA, WDNR and Ansul.
- Previous remediation activities by Ansul (1981 - 1986).

Implementation Steps and Schedule

To be determined in RCRA Facility Investigation and Corrective Action work plan. This information will be included future RAP updates.

Remedial Options and Alternatives

An *Investigation of Disposal Options For Menominee - Marinette Harbor, Michigan and Wisconsin* was prepared for the U.S. Army Corps of Engineers Detroit District by Baker Engineering (1988). This report is further described in *Appendix V: Sediment Disposal Option Investigations.*

Relative Priority

High.

RAP Goals and Objectives Addressed

Goals: A,B, C
Objectives: 1 ,3, 6, 7, 11, 15, 17.

Green Bay Paint Sludge Contamination

49 Cleanup of the submerged paint sludge contamination site should continue until impaired uses associated with this site (degradation of benthos, loss of fish and wildlife habitat) are restored.

Existing Activities Related to the above recommendation

Proposed and ongoing assessments of benthos, sediment and water quality in the Lower Menominee River as part of the RAP and the *Upper Green Bay Areawide Water Quality Management Plan.*

Expected Benefits

- Restoration of fish and wildlife habitat.
- Containment and removal of solidified paint nodules containing elevated levels of lead.

Rationale for Selection

Part of MDEQ enforcement program, Act 201 (formerly Act 307).

Estimated Cost and Funding Source(s)

Unknown.

Evidence of Commitment

- Ongoing remediation activities.

Implementation Steps and Schedule

Removal of remaining paint sludge was completed in 1995. Removal of the rock bern is scheduled for 1996. Followup monitoring activities have not been determined.

Menominee River Fisheries Plan

The *Menominee River Fisheries Plan*, designed to give long-range guidance to the management of fish and aquatic resources in the system, was completed by MDNR and WDNR in December 1992. This plan pertains to the entire Menominee River and does not contain a specific implementation schedule. It includes objectives and general recommendations for restoring, improving and maintaining fish populations and fishing opportunities. Excerpted background from the plan appears in *Appendix VII.*

Implementation of the fisheries management plan and the RAP compliment each other. The fisheries plan will partly address the following RAP goal and objectives:

Goal

Maintain and improve a balanced aquatic and terrestrial community to ensure long-term ecosystem health.

Objectives

- Maintain a balanced and productive fishery, with fish that are safe to eat (RAP Objective 5).
- Protect wildlife and fishery habitat in near-shore and wetland areas (RAP Objective 11).

Recommendations

50 WDNR and MDNR should continue to evaluate stocking efforts in and around the Area of Concern.

51 WDNR, MDNR and Scott Paper Company should assess and, if necessary, implement techniques to reduce dam entrainment fish mortality in the Upper and Lower Scott Flowage.

Note: For more information on fish assessment, see *Fish Data Acquisition and Monitoring* in the next chapter.

Existing Activities Related to these recommendations

Menominee River Fisheries Plan, and *Upper Green Bay Area Wide Water Quality Management Plan.*

Expected Benefits

- Enhancement of trend monitoring database.
- Assessment of fish stocking efforts.
- Enhancement of local fishery and fishing opportunities.
- Increase in natural reproduction capabilities.

Rationale for Selection

- Evaluation of fish stocking efforts may assist in evaluating implementation of some remedial actions.
- Protection and enhancement of public resources.

Estimated Cost and Funding Source(s)

Work plan as part of existing fisheries programs.

Evidence of Commitment

- Together, over 1,000,000 yearlings and fingerlings were stocked by MDNR and WDNR in the Area of Concern between 1988 and 1995.
- Ongoing five-year plan by MDNR to tag 1,000 to 1,500 walleyes per year in the Menominee River.
- Continuation of MDNR brown trout strain evaluation.
- Contaminant monitoring in sport fish is an ongoing activity by both MDNR and WDNR staff.

Implementation Steps and Schedule

1. Determine sampling and assessment locations.
2. Develop work plan(s).
3. Implement sampling assessment activities.

Relative Priority

Medium.

RAP Goals and Objectives Addressed (See Summary)

Goals: B, C
Objectives: 5, 11

Upper Green Bay Basin, Areawide Water Quality Management Plan

This is a five-year plan required by the Clean Water Act and produced by the WDNR Bureau of Water Resources Management to guide the protection and enhancement of water resources of the Upper Green Bay Basin. The Lower Menominee River RAP addresses a specific Area of Concern encompassed by this basin..

OTHER REMEDIAL ACTIONS

Menominee Paper Company

In July 1989, the Menominee Paper Company terminated its discharge to the City of Menominee wastewater treatment plant and began operating its own treatment facility. Post-construction waste stream monitoring indicated the facility is in general compliance with its NPDES permit limits.

Menominee Landfill

The Lower Menominee River RAP Stage One Report identified the former Menominee Landfill as a potential source of contamination to the Lower Menominee River AOC. Two plumes of groundwater contaminated with volatile organic compounds are present under the old landfill; at least one of the plumes is believed to be moving toward the River.

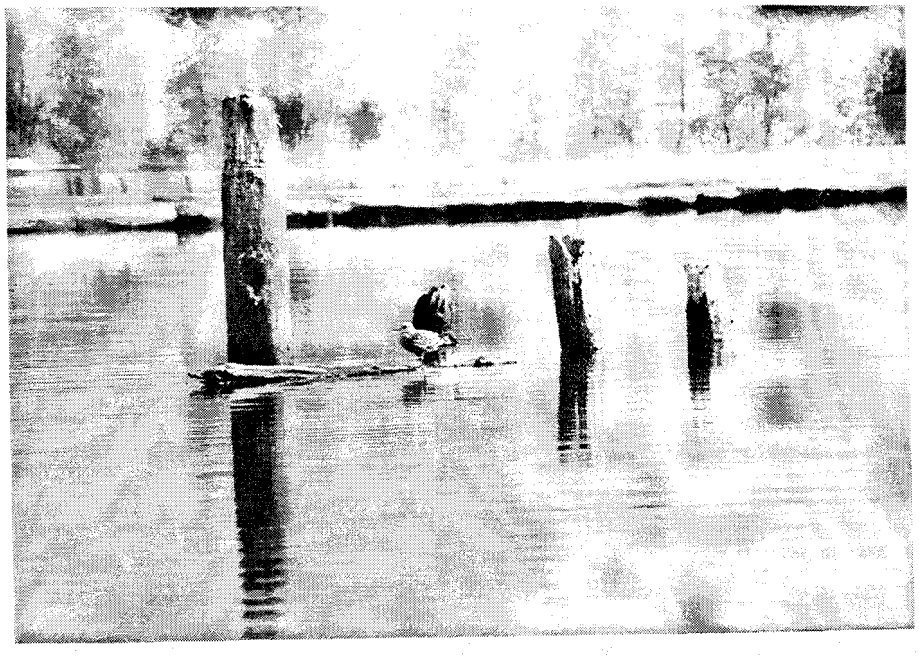
Nine purge wells were installed in 1991 to limit the off-site flow of these contaminants. The wells extract 50,000 to 70,000 gallons of groundwater per day. The water is sent to the Menominee WWTP for treatment. Four of the purge wells underwent a refracturing procedure in 1992 to increase their pumping efficiency from the underlying aquifer. The surface of the landfill was capped with a semi-permeable silty sand cover and seeded with grass in 1992. Monitoring of the site indicates the remediation process had been successful in containing the contamination.

Marinette Pretreatment Program

Since 1993, the City of Marinette has implemented a pretreatment program to help ensure that wastewater discharged from local industry does not pose a human health concern, damage the treatment facility or harm the environment. Pretreating industrial wastewater before discharging it to a treatment plant is often necessary to facilitate safe and effective wastewater treatment. Elements of pretreatment programs include sewer use ordinances, local limits on industrial wastewater discharges, program implementation procedures and funding mechanisms.

Menominee Combined Sewer Overflow/Correction Program

See *Chapter II - Background.*



The Menominee River was lined with moorings during the logging boom of the late 1800s. The main channel of the river near the Sixth Street Slip is one of the sites still dotted with these old remnants.

CHAPTER IV - SURVEILLANCE AND MONITORING

Surveillance and monitoring recommendations, including those to complete triad assessment of the Area of Concern (AOC) are included here. The following surveillance and monitoring strategy will help fulfill several purposes:

- Document and quantify, as necessary, impaired uses where data from the AOC is incomplete, outdated or conflicting.
- Provide ongoing assessment of environmental conditions to determine whether rehabilitation goals and objectives are being achieved and maintained.
- Recommend corrective actions if objectives are not being met.

According to the Intergovernmental Task Force on Monitoring Water Quality (1992), ecosystem monitoring should address the following:

- Status and trends.
- Identification of existing and emerging problems.
- Information to support resource management policy development (i.e., remediation options).
- Evaluation of program effectiveness.
- Emergency response.

This chapter includes guidelines for collecting cost-effective and useful information. The information is divided into three parts:

- Baseline data acquisition and short-term assessment monitoring.
- Remediation assessment monitoring.
- Long-term/trend monitoring.

Discussions of various surveillance and monitoring activities include references to river reaches as depicted in **Figure E.** Emergency response is not included.

BASELINE DATA ACQUISITION AND SHORT-TERM ASSESSMENT MONITORING

Water Quality Assessment

River Flow Model

Understanding river flows is critical to understanding contaminant transport from sediment deposition zones, to evaluating habitat and to setting fisheries management objectives.

Recommendation

52 WDNR should develop and maintain a computer simulation flow model for Menominee River reaches 1 - 6 (**Figure E**).

Stormwater

53 Same as Recommendation No. 33.

South Channel Dissolved Oxygen Studies

The lack of water chemistry data for the south channel was noted in the Stage I RAP.

Recommendation

54 (**Completed**) WDNR Lake Michigan District Water Resources Management personnel should assess dissolved oxygen levels in river reach 6 of the South Channel, using continuous dissolved oxygen meters and/or hydrolab monitoring units.

Note: Dissolved oxygen data was collected in the South Channel by WDNR in 1993 (See Appendix IV). Daily fluctuations in dissolved oxygen levels were within an acceptable and expected level. No violations of Wisconsin water quality standards for dissolved oxygen occurred during the study. Additional monitoring is not recommended at this time. However, dissolved oxygen measurements should be taken in conjunction with any future water chemistry or macroinvertebrate work conducted in the river.

Sediment Mapping

Recommendations

55 **(Partially Completed)** WDNR Bureau of Water Resources Management should utilize sediment poling techniques to map sediment deposition zones in the AOC's lower portion.

A sediment deposit survey in the AOC was started in 1994. This deposit information, along with existing sediment quality data, will be used to determine where additional sediment samples will need to be collected and analyzed.)

56 WDNR Lake Michigan District Water Resources Management staff should collect and analyze additional sediment data based on the sediment deposit survey results. In addition, WDNR should conduct toxicity tests at the two sites previously showing toxicity (Tusler/Masnado sites) to verify toxicity. Additional toxicity testing should identify the primary causes, delineate the area of toxicity and serve as a baseline for evaluating remedial actions.

Fisheries Data Acquisition And Monitoring

The following four recommendations are based on guidance developed for WDNR fish managers and water quality planners for determining fish community attributes in areas of concern.

57 *Long-term trends in general fish community composition:* Information on the composition of the fish community in the area of concern should be obtained through WDNR and MDNR fisheries management programs to assist in developing specific goals for remediation efforts.

58 *Population trends of one or two indicator species:* WDNR and MDNR fish managers should monitor population trends on one or two indicator species identified as important or critical to restorations of impaired uses.

Description

Information on fish community composition in the Area of Concern is needed for setting more detailed and meaningful goals to direct future remediation efforts, including fisheries management plans. Information on composition trends is valuable for deciphering other changes and observations regarding the aquatic ecosystem.

An index of biotic integrity (IBI) is an ambient ecological index for evaluating the overall environmental health and integrity of an aquatic system, using fish community attributes. A

preliminary IBI has been developed for Lake Erie estuaries and large rivers in Ohio. Wisconsin has an IBI for wadable warmwater streams, and an IBI is being developed for coldwater streams. No IBI is available for Lake Michigan Areas of concern where, typically, large rivers enter Lake Michigan. The fish communities using these habitats are likely unique. Therefore, site-specific information is necessary. Although funding has not yet been obtained, the project proposal is still viable and opportunities for outside funding will be pursued when they arise.

59 *Fish habitat types, quantity and quality:* WDNR and MDNR fish management programs should include identification of habitat parcels important to restoring or maintaining a healthy fish community.

Description

Fisheries personnel should identify habitat parcels of species that are important or critical to restoring or maintaining a healthy fish community. This monitoring could include life history studies of important or critical species of fish to identify habitat use and needs, and evaluation of habitat protection/restoration activities.

60 *General health condition of one or two indicator species and indicators of exposure and response to contaminants:* WDNR and MDNR fish managers should obtain necessary information to describe the population and general health characteristics of one or more fish species chosen to indicate the exposure and response to contaminants in the system.

Description

This part of the long term monitoring project is intended to describe the general health of one or more fish species chosen to indicate exposure and response to contaminants in the system. Experts in the aquatic toxicology field can recommend species thought to be especially sensitive to contaminants. The species should be common, as well as sensitive to pollutants of concern. Conducting at least one survey in the summer will help reduce the possible effects of poor food availability and stresses other than contaminants that can occur in colder seasons.

General health assessment is typically conducted on 20 to 30 live fish at each site. Fish are kept alive in aerated and temperature-controlled water. Researchers determine general health conditions, such as visceral fat and blood properties (hematocrit, hemoglobin, cell counts, etc.) Selected species' signs of exposure and response to toxicants (biomarkers or bioindicators) are monitored over time to help evaluate exposure and possible effects on the fish community. Since WDNR has little experience in monitoring biomarkers or bioindicators, continued development, evaluation and modification of procedures is necessary.

Wildlife Baseline Data Acquisition

Habitat Inventory and Assessment

The EPA and USFWS Special Wetlands Inventory Study (SWIS), completed in 1993 includes an inventory of wetlands on the Wisconsin side of the AOC. No similar effort exists on the Michigan side; however, there are few remaining wetlands in Michigan's portion of the AOC.

Recommendations

61 WDNR and MDNR Wildlife Management personnel should identify necessary and available habitat for meeting wildlife management objectives in the AOC, including identifying potential sites for wildlife habitat improvement projects.

62 WDNR and MDNR should delineate available habitat, including critical wildlife habitats on river reaches 1-6 within the AOC.

Wildlife Health Assessment

No data exist on the health of wildlife species in the AOC. Only limited contaminant data on a few waterfowl species are available for examination and interpretation.

Recommendation

63 WDNR and MDNR Wildlife Management personnel should capture resident avian, amphibian, reptilian and mammalian species from river reaches 1-6 for gross health exams, necropsy and contaminant analysis.

Wildlife Health Assessment and Contaminant Monitoring

Avian tissue analysis from 1988 and 1989 indicates that some piscivorous species may be experiencing reproductive impairment as a result of mercury exposure. Other contaminants present in the AOC are also known to impair reproduction. Although concentrations of individual contaminants may be below lowest observable adverse effects levels, toxins may act in an additive or synergistic manner.

High concentrations of PAHs have been documented in fish near the former coal gasification site. No data exists on PAH burdens in wildlife species in this area. Some PAHs are known to cause immunosuppression, especially when exposure occurs in utero or in ovo. With a lowered resistance, populations can be more susceptible to die-offs from ubiquitous bacteria and viruses.

Arsenic exposure has been documented in fish collected below the Ansul Fire Protection Company site. No data exists on wildlife in that area. Amphibians and reptiles in contact with sediment are likely exposed. Low water concentrations of arsenic are known to cause death and malformations in amphibian embryos.

Recommendation

64 WDNR and MDNR staff should assess the reproductive performance (egg production, viability and hatchling survival) of a representative piscivorous bird, such as the common merganser, above and within the AOC. Contaminant concentrations should be determined in eggs, adult and hatchling serum, and in adult and hatchling feathers and livers.

65 WDNR and MDNR staff should assess the PAH exposure and immune status of waterfowl near the Marinette wastewater treatment plant. Samples of food items and gastrointestinal tract contents can be analyzed to determine if waterfowl are being exposed to PAHs. Serial blood sampling of live-trapped birds will be used if immune system function has been supressed by PAHs.

66 WDNR and MDNR staff should identify any amphibian and reptile populations in the contaminated area. Tissue samples should be obtained above and below the site to determine arsenic concentration. Reproductive performance should be monitored, including egg production and viability, larval survival, growth and deformities. If amphibians are not present in sufficient numbers, the Frog Embryo Toxicity-Xenopus (FETAX) can be performed in a laboratory. There, the frogs would be exposed to water and sediments from the contamination sites to determine if arsenic concentrations are contributing to reduced amphibian populations.

Wildlife Contaminant Monitoring

There are no snapping turtle consumption advisories in Michigan or Wisconsin. (Levels of consumption are unknown.) However, contamination may still be a concern. Chapter III covers the need to further study snapping turtles.

Recommendation

67 WDNR Lake Michigan District staff should collect additional snapping turtles from throughout the AOC for PCB analyses in fat and mercury analyses in muscle tissues.

Endangered/Threatened And Nongame Resources Inventory

Few or no data are available on nongame wildlife occurrence or use in the AOC. No comprehensive surveys have been completed.

Recommendations

68 WDNR and MDNR should conduct an inventory to determine if flora and fauna on the endangered and threatened species lists are present in the AOC.

69 Hydroelectric dam operators should conduct a survey of unionid mussels in river reaches 1 and 2 in conjunction with the Federal Energy Regulatory Commission (FERC) relicensing process.

Note: For supporting information, see Recommendation No. 37 on page 87.

REMEDIATION ASSESSMENT MONITORING

Surveillance and monitoring recommendations associated with Corrective Action Programs (e.g. the Ansul site, Green Bay paint sludge, PAH-contaminated sediments) can be determined only when final assessment requirements and corrective actions have been selected. Remedial action assessment monitoring will be designed to answer very specific questions regarding contaminant exposure and effects. After a remedial measure has been proposed, a monitoring component should be designed to evaluate the effects of implementation.

LONG-TERM/TREND MONITORING

Water Quality Trend Monitoring

Baseline water quality and biological data will be collected as a part of WDNR Lake Michigan District's basin assessment monitoring program. The Lake Michigan District has five major drainage basins. Each year, one basin is selected for intensive monitoring, whereby a five-year cycle of assessment work has been established. The Upper Green Bay basin was monitored in 1993 and will be monitored again in 1998.

Monitoring and assessment results support a variety of water quality-related programs including wastewater permitting and potential selection of priority watershed projects (under Wisconsin's Nonpoint Source Water Pollution Abatement Program).

Dissolved Oxygen

Recommendation

70 WDNR and MDEQ should monitor dissolved oxygen levels below the Upper and Lower Scott dams and near the Menekaunee Bridge (river reaches 1 through 4) using continuous meters from June through September.

Sediment Quality Trend Monitoring

Sediment Quality Monitoring

See *Chapter III, Sediment Quality (Sediment Characterization).*

Benthic Macroinvertebrate Monitoring

Recommendation

71 (**Partially completed. See recommendation No. 77**). WDNR should conduct macroinvertebrate trend monitoring in the following locations: near the Hattie Street bridge, near Boom Landing, in the Turning Basin, at the upstream end of the South Channel, at the mouth of the South Channel and at a site upstream of the AOC (river reaches 2, 5, & 6). A minimum of three artificial substrates should be placed on the river bottom at each site. Samplers should be retrieved after thirty days and invertebrates collected, identified and enumerated.

Project description

The composition of bottom-dwelling organisms has been one of the most widely used water quality indicators. Macroinvertebrates form relatively sedentary communities in the sediments and reflect the local character of both the water and the sediment (Fitchko 1986; Seidl and Murray 1991). Benthic faunas respond to gradual and rapid changes in the quality of their environment,and thus indicate both short and long-term water quality characteristics.

Species composition is affected by many environmental parameters in addition to water and sediment quality. Water depth, sediment type, organic matter content, temperature and current all contribute to producing heterogeneity in benthic communities. These factors must be considered when interpreting benthic composition (Fitchko, 1986). *For more information on project description, purpose and design, see Appendix III.*

Fisheries Population Monitoring

Recommendation

72 WDNR and MDNR Fisheries Management personnel should monitor stocks of selected species and the magnitude of migrations to ascertain when population goals listed in **Table 7** are reached, or whether other actions, such as selected stocking, are needed.

Table 7: Fish Migration Goals (Adult Fish)*

Fish Species	Migration Goal
Lake Whitefish	100,000
Lake Herring	100,000
Walleye	100,000
Smallmouth Bass	25,000
Northern Pike	10,000
Muskellunge	5,000

*Source: Menominee River Fisheries Plan, 1993, Thuemler and Schnicke

Fish Contaminant Monitoring

Recommendation

73 WDNR Lake Michigan District Fisheries Management personnel and MDNR District Fisheries Staff should collect fish from river reaches 1-6 and upstream of the AOC every two to five years for contaminant analyses.

Air Quality Monitoring to Determine Deposition

Recommendations

74 WDNR and MDEQ Air Management programs should obtain measurements to support determination of atmospheric deposition of toxic substances found in the Menominee River by monitoring ambient air quality for toxicants of concern, using state-of-the-art sampling and analytical techniques.

75 WDNR and MDEQ Air Management programs should use air emissions inventories, additional air monitoring and air quality modeling techniques to quantify local deposition of contaminants of concern.

76 WDNR and MDEQ Air Management programs should use a technique such as back trajectory analysis to analyze data from the Green Bay urban toxics monitoring station, the Great Lakes regional monitoring stations and current studies to quantify long range contaminant transport and deposition.

Dreux Watermolen and Charmaine Robaidek of WDNR's Lake Michigan District collect macroinvertebrates from artificial substrates placed in the Menominee River.

CHAPTER V: ADDITIONAL STUDIES

Additional data is required at some contamination sites to document pollutants, determine sources, define contaminant transport, delineate the location of specific pollutants and establish and predict environmental conditions. For studies required to complete identification of use impairments, or descriptions of causes or quantification of sources relating to sediment contamination, see *Chapter III, Sediment Quality* and *Chapter III, Arsenic Contamination.*

DEGRADED BENTHOS

Benthic Survey

Recommendation

77 WDNR Lake Michigan District staff should conduct a benthic invertebrate analysis of samples collected in 1994.

Expected Benefits

Monitoring will document benthic variability at specific sites over time. It will also provide seasonal data on these bottom-dwelling invertebrate communities at selected sites.

Rationale for Selection

Surveys assessing benthic communities using artificial substrates are useful in demonstrating water quality trends.

Estimated Costs and Funding Source

- Construction of artificial substrates: $150.00.
- Invertebrate identification and enumeration: Wisconsin state contract with UW-Stevens Point for macroinvertebrate analysis.

Evidence of Commitment

The *Upper Green Bay Basin Areawide Water Quality Management Plan* lists recommendations for additional benthic monitoring.

Time Frame

1995 - 1996.

Relative Priority

High.

Rap Goals and Objectives Addressed (See Summary)

Goal: A
Objective: 6

FISH CONSUMPTION ADVISORIES

Restrictions On Fish Consumption

Recommendation

78 WDNR and MDEQ should continue contaminant monitoring in the AOC for toxic pollutants of concern (including PCBs, dioxin and mercury) in water, sediment, fish and wildlife as part of existing permit, surveillance and monitoring programs. WDNR should assess mercury concentrations and sources as part of the *Upper Green Bay Basin Areawide Water Quality Management Plan* and by EPA as part of the Lake Michigan Lakewide Management Plan. If significant sources of mercury, dioxin, PCBs or other pollutants of concern are found originating from within the AOC, remedial recommendations should be developed and included in the RAP.

Existing Activities Related to this Action

- *Upper Green Bay Areawide Water Quality Management Plan.*
- EPA Lake Michigan Lakewide Management Plan.
- Michigan Fish Contaminant Monitoring Program.

Expected Benefits

Trend monitoring, data analysis, and development and refinement of fish consumption advisories.

Rationale for Selection

Recent data indicate that the mercury levels in walleye 15 to 18 inches in length from the AOC exceed the fish consumption advisory level of 0.5 mg/kg. The mean value of mercury in fillets (with skin) of five fish sampled from the Lower Scott Flowage was .56 mg/kg. Mercury levels in rock bass were lower than previously detected, resulting in a less stringent fish consumption advisory. Similarities in mercury concentrations in fish in and above the AOC may indicate natural background concentrations, atmospheric deposition or both. For additional information see: *Chapter III - Environmental Quality Recommendations.*

Like mercury, PCB fish consumption advisories may be primarily due to sources outside the AOC, or to larger fish species moving in and out of the Fox River and Green Bay.

Composite fillets of three carp obtained from the Lower Menominee River in 1991 and analyzed by WDNR had a dioxin (equivalency) total of 8.42 parts per trillion (ppt) which is near the consumption advisory level of 10 ppt (WDNR, unpublished data, 1992). As noted (and corrected) in the Stage I RAP, a carp fillet obtained from the AOC in 1985 had a dioxin detection of 17 ppt.

Estimated Cost and Funding Source(s)

Included as part of existing surveillance and monitoring programs.

Evidence of Commitment

The Green Bay and Fox River Mass Balance Study included quantification of the load and type of PCBs entering and leaving Green Bay. PCB sources analyzed included atmospheric, in-place pollutants, and PCB loading from tributaries, including the Menominee River. PCB water column concentration obtained as part of the mass balance in Green Bay tributaries October 1988 through September 1990 is summarized *Chapter III - Environmental Quality Recommendations, Fish Consumption Advisories.* In addition, WDNR assessed dioxin levels in fish from the AOC in 1991.

Implementation Steps and Schedule

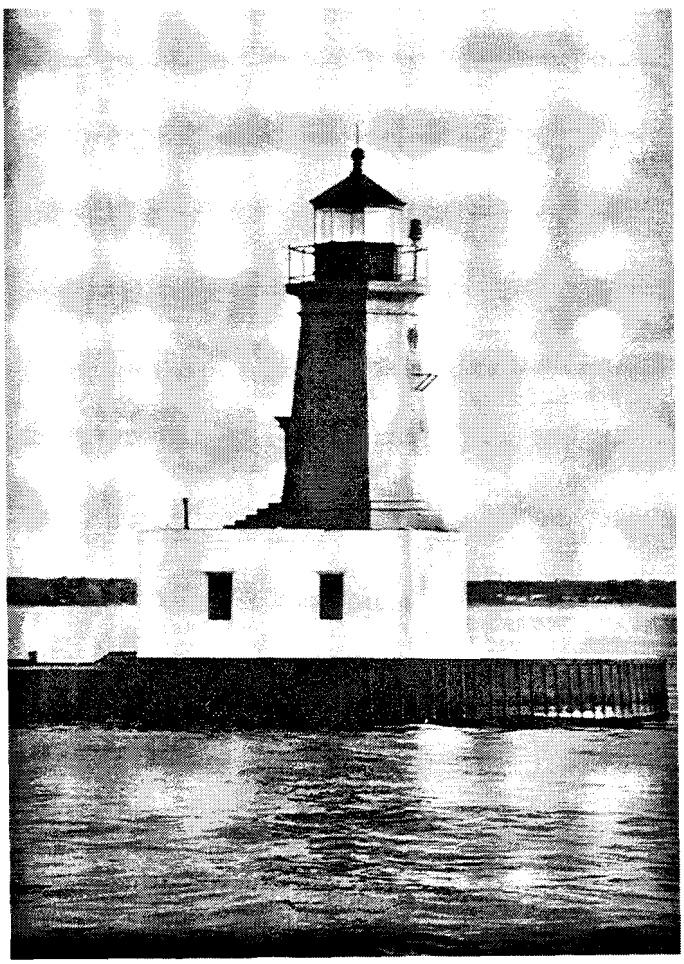
Ongoing monitoring and assessment recommendations for mercury, PCBs, dioxin and other toxic substances should be included in applicable Areawide Water Quality Management Plans (basin plans), enforcement activities and in the issuance and renewable of wastewater discharge (NPDES) permits.

Relative Priority

Medium

RAP Goals and Objectives Addressed (See Summary)

Goals: A, B
Objectives: 1, 2, 3, 4, 5, 6, 11, 15, 17



The Menominee Lighthouse, an area landmark, guards the mouth of the Menominee River in Green Bay.

APPENDIX I - GOVERNMENT INVOLVEMENT IN THE RAP

FEDERAL

U.S. Environmental Protection Agency (U.S. EPA)

- Resource Conservation and Recovery Act (RCRA, PL 94-580) 1976

  Establishes guidelines for treatment storage and disposal of hazardous wastes.

- RCRA Section 3008(h) 1984

  Establishes a Corrective Action Program which includes facility investigation, corrective measures study and corrective measures implementation.

U.S. Army Corps of Engineers (COE)

- Regulates dredging operations in federal navigable waters.

- Section 404 Clean Water Act requires permits for wetland filling operations.

STATE

Wisconsin

Wastewater Management

Treatment Systems and Sanitary Sewers

Wisconsin Department of Natural Resources (WDNR) - Ch. 144 and 147 Wis. Stats., NR 110 and 114, Wis. Adm. Code.

> Requires approval of plans for treatment facilities (WWTPs) and sewer systems (interceptors and collectors), certification of operators.

Wastewater discharges to surface water and land, WDNR Ch.147 and 160, Wis. Stats., NR 200 -299, 102, 104 - 106, 140, Wis. Adm. Code.

> Regulates wastewater discharges through the Wisconsin Pollution Discharge Elimination System (WPDES). Regulations address categorical limits for industrial categories, water quality based effluent limits, waste load allocation process, water quality certification and regulations for land disposal.

Industrial and commercial discharges to municipal treatment plants, WDNR Ch.147 and 144 Wis. Stats., NR 202, 211, 220-297, Wis. Adm. Code.

> Requires pretreatment programs for certain industrial and commercial dischargers to larger municipal wastewater treatment plants. Establishes effluent limits and monitoring requirements for certain types of industry.

Stormwater Management

Federal regulations requiring permits for certain categories of stormwater discharges became effective November 16, 1990. The regulations address point sources of stormwater discharges and emphasize the use of best management practices (BMPs) to prevent contaminants from getting into stormwater. Incorporated areas over 100,000 in population and certain types of industrial entities and activities are required to apply for permits.

The Department of Natural Resources will be the permitting authority in Wisconsin. Permits may include numeric limits. Management practices to prevent pollutants from entering stormwater could range from performing industrial activities indoors or under cover, using educational and spill prevention programs, installing detention basins, increasing street sweeping, incorporating fertilizer, developing pesticide and pet waste control ordinances and reducing air pollutant emissions.

Private Wastewater Systems and Waste Disposal

Wisconsin DNR and Wisconsin Department of Industry, Labor and Human Relations (DILHR)

DILHR - Ch. 145 and Ch. 236, Wis. Stats., DILHR 83 and 85, Wis. Adm. Code

Regulates siting, design, installation and inspection of on-site treatment systems for private wastewater systems and waste disposal.

WDNR - Ch. 146, Wis. Stats., NR 113 and 206, Wis. Adm. Code

Regulates holding tank maintenance and waste disposal activities. Regulations also apply to land disposal of domestic wastewater.

Wisconsin Fund

WDNR - Ch. 144, Wis. Stats., NR 128, 160, Wis. Adm. Code

Provides cost-sharing for planning and construction of publicly owned treatment works as well as cost-sharing for replacement of failing private sewer systems.

Polluted Runoff Management

Wisconsin Priority Watershed Program

WDNR - Ch. 144, Wis. Stats., NR 120, Wis. Adm. Code

Wisconsin's Nonpoint Source Water Pollution Abatement Program (Priority Watershed Program) provides cost-sharing and technical assistance for agricultural and urban NPS management.

Soil and Water Resources Management

WDATCP - Ch. 92, Wis. Stats., AG 160, Wis. Adm. Code.

Provides county funding for technical assistance: water quality, soil erosion, conservation compliance and other resource management projects.

Urban Stormwater and Construction Site Erosion

WDNR - Ch. 144, Wis. Stats., NR 122, Wis. Adm. Code:

Provides model ordinances and management procedure handbooks to local governments for implementation. As part of priority watershed programs urban NPSs are inventoried, cost sharing may be provided and construction erosion control ordinances are required at the local level.

Water Resources Management

Water Quality Standards

WDNR - Ch. 144, Wis. Stats., NR 102 - 106 and NR 299, Wis. Adm. Code.

Provides water quality criteria and standards for surface water based on use categories and pollutant characteristics

Groundwater Quality

WDNR - Ch. 160, Wis. Stats., NR 140, Wis. Adm. Code.

Establishes groundwater quality standards and procedures for their application.

Water Resources Planning

WDNR - Ch. 144, Wis. Stats; NR 121, Wis. Adm. Code:

Provides for state water quality management plans including sewer service area plans, areawide water quality management plans and nonpoint source watershed protection plans.

Water Management and Conservation

WDNR - Ch. 144, Wis. Stats., NR 142, Wis. Adm. Code:

Protects and promotes the conservation of the waters of the state; provides for the management through the development of a statewide water quantity resources plan; requires registration of major water withdrawals and WDNR approval for major inter-basin diversions and consumptive uses of water.

Sediment Quality Criteria

WDNR - Ch. 144 Wis. Stats., NR 347, Wis. Adm. Code:

Sediment quality criteria do not exit. NR 347, Wis. Adm. Code applies to removal and disposal of materials from beds of waterways except where exempted by statute. All dredging projects require review under NR 500-522, Wis. Adm. Code for disposal of dredge material under the Solid Waste Management Program and NR 181, Wis. Adm. Code, if the dredged material meets hazardous waste criteria.

Water Regulation and Zoning

Modifications to Navigable Waters

WDNR - Ch. 30 and 31 Wis. Stats., NR 300 - 340, Wis. Adm. Code:

Regulates modification of navigable waters and shoreline modifications including dams, bridges, withdrawals, etc.

Dredging

WDNR - Ch. 30 and 147, Wis. Stats., NR 346, Wis. Adm. Code:

Regulates dredging activities. Dredge materials are prohibited from being disposed of in open water.

Shoreline and Wetland Zoning

WDNR - Ch. 59, 61, 62, Wis. Stats., NR 115 and 117, Wis. Adm. Code.

Provides assistance for the preparation and implementation of floodplain regulations for Wisconsin municipalities. Requires county regulation of activities in shore land and shore land wetlands.

Floodplain Zoning

WDNR - Ch. 87.3 Wis. Stats., NR 116 and 129, Wis. Adm. Code.

Requires local regulation of construction in floodplain areas.

Solid and Hazardous Waste Management

Landfills

WDNR - Ch. 144 and 160, Wis. Stats., NR 140, 180 (500-520) Wis. Adm. Code:

Regulates siting, planning, construction, monitoring and closure of solid waste landfills.

Hazardous Waste Management

WDNR - Ch. 144, 160, Wis. Stats., NR 181 Wis. Adm. Code:

Regulates the generation, transportation, treatment, disposal and storage of hazardous wastes.

Spills

WDNR - Ch. 144, 160 Wis. Stats., NR 158, 140 Wis. Adm. Code:

Establishes a state contingency plan of action to minimize damage to the air, land and waters of the state caused by the discharge of hazardous substances.

Management of PCBs

WDNR - Ch. 144, 160, Wis. Stats., NR 157, 140, Wis. Adm. Code:

Regulates the management of PCBs in Wisconsin.

Petroleum Storage Tanks

DILHR - Ch. 101 and 160, Wis. Stats., ILHR 10, Wis. Adm. Code:

Includes leak detection program, plan review, tank inspection, design and construction standards and record keeping.

Environmental Response and Repair

WDNR - Ch. 144 and 160, Wis. Stats., NR 550 - 551 and 140, Wis. Adm. Code:

Inventories and ranks potential contamination sites and provides for remedial action to cleanup pollution at high priority sites. Also provides for the response to abandoned containers of hazardous substances.

Air Management

Ambient Air Quality Standards

WDNR - Ch. 144, Wis. Stats., NR 404, 400 - 494, Wis. Adm. Code:

Provides state ambient air quality standards

Criteria Pollutant Emission Controls

WDNR - Ch. 144, Wis. Stats., NR 400 - 440, Wis. Adm. Code:

Provides for emission control of certain pollutants

Toxic and Hazardous Emission Controls

WDNR - Ch. 144, Wis. Stats., NR 445 - 449, Wis. Adm. Code:

Provides for control of emission of toxic and hazardous pollutants.

Environmental Programs

Industrial Discharge Fees

WDNR - Ch. 144, Wis. Stats., NR 101, Wis. Adm. Code:

Requires industries discharging to water, land, or publicly owned WWTPs to pay fee based on amount and type of discharge.

Wisconsin Environmental Policy Act

WDNR - Ch. 23, Wis. Stats., NR 150, Wis. Adm. Code:

Establishes a policy to assure governmental consideration of the short and long term environmental and economic effects of policies, plans and programs upon the quality of the human environment. Requires environmental assessment to evaluate state funded projects.

Laboratory Certification

WDNR - Ch. 144, Wis. Stats., NR 149, Wis. Adm. Code:

Requires laboratory certification and registration of laboratories conducting testing required by administrative rule.

Natural Resource Management

Fish

WDNR - Ch. 29, Wis. Stats., NR 20 - 26, Wis. Adm. Code:

Provides for assessment and management of fishery by habitat protection, stocking and regulation of sport and commercial fishing.

Wildlife

WDNR - Ch. 29, Wis. Stats., NR 10 - 19, Wis. Adm. Code:

Provides for assessment and management of wildlife by habitat protection and regulation of hunting.

Endangered Species

WDNR - Ch. 29, Wis. Stats., NR 27, Wis. Adm. Code:

Provides for management of endangered species.

Forests

WDNR - Ch. 26, 28, 70, 77, Wis. Stats., NR 30 - 40 and 46, Wis. Adm. Code:

Provides for management of state forests, technical assistance to landowners and tax credits for managed forest lands.

Michigan

Michigan's environmental statutes listed here as separate Acts are now part of the Michigan Compiled Laws and are included in the State of Michigan Natural Resources and Environmental Protection Act (updated through Public Act No. 451 of 1994). A copy of this document is available through the Legislative Reference Bureau, P.O. Box 30036, Lansing, MI 48909-7536. Phone (517) 373-0170.

Surface Water Quality Division

Water Quality Standards

Michigan Department of Environmental Quality (MDEQ) - Michigan Water Resources Commission Act (Act 245, P.A. 1929, as amended), Sections 2 and 5, Part 4:

> Provides water quality standards for the surface waters of the state, to protect public health and welfare, enhance and maintain the quality of water. The water quality standards define parameters and criteria levels necessary to protect a water body for its designated uses.

Water Quality Standards for Toxic Substances

Michigan Water Resources Commission Act (Act 245, P.A. 1929, as amended):

> Establishes allowable levels of toxic substances in surface waters.

Wastewater Management

MDEQ regulates wastewater management activities.

Point Source Discharge Permits

Federal Water Pollution Control Act, PL 92-500; delegated to Michigan in 1973; Michigan Water Resource Commission Act (Act 245):

> Effluent requirements for wastewater discharged to Michigan surface waters are established in National Pollutant Discharge Elimination System (NPDES) permits. The NPDES permits may include: specific authorization to discharge wastewater; effluent limitations and monitoring requirements; industrial pretreatment program requirements, management requirements for sludge and other residuals, combined sewer overflow requirements, emergency situation procedures, operator certification and permit modification procedures, compliance and enforcement measures.

Critical Materials and Wastewater Report

Michigan Water Resources Commission Act:

> Requires all businesses discharging wastewater to lagoons, deep wells, the surface of the ground, surface water, septic tanks, or municipal sewer systems to file a Critical Materials and Wastewater Report annually which specifies

types and volumes of wastewater discharged and a list of materials used in or incidental to its manufacturing process.

Polluted Runoff Control

Nonpoint Source Management Plan

MDEQ - Plan purpose is to improve and protect the states' water resources from impacts of polluted runoff and to achieve water quality standards and desired water uses through the application of best management practices.

Erosion

MDEQ, County - Soil Erosion and Sedimentation Control Act (PA 347 of 1972) Administered by MDEQ through local enforcement agencies:

Established performance standards to be applied at sites falling under the purview of the Act regarding the use of suitable erosion control technologies.

Spills

MDEQ - Michigan Water Resources Commission Act (Act 245, PA 1929 as amended), Oil and Gas Act (Act 61):

Details oil spill containment and emergency procedures.

Contaminated Sediments

MDEQ Surface Water Quality Division is in the preliminary stages of establishing sediment toxicity testing capabilities in its toxicology laboratory to consider the effects of contaminated sediments on biota as well as sediment chemistry in regulations addressing sediment assessments.

Navigational Dredging and Sediment Disposal

MDEQ - Guidelines and Register for Evaluation of Great Lakes Dredging Projects, IJC Report of the Dredging Subcommittee; Interim Guidelines for the Disposal of Great Lakes Harbor Sediment, U.S. EPA 1977; Federal Clean Water Act Section 401(a) and 404(t); Inland Lakes and Streams Act (Act pa 1972); Great Lakes Submerged Lands Act (Act 247 PA 1955 as amended); Michigan Hazardous Waste Codes (Act 64 PA 1979, Hazardous Waste Management Act, as amended).

Dredging projects and dredged material disposal are evaluated according to the programs noted previously. Water quality Standards are applicable during and subsequent to the dredging activity.

Wetlands and Shorelines

Wetlands are protected under several state and federal laws.

MDEQ - Wetland Protection and Management Act (Act 203, PA 1979); shore lands Protection and Management Act (Act 245, PA 1970); Great Lakes Submerged Lands Act (Act 247, PA 1955); Inland Lakes and Streams Act (Act 346, PA 1972); Michigan Environmental Protection Act (Act 127, PA 1970).

Solid Waste and Hazardous Waste

Michigan Solid Waste Management Act

Act 641 of 1978:

MDEQ regulates solid waste.

Hazardous Waste Management Act

Act 64, PA 1979, Michigan Environmental Response Act (MERA, Act 307, PA 1982), Act 307 program:

MDEQ regulates the transport, storage and disposal of hazardous wastes and the response to sites of contamination, respectively. MERA may provide funding on a priority basis for clean up actions.

Management of PCBs (Act of 1976)

MDEQ - Prohibits the manufacture, sale and use of PCBs and regulates their disposal.

Liquid Industrial Waste Haulers Act (Act 136, of 1969)

MDEQ - Manages removal and transport of liquid industrial waste. Provides for control of the disposal and penalties for violation of the Act.

Water Craft Pollution Contract Act (Act 167 of 1970)

Provides for the regulation of disposal of oil and sewage from Water Craft and prohibition of litterways.

Act 230 of 1925

Provides for the protection of fish, game and birds.

Act 203 of 1974 (Endangered Species Act)

Provides for the conservation, management and enhancement and protection of fish, plant and wildlife species endangered or threatened with extinction.

Act 128 of 1985 (Great Lakes Protection)

Provides for the establishment of the Office of the Great Lakes and development of policies and programs on the Great Lakes.

Pesticides

Michigan Department of Agriculture.

Michigan Pesticide Control Act (Act 171, PA 1976):

Specifies the requirements for registration of pesticides, certification and licensing of pesticide applicators and investigations of suspected pesticide problems.

Air Quality

MDEQ - Michigan Air Pollution Act (Act 348, PA 1968):

Establishes air pollution regulations.

Public Health

Fish Consumption Advisories

Michigan Department of Public Health (MDPH):

MDPH provides guidance to the public on ways to reduce their exposure to contaminants from fish.

Drinking Water

MDPH - Sets drinking water standards.

Michigan Safe Drinking Water Act (Act 399, PA 1976) :

> The Michigan SDWA authorized the MDPH to provide for the supervision and control of public water supplies as well as the continuous, adequate operations of privately owned, public water supplies.

REGIONAL

Wisconsin

Bay Lake Regional Planning Commission

Provides contracted planning services for the Marinette area.

Michigan

Central Upper Peninsula Planning and Development

Provides contracted planning services for the Menominee area.

LOCAL

Marinette, Wisconsin

- Urban Stormwater and Construction Erosion ordinances
- Shoreland and Wetland Zoning ordinances
- Floodplain Zoning ordinances
- Sewer Service Area Plan

Menominee, Michigan

- Erosion Control ordinances
- Sewer Service

Marinette County

- Land and Water Conservation Department RAP implementation specialist
- Priority Watershed Project implementation

Menominee County

- Bacteria monitoring of marina by Delta-Menominee Health Dept.

APPENDIX II - RCRA PROCEDURES

A. RCRA Facility Investigation (7 tasks)

Task I - Description of Current Conditions

Task II - Pre-Investigation Evaluation of Corrective Measure Technologies

Task III - RFI Workplan Requirements
- A. Project Management Plan
- B. Data Collection and Quality Assurance Plan
- C. Data Management Plan
- D. Health and Safety Plan
- E. Community Relations Plan

Task IV. Facility Investigation
- A. Environmental Setting
- B. Source Characterization
- C. Contamination Characterization
- D. Potential Receptors

Task V. Investigation Analysis
- A. Data Analysis
- B. Protection Standards

Task VI. Laboratory and Bench-Scale Studies

Task VII. Reports
- A. Preliminary and Workplan
- B. Progress
- C. Draft and Final

B. RCRA Corrective Measure Study (4 tasks)

Task VIII (Identification and Development of the Corrective Action Alternative or Alternatives)
- A. Description of Current Situation
- B. Establishment of Corrective Action Objectives
- C. Screening of Corrective Measures Technologies
- D. Identification of the Corrective Measure Alternative or Alternatives

Task IX: Evaluation of the Corrective Measure Alternative of Alternatives
- A. Technical, Environmental, Human Health, Institutional
- B. Cost Estimate

Task X: Justification and Recommendation of the Corrective Measure or Measures

A. Technical
B. Human Health
C. Environmental

Task XI: Reports

A. Progress
B. Draft and Final

The Report shall at a minimum include:

1. A description of the Facility including a site topographic map and preliminary layouts.
2. A summary of the corrective measure or measures including:
   a. Description of the corrective measure(s) and rationale for selection;
   b. Performance expectations;
   c. Preliminary design criteria and rationale;
   d. General operation and maintenance requirements;
   e. Long-term monitoring requirements;
   f. Potential environmental, health and safety impacts.
3. A summary of the RCRA Facility Investigation and impact on the selected corrective measure or measures including:
   a. Field studies (groundwater, surface water, soil);
   b. Laboratory studies (bench scale)
4. Design and implementation precautions including:
   a. Special technical problems;
   b. Additional engineering data required;
   c. Permits and regulatory requirements;
   d. Access, easements, right-of-way;
   e. Environmental health and safety requirements;
   f. Community relations activities.
5. Cost estimates and schedules including:
   a. Capital costs and estimates;
   b. Operation and maintenance cost estimates; and
   c. Project schedule (design, construction, operation).

C. Corrective Measure Implementation (4 tasks)

If necessary, a Corrective Measure Implementation program based on the RFI and CMS is developed:

Task XII: Corrective Measure Implementation Program Plan

A. Program Management Plan
B. Community Relations Plan

Task XIII: Corrective Measure Design

A. Design Plans and Specification
B. Operation and Maintenance Plan
C. Cost Estimate
D. Project Schedule
E. Construction Quality Assurance Objectives
F. Health and Safety Plan
G. Design Phases

Task XIV: Corrective Measure Construction

A. Responsibility and Authority
B. Construction Quality Assurance Personnel Qualifications
C. Inspection Activities
D. Sampling Requirements
E. Documentation

Task XV: Reports

A. Progress
B. Draft
C. Final

APPENDIX III - MENOMINEE RIVER LONG TERM TREND MACROINVERTEBRATE SUBSTRATE ASSESSMENT SUMMARY

Prepared by Lisa Kosmond, 8/22/94

Study Background

In past studies, the diversity and abundance of the macroinvertebrate community has been low. Problems with dissolved oxygen (DO) levels were considered a possible contributor. A 1993 DO study did not reveal DO sags, but showed consistent DO levels capable of supporting a healthy macroinvertebrate community at the study site.

The Lower Menominee River Remedial Action Plan advisory committees questioned if water or sediment chemistries may be the cause of the degraded macroinvertebrate communities found in the AOC (Watermolen, pers. comm., 1994). In past studies, sites 1, 2 and 3 of the present study exhibited elevated levels of metals and organics (Watermolen, pers. comm, 1994). However, the water quality planner in the WDNR Lake Michigan District (1993), suspected that the lack of substrate from historic and current nonpoint source loads of wood chips, sediment and other organic matter contributed to the lack of suitable substrate for macroinvertebrate reproduction and survival (Watermolen, pers. comm., 1994). Arsenic and other contaminants may also play a role in the lack of abundance diversity.

Study Purpose

This study will assess substrate availability in the Lower Menominee River through a long-term trend analysis assessing the presence or absence of macroinvertebrates on artificial substrate samplers every five years during the spring and fall. As Menominee RAP implementation moves forward, macroinvertebrate community composition, structure and abundance may change. This study will document those changes if and when they occur.

Study Design

A pilot of this study was conducted in fall 1993 when artificial substrate samplers were placed at five test sites and one reference site for 4-6 weeks to assess macroinvertebrate use of the available substrate. Test sites were located downstream of dam #3 in the Lower Menominee River and the reference site was upstream of dam #3 in the Upper Scott Flowage. All sites were depositional areas, approximately 3-5 feet deep. One ponar grab sample was collected at each site during substrate sampler pickup (October) to provide a sample of the benthic community only. Conventional parameters were collected, including DO, conductivity, pH and temp. Locational data was also collected using a GPS and compass bearings. During recovery one sampler was missing and was never found. Also, the data sheets for this pilot run were misplaced and are not available. The macroinvertebrate data will still be analyzed.

In spring 1994, the long-term trend study officially began. Artificial substrate samplers consisting of 30 concrete balls approximately 3" in diameter placed in wire cages (10 balls per cage/3 cages per sampler, totalling 30 balls per sampler) were secured to the Lower Menominee River bottom by concrete-filled, five-gallon buckets. One sampler (30 balls) was placed at each of the five test sites and at the reference site previously tested during the pilot. The samplers were placed from May 6 through May 10 and picked up June 25 through 27. These dates were chosen to coincide with seven days following the river's water temperature reaching 4°C (temperature when H_2O density is greatest and bioactivity begins). The pickup dates were chosen based on U.S. Environmental Protection Agency guidance that suggested four to six weeks is the optimal time to leave out artificial substrate samplers for macroinvertebrate analysis (Watermolen, pers. comm., 1994). During sampler recovery, three ponar grab samples were also collected to assess the benthic community only; the number of grabs was increased to reduce test result variability.

The site five sampler was "lost," probably due to heavy wind storms (sites exhibited evidence of recent heavy wind/rain storms). During sampler pickup (June 25-27), conventional parameters (DO, pH, cond., temp) and locational data using the Global Positioning System (GPS) were taken.

The study will be repeated in fall 1994 and data analysis prepared the following spring or when the data are available from UW Stevens Point. The study will be repeated once every five years in the spring and fall to provide long-term trend data on the importance of available substrate for macroinvertebrate establishment in light of the Lower Menominee RAP's progress in setting and meeting nonpoint source sediment reduction objectives.

Continued funding of this study is strongly recommended to track the restoration of beneficial uses in the Lower Menominee Area of Concern.

APPENDIX IV - DISSOLVED OXYGEN & SPECIFIC CONDUCTIVITY LEVELS OBSERVED IN THE SOUTH CHANNEL OF THE MENOMINEE RIVER, WI—1993

Prepared by Dreux J. Watermolen, WDNR Lake Michigan District
- (edited for this report)

INTRODUCTION

Relatively little water chemistry data have been collected from the south channel of the Lower Menominee River. As a result of this concern, Watermolen (1993) and the Wisconsin DNR (1993) recommended that dissolved oxygen levels be assessed in the south channel.

Lake Michigan District staff conducted an assessment of dissolved oxygen levels in the south channel and the results are reported here. Specific conductivity levels are also reported.

METHODS

A Hydrolab DataSonde 3 multi-parameter water quality data logger was placed at mid-channel in the south channel of the Menominee River. The substrate at the sampling location is predominantly clay covered with bark and wood chip deposits.

The sampler was suspended on an aluminum frame at mid-depth in approx. 1 meter of water and anchored by a chain padlocked to two large construction bricks buried in the river bottom.

Temperature, dissolved oxygen (concentration and percent saturation) and specific conductivity were measured. Samples were collected at half-hour intervals for three weeks during the spring (May 5 to 17) and at hourly intervals for three weeks in the fall (August 31 - September 21). At total of 884 and 482 readings were obtained in the spring and fall, respectively.

Data were stored in the sampling unit's data logger and downloaded into a lap top computer. Data analysis was conducted at desk top.

RESULTS

Dissolved oxygen levels ranged from 6.04 ppm (60% saturation) to 10.49 ppm (110% saturation) in the spring and 5.18 ppm (56% saturation) to 9.25 ppm (96.3% saturation) in the fall. The lows occurred at 6:30 a.m. on May 24 and at 7:30 a.m. on September 14 when water temperatures were 13.58° C and 14.5° C, respectively.

Spring concentrations were reported every six hours on the hour for the entire sampling period (e.g., 12:00 am, 6:00 am, 12:00 pm, etc.). A gap in the data resulted from a two-day period in which the sampler was removed from the river for data downloading and recalibration. Fall concentrations were reported every six hours on the half-hour. Dissolved oxygen levels fluctuated a great deal.

Conductivity (specific conductance) ranged from 160 umhos/cm (daily mean = 159 umhos/cm) to 224 umhos/cm (daily mean = 223 umhos/cm) in the spring, with the minimum occurring May 9 and the maximum occurring May 26 & 27. Levels in the fall ranged from 247 um hos/cm (daily mean 246.8 uS/cm) to 309 um hos/cm (daily mean = 309 um hos/cm) on September 20 and September 9, respectively.

DISCUSSION

Daily fluctuations in dissolved oxygen were common, but not surprising as oxygen levels generally rise throughout the day as a result of photosynthesis and then dip in the evening as plant respiration begins. This normal fluctuation likely accounts for the lower levels noted above. No violations of Wisconsin water quality standards for dissolved oxygen occurred during the study period (NR 102, Wis. Adm. Code).

Specific conductivity measurements are indicative of the hard water, slightly alkaline conditions of the Menominee River system.

Additional monitoring is not recommended at this time. However, dissolved oxygen measurements should be taken in conjunction with any future water chemistry or macroinvertebrate work conducted in the river.

ACKNOWLEDGEMENTS

Mary Gansberg
Charmaine Robaidek

REFERENCES

State of Wisconsin. 1989. Wisconsin Administrative Code NR 102. Cr. Register, February, 1989, No. 398, eff. 3-1-89.

Watermolen, D.J. 1993. Upper Green Bay Basin Water Quality Management Plan. Wisconsin Dept. Natural Resources, Madison. 238 p. [PUBL-WR-316-93]

Wisconsin Department of Natural Resources. 1993. Lower Menominee River Remedial Action Plan. Wisconsin Dept. Natural Resources, Madison. 143 p.

APPENDIX V - SEDIMENT DISPOSAL OPTION INVESTIGATIONS

An *Investigation of Disposal Options For Menominee - Marinette Harbor, Michigan and Wisconsin* was prepared for the U.S. Army Corps of Engineers Detroit District by Baker Engineering (1988). Investigation goals were to (a) develop environmentally safe alternatives for treatment and disposal of sediment from the Menominee (River) Turning Basin and (b) estimate the cost of alternative treatment/disposal processes. *This investigation was not completed, nor is it being used in the ongoing RCRA Corrective Action Program.* This study was completed before quality assurance control measures in the Corrective Action Order were established; it is summarized here for information only. The investigation did, however, assess sediment contamination in the Turning Basin as well as identify potential treatment technologies and associated (1986) costs. The study also provides a summary of previous EPA and COE sediment-quality data generated at this site.

The Baker Engineering investigation was limited to assessing the Turning Basin shipping channel's navigable portion. It did not address contaminated sediments in and between the Sixth and Eighth Street Slips. Nor did the study address the contamination source (adjacent arsenic-contaminated soils and groundwater from the Ansul property) that could recontaminate the shipping project area if not addressed. Nevertheless, the investigation provides an extensive ecological assessment of the project area and information concerning remediation alternatives and cost. Cost estimates generated in 1986 for various dredging and treatment options for arsenic-contaminated sediment in the Turning Basin ranged from $4.7 million to $8.4 million. Possible treatments and their estimated costs (per 1986 estimates) are:

- Closed clamshell dredging, followed by disposal at a RCRA-permitted hazardous waste management facility (no treatment of sediment): $8.3 to 8.4 million.
- Treatment of closed clamshell dredge spoils with potassium permanganate and ferric sulfate or alum, followed by disposal in a non-hazardous waste facility: $6.6 to 6.8 million
- Treatment of hydraulic-dredged slurry with potassium permanganate and ferric sulfate followed by sediment/water separation (using gravity, cyclone, or filtration techniques) and dewatering, with subsequent disposal at a non-hazardous waste facility: $4.7 to 4.8 million
- Combined in-situ/post-hydraulic-dredging treatment with potassium permanganate and ferric sulfate followed by sediment/water separation, gravity, cyclone, filtration techniques and dewatering with final sediment disposal at a non-hazardous waste facility: $5.4 million

All dredging would be conducted within the confinement of a sheet-pile curtain wall to isolate the project area. To manage the contaminated sediment in an environmentally acceptable and safe manner, two potential concerns must be addressed:

- Release of volatile toxic arsenical gases (observed during sampling).
- Release of arsenic to the water column.

The latter concern was addressed by proposing installation of a sheet-pile containment wall to confine the dredge area and post-dredging treatment of the contaminated water. Atmospheric release was addressed by proposing to provide safety equipment for the workers in the immediate areas. However, the concern for people living nearby can not be resolved using the same approach.

All the options except in-situ treatment have the potential to release arsenic into the atmosphere. The in-situ treatment alternative has the greatest potential for mitigating arsenic releases to the atmosphere and water column. However, because of the inherent uncertainties in achieving complete treatment of all sediment in an in-situ treatment operation, post-dredging treatment was included to ensure effective treatment of all the sediment. This combination of in-situ and post dredging treatment may be the best alternative to ensure environmentally-safe sediment removal in the Menominee Turning Basin. However, further development and testing of in-situ chemical addition and mixing procedures is required before this or any method can be recommended.

APPENDIX VI - STAGE I RAP CORRECTIONS

Table 8: Stage I Rap Corrections

Page	Corrections
p. 1	- Under "Impaired uses identified in Stage I of the plan (Chapter IV) after "total and partial body contact" add the word "restrictions." - Under "loss of fish and wildlife habitat" delete "and wildlife." - In the next paragraph, starting with, "Both conventional..." add the words "in-place pollutants (contaminated sediments)" after the word "spills," and before the word "and."
p. 2	- Last paragraph cross out the word "September". Also add the words "the impaired beneficial uses" between the words "restore" and "and" on the same page.
p. 6	- Cross out the words "the TAC" in the last sentence.
p. 42	- Add the word "restrictions" after Total and partial body contact.
p. 46	- Second paragraph, first sentence add the words "may not" after the word "there." - Last paragraph has been changed to note that Wisconsin does issue a separate fish consumption advisory for mercury for part of the AOC.
p. 48	- The detection of dioxin in the carp fillet (09/26/85) should be 17.0 (ppt) instead of 1.7 (ppt).
p. 53	- In the second to the last sentence on this page replace the word "bioconcentrate" with the word "biomagnify."
p. 58	- Description of fish tumor study is inaccurate, See Updates - Stage I RAP in the next section.
p. 74	- Second paragraph under Wildlife - The results of contaminant monitoring in waterfowl were not included as Appendix IV.5, see Updates - Stage I RAP, in the next section.
p. 76	- The mean value for total phosphorous (Table IV.11) in the Upper Scott Flowage should be 0.03, not 0.3 as reported.
p. 80	- The mean value for total phosphorous (Table IV.12) at the Hattie Street Bridge should be 0.025, not 0.25 as reported.
p. 84	- Add the following sentence at the end of the paragraph under the heading Sediment Quality Assessment: "All sediment concentrations of in-place pollutants in the following section are on a dry weight basis unless otherwise noted."
p. 85	- Add the words "dry weight" to the end of the description of Table IV.14.
p. 182	- The word "convenient" in the first goal statement should be changed to "conventional."
p. 183	- The first two words of objective number 15 (clean up) should be replaced with "remediate."

APPENDIX VII - MENOMINEE RIVER FISHERIES PLAN EXCERPT

Lower Scott Flowage

Northern pike are the most abundant game fish in this flowage, a 121 acre impoundment between two dams. Rock bass are the dominant panfish, however yellow perch, blue gill, black crappie and pumpkinseed are also present. Additionally, all three species of bullhead (black, brown and yellow) are found. Apparently, self-sustaining populations of walleye, smallmouth and largemouth bass also exist in the flowage, however, dam entrainment may be adversely affecting these populations in upstream reaches. Some channel catfish and lake sturgeon also exist, but population sizes are unknown.

Fish mortality from dam (turbine) entrainment was identified as a concern in the original Lower Menominee River RAP. The average annual mortality rate for northern pike (between three and seven years of age) according to the Fisheries Plan, is 62 percent.

Lower Scott Paper Company Dam to the River Mouth

This 2.5 mile segment contains the most diverse community in the river due to its open access to Green Bay and Lake Michigan. Most species of anadromous salmonids found in Lake Michigan are likely to be found in the Lower Menominee at some time during the year. Chinook salmon, brown trout and steelhead (rainbow trout) are abundant during fall and spring runs. These species are planted annually by WDNR and MDEQ to enhance the fishery in the Lower Menominee River as well as in the adjacent waters of Green Bay.

Rainbow smelt were introduced into the Lake Michigan watershed at the turn of the century. They have since become an important sport, commercial and forage fish. Smelt populations in some of Lake Michigan tributaries, including the Lower Menominee River, have recently appeared to decline. Genetic testing is underway to determine if discrete stocks exist. Other species important to anglers in this area include walleye, yellow perch, black crappie, channel catfish, northern pike and smallmouth bass.

Although not quantified, the walleye population appears to be increasing in the Lower Menominee River. Recent fish collections for contaminant analysis have documented the presence of substantial numbers of adult and juvenile walleye. Because of the contaminants found in some of these fish, the adult walleye likely spend time in Sturgeon Bay or lower Green Bay. Natural reproduction is occurring, but its magnitude and source are unknown.

Michigan DNR has recently begun stocking fingerling walleye at several locations along the Green Bay shoreline in an attempt to reestablish a fishery in Green Bay and its tributary streams. Wisconsin recently began stocking the Great Lakes (or spotted) strain of

Muskellunge in the Lower Menominee River in an attempt to reestablish this fish in its former range. Evaluation of these stocking efforts is needed.

The Lake Sturgeon population in the lower segment of the Menominee River also appears to have increased in the 1980s. Catch statistics from a mandatory sturgeon registration program for the Menominee River show a harvest increase nearly every year starting in 1983, the first year of mandatory registration. In July 1991, the estimated lake sturgeon population in the lower segment (up to the first dam) was estimated to be 893.

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GLOSSARY

A

Abatement: Actions which capture, retain or treat a pollutant at or near its point of origin, prohibiting its downstream transport. Abatement also includes all actions which capture, treat or otherwise control the contaminant of a pollutant after it has been introduced in sewers, drainage ways, waterways or sediments.

Action level: The concentration of a contaminant (in a species) that would trigger the issuance of a fish or wildlife consumption advisory.

Acute toxicity: Any poisonous effect, produced by a single, short-term exposure to a chemical, that results in a rapid onset of severe symptoms.

Aesthetics: Theories or ideas of what is considered beautiful.

Algae: A group of microscopic, photosynthetic water plants. Algae give off oxygen during the day as a product of photosynthesis and consume oxygen at night as a result of respiration. Thus they affect oxygen content in water. Nutrient-enriched water increases algae growth.

Ambient: Refers to the environmental conditions that affect an organism or system, but are not affected by it.

Ammonia: A form of nitrogen (NH_3) found in human and animal wastes. Ammonia can be toxic to aquatic life.

Anthropogenic: Occurring because of, or influenced by, the activities of people.

Area of concern (AOC): Typically an area of the great lakes identified by the International Joint Commission as having serious water pollution problems requiring remedial action. In this plan, the AOC is an inland waterbody.

Areawide Water Quality Management Plans (208 plans): Plans that document water quality conditions in a drainage basin and make recommendations to protect and improve water quality in that basin. A plan must be prepared for each basin in Wisconsin in accordance with Section 208 of the Clean Water Act.

Army Corps of Engineers (COE): See *U.S. Department of Defense (DOD) Army Corps of Engineers (COE).*

Arsenic: A highly poisonous heavy metal. Use of arsenic and its compounds includes insecticides, weed killers and alloys.

Assimilative capacity: The ability of a waterbody to purify itself of pollutants.

ASTM: American Standard for Testing Materials.

Atmospheric deposition: The process through which airborne pollutants or contaminants either settle directly onto surface water or fall onto land and are then transported to a water body via storm runoff.

B

Bacteria: Single-cell, microscopic organisms. Some can cause disease, and some are important in stabilizing organic wastes.

Basin plans: See *Areawide Water Quality Management (208) Plans.*

Basin: See "drainage basin"

Beneficial use: A waterbody use that is protected by a state law called a water quality standard. The beneficial, or designated use of a waterbody identifies the type of aquatic community and functions the water should be able to support, such as a trout fishery, if it were not affected by outside influences, such as human activity. Beneficial uses are uses that maintain the chemical, physical and biological integrity of an ecosystem. See *ecological integrity.*

Benthic organisms (benthos): Organisms living in or on the bottom of a waterbody.

Best available technology (BAT) : Effluent limitation guidelines and standards that represent the best existing performance in an industrial category.

Best Management Practices (BMPs): Pollution controls for nonpoint source water pollution (polluted runoff). BMPs consist of structural, vegetative or management systems that human beings can perform or install to prevent water pollution originating from human activity. Legally, BMPs refer strictly to controls for nonpoint source water pollution.

Bioaccumulation: The uptake and retention of substances by an organism from its surroundings and from its food. Toxic chemicals tend to concentrate in organisms higher up on the chain, such as predator fish, and in people and birds who eat these fish.

Bioassay: A test for pollutant toxicity. Tanks of fish or other organisms are exposed to varying doses of treatment plant effluent. Lethal doses of pollutants in the effluent are thus determined.

Bioavailability: The degree to which toxic substances or other pollutants are present in sediments or elsewhere in the ecosystem to affect or be taken up by organisms. Some pollutants may be "bound up" or unavailable because they are attached to clay particles or are buried by sediment. The amount of oxygen, pH, temperature and other conditions in the water can affect bioavailability.

Biochemical oxygen demand (BOD): A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. BOD_5 is the biochemical oxygen demand measured in a five-day test. Carbonaceous BOD is the result of the same test conducted in a shorter time period. The greater the degree of pollution by organic matter, the higher the BOD.

Biomagnification: A result of bioconcentration and bioaccumulation through which the concentration of a chemical in fish and wildlife tissue increases as the chemical passes up two or more food chain levels.

Biomonitoring: Use of living organisms as "sensors" in water quality surveillance to detect changes in an effluent or water, and to indicate whether aquatic life may be endangered.

Biota: All living organisms in a specified area.

Buffer strips: Strips of grass or other erosion-resisting vegetation between disturbed areas and a stream or lake.

C

Carcinogenic: Cancer-causing.

Categorical limits: The basic levels of treatment required for all point source discharges. For municipal discharges, this is secondary treatment (30 mg/1 effluent limits for TSS and BOD). The industrial level depends on the type of industry and the level of production. Effluent limits more stringent than categorical may be required to meet water quality standards.

Chlorophyll-a: A green pigment in plants and algae indicating their productivity.

Chlorophyta: The "green algae."

Chlororganic compounds (chlororganics): A class of chemicals containing chlorine, carbon and hydrocarbon. Generally refers to pesticides and herbicides that can be toxic. Examples include PCBs and pesticides such as DDT and dieldrin.

Chronic toxicity: Injurious or debilitating effects of long-term exposure of organisms to non-lethal toxic chemicals. An example of chronic toxicity could be reduced reproductive success.

Classification: A category (e.g. warmwater sport fishery, limited aquatic life) assigned to a waterbody as part of a state water quality standard. See *Water quality standard.*

Clean Water Act (Public Law 92-500): The federal law that set national policy for improving and protecting the quality of the nation's waters. The law set a timetable for the cleanup of the nation's waters and stated that they are to be fishable and swimmable. It also required all pollutant dischargers to obtain a permit and meet the conditions of the permit. To accomplish this pollution cleanup, billions of dollars have been made available to help communities pay

the cost of building sewage treatment facilities. Amendments in the Clean Water Act were made in 1977, 1981 and 1989.

Combined sewer outfalls: Sewer outfalls that receive the discharges of both storm sewers and municipal wastewater sewers.

Concentration: The quantifiable amount of chemical in water, food or sediment.

Congeners: Chemical compounds that have the same molecular composition, but have different molecular structures and formula. For example, the congeners of PCB have chlorine located at different spots on the molecule. These differences can cause differences in the properties and toxicity of the congeners.

Consumption advisory: A health warning issued by a public agency recommending that people limit their eating of fish or wildlife from certain areas, based on the levels of toxic contaminants found in the tissues.

Contaminant: A substance that causes a deviation from the normal composition of the environment. Contaminants are not classified as pollutants unless they have some detrimental effect.

Conventional pollutant: Refers to suspended solids, fecal coliform bacteria, biochemical oxygen demand and pH, as opposed to toxic pollutants.

Criteria: See *Water quality criteria.*

D

Designated use: See *beneficial use.*

Detention basins: Holding ponds for temporary storage of stormwater where sediments are allowed to settle out before discharge to receiving waters. They are usually used in association with construction sites or areas of land disturbance.

Dewatering: Removing water (e.g., from contaminated materials, to reduced the total volume of materials to be removed.)

Dioxin (2,3,7,8-Tetrachlorodibenso-p-dioxin): A chlorinated organic chemical which is highly toxic. Dioxins are the unwanted byproducts of combustion, such as that which occurs during waste incineration and from some industrial processes using chlorine, such as bleaching of pulp and paper.

Disinfection: A chemical or physical process that kills organisms which cause disease. Chlorine is often used to disinfect wastewater.

Dissolved oxygen (DO): Oxygen dissolved in water. Low levels of dissolved oxygen cause bad-smelling water and threaten fish survival. Low levels of dissolved oxygen are often due to inadequate wastewater treatment. WDNR considers 5 ppm dissolved oxygen necessary to support a balanced community of fish and aquatic life.

Drainage basin: The area of land from which water drains into a major water body (e.g. the Wisconsin river basin).

Dredging: Removal of sediment from the bottom of a water body.

E

Ecological integrity: A measure of the health of the entire area or community based on how much of the original physical, biological and chemical components of the area remain intact.

Ecosystem: The interacting system of a biological community and its non-living surroundings.

Endangered species: Any Wisconsin species whose continued existence as a viable component of the state's wild animal or wild plant is determined by WDNR to be in jeopardy, based scientific evidence.

Effluent limits: These establish the maximum amount of a pollutant that can be discharged to a receiving stream. Limits depend on the pollutants involved, the water quality standards that apply to the receiving waters, and the characteristics of the receiving waters.

Effluent: Solid, liquid or gas wastes (byproducts) disposed of on land, in water or into the air. In this plan, effluents are generally wastewater discharges.

Emission: A release of any contaminant into the air.

Endangered resource: A natural resource, usually plant or animal, that has been sufficiently depleted, enough for it to be considered in danger of extinction.

Enrichment: Excess nutrients entering a system (e.g., a lake) causing an increase in organic, (typically plant and algae) productivity.

Entrainment: Entrapment.

Environment: All living and non-living things that exist around and can potentially affect an organism or group of organisms.

Environmental Protection Agency (EPA): The federal agency responsible for enforcing federal environmental regulations. The environmental protection agency delegates some of its responsibilities for water, air and solid waste pollution control to state agencies.

Environmental corridor: Environmentally sensitive areas, within sewer service areas, which are not eligible for sewered development. Environmental corridors may include wetlands, shorelands, floodway and floodplains, groundwater recharge areas and other sensitive areas.

Epilimnion: The warmer, surface layer of water in stratified lakes.

Esherichia coli: Bacteria found abundantly in the vetebrate intestine.

Eutrophic: Refers to a nutrient-rich lake or stream. Large amounts of algae and aquatic plants characterize a eutrophic lake. See also *hypereutrophic, oligotrophic and mesotrophic.*

Eutrophication: The process of nutrient enrichment of a water body. Eutrophication can be accelerated by human activity such as agriculture and improper waste disposal.

F

Fecal coliform: A group of bacteria used to indicate the presence of other bacteria that cause disease. The number of coliforms is particularly important when water is used for drinking and swimming.

Federal Energy Regulatory Commission (FERC): The federal agency responsible for renewing hydropower (dam) licenses.

Fisheries Management (FM): WDNR Bureau of Fisheries Management.

Flowage: The waterbody that forms on a river when a dam is built.

Food chain: A sequence of organisms in which each one uses the next one down the line as a food source.

Furans (2,3,7,8-Tetra-chloro-dibenzofurans): Chlorinated organic compounds which are highly toxic.

FWS: See *U.S. Department of the Interior (DOI) Fish and Wildlife Service (FWS)*

G

Genus: A group of organisms constituting one or more species. (e.g., fish that are all "pike" constitute the genus "esox." There are many different species of pike within this genus.)

Groundwater: Water stored below the soil's surface.

H

Habitat: The place or the type of site where a plant or animal naturally lives.

Heavy metals: A group of metals that may be present in municipal and industrial wastes and that may pose long-term environmental hazards if not disposed of properly. Heavy metals can contaminate ground and surface waters, fish and food. The metals of greatest concern are arsenic, cadmium, chromium, copper, lead, mercury, selenium and zinc.

Herbicide: A type of pesticide designed to kill plants, but which can also be toxic to other organisms.

Hydrocarbons: Any of a large class of chemicals containing carbon and hydrogen in a virtually infinite number of combinations.

I

Impaired beneficial use: A detrimental change in the chemical, physical or biological integrity of a surface water, such as degraded water quality or restrictions on fish consumption.

Incineration: Reduction of waste materials through combustion.

Integrity: See *ecological integrity.*

Isopleth maps: Maps used to depict areas of equal sediment depth, water depth or other characteristic.

L

Load: The amount of materials or pollutants reaching a given water body.

M

Macroinvertebrates: Animals without a vertebral column and which are visible to the unaided eye.

Macrophyte: Rooted aquatic plant.

Management: In this plan, refers to the care and tending of a natural resource.

Marginal use: A use that cannot support a fishery or a balanced community of aquatic organisms because of natural conditions (physical, chemical, biological or human activities).

Mass balance study: A study that examines all parts of the ecosystem to determine the amount of toxic or other pollutants present, their sources, and the processes by which the chemical moves through the ecosystem.

MDEQ: Michigan Department of Environmental Quality.

Monitoring programs: Programs to monitor or quantify the existence, transport, effect, and remediation of pollutants or contaminants.

N

National Pollution Discharge Elimination System (NPDES): A federal permit system to monitor and control discharges of wastewater. Dischargers are required to have a discharge permit and meet the conditions it specifies.

Natural resource: Air, water, land and the natural things in or on them that can be considered a source of sustenance for a living organism, or a source of aesthetic or monetary value for a human being.

Natural area: Any place with natural, undisturbed plant or animal communities. Some of these places have been inventoried by the Natural Heritage Inventory Program.

Natural: Not measurably influenced by humans.

Naturally occurring pollutants or contaminants: Those that are widely distributed throughout the natural environment and are the result of or are caused by natural process or phenomena. The contribution of these pollutants or contaminants can be made worse by human activities.

Neoplasia: Condition characterized by any new and abnormal localized cell growth.

NH_3: Unionized ammonia

NH_3-N: Ammonia-nitrogen

NH_4: Ammonium or ionized ammonia

Nitrate, NO_3: A form of nitrogen used by algae. Excessive concentrations result in eutrophication and algal blooms within a waterbody.

Nitrite, NO_2,: Nitrogen dioxide. A form of nitrogen toxic to aquatic life, one which rapidly oxidizes to nitrates.

Non-conventional pollutant: Chemicals that are neither toxic nor conventional pollutants as classified by the EPA and the Clean Water Act.

Nonpoint source water pollution (NPS): Pollution where the sources cannot be traced to a single point such as a pipe, tank or ditch. Nonpoint sources include eroding farm land and construction sites, urban streets and barnyards. Pollutants from these sources combine and reach water bodies through rainfall runoff, snowmelt, irrigation and stormwater runoff. Nonpoint source water pollution can best be controlled by proper land management practices.

NR: Natural Resource, as in Chapter NR 208, Wisconsin Administrative Code.

Nutrient: Chemicals required for life (e.g., nitrogen, phosphorus, iron, carbon, oxygen.)

O

Organochlorines: Organic compounds containing chlorine.

Outfall: A sewer, drain or pipe opening where effluent from a wastewater treatment plant is discharged.

P

PAHs: Polycyclic aromatic hydrocarbons.

PCBs: See *Polychlorinated biphenyls.*

PCDD: Polychlorinated-dibenzo-p-dioxin

PCDF: Polychlorinated-dibenzo-p-furan

Pelagic: Refers to the open-water portion of a lake.

Persistence: The amount of time a chemical remains in the environment in the form in which it was introduced.

Persistent toxic substance: Toxic substances resistant to physical, chemical or biological modification or breakdown into less toxic substances.

Pesticide: Any chemical used for control of specific organisms. Pesticides include insecticides, herbicides and fungicides.

pH: A measure of acidity or alkalinity, measured on a scale of zero to 14, with seven being neutral, zero being most acid, and 14 being most alkaline (basic).

Phenols: Organic compounds that are byproducts of petroleum refining, textile, dye or resin manufacture. High concentrations can cause taste and odor problems in fish. Higher concentration can be toxic to fish and aquatic life.

Phosphorus: A nutrient that in excess amounts in lakes and streams can lead to overfertile (eutrophic) conditions and algae blooms.

Photosynthesis: The process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Phytoplankton: One-celled algae.

Piscivorous: Preying on fish.

Plankton: Tiny plants (including multi-celled algae) and animals (zooplankton) that live suspended in water.

Point source water pollution: Water pollution from a single source, such as a pipe, outfall, tank, pit or ditch.

Pollutant: A substance present in greater than natural concentration as a result of human activity and having a net detrimental effect upon its environment or upon something of value in the environment.

Pollution prevention: Changes in processes or raw materials that reduce or eliminate the use or production of hazardous substances, toxic pollutants and hazardous waste. This does not include incineration, changes in the manner of release of a hazardous substance, recycling of a substance outside of the process or treatment of that substance after the completion of the process.

Polychlorinated biphenyls (PCBs): A group of more than 200 compounds, PCBs have been manufactured since 1929 for such common uses as electrical insulation, heating/cooling equipment, hydraulic equipment and consumer products such as fluorescent lights and carbonless copy paper because they resist wear and chemical breakdown. Although banned in 1979 because of their persistence in the environment, they have been detected in air, soil and water. Recent surveys have found PCBs in every section for the country, even those remote from PCB manufacturers. PCBs are very persistent and accumulate dramatically in the food chain. They have been linked to health problems such as embryo mortality and deformties in wildlife, and are suspected of causing developmental problems in human infants.

Polycyclic aromatic hydrocarbon (PAH): PAHs result from the incomplete combustion of organic compounds due to insufficient oxygen. They are associated with oils, greases and other components derived from petroleum products. They can end up in the bottom sediments of lakes and rivers. Examples of compounds in the PAH group include benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, phenanthrene and pyrene.

Pretreatment: A partial wastewater treatment required from some industries. Pretreatment removes some types of industrial pollutants before the wastewater is discharged to a municipal wastewater treatment plant.

Priority watershed: A drainage area selected to receive state funding to help pay the cost of controlling polluted runoff through implementation of best management practices. Because money is limited, the watersheds selected for funding are those where problems are critical, control is practical and cooperation is likely.

Priority pollutant: Toxic chemicals identified by the federal government because of their potential effect on the environment and/or human health. Major dischargers are required to monitor for all or some of these chemicals when their WPDES permits are reissued.

Productivity: A measure of the amount of living matter which is supported by an environment over a specific period of time. Often described in terms of algae production for a lake.

Public law 92-500: See *Clean Water Act.*

R

RCRA (Resource Recovery Conservation Act): A nationl regulatory system for tracking hazardous wastes and establishing accountability of waste management practices.

Remedial action plan (RAP): A plan designed to restore all beneficial uses to an *area of concern.*

Remediation: Cleanup of a contaminated site.

Runoff: Water from rain, snow melt or irrigation that flows over the ground surface and returns to streams. Runoff can collect pollutants from air or land and carry them to receiving waters. See *nonpoint source water pollution.*

S

Salmonids: A Family of fish (trout).

Sediment: Soil from erosion and other particles suspended in and carried by water. Particles are deposited in areas where water flow slows, such as in harbors, wetlands and lakes.

Sewer service area: An area served or anticipated to be served by a sewage collection system.

Significant: Refers to the statistical probability that the conclusion that is reached is correct (i.e., 95 percent probability or $p < 0.05$ are common expressions of significance).

Slimicide: A substance used to control nuisance organic growth on industrial or other equipment.

Sludge: A byproduct of wastewater treatment; waste solids suspended in water

Soil Conservation Service (SCS): See *USDA Natural Resources Conservation Service.*

Solid waste: Unwanted or discharged material with insufficient liquid to be free flowing.

Sp.: Species

Spills: Contributions of pollutants/contaminants to the Area of Concern as a result of accidental spillage, or improper transport and handling practices and procedures.

Stakeholder: Anyone who lives in a watershed or has land management responsibilities in it. Anyone who represents the major land uses in the watershed. Stakeholders include government agencies, businesses, private individuals and special interest groups.

Standards: See *Water quality standards.*

Storm sewers: A system of sewers that collect and transport rain and snow runoff.

Stress: Physical, chemical or biological constraints that limit the potential productivity of the biota.

Surveillance: Includes specific observations and measurements relative to control or management. A continued program of surveys systematically undertaken to provide a series of observations in time.

Survey: An exercise in which a set of standardized observations is taken from a station(s) within a short time to furnish quantitative or qualitative descriptive data.

Suspended solids (SS): Small particles of solid matter suspended in water. Cloudy or turbid water is due to the presence of suspended solids in the form of silt or clay particles. These particles may carry pollutants adsorbed to the particle surface.

T

Threatened: A species that appears likely, within the foreseeable future, on the basis of scientific evidence, to become endangered. See *Endangered species.*

Tolerance: Refers to the genetically-based resistance of an organism to an environmental stress or combination of stresses.

Total organic carbon (TOC): A chemical parameter used to measure the enrichment of sediment with organic materials. TOC levels can affect the bioavailabity of organic contaminants.

Toxic substance: A substance that can cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological or reproductive malfunctions or physical deformities in any organism or its offspring, or a substance that can become poisonous after concentration in the food chain or in combination with other substances.

Toxicant: An agent or material that can impair a biological system, seriously injuring structure or function, or causing death.

Toxicity: The degree of danger posed by a toxic substance to animal or plant life.

Treatment plant: See *Wastewater treatment plant.*

TP: Total phosphorus

Turbidity: Turbidity is the lack of water clarity usually closely related to the amount of suspended solids in water.

U

Unionid: A large, freshwater mussel. Family Unionidae includes nearly all U.S. freshwater mussels.

Undetectable concentration: The concentration of a substance that is smaller than what can be detected but does not imply a concentration of zero.

USDA Natural Resources Conservation Service (NRCS): Provides technical assistance on planning, site-specific design, and installation and management of soil and range conservation, animal waste and water quality management systems. Conducts special land and water resource assessments and inventories. Cost-share funds for installation of BMPs on private lands are available from some SCS programs. SCS programs include Small Watershed Program, Resources Conservation and Development Program, River Basin Program, Natural Resource Assessment Program, Soil Survey and many others.

U.S. Department of Defense (DOD) Army Corps of Engineers (COE): Oversees construction and operation of large flood control and public water supply reservoirs and conducts water quality monitoring on lakes within its jurisdiction. Regulates in-lake activities and shoreline development. Cooperatively administers wetlands dredge and fill permit program with EPA and Fish and Wildlife Service. Can enforce permit requirements for wetland BMPs or other mitigation measures.

U.S. Department of the Interior United States Geological Survey (USGS): Provides long-term baseline monitoring of water resources (quantity, flow and quality), hydrologic and geologic investigations and data, and special intensive short-term studies.

U.S. Environmental Protection Agency (EPA): A federal agency that administers educational and regulatory programs designed to protect the environment. The EPA works mainly with state,

federal, regional and local agencies on pollution prevention and control efforts. It provides environmental assessments, water quality monitoring, regulations and regulatory oversight, education, planning, technical assistance, grants and loans for pollution control.

U.S. Department of the Interior (DOI) Fish and Wildlife Service (FWS): Oversees and regulates the nation's wildlife resources. Manages national wildlife reserves, enforces federal game and fish laws, cooperatively administers national wetlands program with the Corps of Engineers and the Environmental Protection Agency. Involved in cooperative projects to enhance wildlife habitat and in special studies, especially fisheries investigations.

V

Volatile: Any substance that readily evaporates (e.g., at low temperatures).

W

Wastewater: Water that has become contaminated as a byproduct of some human activity. Wastewater includes sewage, washwater and the waterborne wastes of industrial processes.

Wastewater treatment plant (WWTP): A facility for purifying wastewater. Modern wastewater treatment plants are capable of removing 95 percent of organic pollutants.

Water quality: The condition of ambient water as measured by: fecal pollution that can cause bacterial or viral disease; toxic contamination from industrial chemicals such as chlorinated hydrocarbons and heavy metals (cadmium, lead, mercury); municipal and industrial wastes; and other pollutants.

Water quality criteria: A measure of the physical, chemical or biological characteristics of a water body necessary to protect and maintain its beneficial water use. See *beneficial use.*

Water Quality Management (208) Plans: Plans that document water quality conditions in a drainage basin and make recommendations to protect and improve basin water quality. Wisconsin. A plan must be prepared for each basin in Wisconsin in accordance with Section 208 of the Clean Water Act.

Water quality standard: A state regulation that assigns a formal classification to a waterbody or waterbody segment, based on designated beneficial water uses that must be achieved and maintained as required by the Clean Water Act. The standard sets goals for protecting or improving water quality so that the waterbody supports its designated uses, and identifies the quantitative criteria that must be met to support those uses. See *water quality criteria* and *beneficial use.*

Watershed program: A group of activities undertaken in a geographic area to maintain clean water once it is obtained.

Watershed project: A group of activities undertaken in a geographic area to restore the beneficial uses of a waterbody already affected, degraded or threatened by water pollution.

Watershed: An area of land from which all the water drains (runs downhill) to the same location such as a stream, pond, lake, river, wetland or estuary. A watershed can be large, such as the Lower Wisconsin drainage basin, or very small, such as the 40 acres that drain to a farm pond. Large watersheds are often called basins and contain many smaller watersheds, called subwatersheds.

WDNR: Wisconsin Department of Natural Resources

Wetland: An area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions. Wetlands generally include swamps, marshes and bogs.

Wisconsin Administrative Code: The set of rules written and used by state agencies to implement state statutes. Administrative codes are subject to public hearing and are enforceable.

Whole body burden: The total amount of a contaminant in the tissues of an affected species, measured in mg/kg.

Wisconsin Nonpoint Source Water Pollution Abatement Program: A state cost-share program established by the State Legislature in 1978 to help pay the costs of controlling nonpoint source pollution.

Wisconsin Pollutant Discharge Elimination System (WPDES): A permit system to monitor and control the point source dischargers of wastewater in Wisconsin. Dischargers are required to have a discharge permit and meet the conditions it specifies. This program is delegated to the state from the federal NPDES program.

WRM: WDNR Bureau of Water Resources Management.

WW: WDNR Bureau of Wastewater Management.

WWTP: See *Wastewater treatment plant.*

Z

Zooplankton: Tiny free-floating or weakly-swimming aquatic animals. They form an important food supply for larger aquatic animals.

MEASUREMENTS

acre: 43,560 sq.ft.

cfs: cubic feet per second, a measure of flow in streams

cm/yr: centimeters per year

hectare: 2.471 acres

kgs/day: kilograms per day (measurement of loading)

lbs/day: pounds per day (measurement of loading)

mg/L: milligrams per liter; a unit of measure of concentration generally equivalent to parts per million.

mg/kg: milligrams per kilogram (equivalent to ppm)

mgd: millions of gallons per day; a measurement of water flow.

mLpd: millions of liters per day; a measurement of water flow.

ng/kg: nanogram per kilogram (equivalent to ppt)

ng/L: nanogram per liter; a unit of measures of concentration generally equivalent to parts per trillion (ppt).

ppb: parts per billion; a unit of measures of concentration.

ppm: parts per million; a unit of measures of concentration.

ppt: parts per trillion; a unit of measures of concentration.

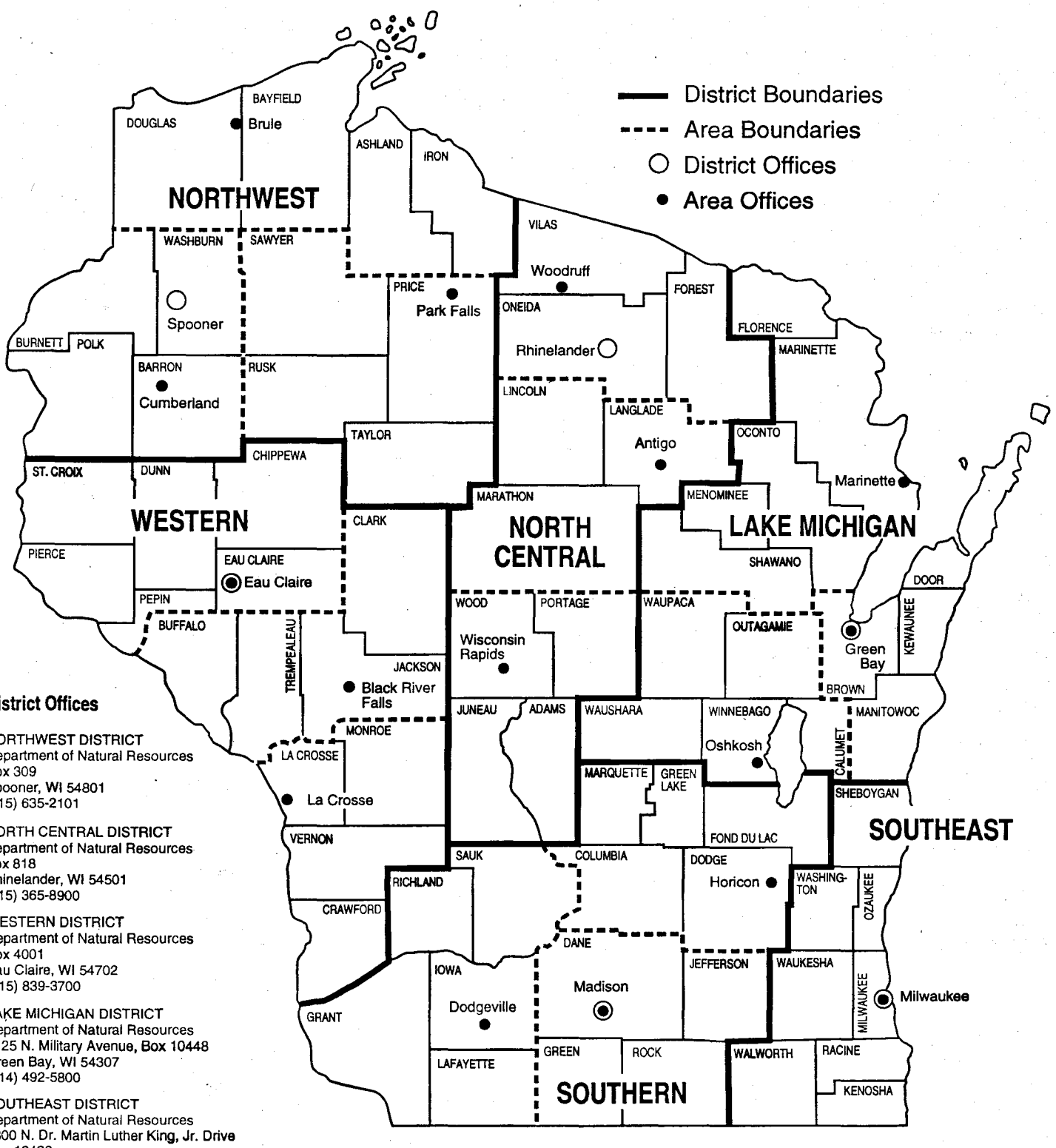
sq. mi.: square mile

ug/kg: micrograms per kilogram (equivalent to ppb)

ug/L: microgram per liter (equivalent to ppb)

umhos/cm^3: micromhos per cubic centimeter. Expression of a substance's (i.e. water) electrical conductivity, usually referenced to 25 degrees Celsius.

DNR Field Districts and Areas



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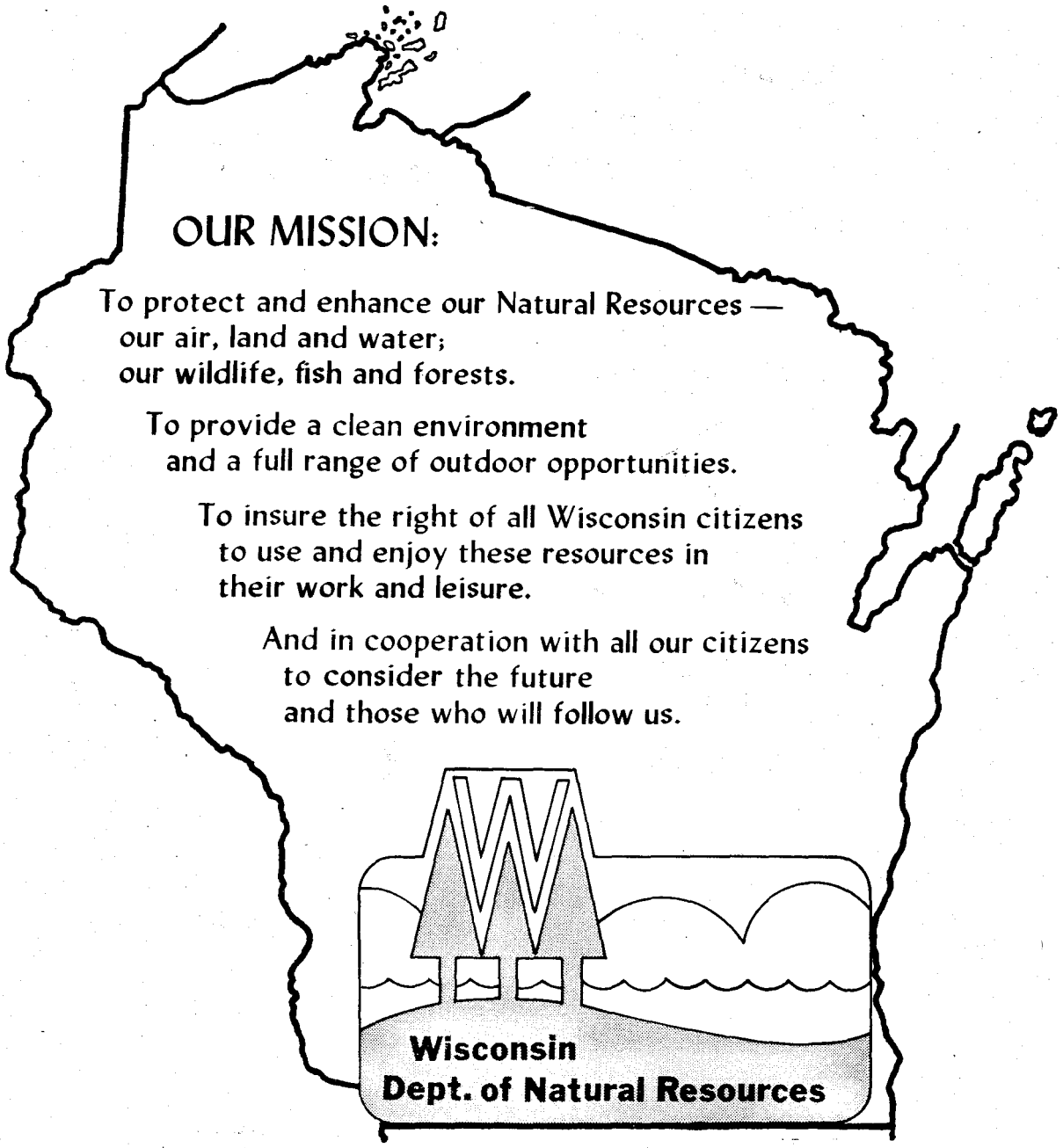

OUR MISSION:

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

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

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

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

Wisconsin
Dept. of Natural Resources