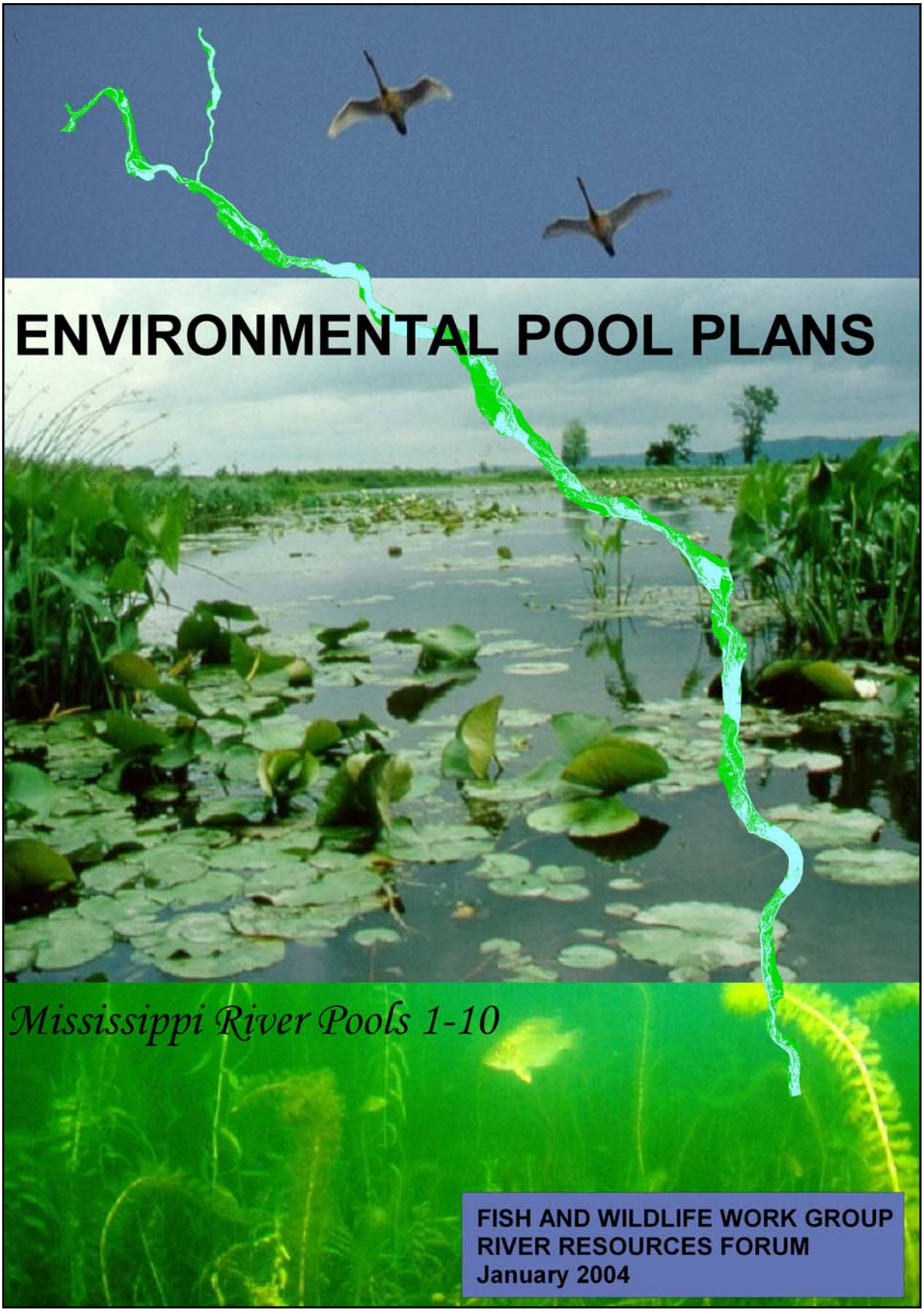

ENVIRONMENTAL POOL PLANS

Mississippi River Pools 1-10

FISH AND WILDLIFE WORK GROUP
RIVER RESOURCES FORUM
January 2004

Mississippi River Pool 7 and Lake Onalaska as seen from the Minnesota bluffs. (Wisconsin Dept. of Natural Resources photo.) (*Front cover photos courtesy of US Army Corps of Engineers and Wisconsin Dept. of Natural Resources.)*

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River Resources Forum Endorsement
August 2003

The attached Environmental Pool Plans were prepared by the Fish and Wildlife Work Group at the request of the River Resources Forum (Forum). The Forum applauds the excellent effort of the work group and especially those individuals that contributed to this product. Preparation of these plans included extensive coordination and input from the public as described in the document.

The plans identify a desired future habitat condition toward which resource agencies and other river interests can strive. The plans will serve as a guide for individual agencies as they carry out their respective missions and seek funding to do so in a way that insures environmental sustainability. The plans are considered to be an environmental concept that the River Resources Forum can reference when considering future projects and activities brought forth by member agencies.

Endorsement of a project or plan by the Forum provides substantial credibility and a collective agency support for the activity as it proceeds through the final approval and implementation process. When endorsing an effort such as the pool plans, the River Resources Forum must consider the multiple resources and values that exist on the river. The Forum's charter and operating principles are based on a balanced approach to river resource management that is in the best interest of the public at large. Recommendations must be within the framework of existing laws and legislative mandates. From that perspective, the Forum has endorsed the environmental plans for Pools 4 through 10 on 27 August 2002, and the plans for Pools 2 and 3 on 29 April 2003. The Forum has not endorsed the Pool 1 plan.

Although the Pool 1 plan may describe a highly desirable environmental condition for the future, it is believed that, realistically, it cannot be achieved without sacrificing or significantly affecting other river uses such as commercial navigation and potentially recreational boating. These are river uses that remain viable in Pool 1. Maintenance of navigation on the river is congressionally mandated.

The Pool 1 plan will be reconsidered for endorsement if substantial changes in river use and laws provide an opportunity to do so.

Backwater channel of the Upper Mississippi River
(Wisconsin Dept. of Natural Resources photo.)

Mississippi River, Pools 1-10, Reach Summary

This document is a result of cooperative efforts among State and Federal agencies and the public to help develop common habitat goals and objectives for the Upper Mississippi River. The desired future was developed on the basis of our current knowledge about the Mississippi River ecosystem, experience with past habitat projects, and observations of river managers, biologists, and members of the public. The document is intended to serve as a communication tool and one of several guides for sequencing habitat management in the St. Paul District of the Corps of Engineers, Pools 1 through 10 on the Upper Mississippi River (project area). The desired future habitat described in this document represents what river managers and the public have identified as the habitat and features necessary to reverse negative trends in habitat quality and move toward a more sustainable ecosystem (Figure 1).

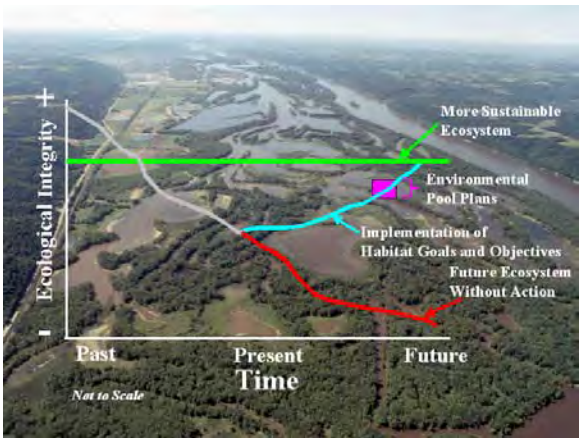


Figure 1. The Environmental Pool Plans establish desired habitat conditions and identify actions to reverse the trend of reduced ecological integrity. Implementation of the Environmental Pool Plans will begin the steps necessary to reach a more sustainable Mississippi River ecosystem.

A variety of funding mechanisms and approaches will be used to complete proposed habitat projects aimed at attaining the desired future conditions. This document will be updated as new information becomes available and technological advances arise. This system/reach/pool/site specific approach to sequencing habitat projects is intended to parallel planning efforts under way for pools in the Rock Island and St. Louis Districts of the Corps of Engineers, and complement the Habitat Needs Assessment.

This document includes sections on:

1. Project cooperators.
2. General description of the project area.
3. Resource issues and detrimental processes or conditions common to all pools in the St. Paul District.
4. Goals, objectives, and strategies for desired future habitat conditions.
5. Information needs.
6. Pool plans for Pools 1 through 10 including:

    a. General description.
    b. Unique attributes, opportunities, and constraints.
    c. Additional objectives.
    d. Summary of proposed actions to meet the desired future.

Project Cooperators

The Environmental Pool Plans were developed by the Fish and Wildlife Work Group, a subgroup of the Corps of Engineers St. Paul District's River Resources Forum. Agency members of the Fish and Wildlife Work Group include representatives from the U.S. Army Corps of Engineers, St. Paul District; U.S. Fish and Wildlife Service; Minnesota Department of Natural Resources; Wisconsin Department of Natural Resources; Iowa Department of Natural Resources; National Park Service Mississippi National River and Recreation Area; and U.S. Geological Survey. Public recommendations were obtained through a series of public meetings held during development of the Environmental Pool Plans.

Description of Project Area

The project area includes 11 pools (1-10, and 5A) within the Upper Mississippi River System (UMRS), from Minneapolis, Minnesota, to just south of Guttenberg, Iowa; the lower 14.7 miles of the Minnesota River; and the St. Croix River upstream to Stillwater, Minnesota. This includes Geomorphic Reaches 1 through 4 as defined by the Cumulative Impacts Analysis for the navigation studies (Figure 2).

Major tributaries entering the project area include, from north to south, the Minnesota, St. Croix, Cannon, Chippewa, Zumbro, Whitewater, Black, Root, Upper Iowa, Yellow, and Wisconsin Rivers. Unique attributes of these tributaries are described in the pool plans.

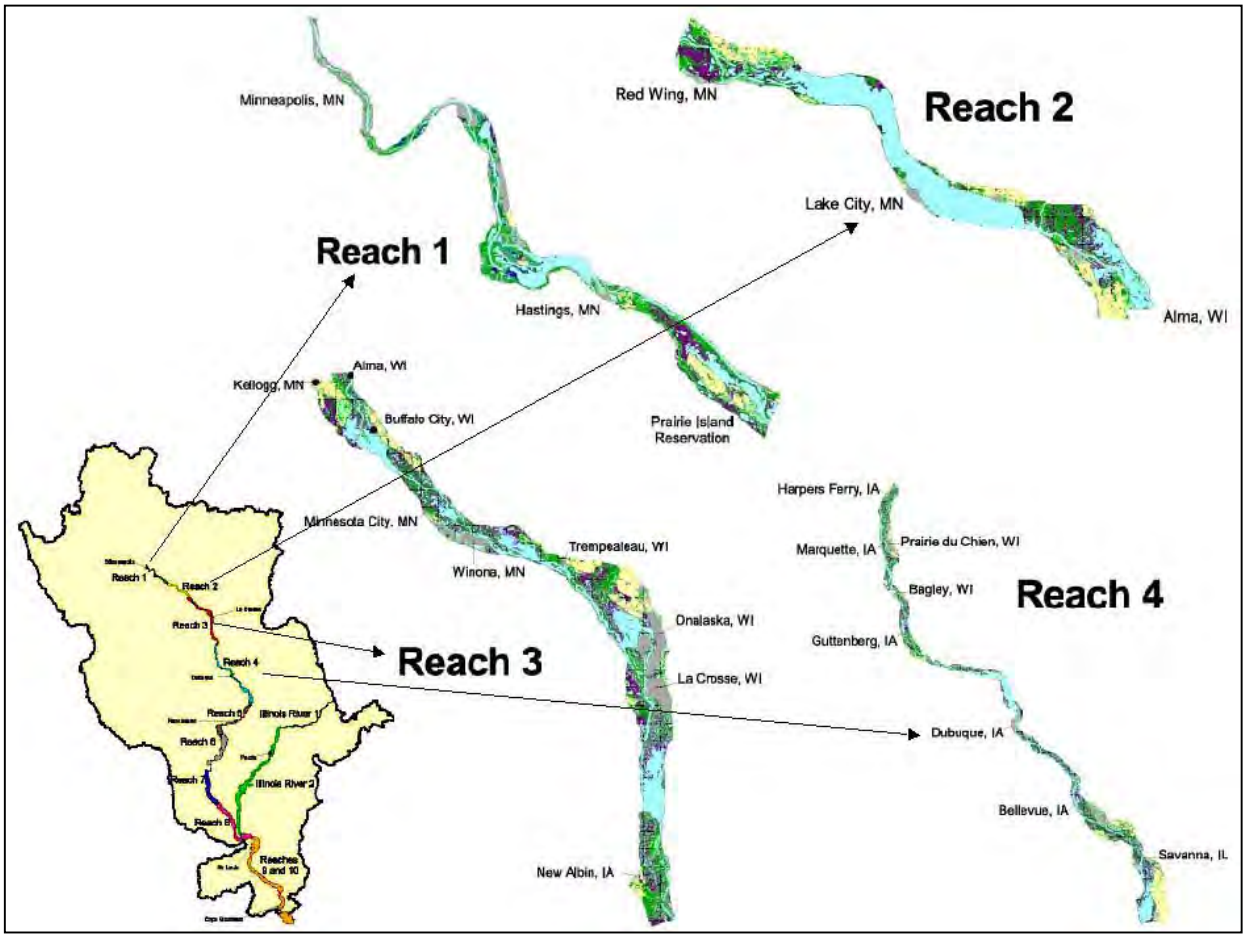


Figure 2. Geomorphic reaches of the Upper Mississippi River (lower left) and geomorphic reaches included in Pools 1-10.

Prior to the construction of the locks and dams, the Mississippi River was a mosaic of braided channels, islands, and wetlands (Figure 3). The basic framework of the Mississippi River was created during the melting of the glaciers 11,000 years ago. Huge amounts of water ran down the valley created by past glaciations. The sediment-laden waters began to build up numerous islands between the bluffs. It was not until the mid-1800's that habitat on the

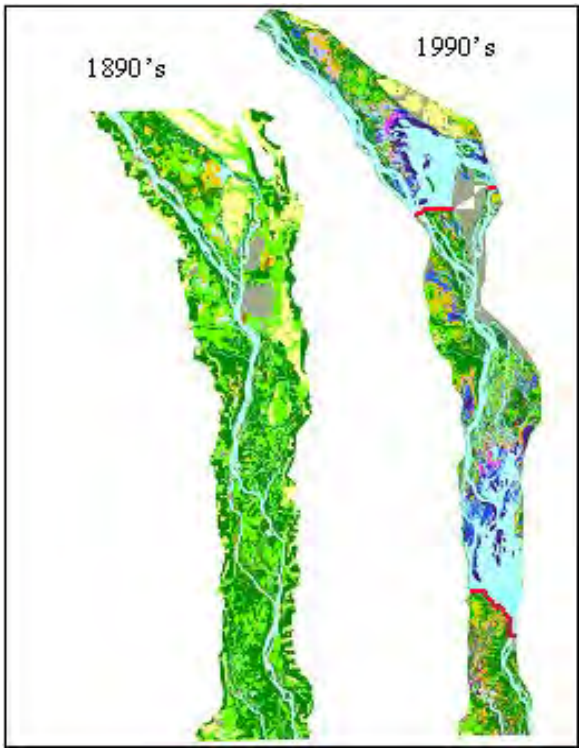


Figure 3. Pools 7, 8 and upper 9, pre-lock and dam (1890) and post-lock and dam (1989).

Mississippi River began to be changed significantly by humans.

The Mississippi River has been altered to meet the demands of humans and to provide for safe river navigation since the early 1800's. The removal of snags and other obstructions began in 1830; wing dams and closing dams were constructed to divert the power of the Mississippi River waters into a single channel to provide first a 4.5-foot channel in 1878 and later a 6-foot-deep channel beginning in 1907; and finally the locks and dams were constructed in the 1930's to create a minimum 9-foot-deep stairway of water from St. Paul, Minnesota, to St. Louis, Missouri.

Construction of the navigation project changed the character of the river between St. Paul and St. Louis. The locks and dams created a series of impoundments, or pools, each named after the dam that creates it (Figure 3). For example, Pool 8 is created by Lock and Dam 8.

There are essentially three different sections, or parts, within each pool. The upper one-third of each pool looks very much like it did before the locks and dams were built (Figure 4). From the air, this area of a pool reveals an intricate mosaic of flowing and dead end channels, shallow water marshes, wetlands and wooded islands, which make up the backwaters of the Mississippi River. When the earthen dikes of the locks and dams were built, some of the backwaters in this portion of the pool were cut off from flowing water.

The middle one-third of each pool reflects a transition area where backwater habitat is giving way to riverine lakes (Figure 5). This diverse area has fewer islands and many more wetlands. Because of the increase in water elevations, soils on many islands in this area are too saturated to support trees and therefore the islands are dominated by grasses. This section of the pool is where the river's current is slowing down and does not have the energy to carry silt and sand

Figure 4. Below the earthen dike, which is part of a lock and dam system, the habitat "looks" similar to what it did pre-impoundment, or before the dams were built.

Figure 5. The middle section of a pool, from the air (left) and on the ground (right).

brought to it from tributaries, causing an unnaturally fast rate of sediment accumulation in backwater lakes.

The most dramatic change has occurred in the lower section of the pools (Figure 6). Here, the water levels were increased the most by dams, flooding the river's valley and creating numerous islands. Islands in the lower third of a pool protect aquatic vegetation by deflecting the river's current and breaking up waves as they roll across large expanses of water immediately above the locks and dams. The lower sections

have been undertaken since the mid-1800's (snag removal, the 4-, 4.5- and 6-foot channel projects). In the 1930's, the project area was transformed from a free-flowing river into a series of impoundments constructed by the Corps of Engineers to improve commercial navigation. These impoundments, or riverine lakes, were created by locks and dams designed to provide a 9-foot-deep channel for commercial navigation by raising and stabilizing water levels of the Mississippi River (Figure 7). The changes in physical and biological features following completion of the locks and dams initially

Figure 6. The lower end of a pool, from the air (left) and on the water (right).

of the pools are also the areas that have been most affected by the stabilization of water levels, which is one factor contributing to a reduction in the diversity and abundance of aquatic vegetation in this section of the pool.

Resource Issues

Several human actions, aimed at improving the Mississippi River for commercial navigation,

benefited some animals because of an increase in acreage of permanent shallow lakes and ponds. Habitat for species adapted to the free-flowing river became restricted as a result of the dams. Habitat for terrestrial species was greatly reduced due to the flooding of thousands of acres of forests and prairies. A few species, particularly migratory fishes and associated mussel species, were adversely affected, if not extirpated, by the disruption of the longitudinal

(upstream and downstream) connectivity of the river system.

Land use practices and the management of the river to improve navigation have also altered many of the river's habitats and natural water flows throughout the floodplain. The habitats

Figure 7. Locks and dams raised and stabilized water elevations on the Mississippi River.

that were initially viewed as enhancements when the dams were completed, such as the impoundments, backwater ponds, and marshes, have undergone a degradation and loss of productivity associated with processes common to reservoirs. For example, sedimentation of channels and backwaters, wind and wave erosion of shorelines, and island loss and dissection have all led to a loss of habitat quality.

The locks and dams and the channel training structures (wing dams and closing dams) have greatly altered the way river waters interact with the floodplain. The locks and dams were designed to impound or hold back water, to raise water elevations for a section of the Mississippi River during periods of low flow, or discharge, such as during a drought. The stabilized water levels, in combination with island loss, have caused a long-term decline in the amount of emergent vegetation in the lower ends of most pools.

These changes to the river system, in combination with water quality issues, commercial and recreational use issues, and exotic species issues, have acted to, and will continue to act to, reduce the productivity and biological diversity of the Upper Mississippi River. The physical and biological interactions influencing the ecosystem of the Upper Mississippi River are complex and not fully understood. However, the following processes and conditions have been identified as contributing factors in the reduction of system productivity and diversity and, unless corrective actions are taken, will continue to affect these system features.

Erosion of Islands: Impoundment of the UMRS increased water levels throughout much of the year. This resulted in permanently flooding the river's valley and creating numerous islands. Islands serve many roles in the Mississippi River's ecosystem. They provide habitat for terrestrial species, and their shorelines provide nesting sites for some aquatic species. Islands in the lower third of a pool protect aquatic vegetation by deflecting the river's current and breaking up waves. The aquatic vegetation located in the protected areas behind islands is used for food by migrating waterfowl and as habitat for other aquatic life.

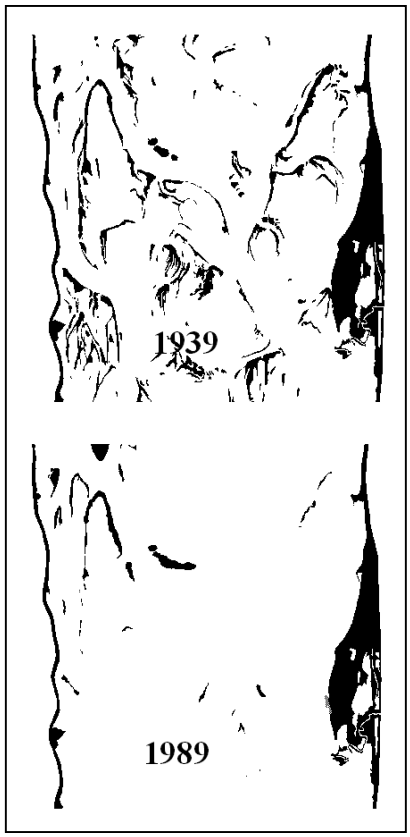


Figure 8. Island erosion in lower Pool 8.

Erosion by waves, ice, and river currents has reduced the number and acreage of islands in the lower section of many pools (Figure 8). When an island is lost due to erosion, the impact is more than just losing land within the river's floodplain; a chain of events begins to occur.

River currents begin to enter the once protected area, uprooting some of the vegetation beds. More vegetation beds are uprooted and lost because of unchecked wave energy rolling across miles of open water. The waves continue to build in size and eventually begin stirring up bottom sediments. Once the sediment is suspended in the water, it blocks out light the underwater plants need to grow.

Islands in the midsection of a pool are also being eroded and causing a different chain of events. Island dissection is a term used to describe areas where channels have formed, or eroded, through an island. This allows for current to enter areas of the backwaters that were formerly free of current. These new channels carry sediment into the backwater lakes, reducing their quality due to sedimentation. This introduction of current can also destroy the value of a backwater lake as an overwintering site for a variety of fish species.

Island erosion has occurred in all of the pools included in this document (Pools 1-10). However, island formation in the form of deltas is occurring in the lower section of a few pools where tributaries enter the Mississippi River.

Excessive Sedimentation of Side Channels and Backwater Lakes (Reduced Bathymetric Structure): Sedimentation, the filling or accumulation of sediments on the bottom of aquatic areas, is a constant physical process occurring on the UMRS. Impoundment of the river has slowed water velocities and thus intensified the process in many backwater areas. Excessive sedimentation of side channels and backwaters has resulted in the loss of valuable fish and wildlife habitat (Figure 9). Side channels have filled or partially filled with sand, restricting flows and eliminating deepwater habitat for riverine fish, including walleye and smallmouth bass.

Sedimentation also affects backwater lakes. Large amounts of fine clay and silt sediments, originating from runoff within the Upper Mississippi River basin, are deposited in areas where river current velocities have slowed. These lake-like conditions allow sediments to be deposited in deeper areas of the backwater, thus flattening the bottom and reducing depth (bathymetric) diversity. Lost are deepwater areas crucial for wintering centrarchids (like bluegill and largemouth bass) as well as diverse water depths to be occupied by various aquatic plants. Sedimentation has also buried large expanses of aquatic plants within backwater lakes, resulting in lost habitat for birds, fish, reptiles, amphibians, and other animals.

Figure 9. Sedimentation of backwaters and side channels has greatly altered some habitats on the Mississippi River.

There are a few locations where sedimentation is creating unique and valuable habitat. Sedimentation is resulting in island formation, in the form of deltas, in the lower section of a few pools where tributaries enter the Mississippi River (i.e., Whitewater River, Pool 5; and Coon Creek, Pool 8). "Delta" type habitat is also being formed due to sedimentation in the midsection of a few pools where side channels leave the main channel of the Mississippi River

and enter backwater lakes (i.e., Weaver Bottoms).

Reduced Flow/Current Diversity: Inundation of the floodplain has reduced the diversity of water velocities on the UMRS, resulting in increased

Figure 10. Sand and mud flats exposed near the Pool 8 seed islands during a water level management event in 2001.

sedimentation, the loss of bathymetric diversity, and loss of aquatic habitats. The loss of islands and filling of channels have also caused water flow to take on widespread "sheetflow" patterns, thus reducing flow and current diversity. This process, combined with factors of sedimentation, wind and wave action, stabilized water levels, and reduced flows through backwaters, has resulted in the loss of aquatic habitat quality.

Excessive Current Scour, Wave Action, and Resuspension of Sediments: During the early years of inundation, backwater lakes of the UMRS were heavily vegetated with giant reed grass, river bulrush, arrowhead, pondweeds, coontail, water lily, and other aquatic plants. Now, many are, or are becoming, windswept riverine lakes lacking significant amounts of aquatic vegetation. A major cause of this change is the adverse effect of wind and wave action on growing conditions for plants. Winds that cross long distances (fetch) of open water create large waves that pound and uproot vegetation that is often lightly anchored in loose bottom sediments. These sediments are lifted off the bottom and suspended in the water column, thus reducing light penetration needed for plant growth. The loss of plant beds and islands lengthens the fetch, and the problem compounds itself. Providing barriers to wind and wave action is a major challenge to river managers when attempting to manage for aquatic vegetation on the UMRS.

Loss/Reduced Sandbar and Mud Flat Habitats: Locks and dams greatly altered sedimentation patterns of the Upper Mississippi River. The free-flowing Upper Mississippi River typically existed as a number of channels that flowed through floodplain forest and associated wetlands. Water flow within the channels and against adjacent islands and shorelines was constantly redistributing sediments within these channels. In some areas, eroding channels and shorelines resulted in the deposition of these materials as sand or mud flats. This was a dynamic process mainly confined to the main channel and larger secondary channels and their shorelines. The formation of sandbars in these locations is influenced by variables such as local geology, landform, hydrology, and climatic conditions.

Completion of the dams and flooding of the river valley greatly reduced the number of mud flats in the river floodplain. Operation of the locks and dams stabilized water levels above each dam and keeps most mud flats submerged year round. Prior to dam construction, water levels varied with seasonal and yearly climatic conditions. The resultant wet and dry cycles would periodically expose sandbar and mud flat habitats, which are used by waterfowl, other waterbird species, and several fish species (Figure 10).

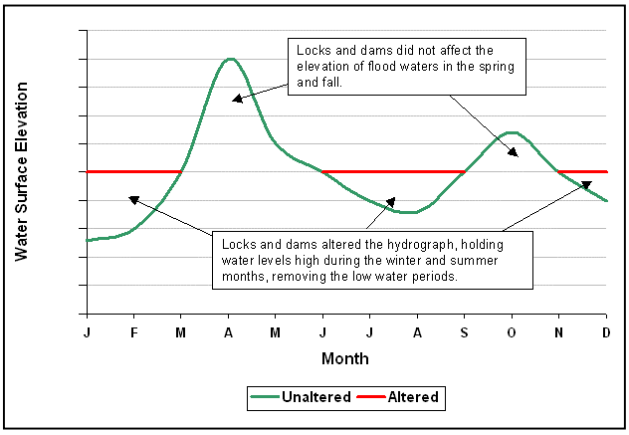


Figure 11. Construction of the locks and dams on the Mississippi River stabilized water levels, eliminating periods of low water during most summers.

Stabilized Long-Term Water Levels (Figure 11): High and more stable water levels within the Upper Mississippi River corridor benefited some fish and wildlife species. For example, many waterfowl species used marsh habitat enhanced or created by increased water levels within the floodplain. However, many of the wetland habitats created or enhanced by the locks and dams have lost productivity since the late 1930's due to continuous inundation and sedimentation. Stabilized water levels have also adversely affected many beneficial functions and attributes inherent in a dynamic river system. Periodic inundation and drying cycles increase the productivity of floodplain habitats. These habitats are typically more productive than permanently dry or flooded areas. As previously flooded soils dry, sediments and organic material increase soil richness. For example, emergent aquatic vegetation beds are more robust and diverse when there are periodic episodes of low water for germination of seeds. When terrestrial and moist soil vegetation becomes established and subsequently flooded, it provides high quality habitat for many fish and wildlife species.

Degraded Natural Function of Tributary Streams and Deltas: Numerous tributaries throughout the reach have been channelized for agriculture and are isolated from their floodplains during most years. These actions have been most common along the tributary mouths in the Mississippi River floodplain and have resulted in increased flood flows downstream, reduced fish passage, reduced assimilation of nutrients, and loss of seasonally flooded habitats. Changing the land use of these floodplain areas will improve natural floodplain processes, reduce flood peaks, and provide seasonal fish and wildlife habitats.

Changes in the Connectivity of Aquatic Habitats: Prior to the locks and dams, much of the water and sediment flowed in relatively well-defined channels. The only time wetlands and lakes (floodplain depressions) were susceptible to sedimentation was during flood events. Some were seasonally flooded, while others were "flooded" at very infrequent intervals. The relationship between backwaters and the main channel has been greatly modified due to dam construction, the placement of dredged material, sediment accumulation behind the dams, and side channel blockages. The primary impact is that the majority of aquatic habitats in Pools 1-10 are now subjected to flows and sedimentation year round. This has altered erosion patterns and caused island dissection, excessive sedimentation, and sediment resuspension throughout many backwater areas, resulting in a degradation of habitat quality.

Locks and dams, side channel closures, wing dams, and other structures have altered the natural distribution of flow across the floodplain. Modifying these structures and constructing other structures (i.e., islands) would improve distribution of flows across the floodplain to improve habitat diversity, help protect areas prone to sedimentation, and return the river to a more natural pattern of sediment movement and deposition.

Loss of Isolated Wetlands: Prior to the locks and dams, many floodplain lakes and ponds were isolated from existing channels during periods of low river flow. These seasonal wetlands were important for a variety of fish and wildlife species and represented a significant component of the pre-lock and dam aquatic area of the pools. The few remaining isolated wetlands are becoming less productive because of sedimentation and succession to other habitat types.

Figure 12. Increased water levels are one reason for a reduction in forest regeneration. Areas once forested are converting to reed canary grass, an exotic species that is more tolerant of "wet" conditions.

Reduced Floodplain Forest and Terrestrial Vegetation Diversity: Much of the existing forest within the Upper Mississippi River floodplain is relatively even aged and composed of relatively few species. They are primarily remnants from near the time of initial impoundment of each navigation pool. Significant portions of the historic forest were commercially logged for wood products or cleared for agricultural purposes prior to construction of the locks and dams. In preparation for inundation by dam closure, large areas of forest were completely removed where trees would have been permanently flooded.

Much of the current forest is not regenerating for a number of reasons (Figure 12). Flat topography, higher groundwater levels caused by impoundment, increased frequency and duration of inundation, reduced creation of new islands and shoreline and subsequent plant succession, and increased competition from reed canary grass and other herbaceous vegetation all affect regeneration. Dutch elm disease has also eliminated most American elm, an old growth component of the Upper Mississippi River corridor. Thus, much of the current floodplain forest is composed of a few highly water tolerant species, such as silver maple. They are now approaching the end of their life span, and a significant younger age class replacement component is missing.

An additional component of the floodplain that is in decline is native prairie. As is the case with floodplain forest, natural prairie areas have been adversely affected by impoundment and changes in floodplain hydrology. Additionally, suppression of fire in the ecosystem has resulted in succession of these prairie remnants to brush and forest habitats. The need for increased management of these sites is urgent. The restoration of a natural fire regime to suppress woody species encroachment on prairies as well as other management activities is needed.

Figure 13. Planting of historic dredged material placement sites is one way to improve the species diversity of floodplain forests.

Figure 14. In 1986, Congress recognized the Upper Mississippi River System "as a nationally significant ecosystem and a nationally significant commercial navigation system." The Upper Mississippi River is also an important recreation area, receiving over 3.5 million visitors a year.

Historic channel maintenance practices resulted in the elevation of some areas adjacent to the main channel through dredged material placement. Although many of these areas are no longer used for placement purposes, they have been slow to revegetate naturally. The increased elevation of these sites, along with the addition of fine material for topsoil, provides an opportunity to restore mast-producing species of bottomland hardwood trees, such as oaks and hickories. These actions improve the overall diversity of the floodplain forest habitat (Figure 13).

Social Issues: The Mississippi River is a diverse ecosystem that is valued by many people in thousands of different ways (Figure 14). For example, the Upper Mississippi River National Wildlife and Fish Refuge, managed by the U.S. Fish and Wildlife Service, has 3.5 million visitors per year. The various social demands placed on the ecosystem sometimes require that management of the Mississippi River's natural

resources include public awareness and input. An example of balancing habitat goals and objectives with social expectations is related to one of the purposes of the Upper Mississippi River National Wildlife and Fish Refuge. A network of Closed Areas/No Hunting Zones has been designated within the Refuge. These areas, when functioning properly, provide safe resting and feeding areas for waterfowl during their fall migration. They also spread out the birds, giving more hunters a chance to experience a quality waterfowl hunt. Improving fish habitat within several of the Closed Areas/No Hunting Zones has been identified in the Environmental Pool Plans. One of the management concerns for these areas is the potential loss of habitat use by waterfowl if increased fishing activity or other human-caused disturbances occur during the waterfowl hunting season. Discussions surrounding human use in specially designated areas, such as Closed Areas, will occur during the development of the U.S. Fish and Wildlife Service's Comprehensive Conservation Plan, which began in 2002.

Desired Future Goals and Objectives

Implementation of the Environmental Pool Plans will result in bringing the Mississippi River's ecosystem closer to a sustainable state by

> A **site** can be at a variety of scales: a 2-acre wetland, backwater complex, pool, reach (multiple pools), or systemic (the entire Upper Mississippi River). For example, some animals may meet all of their needs in a small geographic area (freshwater mussels) or they may require many distinct patches of habitat spread

reestablishing desired habitat structure and function through a series of actions. The following goals and objectives will be met using a variety of "tools" implemented in combinations appropriate for site-specific physical, chemical, and biological conditions. The desire is to reach these goals and objectives through the use of project features that are ecologically self-sustaining, complementary, low maintenance, aesthetic, and work with the river's natural function whenever possible.

Planning guidelines considered during identification of measures to achieve the goals and objectives included the following:

- **The locks and dams will exist for the life of this plan.**
- **Public involvement and awareness is a critical component for implementation of the plan.**
- **Implementation is dependent on adequate funding and personnel.**
- **The reach and pool plans will continue to be revised and updated.**
- **There are social values and issues that will affect habitat management decisions.**

A unique constraint that may be considered during the planning of some projects is the potential to decrease the habitat value of a site due to potential increases in animal disturbance by humans.

Each goal and objective will be implemented to address different physical, chemical, and biological criteria that define habitat characteristics needed for a species' survival. These habitat criteria will be described in detail during the site-specific project planning phase based on unique opportunities and constraints encountered in the project area.

The following goals and objectives identify specific measures that can be implemented in the

St. Paul District's jurisdiction of the Mississippi River's floodplain to address systemic goals and objectives presented in the Upper Mississippi River Conservation Committee's report entitled, "A River That Works and a Working River" (visit the following link to view the report: http://mississippi-river.com/umrcc/pdf/1.pdf).

1. Improve Water Quality

Water quality will be improved through:

- Reducing wave resuspension of bottom sediments.
- Avoiding and minimizing the disturbance of contaminated sediments.
- Increasing the diversity and abundance of floodplain terrestrial vegetation.
- Promoting land use change of tributary deltas.
- Coordinating with watershed initiatives to reduce sediment and nutrient inputs to the Mississippi River.

2. Reduce Erosion, Sediment, and Nutrient Impacts

Erosion, sediment, and nutrient impacts will be reduced through:

- Avoiding and minimizing the disturbance of contaminated sediments.
- Reducing wave resuspension of bottom sediments.
- Providing shoreline protection of eroding sites.
- Increasing the diversity and abundance of floodplain terrestrial vegetation.
- Changing land use in tributary deltas.
- Coordinating with watershed initiatives to reduce sediment and nutrient inputs to the Mississippi River.

3. Return of Natural Floodplain to Enable More Habitat Diversity

A return of the natural floodplain to enable more habitat diversity will be accomplished through:

- Improving natural flow distribution by removing levees to reconnect tributary deltas to the floodplain through acquisition of floodplain lands from willing sellers or conservation easements.
- Protecting, managing, and developing prairie (savanna, dunes, etc.) and wet meadow (marsh) communities.
- Increasing species and age diversity of floodplain forests.
- Raising the elevation of some islands and lands within the floodplain to promote a diversity of terrestrial communities.

4. Emulate Seasonal Flood Pulse and Periodic Low Flow Conditions

Emulation of the seasonal flood pulse and periodic low flow conditions will be accomplished by:

- Evaluating the potential benefits of revised water level management for each pool.
- Implementing revised water level management regimes to provide greater flexibility and range of water levels, particularly lower water levels or scheduled water level reductions.

5. Restore Backwater/Main Channel Connectivity

Management of the connectivity of backwater areas and the main channel to optimize spatial and temporal availability of habitats for floodplain species will be accomplished through:

- Constructing or modifying side channel closing structures, wing dams, and lock and dam dikes to modify flows as appropriate.
- Constructing islands to increase the diversity of velocities within the floodplain and reestablishing backwaters in the lower sections of the pools.

6. Manage Sediment Transport, Deposition, and Side Channels

Management of sediment transport, deposition, and side channels will focus on measures designed to increase the diversity and abundance of aquatic and terrestrial vegetation and increase the diversity of depth, velocity, and substrate types in aquatic communities. This will be accomplished through:

- Stabilizing historic, maintaining existing, or constructing "new" islands at selected locations.
- Increasing depth through dredging or directing flow in selected areas to promote scouring of sediment.

7. Manage Dredging and Channel Maintenance

Management of dredging and channel maintenance activities will be accomplished through implementation of the recommendations contained in the St. Paul District's Channel Maintenance Management Plan (CMMP). The CMMP is an important and flexible tool for accomplishing many of the goals stated here. The utilization of dredged materials for beneficial uses, such as island construction or nourishment, as well as the ability to manage channel flows through modification of existing channel maintenance infrastructure will be an important implementation component of these environmental pool plans.

8. Sever Pathways for Exotic Species

The spread of exotic species will be addressed through:

- Managing floodplain plant communities (forest, grasslands, wetland) to eradicate exotic species.
- Implementing management recommendations to slow or stop the spread of aquatic exotics.

9. Provide Opportunities for Native Fish Passage at the Dams

Providing opportunities for native fish passage at the dams will be accomplished through:

- Identifying lock and dam operation or construction alternatives that will enhance inter-pool movement of fish and other aquatic species.
- Modifying lock and dam operation or construction to provide opportunities for native fish passage.

Information Needs

Several information needs were identified during development of the St. Paul District reach plan. This information is needed to improve understanding of habitat needs for the Mississippi River species and is necessary for implementation of the reach and pool plans.

- Complete fine-scale topographic surveys.
- Complete bathymetric (depth) surveys.
- Complete forest inventory of the floodplain.
- Complete two-dimensional hydraulic models for each pool.
- Characterize substrate for each pool.
- Gather information on the habitat needs and life history requirements for many species as they pertain to the Mississippi River.

The multiple national values of the Mississippi River prompted Congress, in 1986, to declare that the river is "***a nationally significant ecosystem and a nationally significant commercial navigation system***." The Environmental Pool Plans describe what needs to happen to move toward a more sustainable river environment. However, improvement of the river's natural resources is not possible

Next Steps

As referenced in the Desired Future Goals and Objectives section, the Upper Mississippi River Conservation Committee's report entitled, "A River That Works and a Working River" identified components of a strategy for operation and maintenance of the Upper Mississippi River ecosystem. The report concluded with a call for leadership and the identification of increasingly more detailed action steps to implement the strategy. These Environmental Pool Plans represent the Fish and Wildlife Work Group's response to that call. We believe these plans provide a desired state for the Upper Mississippi River ecosystem with sufficient detail to allow river managing partners to move forward with actual implementation actions. The next steps are for each of the project cooperators and partners to contribute to these actions using their respective management authorities, responsibilities, and resources to help make this desired future a reality.

The Fish and Wildlife Work Group will review these plans periodically to keep them updated with current knowledge on resource issues, information needs, and new management opportunities and authorities. All interested parties are encouraged to continue their contribution to this planning and management effort by providing additional comments as they become available. Contact information for the Fish and Wildlife Work Group is available at http://www.mvp.usace.army.mil/rrf/.

Land Cover Definitions for Habitat Maps

The Existing Habitat Conditions maps depict current conditions. The Desired Future Habitat Conditions maps depict one example of possible future habitat conditions for each of the pools. These maps were developed by river managers familiar with these sections of the Mississippi River.

Historic photographs were used as a reference to determine the approximate locations of pre- and post- impoundment floodplain features for: prediction of habitat response (i.e., vegetation establishment potential), improvement in the aesthetic properties of proposed habitat modifications, and identification of potential locations for habitat where it occurred historically. Using the historic data must include consideration of changes that have occurred within the floodplain (bathymetry, velocities, wave fetch, etc.) that may make some areas more suited for a certain community today than in 1939 or 1975. However, these historic images are useful as an aid for visualization of the mosaic of aquatic communities for the desired future.

For the purpose of the plans, the following habitat/land use types have been identified and a description is provided for each. These habitat types match the legends for each Pool's Desired Future Habitat Conditions map. Refer to Figure 15 for an example legend.

Figure 15. Map legend for existing and desired future habitat maps.

Open Water: Open water, shown in dark blue, includes all areas permanently flooded that are deeper than 3 feet. There may be scattered areas of submergent aquatic vegetation in some areas up to 6 feet deep. Open water is found in

contiguous and isolated backwaters, secondary and tertiary channels, the main channel, and impounded areas above the locks and dams. These areas are especially important for fish (particularly sturgeon, paddlefish, blue sucker, and other species that prefer current and deepwater habitats), mussels (fingernail clams, native mussels), and waterfowl (especially diving ducks).

Submergents: Submergents, shown in light green, are found primarily in permanently flooded areas from 1 to 3 feet deep. They are dominated by a diversity of submergent aquatic vegetation with some emergent vegetation in the shallower areas. They are found primarily in contiguous and isolated backwater areas, somewhat in secondary and tertiary channels, and in open water areas above the locks and dams. This habitat type supports a diverse aquatic plant community and is important habitat for waterfowl (especially puddle ducks, geese, and swans), fish, furbearers (muskrat), and amphibians (frogs, snakes).

Emergents: Emergents, shown in medium light green, include more permanently wet areas from zero to 1 foot deep that are dominated by emergent aquatic vegetation. This habitat type is found primarily in contiguous and isolated backwater areas and alongside channel borders. It is especially important for migratory waterbirds (rails, bitterns, terns, ducks and geese, swans, etc.), furbearers (mink, muskrat, beaver, otter, etc.), amphibians (frogs), reptiles (turtles, snakes) and as spawning and nursery areas for fish. Floating leaf plants such as water lily and lotus are included in this habitat type.

Sand/Mud: Sand/mud areas are shown as a mottled brown. The areas delineated on the maps most often are associated with sand deposited by dredging for maintenance of a 9-foot channel depth for navigation. Revegetation of disposal sites is limited without active management, requiring the placement of topsoil and planting the site to grass or trees. Sand and mud flats that are within zero to 1 foot above the water surface are valuable habitat for turtles, loafing waterfowl, and migrating and resident shorebirds. Sandbar areas greater than 1 foot above the water level are important for nesting turtles. These habitats also provide important substrate for pioneering floodplain forest species such as cottonwoods and willow.

Urban: Urban areas, identified in gray, include: cities and other urban communities, rural farms and dwellings, and other developments such as sewage treatment facilities, power plants, airports, etc.

Agriculture: Agricultural areas, shown in yellow, include row cropping and grazed pasture. Some of the desired future maps include yellow and green hatch-marked areas to represent general agricultural areas where land use changes could occur to benefit floodplain habitat, but the exact locations are unknown.

Grasslands: Grassland areas, shown in grey green, include prairies and wet meadows. Prairies are important nesting and feeding areas for many birds (neotropical and resident species), mammals (deer, fox, coyote, badger, etc.) and reptiles (snakes, turtles, etc.). Wet meadows flood frequently and are wet most of the year, providing a diversity of plant types and excellent habitat for waterfowl, amphibians (frogs, salamanders, toads), reptiles (turtles, snakes), furbearers (muskrat, beaver), and fish (spawning and nursery areas for many species).

Forest: Forested areas are shown in dark green. Forests include upland and bottomland hardwoods and are especially important habitat for a variety of wildlife including birds (songbirds, raptors, herons, etc.) and mammals (deer, squirrels, raccoons, etc.).

Terrestrial (forest or prairie) (Desired future maps only): Terrestrial (forest or prairie), shown in medium green, represents areas where vegetation will be planted on islands, or where existing cover types may be converted to a different type in the desired future. Specific plans for plantings will be determined during development of each project.

Cordgrass plants thrive on some meadows. (US Fish and Wildlife Service photo.)

Desired Future Habitat Conditions In Pool 1 Reach, Mississippi River

Description of Pool 1 Reach

Pool 1 Reach includes an impoundment of the Mississippi River resulting from the construction of Lock and Dam 1 (originally known as the Twin Cities Lock and Dam; now also known as the Ford Dam) about 2 miles upstream of Fort Snelling at river mile 847.6. This dam was completed in 1917 and included hydroelectric facilities. Reconstruction took place in 1929 and a second lock was completed in 1933. The dam consists of a 574-foot-long concrete overflow spillway with an inflatable crest. The locks are 56 feet wide by 400 feet long. In 1939, Lock and Dam 1 was incorporated into the 9-foot channel navigation project. More than 2,000 barges pass through the lock annually, carrying over 2 million tons of materials consisting mostly of crude materials and manufactured goods. Over 6,000 recreational boats also use the lock each year. Pool 1 Reach, for the purposes of this plan, includes that reach of river from Coon Rapids Dam at river mile 866.2 to Lock and Dam 1 at river mile 847.6 in St. Paul, Minnesota. This reach includes two other locks and dams (Upper and Lower St. Anthony Falls at river miles 854.0 and 853.9, respectively) completed in 1963 that together allow navigation to traverse the Falls of St. Anthony. Commercial navigation extends above St. Anthony Falls to river mile 857.6. The east and west boundaries of the Pool 1 planning area are the tops of the bluffs along the river gorge on either side of the Mississippi River. Upstream of St. Anthony Falls, where bluffs are absent, the area includes the floodplain of the river and that of its tributaries where they enter the Mississippi River. The Pool 1 Reach area encompasses over 1,500 acres.

All of the Pool 1 Reach area considered for this plan is within the Mississippi National River and Recreation Area, a unit of the National Park system, and the State-designated Mississippi River Critical Area. Both the Federal and State designations cover the same 72-mile corridor from the mouth of the Crow River, at Dayton and Ramsey, Minnesota, (above Coon Rapids Dam) to below Lock and Dam 2 in Hastings, Minnesota. In 1988, Congress conferred the Federal designation in order to preserve and protect the natural, cultural, historic, economic, scenic, and recreational values of this 72-mile stretch of the Mississippi River. The 1976 State Critical Area designation was made for similar purposes.

Unlike most navigation pools of the Upper Mississippi River, the surface water area does not increase significantly above the Pool 1 dam because of the narrow gorge at the downstream end of the pool. Above St. Anthony Falls, the river corridor is wider and the valley walls are lower and less precipitous than they are below the falls, where the river flows through a deep, narrow gorge. While St. Anthony Falls was a barrier to the upstream dispersal of fish and mussels for several thousand years, that barrier was removed when the Upper and Lower St. Anthony Falls Locks and Dams were constructed. However, an effective barrier now exists at the Coon Rapids Dam.

Historic St. Anthony Falls (Ferdinand Reichardt, artist, Minnesota Historical Society.)

Pool 1 Reach is entirely within the Minneapolis/St. Paul metropolitan area and represents a significant corridor of open space and habitat for both aquatic and terrestrial plants

and animals. A large portion of the corridor is publicly owned open space that provides an important north-south wildlife corridor. A mixed species heron rookery, one bald eagle breeding territory, and two peregrine falcon breeding territories are present in Pool 1. Forty-seven species of birds breed in the gorge area, and an additional 100 bird species are known to occur in this corridor during migration.

The public land is regional or local parkland managed by city parks departments for recreation and natural resources, including remnant native plant communities. A variety of agencies and private organizations are working in the gorge and farther upstream in Pool 1 to remove exotic, invasive plant species and restore native communities. The private land is both residential and commercial/industrial in nature, and includes one privately owned nature sanctuary. Private landowners are increasingly interested in restoring their shoreline to a more natural condition.

While there are no major tributaries to the Mississippi River within the Pool 1 Reach area, several creeks contribute flow. Coon, Bassett, Rice, and Shingle Creeks are the most notable of these tributaries.

Description of Pool 1 Reach Subareas

There are three distinct areas within the Pool 1 Reach. These areas, described below, are referenced in subsequent discussions of goals for desired future habitat conditions and actions that would achieve or address those goals.

Coon Rapids Subarea (Coon Rapids Dam to Interstate Highway 694 Bridge (river mile 866.3-860.4)) - The river in this subarea passes through the communities of Coon Rapids, Brooklyn Center, Brooklyn Park, and Fridley. The Coon Rapids Dam has replaced St. Anthony Falls as the upstream barrier to fish movement on the Mississippi River. Many fish species are able to pass through the locks and dams at St. Anthony Falls and reach upstream areas that previously were inaccessible. Below Coon Rapids Dam, river features include three large wooded islands and a rapids from river mile 860.9 to 860.7. Land use on either side of the river is suburban, with a mix of public parks and private residences. Coon Creek enters the Mississippi River at river mile 865.2 and Rice Creek enters at river mile 861.9. Both tributaries deliver sediment to the river. However, Rice Creek is well vegetated along the reach upstream to Long Lake and provides important habitat for migratory birds and other resident urban wildlife. The Rice Creek West Regional Trail follows the creek course to Long Lake Regional Park in New Brighton. Both the cities of St. Paul and Brooklyn Park have water intake structures located in this area, supplying water to a population of over 400,000.

The desired future habitat conditions propose maintaining much of the aquatic habitat in its 1989 conditions.

Present Day St. Anthony Falls (Minnesota Dept. of Natural Resources photo.)

North Minneapolis Subarea (Interstate Highway 694 Bridge to Upper St. Anthony Falls Lock and Dam (river mile 860.4-853.9)) In this area, the river flows through Brooklyn Center, Fridley, and Minneapolis. The upstream portion is characterized by a wooded shoreline, lawns, and high banks through river mile 859. Land use downstream from this point is industrial, commercial, and residential in nature, with more intensive development and more impervious surface than is found upstream. Shingle Creek enters at river mile 857.8. The head of navigation is at river mile 857.6, and an unknown number of islands have been removed

to facilitate navigation by 9-foot draft vessels. The City of Minneapolis water intake structure and treatment plant is located in this area, supplying water to a population of about 500,000. The Riverside Power Plant, owned and operated by Xcel Energy, is located at river mile 857.0.

Some opportunities exist for improving aquatic habitat above St. Anthony Falls by restoring historic rapids, improving connectivity of a small stream and side channel, and building a string of small islands from Boom Island Park upstream to the head of navigation. Improvements to terrestrial habitat could be achieved through actions taken by adjacent landowners to eliminate exotic plants and restore native vegetation along streambanks on public land as well as on privately owned properties, if owners are interested.

Lock and Dam No. 1 and the Mississippi River Gorge (Minnesota Dept. of Natural Resources photo.)

Mississippi Gorge (from Upper St. Anthony Falls Lock and Dam at river mile 853.9 to Lock and Dam 1 (also known as the Ford Dam) at river mile 847.6) - This area encompasses both the Upper and Lower St. Anthony Falls Locks and Dams. Prior to construction of the Ford Dam in 1917, this stretch of the river was primarily rapids that were difficult to navigate and at times impassable. A number of islands divided the historic river, but were removed to accommodate 9-foot draft vessels. For centuries, large blocks of limestone from the collapsing falls created "reefs" and swift, impressive rapids extending 6 to 8 miles below where the falls exist today. Construction of the locks and dams and a concrete "apron" at St. Anthony Falls prevented ongoing erosion and upstream migration of the falls. The Upper St. Anthony Falls Dam is owned and operated by Xcel Energy.

Along this stretch, the Mississippi River drops 73.7 feet, the steepest drop found on the entire length of the river. From the close of the Pleistocene era 12,000 years ago until construction of the locks and dams, this steep, long rapids was one of the most significant ecological features of the Upper Mississippi River, and was the terminus of upriver fish movement. The rapids were critical spawning grounds for a number of river fish, such as sturgeon and suckers of various species. Today, the rapids are submerged and have been covered by sand deposition in the area just above the Ford Dam. Bassett Creek enters the Mississippi River just below Upper St. Anthony Falls Lock and Dam at river mile 654.0 via an underground tunnel. The gorge area is bordered on either side by steep, wooded slopes and rock cliffs. The entire gorge area on both sides of the river is designated as the Mississippi Gorge Regional Park, managed by the Minneapolis Park and Recreation Board (on the west side of the river and on 3.5 miles of the upper east side) and the St. Paul Parks Department (on 2.5 miles of the lower east side). In much of the gorge, buckthorn, honeysuckle, and other exotic plants have replaced the native riparian plant community or are stressing it by shading the forest floor and exposing the soil to erosion. Rock blasted from the rapids to provide a channel for navigation was deposited in and beside the river. Dredged material from ongoing channel maintenance is temporarily placed beside the river at designated locations for beneficial use. Water today extends from wall to wall of the gorge, leaving very little usable shoreline for some wildlife species and for human recreation use.

There is substantial interest in reclaiming the unique habitat provided by the historic rapids. However, the ability to do so in conjunction with operation of the locks and dams (a condition of the Pool Environmental Plans) and hydropower

generation is questionable and would require further evaluation before pursuing any action.

Wooden pilings in Upper St. Anthony Falls Pool, Mississippi River (Minnesota Dept. of Natural Resources photo.)

Unique Attributes, Opportunities, and Constraints

Increasingly, communities along Pool 1 are recognizing the recreational and aesthetic opportunities that the river provides. In Minneapolis, extensive redevelopment is converting industrial sites to residential and business uses, with public parks and access to the river. Some developments include features to help retain storm water, protect water quality, and provide habitat and public open space. Smaller communities, such as Brooklyn Park, have acquired additional parkland along the river and are integrating natural shoreline treatments and native plantings with developed recreation facilities. Regional parks along the river are changing their policies to encourage more natural vegetation along trails and in undeveloped areas. Private landowners are also increasingly interested in revegetating shorelines and planting native vegetation on their riverfront property. In the watershed, groups are working to establish greenbelts along tributaries and restore ecological function. These types of projects along the river, its tributaries, and the watershed are consistent with goals of the Environmental Pool Plan.

Local enforcement of land use standards for the State Mississippi River Critical Area and voluntary policies of the Federal Mississippi National River and Recreation Area can also help achieve goals of this Plan.

The Mississippi River below Coon Rapids Dam to the Interstate Highway 694 Bridge is in a relatively natural condition and has not been modified for navigation. Bald eagle and peregrine falcon nesting territories, warbler migrations, and a heron rookery are examples of this reach's unique natural value in an urban setting.

As noted in the description of subareas, the Mississippi Gorge area is unlike any other segment of the Mississippi River. The opportunity to draw down the entire pool, St. Anthony Falls to the Ford Dam, would expose a rapids area of outstanding spawning value to certain species of fish, including lake sturgeon, suckers, and paddlefish; it would also provide for unique whitewater recreation and outstanding scenic value. River ecologists recognize the unique ecological significance of the rapids, and public meetings on the Environmental Plan for Pool 1 indicated there is broad interest in reestablishing the rapids. Such an action may not be consistent with the underlying Pool Environmental Plan assumption that locks and dams will continue to operate. However, because of the ecological importance of the historic rapids and the extent of public interest, three possible means of restoring the rapids or emulating their function are described below, along with discussion of social, economic, and environmental issues that would need to be considered. These are only three examples—there also may be other ways to accomplish restoration of the rapids should it prove to be a viable project.

Example 1: Conduct a short-term drawdown of the water level during the spring spawning season. There would be significant constraints to taking such an action. Lock and Dam 1 contains an operating hydroelectric plant, and a complete drawdown of the pool would shut down the hydroelectric operation at some cost. It could also be expected that commercial barge navigation would need to be halted for the drawdown period, and there would be costs associated with that action. Material now being

transported by barge into the Minneapolis Upper Harbor would need to be obtained through an alternative means or stockpiled ahead of time. A complete pool drawdown may flush significant accumulated sediment out of Pool 1 and into Pool 2; the impacts of that sediment transport are unknown. The nature of the sediment is unknown, but it may be contaminated. A sediment management plan would need to be implemented to avoid, minimize, or mitigate for any adverse impacts. Reestablishing pre-impoundment water levels in Pool 1 would not include the area upstream of St. Anthony Falls and therefore would not affect the water intakes at the water treatment plant at river mile 857.5.

Example 2: Construct a secondary channel through the gorge, alongside the navigation channel, to mimic the rapids that once existed there and provide for fish spawning and whitewater recreation. This action could be very costly but it might not interfere with commercial navigation or hydropower operation, nor would it flush much of the pool's accumulated sediment. Alternatively, it might be possible to reconstruct the navigation channel to allow the river rapids to flow alongside it.

Example 3: Permanent drawdown of the Pool 1 water level. This could be an option only if commercial navigation through this pool were to end for reasons independent of this pool plan. The Reach Plan states that the locks and dams will exist for the life of this plan, so such an action ordinarily would not be considered in a pool plan. However, the City of Minneapolis plans call for closure of the Upper Harbor terminal at some time in the future. If that were to occur, it would reduce commercial traffic through the gorge. However, the situation in Minneapolis suggests elimination of all traffic is unlikely in the foreseeable future. There would be significant constraints to a permanent drawdown. The potential impacts of sediment transport would be the same as discussed previously with respect to a temporary drawdown. The hydropower use of the dam would be permanently eliminated. The construction materials now transported to Minneapolis by barge would have to be obtained from an alternative source or another transportation mode; the other most likely transport mode would be truck, with impacts on the road system and urban traffic. In addition, if the navigation infrastructure currently found in the Upper Harbor were removed, some or all of it would need to be relocated somewhere in Pool 1, and the environmental impacts of that construction are unknown.

Although these three examples describe highly desirable ecological conditions for the future, they could not be realistically achieved without significant impacts to current river uses such as commercial navigation and hydropower generation. Maintenance of navigation on the river by 9-foot-draft vessels is congressionally mandated, and any plans to restore the rapids would have to be approved by Congress or would have to make provisions for continuance of this use.

Goals for improving habitat conditions in all of the above-mentioned subareas of Pool 1 are consistent with goals for all pools of the Upper Mississippi River System (see Pools 1-10 Reach Plan), as identified by the Upper Mississippi River Conservation Committee. Five primary tasks would be needed to accomplish these goals: 1) promote watershed management programs on tributary streams; 2) manage for more natural water levels by restoring or mimicking the natural range of variations that would occur seasonally; 3) restore native plant communities along the riparian corridor; 4) modify or remove infrastructure no longer essential to the public; and 5) further improve the quality of effluents discharged into the river upstream of and within this reach. Many of these tasks can be accomplished through specific actions discussed in further detail below.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Public meetings held to solicit input on desired future habitat conditions for Pool 1 resulted in numerous comments regarding the importance of improving water quality in this section of the Mississippi River and controlling/eliminating

exotic species. These issues are common to the entire Mississippi River, but are discussed in greater detail here because of the interest expressed by attendees at the Pool 1 public meetings.

1.) Reduce or Eliminate Sources of Pollution

Improvements in water quality over the past two decades have allowed this entire reach of the river to begin recolonizing with aquatic life. Improved water quality has made the river more attractive, and has increased the demand for recreational use as well as redevelopment of abandoned industrial areas for residential and commercial uses.

In the future, it would be desirable to continue improving water quality. Water entering this reach through the Coon Rapids Dam should carry less sediment and nutrients. The river may flood less frequently with improved retention of runoff and land management practices in the watershed. Such improved water quality and flow would reflect a watershed in a sustainable balance with human uses. Wastewater treatment plants upstream of this area should be upgraded to remove phosphorus and organic and inorganic contaminants. These actions would allow water quality to meet or exceed Clean Water Act goals and continue to provide the Twin Cities area with potable water following minimal treatment for pathogens. Management of storm water from suburban and urban areas should include implementation of measures that would eliminate the present connections to sanitary sewers that allow untreated sewage to enter the river and eventually eliminate all direct discharge into the river. Some actions to accomplish this include processing storm water through detention ponds and restored wetlands to remove trash, sediments, and nutrients and reduce the magnitude of runoff into the Mississippi River. Improvement in water and sediment quality could make fish consumption advisories no longer necessary.

As wastewater treatment plants are expanded or permits renewed, effluent standards should be upgraded to include phosphorus removal and removal of hormone-mimicking chemicals from all municipal and industrial discharge to the river. Runoff from farm fields and feedlots treated by filtration through restored wetlands, buffer strips, and modification of drainage systems to retain more water on the land would also benefit water quality in this, and other, sections of the Mississippi River.

2.) Reduce and Eliminate Exotic Species

This reach of river, like other reaches of the Mississippi River upstream of Lake Pepin, supports only a few zebra mussels today. In the desired future, zebra mussels would no longer be imported to this reach by boats or barges because of measures implemented to control the species. The suitability of the river for zebra mussel colonization might be reduced by measures to emulate a more natural river flow regime; this could be done in a manner that would be compatible with lock and dam operation and hydropower generation.

The desired future supports the evaluation and implementation of actions that would control or eliminate other aquatic and terrestrial plant and animal exotic species from the area. Exotic plants are common due to the urban characteristics of the area and use of exotic species in landscaping. Terrestrial habitat could be improved by removing exotic species and planting native species to protect the soils and increase habitat diversity. Many of the aquatic exotic species find their way to the Mississippi River, and Pool 1, through water pathways from the Great Lakes. Options to sever this pathway for aquatic exotic introductions to the Mississippi River should be evaluated and implemented. Tools that may be evaluated to sever the pathway include physical, technological, and/or biological means.

The following list of potential actions is consistent throughout the remainder of the individual pool plans. These actions are interrelated, and specific actions may require overlapping solutions. Maintaining and developing diverse aquatic and terrestrial habitats as well as restoring those natural ecological processes that are critical to river

health are the key to promoting a healthy ecosystem.

3.) Increase Depth Diversity in Channels and Backwaters

A great deal of sediment has been trapped in the pool above Lock and Dam 1. It would be desirable to remove the sediment or release it to expose the rocky substrate of the original riverbed. If the original gradient of the rapids could be restored, sediment would move downriver and no longer accumulate in the gorge area.

Restoration or emulation of historical rapids would improve habitat conditions for a variety of fish and mussel species that once used this area. Recreating the rapids and riffles would restore water depth diversity and promote the scour of accumulated sediment in areas adjacent to recreated rapids. Discussion of some options for recreating the rapids and riffles is presented in some following actions. Many of the options may be possible to implement without compromising social, recreational, and commercial values of this portion of the Mississippi River. The physical features of any rapids above the dam should be reconstructed from natural stone like that removed during construction of the 9-foot channel.

Removal of accumulated sediment in Pool 1 is proposed as an action for the desired future. The sediment could be removed by a variety of measures that would need to be evaluated to determine the best approach (i.e., dredging, island placement, etc.). Another option that should be evaluated for management of sediment in Pool 1 is water level management. The 30 feet of sand that has accumulated above the Ford Dam could be flushed or physically removed from the channel portion of the gorge during water level reductions to expose the natural rocky rapids. To accomplish this, the pool could be lowered using the lock chamber as a bypass channel, or it might be necessary to make the sluice bays in the Ford Dam operational again. Rapids immediately below St. Anthony Falls itself would be "revealed" by lowering the Lower St. Anthony Falls pool.

4.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas in Pool 1 are considered quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

Local enforcement of the State's Mississippi River Critical Area land use standards, parkland acquisition and management, and natural resource stewardship on private lands within the Pool 1 planning area would contribute to a continuous "green" corridor of wildlife habitat and open space. These measures would contribute to a more sustainable river environment, as ecological functions are restored, unique natural resources protected, and regional biodiversity enhanced. Efforts of non-governmental groups, as well as local, State, and Federal agencies, would play a crucial role in protecting and maintaining native plant communities.

5.) Protect and Restore Islands

Islands, created from dredged material and rock, would reduce wave action from commercial and recreational vessels that resuspend bottom sediments and cause shoreline erosion. The islands would provide loafing, feeding, and nesting areas for waterfowl, songbirds, and other species. The shallow protected area between the island and the riverbank would provide a nursery area for fish. The use of natural shoreline materials found in the gorge, such as limestone cap rock and cobble, should be incorporated into island designs.

Several proposed islands are included as part of the desired future for Pool 1. The locations of proposed islands are based on historic islands that have been removed, flooded by water impounded by the dams, or eroded away. Evaluation of the proposed islands should consider restoration to their original dimensions

and plantings of native plant cover where practical.

6.) Manage Floodplain Forests and Prairies for Diversity and Quality

As industrial sites are redeveloped and zoning changes made, the opportunity to restore these areas to functional riparian habitat for wildlife and humans would be possible. In the event that the existing navigation infrastructure is no longer essential or navigation needs are reduced, the infrastructure can be modified or removed to accomplish restoration goals for public recreation and ecological structure and function.

7.) Manage Water Levels to Improve Aquatic Habitat

Historically, the most significant habitat feature of this reach of the Mississippi River was the 6 to 8 miles of rapids that once existed below St. Anthony Falls. This was probably the longest and steepest rapids of the entire Mississippi River. Its existence at the upstream terminus of fish movement made it of particular ecological significance. Many of the river's distinctive fish and mussel species were dependent on this rapids area for successful reproduction. To the extent possible, it would be desirable either to emulate a seasonal flood pulse and periodic low flow conditions or to fully restore these ecological functions. This would permit recolonization by historically present native fish and mussel species. The extent to which the historically occurring steep gradient and range of flows can be realized would depend upon the operation of the locks and dams for commercial barge navigation in this pool, as well as the requirements for hydropower generation at the Ford Dam.

The process used for planning the drawdown of Pool 8, farther downstream on the Mississippi River, was considered very successful, and could serve as a guide for Pool 1. The interagency and citizens Water Level Management Task Force has taken a lead role in the Pool 8 drawdown and is obtaining technical information on how to implement a drawdown project in other pools. This information could be useful in determining whether it would be possible to modify hydropower operations at the Ford Motor Company facility and modify navigation requirements to implement at least a seasonal restoration of the rapids between Lock and Dam 1 and St. Anthony Falls.

8.) Work Cooperatively with Private Property Landowners

There is very little floodplain area in this reach, other than at local parks and some residential properties in Brooklyn Park and Fridley. In the river corridor, industries that are not dependent on the river should be encouraged to evaluate options for relocation as opportunities present themselves. Restoration of former industrial sites would improve terrestrial habitat conditions, and pollutants would be better isolated from the river to protect against accidental spills.
As urban changes take place, options for the removal or setting back of parking lots should be evaluated, and abandoned dredged material disposal sites should be evaluated for removal or capping. These, and other similar actions, would be needed to restore native riparian plant communities and reestablish an ecologically functional corridor. Restored habitat diversity would lead to increased native plant and animal species richness and diversity over time. The river floodplain, slopes, and bluffs throughout most of this reach would provide critical habitat for wildlife, fish, and humans seeking a quiet experience in a unique and natural setting.

The public parks and open space along the river corridor should be managed to both protect the natural resources and improve human recreation opportunities that are compatible with sustaining habitat improvements. Existing efforts of public agencies, neighborhood groups, and non-profit organizations, such as Great River Greening and Friends of St. Paul and Ramsey County Parks and Trails, could be expanded and augmented to accelerate the removal of exotic plants and restoration of native species. A grant program of the Mississippi National River and Recreation Area could provide matching funds for restoration projects, as could grants presently

available through the Minnesota Department of Natural Resources.

Private landowners with an interest in restoring shoreline, floodplain, bluff line, and other plant communities should be encouraged to enhance habitat on their properties, contributing to habitat continuity. Achieving desired future habitat conditions within the Pool 1 area is dependent on private landowners. Programs and incentives should be identified or implemented to encourage landowners to replace exotic plants with native species and establish vegetative buffers that provide more natural habitat, thus contributing to a continuous riparian corridor.

9.) Manage River Floodplain Flows and Connectivity to Improve Aquatic Habitat

This reach of the river does not have the extensive backwater features of other Mississippi River pools and so does not require restoration of backwater connectivity. It is desirable to restore longitudinal connectivity through Lock and Dam 1 to permit the seasonal movement of aquatic life between Pools 1 and 2.

Example Action: *Support Watershed Management Programs.* Conservation stripcropping within the Mississippi River watershed. (USDA Natural Resources Conservation Service photo.)

Restoration of the rapids through Lock and Dam 1 should be evaluated as a method to allow for fish passage through this barrier with greater frequency and ease for the 134 species of river fish that are present below the dam. Historically, more than 40 species of native mussels lived below St. Anthony Falls and 9 species lived above the falls. The ability to restore this fauna is dependent on the presence of various fish hosts that carry larvae upstream. For as long as it is maintained, the Coon Rapids Dam will functionally replace St. Anthony Falls as a barrier to fish movement upstream, and species of fish and mussels will continue to be separated by this barrier. From a geologic perspective, the falls at St. Anthony was gradually retreating upstream and diminishing in size over time. In the absence of human intervention, at some point it would no longer have been a barrier to fish movement into the headwaters of the Mississippi River. In this sense, it would not be inconsistent with natural processes if species were to mix should the Coon Rapids Dam no longer serve as a barrier at some time in the future.

10.) Support Watershed Management Programs

The Environmental Pool Plan for Pool 1 calls for support of river corridor and watershed management programs that would regulate and encourage good land use practices that will reduce sediment and nutrient inputs into the Mississippi River. The State's Mississippi River Critical Area land use regulations, implemented by local governments, provide standards to guide land use and development along the metropolitan Mississippi River. These State standards are adopted and promoted by the National Park Service, Mississippi National River and Recreation Area, in its work with communities. Well-conceived, multi-disciplinary watershed management efforts, such as the Chain of Lakes Clean Water Partnership (of Minneapolis), are desirable throughout the corridor. Urban sewage treatment, sustainable agricultural use, and storm water retention and treatment are all essential components of this management program.

Sediment loading from Shingle Creek, Rice Creek, and Coon Creek watersheds will be reduced by restoration of wetlands that collect and process storm water, releasing it at a slower rate. A buffer zone of native plant communities will intercept sediment and nutrients flowing from urban streets and lots and will exist on both

riverbanks and extend up all tributary creeks. A canopy of native plants protecting the soil will reduce localized erosion in riparian areas and provide a shaded greenway connection to the

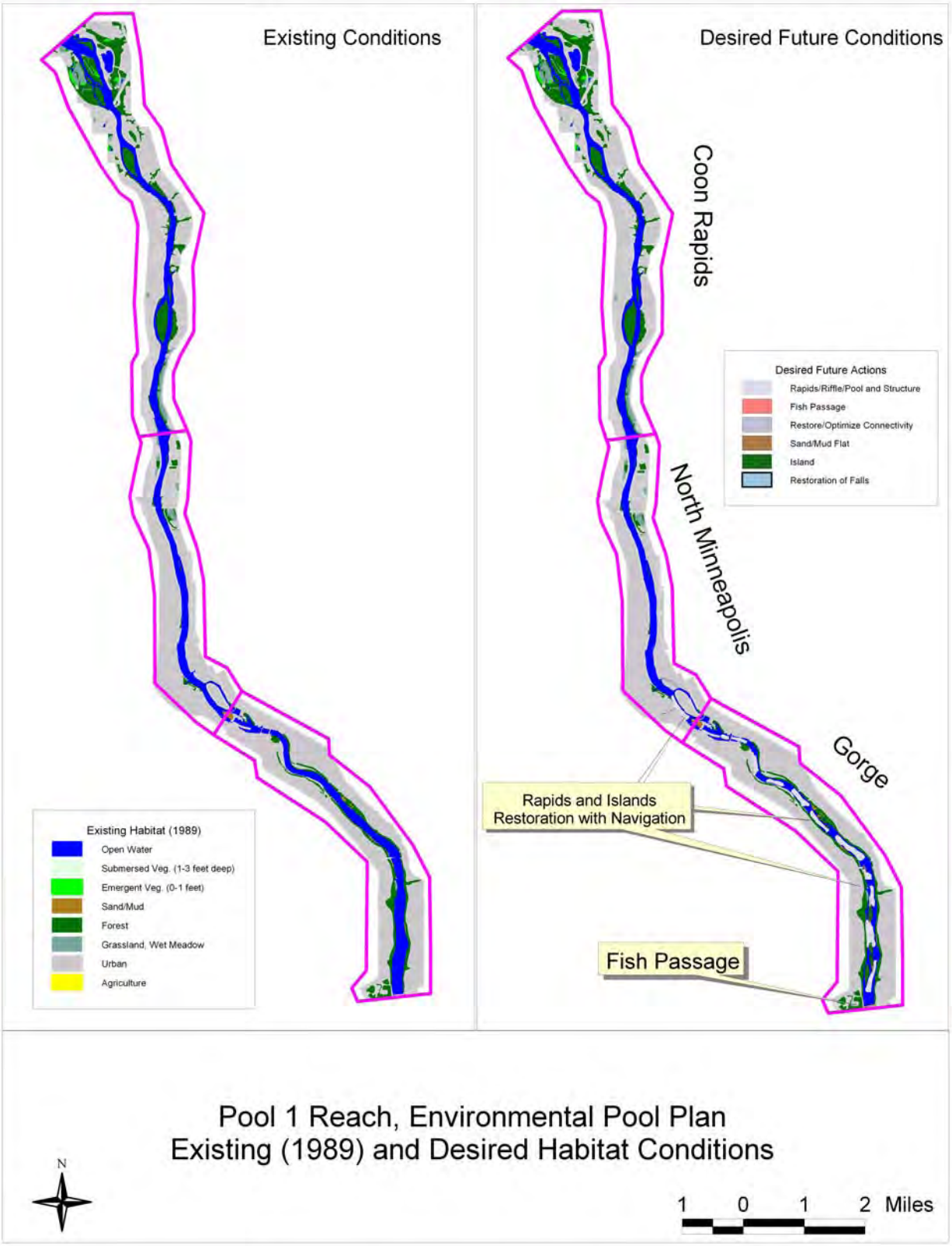
Example Action: *Support Watershed Management Programs.* Bank stabilization work at Halfway Creek above Holmen, WI. (US Fish and Wildlife Service photo series.)

Mississippi River. It would be desirable for boaters and other surface water users to voluntarily modify their use of the river in order to reduce bank erosion and resuspension of sediments, which reduces water clarity and mobilizes nutrients and other contaminants that are harmful to aquatic life.

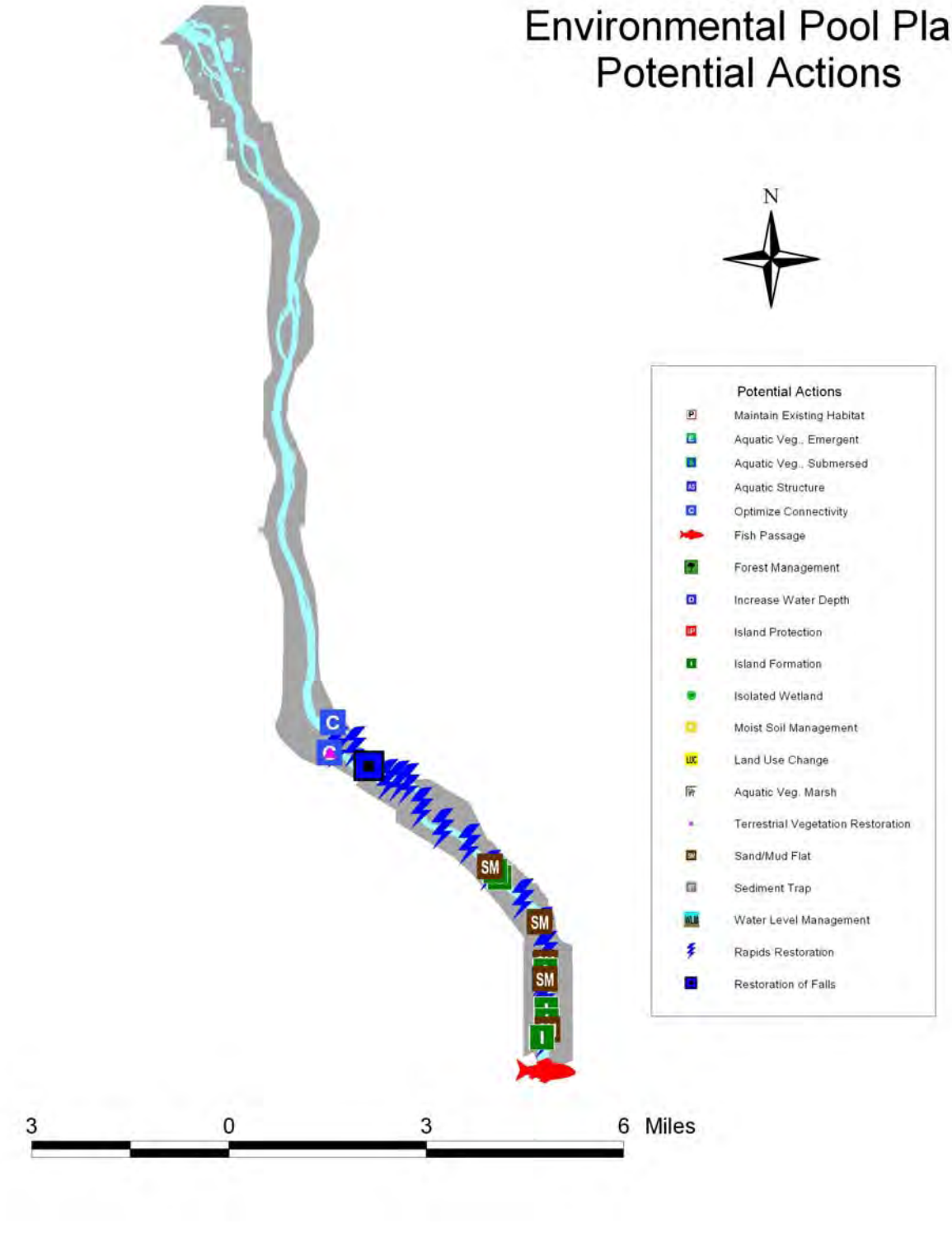
Tributaries upstream of Coon Rapids, such as the Crow River, are affecting the health of the Mississippi River in the Pool 1 area. Watershed improvements upstream of the Coon Rapids Dam are essential to accomplishing this objective and will be implemented with the assistance of local groups and educational projects such as Project NEMO (Nonpoint Education for Municipal Officials) and Watershed Partners. Watershed projects will include efforts to restore more natural hydrology by modifying extensive agricultural drainage projects, reducing row crop acreage, restoring historic wetlands, and retaining runoff in urban developments.

Desired Future Habitat Conditions "Map"

The following map depicts possible future habitat conditions for Pool 1. River managers familiar with this section of the Mississippi River developed the map. Locations of restored or constructed islands are suggested to provide this as a concept; actual locations would be determined during project-specific planning.


Existing Conditions
Desired Future Conditions
Coon Rapids
North Minneapolis
Gorge
Desired Future Actions
Rapids/Riffle/Pool and Structure
Fish Passage
Restore/Optimize Connectivity
Sand/Mud Flat
Island
Restoration of Falls
Existing Habitat (1989)
Open Water
Submersed Veg. (1-3 feet deep)
Emergent Veg. (0-1 feet)
Sand/Mud
Forest
Grassland, Wet Meadow
Urban
Agriculture
Rapids and Islands
Restoration with Navigation
Fish Passage
Pool 1 Reach, Environmental Pool Plan
Existing (1989) and Desired Habitat Conditions
N
1 0 1 2 Miles

Pool 1
Environmental Pool Plan
Potential Actions



Desired Future Habitat Conditions In Pool 2, Mississippi River

Description of Pool 2

Pool 2 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 2 at Hastings, Minnesota. Construction of Lock and Dam 2 was completed in 1930. The concrete portion of the dam is 722 feet long and the earthen embankment is 3,000 feet long. Because of settlement of the lock walls, a new lock was constructed in 1948 adjacent to the original lock. The lock is 110 feet wide and 600 feet long. In 1939, Lock and Dam 2 was incorporated into the 9-foot channel navigation project. More than 11,000 barges pass through the lock annually, carrying over 11 million tons of materials consisting mostly of farm products. About 12,000 recreational boats also use the lock each year. A 4.4-megawatt power plant, owned and operated by the City of Hastings, was placed in the dam in 1987. This is the most engineered stretch of the Mississippi River in the St. Paul District and includes over 300 wing dams constructed prior to the 9-foot channel project.

Pool 2, for the purposes of this plan, includes that reach of river from Lock and Dam 1 (river mile 847.6) downstream to Lock and Dam 2 (river mile 815.2) and includes the Minnesota River from Savage, Minnesota, to the confluence with the Mississippi River. All the communities along this stretch of the river are located in Minnesota and include Minneapolis, St. Paul, Bloomington, Eagan, Burnsville, Savage, Mendota Heights, Mendota, Lilydale, South St. Paul, Newport, Inver Grove Heights, St. Paul Park, Cottage Grove, Rosemount, Grey Cloud Island Township, Ravenna Township, Nininger Township, Denmark Township, and Hastings. In general, the lateral boundaries of the Pool 2 planning area are the tops of the river bluffs on either side of the river, including its floodplain and that of its tributaries where they enter the Mississippi River. The Pool 2 area encompasses 9,652 acres.

As is Pool 1, this pool is in the Mississippi National River and Recreation Area, a National Park unit, and the State-designated Mississippi River Critical Area. Portions of the Minnesota Valley National Wildlife Refuge and Fort Snelling State Park are also within Pool 2.

This pool represents a significant corridor of open space, aquatic areas, and floodplain forests that provide important and unique habitats in an urban, suburban, and rural setting for both aquatic and terrestrial plants and animals. Significant habitat features in this area include:

- the floodplain forests of Hidden Falls-Crosby Farm and Lilydale-Harriet Island Regional Parks;
- the 14,000 acres of forest, marsh, and wet meadows of the Minnesota Valley National Wildlife Refuge;
- the historic sites, lakes, forested floodplain, and bluffs of Fort Snelling State Park;
- a major rookery for herons and egrets that has been designated as the 100-acre Pigs Eye Island Heron Rookery Scientific and Natural Area (SNA);
- Pigs Eye Lake, a winter eagle use area at the outlet of the regional wastewater treatment plant;
- Pigs Eye SNA;
- prairie and oak savanna remnants in Grey Cloud Island Township, including Grey Cloud Dunes SNA;
- unique aquatic habitats in Grey Cloud channel;
- land proposed for a regional park on Lower Grey Cloud Island;
- native plant communities within the proposed 950-acre Pine Bend Bluff SNA;
- migrating waterfowl feeding and staging areas at Baldwin and Spring Lakes;
- Spring Lake Regional Park;
- six bald eagle breeding territories; and
- three peregrine falcon nest sites.

Prior to construction of the locks and dams, the rapids and gorge area that began at St. Anthony Falls (Pool 1) continued downstream as far as the Minnesota River.

Confluence of the Minnesota and Mississippi Rivers
(Minnesota Dept. of Natural Resources photo.)

Like most navigation pools of the Upper Mississippi River, the water area in the pool is greatest at the downstream end of the pool, in the impounded area that was submersed by Lock and Dam 2 at Hastings. At the upstream end of the pool, the land area in the floodplain increases. An exception to this is the area between the Interstate Highway 494 Bridge at South St. Paul and Newport upstream to Harriet Island in St. Paul. Along this part of the river, levees and fill have eliminated a considerable amount of floodplain in places such as Holman Field (St. Paul Downtown Airport), which was once a marsh. Immediately below Lock and Dam 1, the river is influenced less by impoundment and influenced more by the gate adjustments at the dam and releases for hydroelectric power that control the water flow and the water level.

The Minnesota River, the only significant tributary to the Mississippi River within the Pool 2 area, has a profound effect on both the size and water quality of the Mississippi River below the confluence. Small tributary creeks that contribute flow are Minnehaha, Phalen, Fish, and Battle Creeks.

Some significant floodplain lakes exist within the Pool 2 area, including Black Dog, Gun Club, and Long Meadow Lakes along the Minnesota River, and Pickerel, Crosby, Pigs Eye, and River Lakes in the St. Paul portion of the Mississippi River. Below St. Paul, Baldwin, Mooers, Lower Mooers, and Spring Lakes are some of the most significant migratory waterfowl feeding and resting areas along the river.

Improvements in wastewater treatment over the past two decades have allowed much of this reach of the river to again support aquatic life, including an emerging world-class game fishery and a rebounding mussel community. Consequently, this area is now attracting greater recreational use.

Description of Pool 2 Subareas

There are five distinct areas within the Pool 2 Reach. These areas, described below, are referenced in subsequent discussion of goals for desired future habitat conditions and actions that would achieve or address those goals.

Minnesota River Valley – The Minnesota River channel flows through the broad valley cut by glacial river Warren, a river that was many times the size of today's river. From Savage (the upstream limit of the 9-foot channel project) to its confluence with the Mississippi River at Pike Island (14.7 river miles), the Minnesota River is managed for commercial navigation as a part of the 9-foot channel project. Several agricultural product shipping facilities are located in the upstream portion of the area. The Black Dog Power Plant, owned and operated by Xcel Energy, is located at river mile 8.8. Fort Snelling State Park and the Minnesota Valley National Wildlife Refuge occupy most of the river's floodplain and are managed for wildlife and native plant communities. The Minnesota River floods frequently, and its water carries a heavy load of sediment, nutrients and other contaminants that are associated with intensive agricultural land use, wetland drainage, and subsurface tiling in its watershed.

The desired future for this subarea is to maintain the interspersion of habitat. The maintenance of the habitat would include evaluation of measures to improve the quality of the habitat for a variety of fish and wildlife species.

Gorge Area (from Lock and Dam 1 to the confluence of the Mississippi and Minnesota Rivers; a continuation of the Gorge Area starting in Pool 1) – Here, the river flows for 3.7 miles through a steep-sided gorge, over what was once a rapids flowing downstream from St. Anthony Falls in Pool 1. Impoundment of Pool 2 and excavation of the riverbed provide for the 9-foot navigation channel. Rocks and ledges that formed the rapids have been removed. Improved water quality during the past two decades has promoted a partial recovery of fish and mussel species that had died out as a result of polluted water. Many fish still attempt to migrate up the Mississippi River and are frequently concentrated below Lock and Dam 1. Hidden Falls Regional Park is located in this subarea and provides public access to the river. Because it is not dominated by the influence of the Minnesota River, the gorge area is limnologically distinct from the rest of Pool 2. A former flowing channel of the Minnesota River (now called Snelling Lake) enters at the upstream end of Pike Island. Bluffs line the top of the gorge area and are important habitat features for resident and migratory birds.

Holman Field near Downtown St. Paul (Minnesota Dept. of Natural Resources photo.)

Proposed features for this subarea include restoration of historic rapids in the area and implementation of fish passage at Lock and Dam 1.

Downtown St. Paul and Industrialized Area (Extending from the mouth of the Minnesota River to the Interstate Highway 494 Bridge at Newport and South St. Paul) – Several floodplain lakes are within this 11.5-mile-long subarea: Crosby, Pickerel, and Pigs Eye. Floodplain forests and natural shorelines in Hidden Falls-Crosby Farm and Lilydale-Harriet Island Regional Parks, Battle Creek Park Preserve on the shores of Pigs Eye Lake, and a bald eagle winter roost and heron rookery found within the Pigs Eye Scientific and Natural Area represent the best natural habitat in this stretch. A significant extent of the floodplain in the downtown area has been filled for development, most notably Holman Field (St. Paul Downtown Airport) – a former river marsh. From river mile 841 to river mile 836, the river's banks are armored with rock, steel sheet piles, or concrete walls, nearly eliminating riparian habitat. This 5-mile stretch of river is one of the largest gaps in riparian habitat upstream of St. Louis, Missouri. Pigs Eye landfill, although closed to dumping for about 30 years, continues to pose a significant threat to human health and to the health of the aquatic ecosystem. Today, it remains the largest source of contaminants in the entire Upper Mississippi River basin. Barge traffic, barge fleeting, and recreational boating in this area are intense. Several passenger packet boats operate from the Harriet Island area, and barge fleeting is especially intense from Lambert's Landing (river mile 839.3) to just below the outlet of Pigs Eye Lake (river mile 833). Fleets of barges often occupy a significant percentage of the river's surface along this stretch. The Pigs Eye Wastewater Treatment Plant, the largest such facility in Minnesota, is located in this area as well and discharges a volume of effluent to the river that can equal the discharge of the Minnesota River when it is low.

Potential actions to improve habitat conditions of Pigs Eye Lake and Pickerel Lake include increasing water depth diversity and increased coverage of emergent and submergent vegetation. An island is proposed for evaluation as the disposal site for the material dredged from Pigs Eye Lake. Other proposed actions in the subarea identify the potential to improve terrestrial habitat and increase aquatic habitat historically affected by human actions.

Interstate Highway 494 Bridge to Lower Grey Cloud Island – In general, the area downstream of Interstate Highway 494 is in a

more natural condition than the downtown area, with the exception that well over 100 wing dams keep the flow somewhat channelized. As the river flows out of St. Paul and the industrialized area, its floodplain broadens in this 13-mile-long subarea to include several flowing side channel areas, wooded islands, floodplain ponds, and River, Baldwin, Mooers, and Spring Lakes. Ashland Oil Company operates a storage area in St. Paul Park adjacent to the navigation channel. A mosaic of flowing side channels, ponds, islands, forest, and rock cliffs lie along the left descending bank from river mile 829.5 to river mile 827.7. Upper Grey Cloud Island includes an active limestone quarry where the limestone is crushed into various sizes and shipped by barge upstream to St. Paul and Minneapolis. Grey Cloud Island includes a gravel mining operation that ships aggregate upstream to St. Paul and Minneapolis from a loading terminal at Baldwin Lake. The remainder of Baldwin Lake is quite shallow and supports considerable numbers of migrating waterfowl in the fall and spring. Grey Cloud Channel separates both Upper and Lower Grey Cloud Islands from the mainland and is cut off from river flow by County Road 75 at its upstream end. It is fed by groundwater along most of its length. Clear water in this channel allows for considerable aquatic plant life and is excellent fish habitat. Mooers Lake separates Upper and Lower Grey Cloud Islands by its connection with Baldwin Lake. It is usually turbid, as is Baldwin Lake and the lower half of Mooers Lake, where it connects to the Mississippi River main channel.

A gravel mine is proposed at the off-channel area at the southeast end of Lower Grey Cloud Island, where a large deposit of gravel underlies the riverbed. Spring Lake occupies the floodplain across the main channel from Grey Cloud Island. Formerly a marsh, the creation of Pool 2 has made Spring Lake a shallow, turbid lake dominated by planktonic algae that appears to restrict aquatic plants to the shallowest areas. Near the upstream end of Spring Lake, a barge loading/unloading facility is operated in conjunction with a Flint Hills Resources refinery. A channel has been dredged to allow access to the facility from the navigation channel.

Many of the actions proposed for this subarea would improve habitat quality for a variety of aquatic and terrestrial species. Using 1994 conditions as a base, the desired future includes a threefold increase in submersed vegetation, a sixfold increase in emergent vegetation, and many potential opportunities to improve terrestrial habitat. The increases in aquatic vegetation would be due to the cumulative effects of island formation, pool-wide water level management, and improvements in water quality through actions in the watershed. Several areas are also identified for potential actions to improve fisheries habitat by increasing water depths in backwater lakes and side channels.

Lock and Dam No. 2 (US Army Corps of Engineers photo.)

Lower Impounded Area – The river from Lower Grey Cloud Island to Lock and Dam 2 (4 miles) is the portion of Pool 2 most affected by impoundment. Here, land submerged by impoundment has become a shallow water area swept by wind- and boat-generated waves, preventing aquatic plants from taking root. Side channels are also submerged and slowly filling with sediment. Approximately 37 wing dams and miles of revetment submerged by the impoundment keep the higher velocity river flow in the main navigation channel area. High areas built by the river as natural channel levees or barrier islands remained above the water surface for a number of years, but most have

been eroded away by wave action. Spring Lake Regional Park sits atop the bluffs on the south side of the river. Lock and Dam 2 and its earthen dike define the downstream limits of this stretch of river.

The 1994 habitat conditions for this section of Pool 2 were very low quality for many species. The 1994 coverage for Pool 2 showed only 7 acres of islands and 5 acres of submersed vegetation. The cumulative effects of island formation, water level management, and water quality proposals would significantly improve habitat in this area. The desired future identifies the potential to improve habitat by greatly increasing the acreage of islands, emergent marsh, and aquatic rooted plants so that wave action no longer inhibits aquatic plant growth in the lower pool area.

Aquatic vegetation near Horseshoe Island in Pool 8.
(Wisconsin Dept. of Natural Resources photo.)

Unique Attributes, Opportunities, and Constraints

Increasingly, communities along Pool 2 are recognizing the recreational and aesthetic opportunities that the river provides. In St. Paul, redevelopment is converting former industrial sites to residential and business uses, with public parks and access to the river. Some developments include features to help retain storm water, protect water quality, and provide habitat and public open space. Smaller communities, such as St. Paul Park, are improving city parkland along the river to provide more access to natural areas, such as floodplain forest. Regional parks along the river are changing their policies to encourage more natural vegetation along trails and in undeveloped areas. Private landowners are also increasingly interested in revegetating shorelines and planting native vegetation on their riverfront property. In the watershed, groups are working to establish greenbelts along tributaries and restore ecological function. Examples are Phalen Creek, where citizen groups have been working with public agencies to create a greenway and reestablish a connection to the Mississippi River, and Battle Creek Regional Park, where the National Park Service, volunteers, and non-profit organizations are helping the Ramsey County Parks Department restore habitat near the river. These and other projects along the river, its tributaries, and in the watershed are consistent with goals of the Environmental Pool Plan for Pool 2.

In the future, it will be important to continue protection of the unique ecological features described above, such as the floodplain lakes and forests of the Minnesota Valley National Wildlife Refuge and other floodplain habitat for migrating waterfowl, heron foraging, and bald eagle breeding, feeding, and roosting, and the large heron rookery at Pigs Eye Lake. Bluffs in portions of Pool 2, such as at Robinson's Rocks and Pine Bend, are another unique feature of this pool. They will be protected by enforcement of existing State Critical Area standards for bluff protection, and in some cases, through easements or acquisition from willing sellers. Privately owned river islands and other riparian areas will be protected by the same means. Because of the sensitive nature of islands and riparian areas, their vulnerability to physical damage and disturbance by large watercraft, marina development and expansion should be limited and surface use regulated to protect the river at critical sites. As proposed in existing regional and local plans, a new park reserve will be established on Grey Cloud Island, providing a significant new recreational opportunity as well as wildlife habitat areas.

The lower Minnesota River and the Mississippi River in Pool 2 once supported more than 40 species of freshwater mussels. Migratory fish also moved through this reach on their way to

spawning grounds and wintering areas. With improvements to water quality and the physical integrity of these rivers, there would be opportunity to reestablish populations of lost aquatic species. Already, a significant trophy walleye fishery has developed in Pool 2. Several trout streams have been degraded but will be restored in the future. Within the Minnesota River valley, unique calcareous fens once supported unique plant communities. Residential development has altered the natural hydrology of these fens, and all are now either gone or severely impaired. This hydrology can be restored and the fen plant communities would reemerge.

It is beneficial that Pool 2 is within the State-designated Mississippi River Critical Area and the Federal Mississippi National River and Recreation Area. Minnesota Department of Natural Resources and National Park Service goals and activities in support of these designations are generally consistent with the Pool 2 goals and can help achieve pool plan goals. Many other agency programs and initiatives, and those of non-profit organizations, can also help achieve goals.

Goals for improving habitat conditions in the above-mentioned subareas of Pool 2 are consistent with goals for all pools of the Upper Mississippi River System (see Pools 1-10 Reach Plan), as identified by the Upper Mississippi River Conservation Committee. Five primary tasks would be needed to accomplish these goals: 1) promote watershed management programs on tributary streams; 2) manage for more natural water levels by restoring or mimicking the natural range of variations that would occur seasonally; 3) reconstruct islands in the lower pool; 4) modify or remove side channel closures, wing dams, lock and dam spillways, and other structures; and 5) acquire lands or floodway easements from willing sellers and restore these areas to native prairie, marsh, or forest. Many of these tasks can be accomplished through specific actions discussed in further detail below.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Public meetings held to solicit input on desired future habitat conditions for Pool 2 resulted in several comments regarding the importance of improving sediment and water quality in this section of the Mississippi River. Also expressed were ideas for control/elimination of exotic species. These issues are common to the entire Mississippi River, but are discussed in greater detail here due to the interest expressed by attendees at the Pool 2 public meetings.

1.) Reduce or Eliminate Sources of Pollution

Wastewater treatment plants would be upgraded to further improve water quality, including removal of phosphorus, organic and inorganic contaminants. Endocrine mimicking chemicals that can feminize male fish pose ominous threats to human health and the future of all river animals. Upgraded wastewater treatment facilities would also remove these chemicals.

Elimination of discharges of storm water from suburban and urban areas directly into the river would be accomplished in the future. This could be done by directing water through detention ponds and restored wetlands to remove sediments and nutrients and reduce the magnitude of runoff into the Mississippi River. All remaining connections from storm water systems to sanitary sewers would be eliminated to prevent overflow of raw sewage into the Mississippi River.

River water would meet or exceed Clean Water Act standards. Pigs Eye landfill, a significant contaminant source to the Upper Mississippi River, would no longer contribute contaminants to the river. Battle Creek would be rerouted away from the landfill, and aquatic plants would recolonize Pigs Eye Lake while maintaining a functional connection to the river. Wave action in backwater lakes such as Pigs Eye would be reduced to prevent resuspension of sediments, permitting light to penetrate the lake water sufficiently to sustain aquatic plant beds. Contaminated and nutrient rich sediments that

have settled in backwater lakes would be contained beneath clean sediments and remain inaccessible to the aquatic food chain. The lakes would develop better marsh and submergent plant communities, with a return to more natural water level variability. Reduced nutrient and sediment pollution from the Minnesota River and urban storm water would significantly benefit human health and recreation opportunities and all aquatic life in this area. "Brownfield" areas of the floodplain would be cleaned up and recolonized by native plants.

As opportunities arise, it would be desirable to relocate industries that are not dependent on the river away from the river. This would permit pollutants to be better isolated from the river, protecting against accidental spills. Previous spills would be cleaned up. Threats from industrial facilities such as refineries and mines would diminish if facilities could be isolated from the river and/or operations modified.

Water entering the Mississippi River from the Minnesota River would carry bed sediment, nutrients, and suspended sediment loads more typical of the pre-industrial river--about 10 percent of the levels carried during the 20th century. Flows from the Minnesota River would be within the natural range of variability that characterized the pre-industrial river and reflective of a watershed in a sustainable balance with human uses. The Minnesota River would be a cleaner and more stable river that can once again support the aquatic life present 150 years ago.

Fish consumption advisories would no longer be needed.

2.) Reduce and Eliminate Exotic Species

This reach of the Mississippi River currently supports only a few zebra mussels. To prevent zebra mussels from becoming a severe problem in the future, their import into this reach by boats or barges should be eliminated by implementing measures to control the species. Other exotic species would also be controlled or eliminated from the area. The Great Lakes pathway for aquatic exotic introductions to the Mississippi River should be severed using physical, technological, and/or biological means.

The following list of potential actions is consistent throughout the remainder of the individual pool plans. These actions are interrelated, and specific actions may require overlapping solutions. Maintaining and developing diverse aquatic and terrestrial habitats as well as restoring those natural ecological processes that are critical to river health are the key to promoting a healthy ecosystem.

3.) Increase Depth Diversity in Channels and Backwaters

Sedimentation at various locations has affected the quality of aquatic habitat for many species. Several locations have been identified for actions designed to improve habitat in selected backwaters for riverine and backwater communities. Dredging, construction of closing structures, island restoration, shoreline stabilization, and improved connectivity are among the tools that may be used.

4.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing high quality terrestrial and aquatic habitat. Some areas in Pool 2 are considered high quality habitat for a variety of species. Maintenance of existing high quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed. For example, the Pigs Eye Scientific and Natural Area should be protected to assure that the heron rookery is sustained. Grey Cloud Island, if developed as a regional park preserve as planned, would provide high-value habitat for wildlife that is dependent on native forests, grasslands, and aquatic habitats. Establishment of a Scientific and Natural Area at Pine Bend Bluffs would protect existing floodplain and habitat diversity.

Local enforcement of the State's Mississippi River Critical Area land use standards, parkland acquisition and management, and natural

resource stewardship on private lands within the Pool 2 planning area would contribute to a continuous "green" corridor of wildlife habitat and open space. These measures would contribute to a more sustainable river environment as ecological functions are restored, unique natural resources protected, and regional biodiversity enhanced. Efforts of non-governmental groups, as well as local, State, and Federal agencies, would play a crucial role in protecting and maintaining native plant communities.

In order to protect particularly unique or significant resources or ecological features, it may be desirable to acquire land or easements from willing sellers. This would be a long-term effort involving acquisition of title, or floodway and bluff land easements, from willing sellers. Opportunities for acquisition often arise unexpectedly, so it would be important to have flexible funding mechanisms in place in order to act on opportunities. For example, after major floods, landowners who have experienced loss or damage are often interested in selling land or easements. Non-governmental organizations, such as land trusts, can provide expertise and help develop a long-term program for acquisition, as well as leverage funding.

5.) Protect and Restore Islands

Island and shoreline erosion in Pool 2 can be caused by a variety of sources. One significant source is waves created by commercial and recreational watercraft. Educating boaters about how their activities can be modified to prevent bank erosion and resuspension of sediments would protect riparian and aquatic habitats. In the Minnesota River, commercial navigation traffic would no long entrain so much of the river's volume that it destabilizes the riverbed and produces flow reversals and surges that cause extreme bank erosion.

Restoration of islands in Pool 2 would use 1891 river charts and historic aerial photos as templates. This information in combination with current bathymetry and flow information would be used to determine how and where islands would be constructed. Islands would be designed to grow naturally from sediments transported and deposited by the river and/or by using dredged material generated from Corps of Engineers channel maintenance activities to construct islands in the lower, open water area of Pool 2. Methods of constructing islands would be based on what has been successful in other Mississippi River pools. Reconstructed islands could be topped with substrate generated by dredging historical fish wintering areas. Dredging these areas would increase water depths and improve fish wintering habitat. Islands would be seeded with native grasses and trees.

It would be desirable to use dredged material to reconstruct islands and other physical forms that have been lost to erosion, such as islands between Newport and Pine Bend. Dredged material not used for this purpose could be used outside the floodplain or capped with soil capable of supporting native plant communities and seeded with native species.

Reconstruction of islands and reestablishment of vegetation would reduce wind fetch and wave action, allowing these features to persist. These restored features would benefit aquatic life and migrating birds and provide additional recreation opportunities for humans.

6.) Manage Floodplain Forests and Prairies for Diversity and Quality

The desired future identifies several locations where the potential exists to improve terrestrial habitat for a variety of species. Some opportunities would be on any islands restored within the floodplain. Additional opportunities have been identified throughout the pool. For example, areas of Grey Cloud Island that are no longer mined could be reclaimed with native plant communities. As opportunities arise, floodplain areas filled or developed in an earlier era could be restored to increase flood storage and conveyance. Lilydale Regional Park is a successful example of how this can be done. Abandoned dredged material placement sites should be removed or capped and native riparian plant communities restored to reestablish an ecologically functional corridor. Land use in the

entire riparian corridor should conform to or exceed standards established for this area by the State. The river floodplain should provide critical habitat for wildlife and fish and for humans seeking a quiet experience in a unique and natural setting.

Other opportunities are proposed for consideration if uses in the floodplain change in the future. Pigs Eye Scientific and Natural Area should be protected to assure that the heron rookery will be sustained. Lower areas of the Phalen Creek floodplain between Warner Road and the Mississippi River could be restored to wetlands. Areas no longer used for barge fleeting should be restored as viable riparian habitats, and existing fleeting activities should not be relocated in high quality habitat areas. All redeveloped areas would be designed to have ecological benefits. The riparian corridor would be dominated by native plant species and be set aside for plant and animal habitat.

7.) Manage Water Levels to Improve Aquatic Habitat

It is desirable to emulate the natural flow regime to achieve an ecologically functional state reflective of the natural range of flows, water levels, and rates of rise and fall that historically occurred on the river. These are the rhythms that aquatic life is adapted to and dependent on for life history queues and successional renewal of plant communities. Recolonization by historically present native fish, mussel species, floodplain forest, and aquatic plant communities would follow. Shoreline erosion would diminish under the emulated flow regime and native plant community's influence. Seasonal low water conditions would restore floodplain lakes by reestablishing their marshy fringe and submersed plant communities.

A great deal of sediment has been trapped in the backwater lakes above Lock and Dam 2. It would be desirable to allow low water conditions to occur in order to consolidate the deposits and stimulate recolonization of former marsh and aquatic plant and invertebrate communities. A return to more natural water level variation would allow aquatic plants to reestablish in the shallow areas and expand the area of marsh within backwaters and surrounding lakes. More sandbar habitat would be available for fish, wildlife, and human use as well.

Water levels that are more natural may also redefine the side channels, periodically sweeping away accumulated fine sediments. These restored features would benefit aquatic life and migrating birds and provide additional recreation opportunities for humans.

Restoring periodic low water levels should be investigated as a method to restore aquatic plant communities, especially emergent species. The process used for planning the Pool 8 drawdown, farther downstream on the Mississippi River, was considered very successful and could serve as a guide for Pool 2. The interagency and citizens Water Level Management Task Force has taken a lead role in the Pool 8 drawdown and is obtaining technical information on how to implement a drawdown project in other pools. This information could be useful in determining the suitability of a drawdown in Pool 2. The extent of drawdown would depend on cost and desires of the public. Planning for water level management in Pool 2 would need to include consideration of effects on hydropower generation at Lock and Dam 2 along with other water dependent municipal features within the pool (i.e., Pigs Eye Treatment Plant).

If Lock and Dam 2 operation could be modified to lower the water level, considerable river bottom in the Grey Cloud Island area (Grey Cloud Slough, Mooers Lake, Baldwin Lake), the open areas across from Nininger, and the Spring Lake area would be exposed. This would stimulate the growth of aquatic plants and the rebirth of lost marsh habitats, and improve the health of floodplain forests. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and

the benefits of occasionally managing water levels at the high end of the operating band. Small-scale water level reductions are proposed as a tool to be used to manage lakes in the Minnesota Valley National Wildlife Refuge that now receive too much water because of accelerated agricultural and urban runoff.

8.) Work Cooperatively with Private Property Landowners

As opportunities arise, it would be desirable to relocate industries that are not dependent on the river. This would permit pollutants to be better isolated from the river, protecting against accidental spills. Previous spills would be cleaned up. Threats from industrial facilities such as refineries and mines would diminish if facilities could be isolated from the river and/or operations modified.

Achieving the desired future habitat conditions will depend on land use in the entire riparian corridor conforming to or exceeding the standards established for this area by State standards. When these standards have been met, the river floodplain throughout this reach would provide critical habitat for wildlife and fish and for humans seeking a quiet experience in a unique and natural setting.

In order to protect particularly unique or significant resources or ecological features, it may be desirable to acquire land or easements from willing sellers. This would be a long-term effort involving acquisition of title, or floodway and bluff land easements, from willing sellers. Opportunities for acquisition often arise unexpectedly, so it will be important to have flexible funding mechanisms in place in order to act on opportunities. For example, after major floods, landowners that have experienced loss or damage are often interested in selling land or easements. Non-governmental organizations, such as land trusts, can provide expertise and help develop a long-term program for acquisition, as well as leverage funding.

9.) Manage River Floodplain Flows and Connectivity to Improve Aquatic Habitat

Some of the best and most diverse habitat in the Upper Mississippi River is associated with the mosaic of small flowing channels, ponds, sloughs, and natural levees. Modification or removal of channel training structures would redistribute energy along the main channel and could increase the river's ability to create and maintain desirable habitat diversity. Flows through side channels that have been blocked to aid channel maintenance could be reopened where possible. Side channels that have been submerged by impoundment or filled by sediment can be restored in order to convey flows sufficient to sustain their form and function. In the lower part of the pool, augmenting natural levees through sediment and flow regime management and subsequent revegetation would restore the historic pattern of channels and native plant communities.

In the desired future, the original channel of the Minnesota River would again convey some flow, revitalizing this backwater. The floodplain lake characteristics of Pickerel Lake would be restored. To prevent the degradation of plant and animal communities in Upper Grey Cloud Channel, this area would remain isolated until water quality improved sufficiently to prevent resource degradation. Once this was achieved, the downstream portion of this channel would be restored to a natural flowage. The natural river levees that once surrounded Spring Lake and other floodplain depression areas would be restored.

Fish passage through Lock and Dam 2 is especially important on the Mississippi River system due to the infrequent raising of the dam's gates that block fish movement. Implementation of fish passage measures would eliminate or substantially reduce this barrier to allow for fish passage past the dam with greater frequency and ease for all species of river fish. Construction of a long spillway through the dam would create a negotiable rapids for migratory fish. Potentially, a connecting channel could be established on either side of Lock and Dam 2 to create rapids

that would allow fish to pass between these pools.

10.) Support Watershed Management Programs

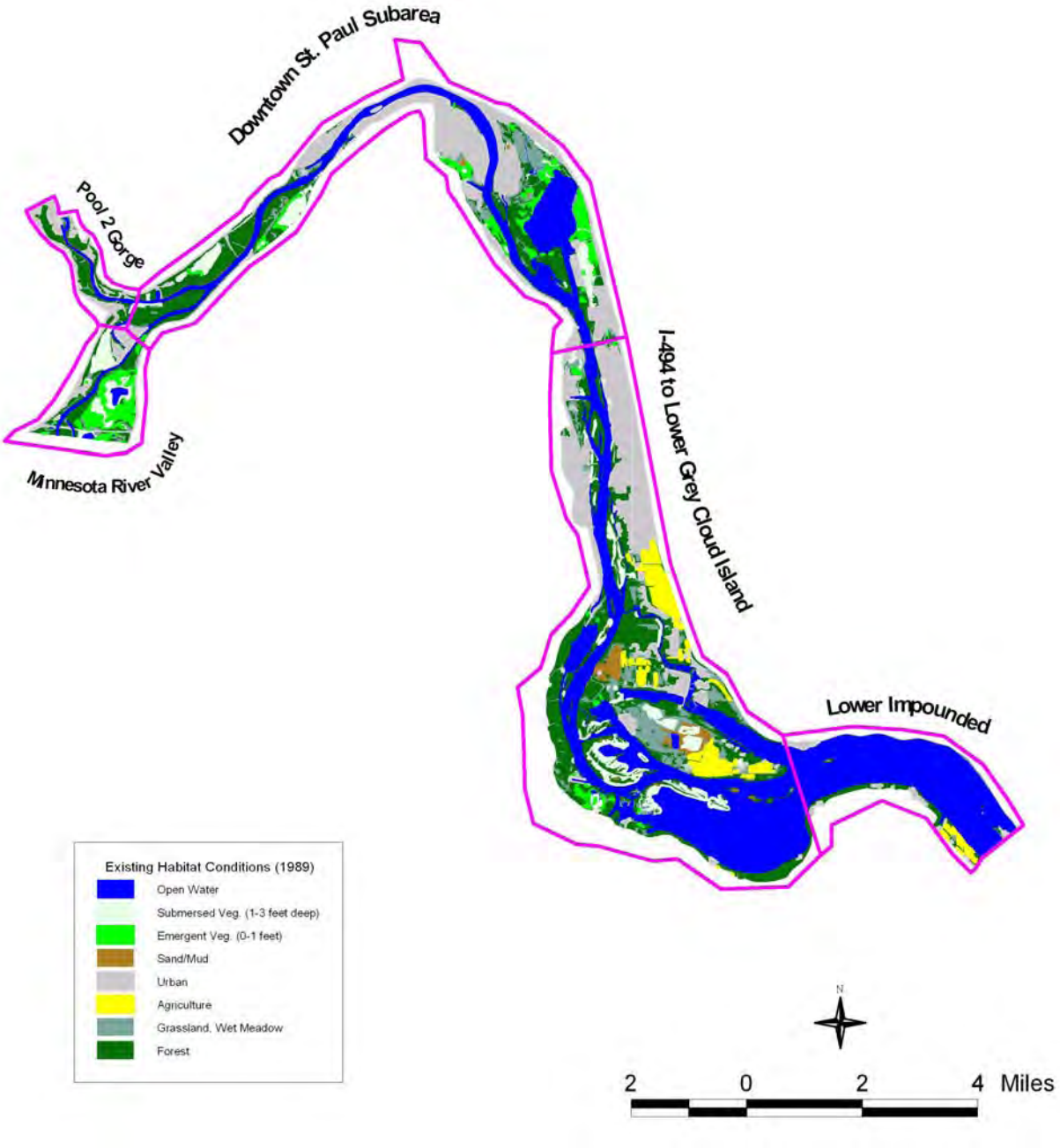
Watershed management programs should be encouraged to promote good land uses that would reduce sediment and nutrient inputs into the Mississippi River. In the future, it is desirable to have well-conceived, multi-disciplinary watershed management efforts, such as the Chain of Lakes Clean Water Partnership (of Minneapolis), throughout the corridor.

In the desired future, water entering the Mississippi River from the Minnesota River would carry bed sediment, nutrients, and suspended sediment loads more typical of the pre-industrial river--about 10 percent of the levels carried during the 20th century. Flows from the Minnesota River would be within the natural range of variability that characterized the pre-industrial river and reflective of a watershed in a sustainable balance with human uses. The Minnesota River would be a cleaner and more stable river that can once again support the aquatic life present 150 years ago.

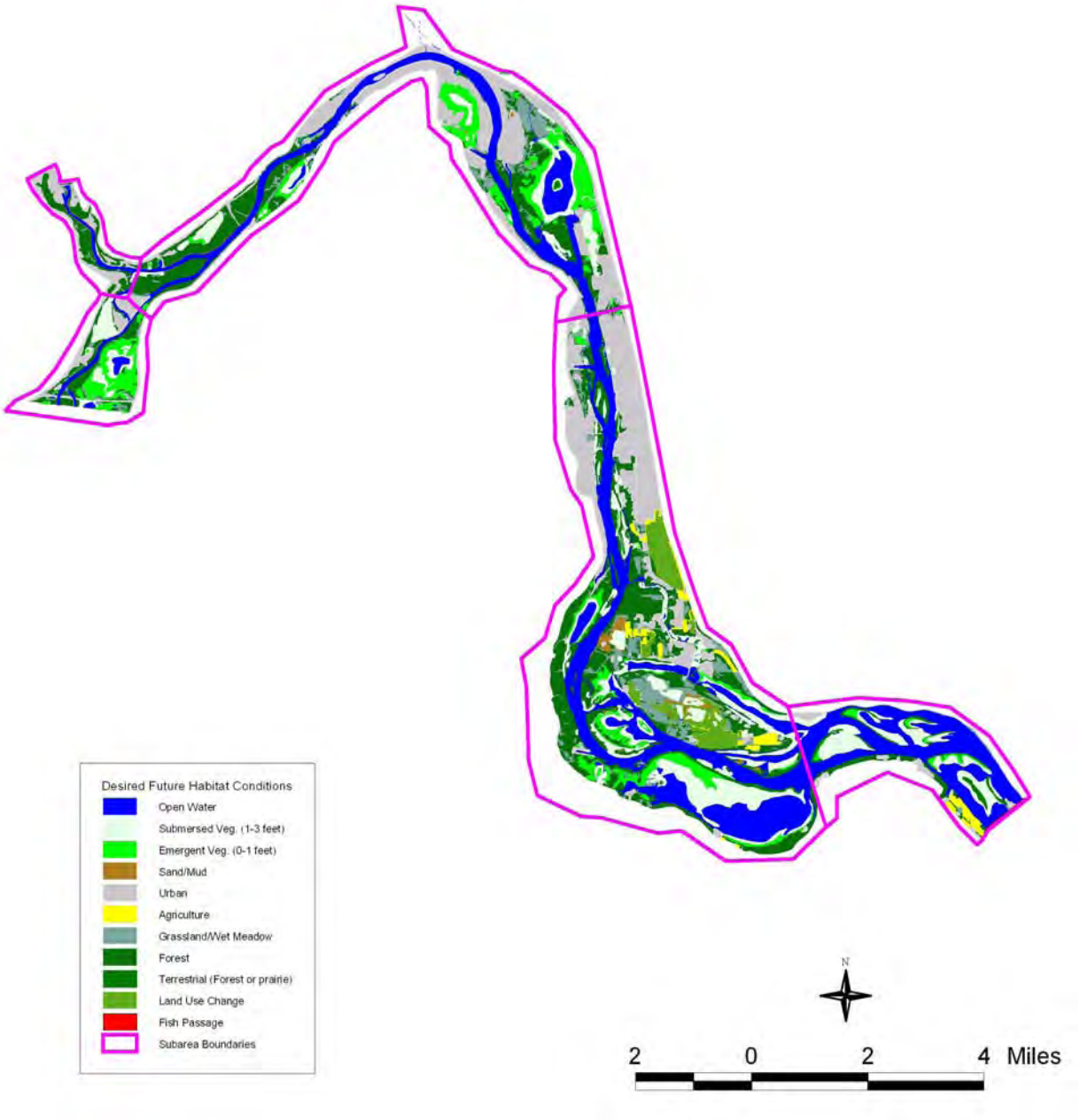
The natural hydrologic regime of the Mississippi River should be restored as an outcome of watershed improvements. This could be accomplished by modifying agricultural drainage projects to retain water and nutrients on the land and by reducing row crop acreage to a sustainable level, especially in the Minnesota River basin. A buffer zone of native plant communities would intercept sediment and nutrients flowing from agricultural fields and urban areas. It would be desirable to restore such buffers on both riverbanks and up tributary rivers and streams, including those of first order magnitude, and drainage ditches. Urban sewage and storm water treatment are integral to watershed management and should include removal of phosphorus and endocrine mimicking hormones. Sanitary sewer effluent would enter the river at a quality usable as a water supply for downstream municipalities. Contaminants in the Pigs Eye landfill would be sequestered from the river to prevent them from entering the food chain.

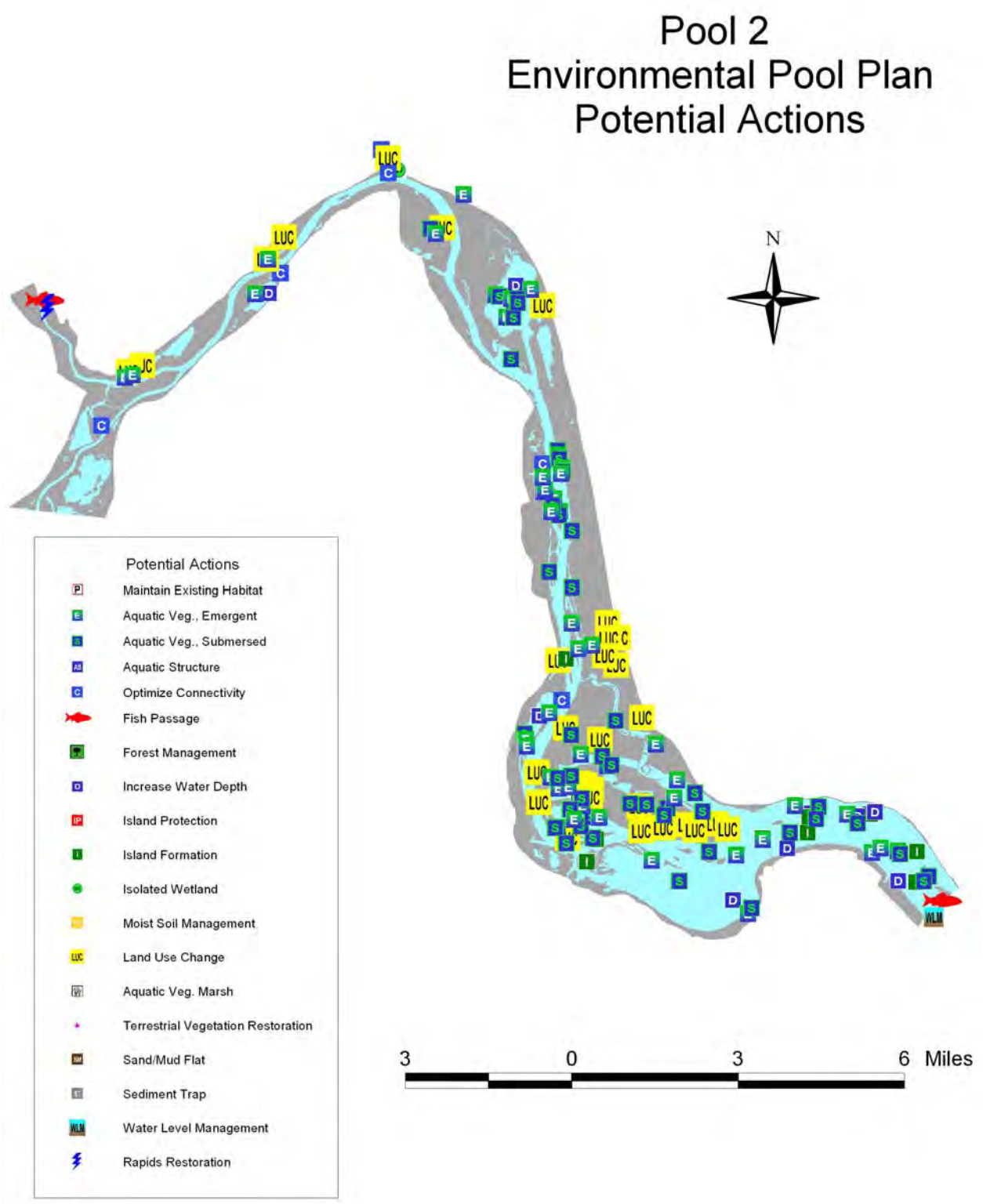
Riverboats on Pool 2 (US Army Corps of Engineers photo.)

Pool 2
Environmental Pool Plan
Existing Habitat Conditions



Pool 2
Environmental Pool Plan
Desired Future Habitat Conditions




Pool 2
Environmental Pool Plan
Potential Actions
N
Potential Actions
Maintain Existing Habitat
Aquatic Veg., Emergent
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
Rapids Restoration
3 0 3 6 Miles

Desired Future Habitat Conditions In Pool 3, Mississippi River

Description of Pool 3

Pool 3 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 3 at Prairie Island, about 5 miles upstream of Red Wing, Minnesota. This dam supports operation of the 9-foot channel navigation project. Construction of Lock and Dam 3 was completed in 1938. Pool 3, for the purposes of this plan, includes that reach of river from Hastings, Minnesota, (river mile 815.2) downstream to Lock and Dam 3 above Red Wing (river mile 797.0). This includes Lake St. Croix, also known as the Lower St. Croix River (from Stillwater, Minnesota, to Prescott, Wisconsin), and the Vermillion River flowage along the right descending side of the valley. In general, the east and west boundaries of the Pool 3 planning area are the tops of the river bluffs on either side of the river including its floodplain and that of its tributaries where they enter the Mississippi River. This pool is within the State of Minnesota upstream of the St. Croix River confluence and forms the border between Minnesota and Wisconsin below this confluence. This represents a significant corridor of open space and habitat for both aquatic and terrestrial plants and animals. The Pool 3 area encompasses 17,950 acres.

Like most navigation pools of the Upper Mississippi River, the water area in the pool is greatest in the impounded area created by the dam. As the pool is traversed upstream, the land area in the floodplain increases. Immediately below Lock and Dam 2, the river is influenced less by impoundment and influenced more by the gate adjustments at the dam that control the water levels in the pool above.

The St. Croix River is the largest tributary to enter the Mississippi River within the Pool 3 area; the Vermillion River and several small creeks also contribute flow. Several large floodplain lakes are within this pool. Most notable are Lakes Isabelle, Conley, and Rebecca (a former side channel) in Hastings; Upper and Lower Rattling Springs, Upper and Lower Clear Lakes, Goose Lake, Larson Lake, Nelson Lake, and Birch Lake, all within the Vermillion River flowage; and Sharp Muskrat, North, and Sturgeon Lakes on the Minnesota side of the Mississippi River. Communities in this reach include Hastings, Minnesota; the Prairie Island Indian Community; and Prescott and Diamond Bluff, Wisconsin. Xcel Energy operates a nuclear power plant at Prairie Island that appropriates water from the river and discharges heated water back into the river. Prairie Island is an ancient deposit of sand and gravel along the Minnesota side that is used for gravel mining and agricultural crops. The Prairie Island Indian Community operates a gaming casino, hotel, and marina on its lands.

Considerable public lands exist in this area and are managed as part of the Minnesota Department of Natural Resources Gores Wildlife Management Area.

Description of Existing and Desired Future Habitat Conditions for Pool 3 Subareas

Several identifiable areas are present within Pool 3. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Lake Rebecca - This floodplain lake is within the City of Hastings park system on the right descending side of the river. Formerly a side channel of the river, it is now isolated except during high floods. It has recently been treated with rotenone to remove rough fish and subsequently stocked with game fish. Historically, this lake extended across what is

now Lock and Dam 2. Lake Rebecca will be flooded again in the future, and at that time, options will be reconsidered to increase the connectivity of the floodplain.

The main management actions identified for this area are to improve the quality and diversity of the forest community and maintain other resources.

Conley Lake - Conley Lake is across the river from Hastings, Minnesota. Most of Conley Lake today is occupied by King's Cove marina, and the outlet at its downstream end is dredged to maintain access for large pleasure craft to the main channel of the river. The portion of this floodplain lake that is not used for docking is shallow and turbid, with little or no aquatic plant life.

The desired future for this area is an increase in emergent and submersed vegetation. It is expected that sedimentation will result in an increase of terrestrial habitat in portions of the area.

Lake Isabelle - Located entirely within the City of Hastings, Minnesota, this lake has a narrow outlet to the Vermillion Slough near the Hastings Marina. The lake is shallow and silted, with little plant life. Groundwater flows into the lake at its upstream end, which is bounded by limestone outcrops. Options for improving habitat include dredging and marsh establishment.

Confluence of St. Croix and Mississippi Rivers
(Minnesota Dept. of Natural Resources photo.)

The desired future for Lake Isabelle identifies a goal of increasing emergent vegetation by 40 percent, and improved and diversified land use patterns through increased conservation measures.

Upper Vermillion River - This large area lies between the main channel of the Mississippi River and the bluffs on the right descending side of the river valley. Considerable agricultural use occurs in the higher elevation, upstream quarter of the area, giving way to floodplain forest downstream. On the west side, the Vermillion River enters the Mississippi River valley through a deep gorge after plunging into the valley from a vertical falls. Floodplain lakes and ponds become more numerous and extensive towards the downstream end of the area. During high water, this area is dominated by flows from the Mississippi River that spill over the natural levees that separate the Vermillion River from the main channel. Downstream, the Gores Wildlife Management Area encompasses most of the area and includes the Mudhen Lakes marsh complex. Considerable groundwater flows enter the channel of the Vermillion River from the foot of the bluffs. Continuous flows from the Mississippi River channel enter through Truedale Slough via a culvert. At the Hastings marina, flows from the Mississippi River enter during high water, but when the Vermillion River is flooding, flows from it enter the Mississippi River via the same route. Resource problems in this area include sedimentation of the backwater lakes and ponds and of the Vermillion River channel. High nutrient inputs hamper the aquatic plant communities in this area. Off-road vehicle use is causing damage to the existing marsh and forest habitats.

Desired future management for this segment of the Upper Vermillion River area focuses primarily on improving the diversity and quality of forest resources and improving connectivity of the channels in the area through a variety of measures. The desired future also identifies the opportunity to promote changes in land use, which will improve terrestrial habitat conditions.

North and Sturgeon Lakes - This area includes a marshy area at the upstream end that encompasses Sharp Muskrat Lake as well. On the west, it is separated from the Vermillion Flowage in the upper end by elevated railroad tracks and by Prairie Island from about river mile 805 through river mile 798. Also included in this area are Twin Lakes and Brewer Lake. Several connections with the main channel exist to the east, including Jackson Run and Miley Run. North Lake, to the north, and Sturgeon Lake, to the south, are connected by Buffalo Slough, a deep flowing channel that is unique in its cobble and gravel substrate. Both lakes today are shallow and subject to frequent wind wave action that keeps sediments suspended and limits aquatic plants. Historically, these two lakes had an extensive marshy fringe and considerable submersed aquatic plant beds. The area separating the lakes from the main channel is floodplain forest, and much of it is set aside for the exclusive use of the Prairie Island Indian Community. Water flowing through these lakes reenters the main channel at the outlet of Sturgeon Lake at river mile 798.

Lock and Dam No. 3 with Prairie Island in the background (Minnesota Dept. of Natural Resources photo.)

The desired future for this area recognizes that sedimentation will most likely continue and result in the formation of mud flats and some islands. This will lead to an increase in the amount of terrestrial habitat in the area. The opportunity also exists to possibly construct islands in selected locations to be used as disposal sites for backwater dredging, to improve conditions for the growth of aquatic vegetation, and to promote increases in depth by concentrating flows to promote scour. The desired future identifies a doubling in acreage of emergent and submersed vegetation, primarily along the fringe of North and Sturgeon Lakes. Measures to increase water depths in approximately 6 percent of the aquatic area have been identified to improve conditions for aquatic species.

Prairie Island - A unique feature of Pool 3, Prairie Island is a relict of the Pleistocene river, an alluvial deposit much of which has not been flooded in historical times. A large gravel mining operation occupies several hundred acres of the island in the north. Agricultural uses have occupied a considerable area also. In the south, the Prairie Island Indian Community has built and operates a large casino operation, hotel, campground, and marina. Xcel Energy operates the Prairie Island Nuclear Power Generating Station at the extreme lower end of the island.

In the distant past, Prairie Island was dominated by prairie and oak savanna plant communities, and wild rice was an important aquatic plant species in the marshes and sloughs. As ownership of land on Prairie Island changes, opportunities for reestablishment of these plant communities may increase and are reflected in the desired future for this area. The desired future also includes recommendations for evaluation of measures to improve the connectivity of various channels and sloughs that have been "cut off" by transportation features. Improving connectivity will help to improve habitat conditions in the adjacent subareas.

Lower Vermillion River Bottoms - Bounded by Prairie Island on the east and bluffs on the west, this area encompasses a large forested floodplain area with several large lakes. Upper and Lower Clear Lakes to the north once supported a popular game fishery. A fishing resort was operated on Lower Clear Lake about 40 years ago. Since that time, these lakes have filled with sediment and the fishery has degraded. Upper and Lower Rattling Springs Lakes lie to the east of Lower Clear Lake and are spring fed from the foot of the bluffs. Farther downstream, Nelson, Larson, Goose,

Birch, Wildcat, and Jones Lakes occupy the floodplain. Of these, Goose Lake is the largest and deepest. Considerable fish movement into this area occurs from the tailwaters of Lock and Dam 3 where the Vermillion River enters the Mississippi River. Historically, a rich mussel bed existed in this lower area as well. A significant winter roost for bald eagles is found at the outlet of the Vermillion River. Water quality measurements indicate that turbidity values in the Lower Vermillion River chronically exceed the State of Minnesota turbidity standard.

The desired future for the Lower Vermillion River Bottoms includes recommendations for maintaining the present coverage of emergent and submersed vegetation, increasing the connectivity of several channels and backwater areas, improving terrestrial habitat conditions through land use changes, and increasing the depth of approximately 9 percent of the aquatic area for improvement of fish habitat and channel connectivity. One of the primary tools for maintenance of aquatic vegetation in the area is water level management. Shallow areas of many of the lakes discussed above could be exposed by lowering water levels to generate marsh plants and stimulate submersed aquatic plant growth.

Unique Attributes, Opportunities, and Constraints

Private landowners will be encouraged and provided with incentives to protect and reestablish native plant communities on their riparian and floodplain lands. Significant bald eagle roosting and nesting areas exist in Pool 3 and will be protected from riparian development, timber harvest, and channel maintenance activities. Areas of Prairie Island, a natural Pleistocene era deposit of sand and gravel, will be planted to native prairie and oak savanna communities. The Prairie Island Indian Community is investigating the restoration and management of native plant communities upon tribal lands.

The Mississippi River in this area once supported more than 40 species of freshwater mussels, and migratory fish once moved through this reach on their way to spawning grounds and wintering areas. With improvements to water quality and the physical integrity of these rivers, the opportunity to reestablish populations of lost species presents itself and will occur in the future. Lake St. Croix is a high quality resource that will remain a positive influence on the rest of Pool 3 in the future.

Sandhill cranes (Wisconsin Dept. of Natural Resources photo.)

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Many of the proposed actions are interrelated. Often, solutions to problems will require implementation of more than one action. Likewise, single actions may address more than one problem. The cumulative goal of these actions is to increase the productivity of the river ecosystem using all feasible means.

1.) Increase Depth Diversity in Channels and Backwaters

Sedimentation has adversely affected many channels and backwater areas in Pool 3. Several different approaches to increase water depths in these channels and backwaters will be evaluated on the basis of site conditions and flows. Material dredged to increase depth may be used for island construction, revegetation of historical disposal sites, and improvement of terrestrial habitat.

Efforts are proposed in all areas of the pool to increase the quantity and quality of secondary and tertiary channel habitat. Maintenance and formation of these channels will consider a variety of factors aimed at providing for a diversity of habitats (undercut banks, mud banks, snags, etc.) and substrate types. Where feasible, channels would be defined by land features (i.e., islands) to further diversify the habitat these channels will provide. Dredging, directing flows, or other techniques may be used to optimize depth diversity.

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas within the pool are considered quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

3.) Protect and Restore Islands

Stabilization of islands in Pool 3 is proposed to reduce the rate of island erosion and island dissection. This will help maintain a diversity of depths, velocities, and substrate. It will also keep selected backwater areas free from flow.

Where possible, island formation in the form of deltas would be promoted in Sturgeon Lake and North Lake. The island formation by delta development would result in diversity in the shape, size, and location of these islands. Islands in these areas would also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach. Where necessary, islands would be constructed to improve terrestrial and aquatic habitats. The constructed islands would be oriented to promote scour and sediment deposition to increase depth, velocity, and substrate diversity. The islands would improve water quality conditions (decrease sediment resuspension) and promote the establishment and maintenance of aquatic vegetation.

A reduction in sediment resuspension in these areas would also reduce fine sediment input to Pool 4. Reduction in sediment resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation.

4.) Manage Floodplain Forests and Prairies for Diversity and Quality

Some floodplain areas currently in agricultural use (especially near the Gores Wildlife Management Area and on Prairie Island) are proposed to be restored to native plant communities following acquisition or easements from willing sellers, or the implementation of land conservation programs. Another option may be to raise the elevation of landforms through the use of dredged material and improve site suitability for other native forest species. Other opportunities for forest and prairie management will be evaluated and initiated where possible.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer reductions in water levels would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Water level management planning for Pool 3 will require evaluation of water level requirements for safe and reliable operation of the Prairie Island Nuclear Power Plant.

6.) Work Cooperatively with Private Property Landowners

Several areas within the Mississippi River floodplain and the majority of the tributary watersheds are privately owned. Maintaining and improving habitat within the Mississippi River floodplain is dependent on a long-term commitment to provide resources to private landowners to improve water quality, reduce erosion and sedimentation, and improve habitat conditions on land within the floodplain. Various approaches and techniques would be evaluated and implemented to work cooperatively with private property owners, especially owners of large parcels like the Red Wing Wildlife Protective League and the Prairie Island Indian Community. Some of the tools include: voluntary measures, landowner incentives, easements from willing owners, and purchase of land from willing sellers.

This would be a long-term effort requiring acquisition or floodway easements from willing sellers. Opportunities for acquisition may arise unexpectedly; therefore, funding mechanisms will need to be in place that allow flexibility and take advantage of unique opportunities such as major floods when landowners are more interested in selling. Partnerships with non-governmental agencies would lend expertise and encourage development of a long-term program for acquisition, as well as leverage additional funding.

Nature-like fishway at a navigation dam on the Loire River at St. Laurent des Eaux, France. (Photo courtesy of American Rivers.)

7.) Manage River Floodplain Flows and Connectivity to Improve Aquatic Habitat

Alternatives to allow for fish passage between Pool 3 and Pools 2 and 4 will be investigated. One alternative that may be considered is a connecting channel on the northeast side of Lock and Dam 2 that will allow fish passage between Pools 2 and 3. If Lake Rebecca is once again invaded by rough fish, its reconnection and restoration as a flowing side channel of the Mississippi River, both above and below the Lock and Dam 2 dike, should be evaluated. Reconnection would also enhance fish migration.

Flows into and out of the Vermillion River flowage area at river mile 813.1 can be increased to improve hydrologic connectivity and help flush sediment and develop coarser substrates. Allowing permanent flow through the Vermillion River Bottoms by removing the closing dam at the inlet from the Mississippi River may be evaluated to allow fish passage between Pools 3 and 4.

Connectivity between North and Sturgeon Lakes and the Mississippi River main channel would be sustained in order to maintain the unique gravel and cobble substrates in Buffalo Slough.

Some of the best and most diverse habitat in the Upper Mississippi River is associated with the mosaic of small flowing channels, ponds, sloughs, embayments, and natural levees. Modification or removal of wing dams would increase the river's ability to create and maintain these features.

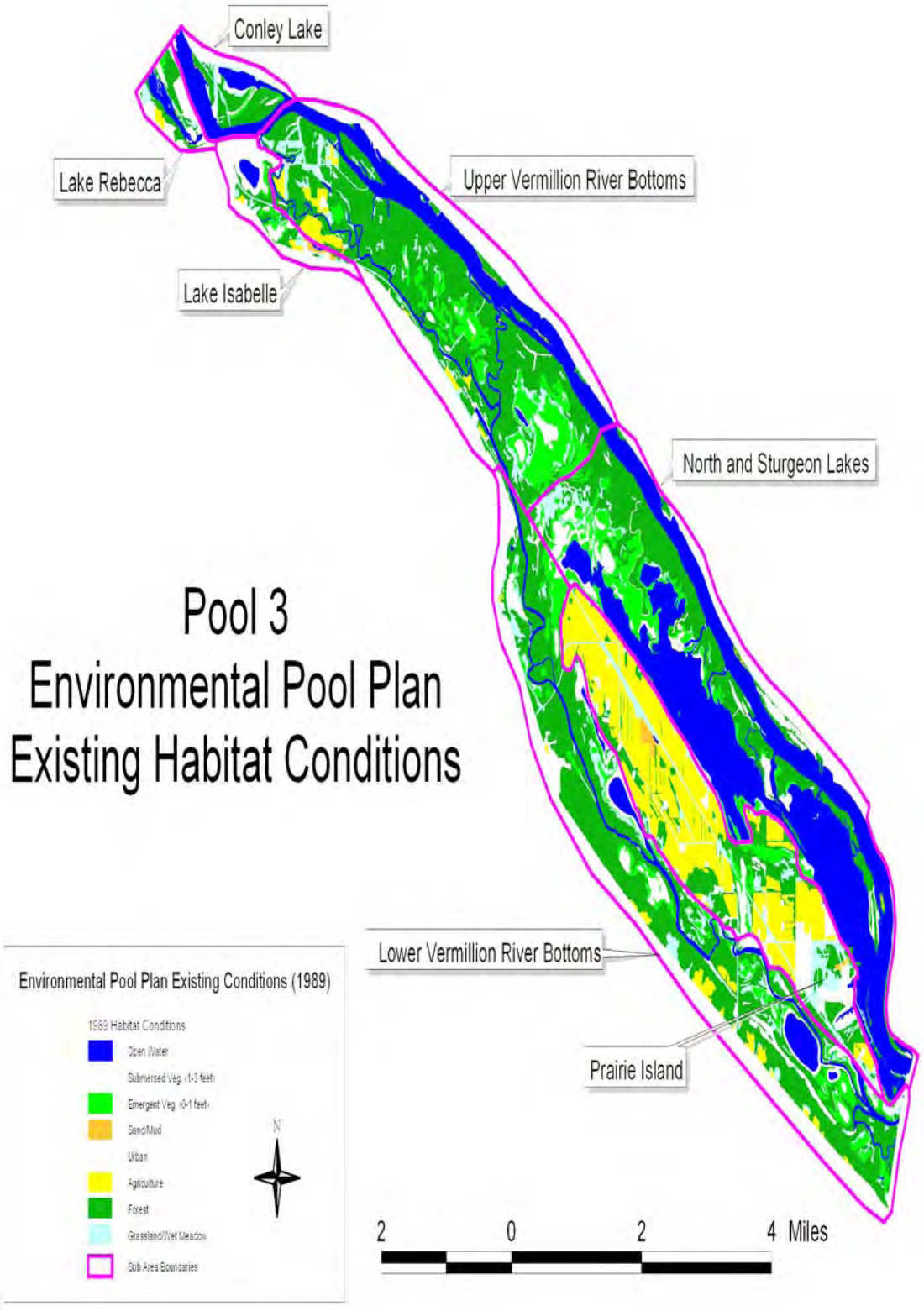
8.) Support Watershed Management Programs

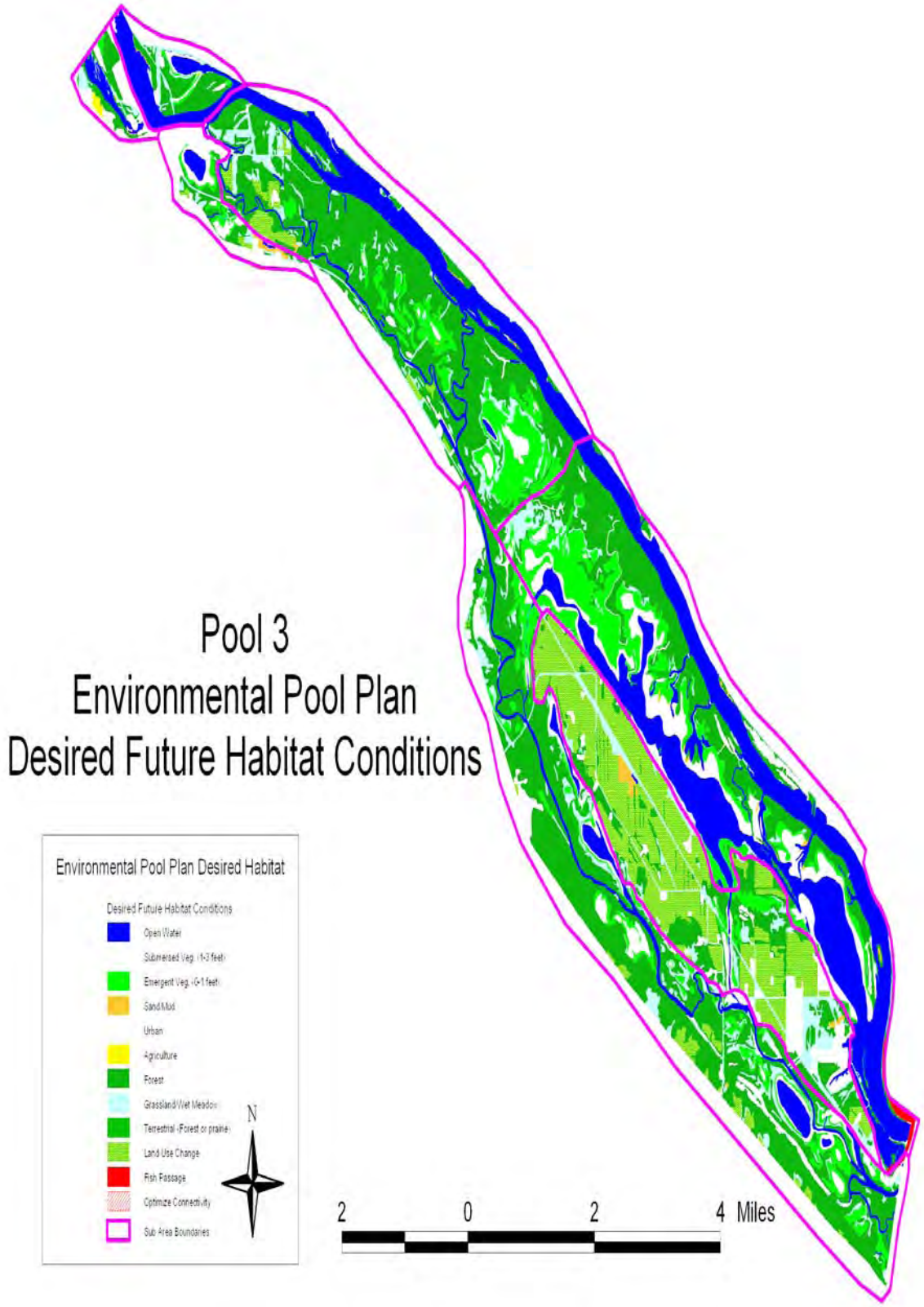
Watershed management programs should be supported to promote improved land use that will reduce sediment and nutrient inputs into the Mississippi River. A target that may be pursued is a return to bed sediment, nutrients, and suspended sediment loads more typical of the pre-industrial river. Wetland restoration and buffer zones could be established to filter sediments and improve water quality. Soon to

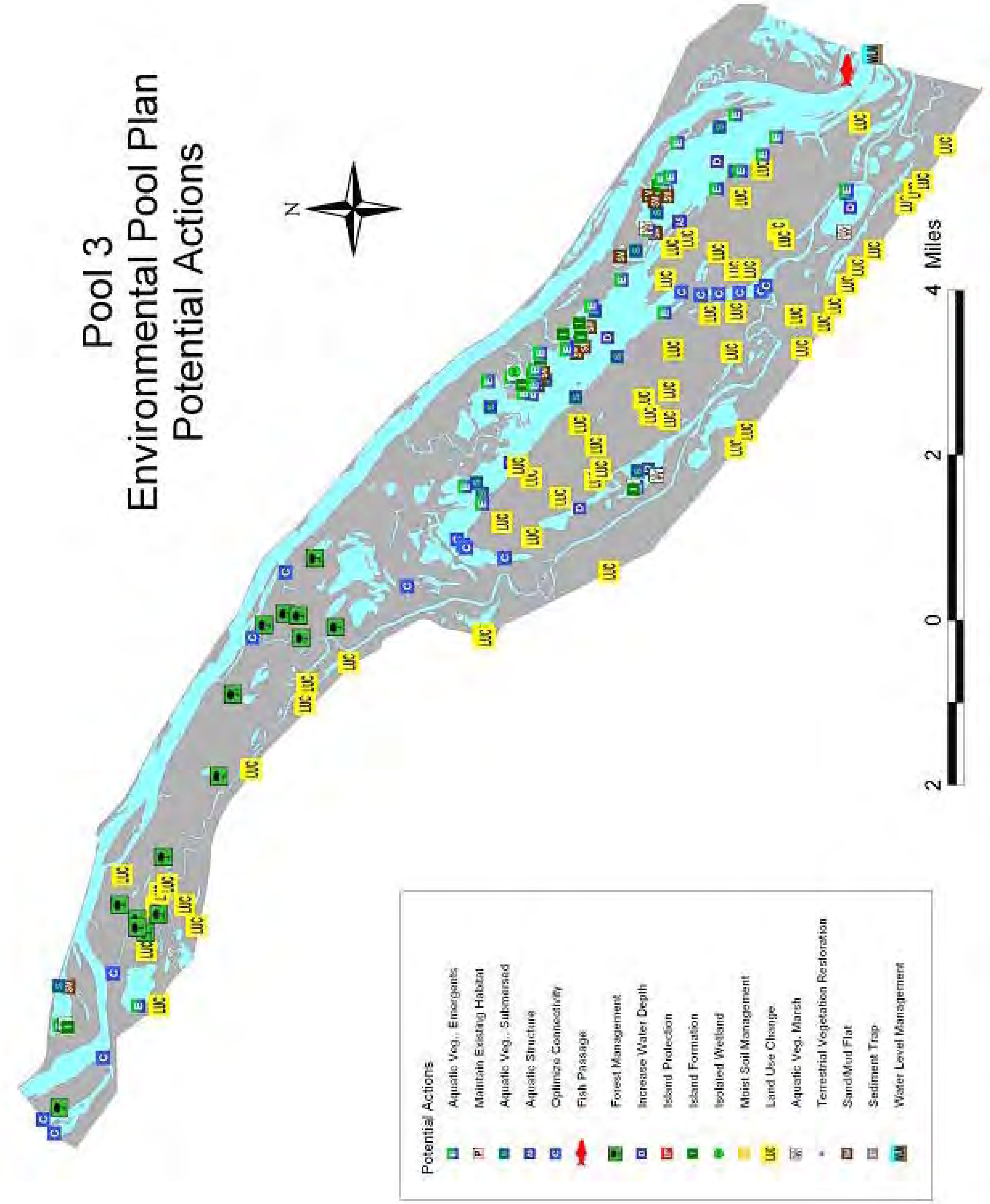
be completed improvements in wastewater and storm water treatment will also improve water quality.

Thermal inputs from the Prairie Island Nuclear Power Plant will meet State water quality standards, and nuclear waste will be stored following Federal standards.

Excel Energy Nuclear Power Plant on the shore of Pool 3. (Minnesota Dept. of Natural Resources photo.)


Conley Lake
Lake Rebecca
Upper Vermillion River Bottoms
Lake Isabelle
North and Sturgeon Lakes
Pool 3
Environmental Pool Plan
Existing Habitat Conditions
Lower Vermillion River Bottoms
Prairie Island
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N
2 0 2 4 Miles


Pool 3
Environmental Pool Plan
Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
2 0 2 4 Miles


Pool 3
Environmental Pool Plan
Potential Actions
N
2
0
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4 Miles
Potential Actions
Aquatic Veg.. Emergents
Maintain Existing Habitat
Aquatic Veg.. Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management

Desired Future Habitat Conditions In Pool 4, Mississippi River

Description of Pool 4

Pool 4 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 4 as part of the 9-foot channel navigation project. Construction of Lock and Dam 4 was completed in 1935. Pool 4 encompasses approximately 62,000 acres from approximately river mile 752.8, near Alma, Wisconsin, north to river mile 796.9 near Red Wing, Minnesota. In general, the east and west boundaries of the Pool 4 planning area are the I & M Rail Link railroad on the Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River.

Unlike most navigation pools of the Upper Mississippi River, the water area in this reach includes a natural lake, Lake Pepin, which forms the widest water body in the entire Mississippi River. The lower part of Pool 4, between Lock and Dam 4 and Lake Pepin, is dominated by floodplain features created by the Chippewa River and its delta. Much of the lower part of Pool 4 was inundated due to the impoundment created by Lock and Dam 4. Above Lake Pepin, the land area in the floodplain increases. Immediately below Lock and Dam 3, the river is influenced less by impoundment and influenced more by the gate adjustments at the dam that control the water level in the pool above.

This pool forms the border between Minnesota and Wisconsin. Bluffs and a relatively narrow floodplain form the borders of Lake Pepin, and an extensive and productive floodplain mosaic of lakes, side channels, and deltas is typical of the river above and below Lake Pepin. This represents a significant corridor of open space and habitat for both aquatic and terrestrial plants and animals. Above Lake Pepin, the river's channels and backwaters provide critical spawning areas for important sport fish species such as sauger and walleye that use Lake Pepin most of the year.

Five significant tributaries enter Pool 4. The Cannon River is the largest tributary to enter the Mississippi River within upper sections of Pool 4. The Chippewa River, which enters the Mississippi River at the lower end of Lake Pepin, influences much of the floodplain features and water quality characteristics in the backwaters on the Wisconsin side of the main channel in lower Pool 4. The Vermillion River in Minnesota, Rush River and Buffalo River in Wisconsin, and several small creeks also contribute flow to the pool. Historically, the Zumbro River had distributary channels that entered Pool 4 near Robinson Lake. Flood control levees and channelization have directed all of the Zumbro River flow to Pool 5. However, this channelization of the Zumbro River has resulted in eliminating the majority of suspended sediment load once contributed to lower Pool 4 by the Zumbro River.

Public lands in the upper section of Pool 4 include the Wisconsin Department of Natural Resources' Pierce County Islands Wildlife Management Area and the Minnesota Department of Natural Resources' Frontenac State Park. A Wisconsin Department of Natural Resources State natural area (Rush River State Natural Area) is located upstream of Maiden Rock. The Upper Mississippi River National Wildlife and Fish Refuge begins near the mouth of the Chippewa River. The Chippewa River Delta also has significant State land ownership in the Tiffany Bottoms Wildlife Area and the Nelson Trevino State Natural Area.

Ten towns are found along the river valley: Red Wing, Lake City, Wabasha, and Reads Landing, Minnesota, and Bay City, Maiden Rock, Stockholm, Pepin, Nelson, and Alma, Wisconsin.

Resource issues for Pool 4 vary by location but can be summarized on the basis of location in the pool. The areas in the upper pool are

affected by sedimentation associated with the suspended sediment load from the Minnesota River and island erosion due to recreational traffic. This has caused a loss in aquatic vegetation and water depth diversity of the backwater lakes and isolated wetlands in areas above Lake Pepin. Lake Pepin is affected by sediment resuspension by wave action and barge travel. The lower end of Pool 4 is affected by island loss caused by inundation and the erosive action of wind generated waves and ice action. Inundation and loss of islands have caused a change in the water flow across the floodplain. In the lower section of Pool 4, the flow can be described as "sheet flow" due to a loss of terrestrial and bathymetric features. The lower end of the pool has also seen a simplification in habitat types due to the bedload contributed by the Chippewa River. This has caused sedimentation of many backwater sites and loss of depth diversity.

Description of Existing and Desired Future Habitat Conditions for Pool 4 Subareas

Several identifiable areas are present within Pool 4. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Gantenbein Backwater Complex (river mile 794-800) – Immediately below Lock and Dam 3 on the Wisconsin side of the main channel is an area known as Gantenbein Lakes that is owned and managed as a waterfowl hunting area by Diamond Bluff Associates. This area is bounded by the Lock and Dam 3 spot dike on the west (upstream), by the main channel to the east and south, and by the Wisconsin mainland on the north. Habitat quality in this area is considered good to excellent for many wetland species. The desired future for this area would be to maintain this backwater in its present state of habitat.

Cannon River Delta (river mile 791.0-796.9) The area is defined by the Minnesota mainland,

Upper Pool 4, with Vermillion and Cannon River confluence on left and Gantenbein Lake on right. (US Army Corps of Engineers photo.)

which includes the Cannon River floodplain to the south, Lock and Dam 3 to the west, and the main channel on the north and east. Several small lakes and many ponds are found in the Cannon River Delta, an area owned and managed by the Red Wing Wildlife League for wildlife habitat. Sedimentation has altered the habitat quality in this area, yet much of the area is considered to be of good habitat quality for a variety of species. Development on the periphery of the area has affected the connectivity of the Cannon River and its floodplain due to the constrictions imposed by the roads and railroads.

The desired future for the Cannon River Delta is to protect and maintain existing habitat conditions along with some measures to improve aquatic connectivity and some increase in water depths.

Pierce County Islands (river mile 785.0-796.9) The area is bordered by the Wisconsin mainland to the north, Minnesota mainland to the south, main channel on the south, and Lake Pepin to the east. Several features of special concern exist in this area of upper Pool 4.

The Pierce County Islands Wildlife Area is located entirely within upper Pool 4 of the Upper Mississippi River, approximately 1 mile west of Bay City, Wisconsin, in Pierce County. The Wildlife Area borders the upstream end of Lake Pepin. The Pierce County Islands Wildlife Area

Pierce County Islands Wildlife Area (Looking north) (Wisconsin Dept. of Natural Resources photo.)

is the only publicly managed waterfowl area and refuge along this section of the Mississippi River in Wisconsin, an area that stretches from lower Lake Pepin to Prescott, a distance of about 50 river miles. The Upper Mississippi River National Wildlife and Fish Refuge, managed by the U.S. Fish and Wildlife Service, begins just below Lake Pepin. The Pierce County Islands wetland complex was acquired by the Wisconsin Department of Natural Resources in 1984. Currently, a portion of this wetland complex is designated as a "no-entry waterfowl refuge" from September 1 to December 31 to minimize disturbance of waterfowl during the fall migration. A unique feature of the no-entry closed area is a system of three old dikes constructed by a previous landowner for the purpose of water level control (circa 1930) and managed as a waterfowl hunting club. An artesian spring in the upstream impoundment was used to provide water to these impoundments. This spring is still functional and serves as a water source for the wetlands in the no-entry refuge. The Management Plan for the Pierce County Islands Wildlife Area identified rehabilitation of the dike system as a management strategy to improve the area for migratory waterfowl and shorebirds.

Additional aquatic areas within this area of upper Pool 4 include: the Wisconsin Channel, which is currently considered fairly good secondary channel habitat; and Mud Lake, Dead Slough Lake, and Goose Lake, which have been severely impacted by fine sediment deposition and are considered of a poor habitat quality for a variety of aquatic species.

Several management actions are proposed: increase the coverage of emergent vegetation approximately 40 percent, stabilize several miles of eroding shoreline, offset the impacts of sedimentation through increasing water depths in selected backwater sites, make improvements in the quality of terrestrial habitat and island construction. As stated above, reconstruction of the dike system in a portion of the Pierce County Wildlife Area is planned to improve habitat for migratory waterbirds.

Lake Pepin (river mile 764.5-785.0) – The upstream boundary is loosely defined as the Pierce County Islands near Bay City, Wisconsin. The downstream boundary of Lake Pepin is the Chippewa River Delta. Lake Pepin is a naturally formed lake resulting from the impoundment caused by glacial outwash from the Chippewa River. Water levels in the lower sections of Lake Pepin have also been raised due to the impoundment of the Mississippi River resulting from the construction of Lock and Dam 4. Lake Pepin is shallow where the Mississippi River enters it at the upper end and averages 25 to 30 feet deep in the middle and lower extent. Sedimentation has covered the pre-settlement lakebed except in the lowermost area that retains significant areas of gravel substrates. Sedimentation studies conducted in the upper end of Lake Pepin predict that approximately one-third of the lake volume will be filled by sediment within the next 100 years if present rates of sedimentation continue. Wind driven wave action in the lake maintains a beach zone of cobble sized rock and coarse sand. Recently, much of the beach zone has been covered by shells of zebra mussels.

Lake Pepin is considered good to excellent habitat for many species of fish. The pre-impoundment assemblage of fish species is still present at approximately the same level of dominance, given the increase in numbers of exotic species. Waterfowl habitat for divers still exists in many areas of the lake, even with the decline in submersed vegetation. Lake Pepin has a diverse mussel community that is in peril due to the exotic zebra mussels.

The recommendation for Lake Pepin is to maintain it in its present condition. This will require efforts to control or eliminate exotic species, especially zebra mussels. Additional management actions may be identified in the future near the shoreline areas of the lake or options to minimize disturbance of contaminated sediments in the upper section of the lake.

Chippewa River Delta at the lower end of Lake Pepin (Looking northeast) (Wisconsin Dept. of Natural Resources photo.)

Chippewa River Delta (river mile 760.1-765.0) This area is bounded by Lake Pepin on its upstream end (west), by Highway 25 between Nelson, Wisconsin, and Wabasha, Minnesota, on the downstream end (east), and by the Minnesota and Wisconsin mainlands to the south and north, respectively. The Chippewa River Delta includes the Nelson Trevino State Natural Area and Tiffany Bottoms Wildlife Management Area. The Upper Mississippi River National Wildlife and Fish Refuge begins at the Chippewa River Delta and continues south to just above Rock Island, Illinois. Much of the Refuge-owned property in this area is closed to waterfowl hunting.

The Chippewa River is a major contributor of sand, in the form of bed load, to the Mississippi River. This sand transport and deposition in the Mississippi River influences channel maintenance activities in Pools 4 through 7. Aquatic and terrestrial areas in lower Pool 4 have been affected by past dredging activities and continue to be affected due to slow revegetation of historic disposal sites. Presently, environmentally sound and economically feasible disposal sites in this area are becoming harder to locate and will need further attention in the future. This sand deposition in the floodplain of the Mississippi River has also affected numerous backwaters and secondary/tertiary channels in lower Pool 4 through Pool 5A.

There are several human actions and historical features in the Chippewa River Delta that influence habitat quality. Hydropower peaking on the Chippewa River results in frequent "flash floods" of the Chippewa River Delta area. This results in altered sediment transport patterns and stranding of aquatic organisms. An abandoned railroad grade crosses through the delta floodplain and influences sediment transport and hydraulic connectivity of the area. However, this railroad grade also provides habitat for many species; therefore, modification must be carefully evaluated. Finally, much of the delta area was affected during the heyday of logging in the Chippewa River pineries. Most notable are modifications to Beef Slough, a distributary channel of the Chippewa River.

Management actions in the delta will focus on maintaining the present habitats and improving conditions of the terrestrial areas. Some shoreline protection has been identified in the area to protect existing resources. One area of concern is the upstream portion of the delta that forms the downstream shoreline of Lake Pepin. Erosion in this area is threatening some isolated wetlands of emergent vegetation adjacent to Lake Pepin.

Indian Slough/Big Lake (river mile 755.5-760.1) - Highway 25 between Nelson, Wisconsin, and Wabasha, Minnesota, forms the upstream (western) boundary of this area. The southern boundary of this area is the main channel, with the northern boundary formed by the Wisconsin mainland. The area has seen a decline in aquatic vegetation and consequently a reduction in the habitat value of the area. Island erosion and dissection are causing a simplification of the habitat in this area and contributing to a loss in diversity of water velocities, depth diversity, backwater fish overwintering habitat, and aquatic vegetation.

Indian Slough and Catfish Slough provide the major input of flow into this backwater complex. Both of these sloughs have had modifications made to their inlets in an effort to reduce sediment input into the backwater complex. The Indian Slough closure also incorporated features to improve fisheries habitat via tree drops and the construction of a riffle-pool complex.

Crats Island divides Indian Slough from the main channel of the Mississippi River. Big Lake is in the background to the left. (Looking downstream) (Wisconsin Dept. of Natural Resources photo.)

Additional activities proposed for this backwater complex include: island construction to improve environmental conditions for aquatic vegetation, increasing bathymetric diversity, and providing a greater diversity of water velocities in Big Lake; maintaining/increasing water depths in approximately 3 percent of the aquatic area for fishery habitat, and increasing emergent vegetation by approximately 14 percent.
A variety of features will also be considered to stabilize shorelines and reduce island dissection to stabilize connectivity between the main channel and backwaters. Revegetation of historic dredged material disposal sites is planned to increase the area of forest in this section of the pool and increase forest diversity. Resource managers have also identified this backwater complex as one location where increasing sandbar and mud flat habitats should be a pursued.

Robinson Lake (river mile 756.5-759.50)
Located downstream of Wabasha, Minnesota, this area is bordered by the main channel to the north and east and by the Minnesota mainland to the south and west. Much of the area has seen a reduction in habitat quality due to sedimentation and erosion of terrestrial habitat. Historically, Zumbro River distributary channels entered Robinson Lake. Much of the shoreline around Robinson Lake is developed as residential sites.

The Minnesota Department of Natural Resources has identified this area as a section of the river floodplain where dynamic river processes are occurring and should be promoted. The desired future acknowledges that these processes will most likely result in the formation of islands and perhaps scouring of some of the backwaters. A slight increase in emergent vegetation is also predicted for the future due to sedimentation in some locations and the effect of possible water level management in Pool 4. Additional increases in water depth may occur as a result of dredging to obtain material for revegetation of historical dredged material disposal sites.

Peterson Lake (river mile 753.7-756.6)
Peterson Lake is bordered on the downstream side (south) by the Lock and Dam 4 dike, on the north and east by the main channel, and on the west by the Minnesota mainland. The area has seen significant erosion of islands that once bordered the eastern side of the complex. The erosion of the islands has resulted in a decrease in aquatic and terrestrial habitat diversity. Emergent vegetation coverage in this area was 9 acres in 1989. Many of the remaining islands were protected in 1995 as part of the Peterson Lake Habitat Rehabilitation and Enhancement Project (HREP). At the same time, some of the islands were "replaced" using rock structures to reduce sedimentation and velocities in Peterson Lake. A small amount of dredging also occurred at the same time. In 1992, culverts were placed

through the Lock and Dam 4 dike to the Finger Lakes area of Pool 5. The culverts "pull" water from the Peterson Lake area. The Minnesota shoreline of Peterson Lake has been developed as home and commercial sites.

Lock and Dam No. 4 with Peterson Lake in the background. (US Army Corps of Engineers photo.)

Some additional island formation is proposed for Peterson Lake, with a portion of them forming through sedimentation and some being constructed. A 500 percent increase in emergent vegetation is proposed due to the cumulative effects of potential island formation and water level management in the pool. Some locations have been identified for their potential to reestablish overwintering habitat for backwater fish species. This habitat could be improved through a combination of measures (closure construction and backwater dredging). Additional backwater fish habitat may be improved in conjunction with dredging to provide material for topsoil at historical disposal sites.

Beef Slough/Rieck's Lake (river mile 752.8-757.2) - This area is bordered on the west by the main channel and Big Lake area, on the south by Lock and Dam 4, on the north by the Wisconsin mainland, and continues up the Buffalo River floodplain approximately 3 miles upstream of the Highway 35 bridge. The Buffalo River has significantly altered much of this area due to sediment deposition. Beef Slough and Tank Ponds were cut off by construction of the railroad, making them susceptible to sedimentation from the Buffalo River. Currently (2003), the Rieck's Lake area is an important habitat for migrating waterfowl, especially tundra swans. However, continued sedimentation will eventually eliminate the value of this area as a stopover except during periods of very high fall water levels. Island dissection and erosion is an important habitat issue in this area, along with sedimentation.

Island protection and construction, increasing water depth, and increasing the coverage of emergent vegetation are the main options identified for future management actions in the area.

Zumbro River Delta (river mile 745.0-760.1 (river mile 751.2-760.1 in Pool 4)) - The Zumbro River is the largest Minnesota tributary located in the lower part of Pool 4. Historically, some channels of the Zumbro River entered into the Robinson Lake area of Pool 4. Channelization has eliminated the connection of the Zumbro River to Pool 4. Historically, the Zumbro River floodplain was dissected by numerous channels and seasonally isolated lakes and ponds. Flows moved laterally within the floodplain, sometimes north toward what is now Pool 4, while at other times flowing south into what is now Pool 5. During flood events, the Zumbro River flowed in both directions across a diverse and natural floodplain. In the mid-1900's, approximately the lower 4 miles of the Zumbro River was straightened and isolated from its floodplain by levees. Additionally, when Wabasha County 24 was elevated, it severely restricted floodplain and channel connectivity with the Mississippi River. Remnant channels, floodplain depressions, and wetlands throughout the historic Zumbro River Delta are all that remain from what was once a very dynamic floodplain ecosystem. The area is now inundated only when Mississippi River water levels become high enough for water to either back up or seep into these areas. There also has been a large net loss of floodplain forest, prairie, and wetland habitats due to most of the area being converted to agricultural use.

The proposed actions for the Zumbro River Delta focus on providing options for private landowners to improve terrestrial and aquatic habitat through land use changes. Working with

the property owners in the area will also include discussions on options to improve the connectivity of the Zumbro River with its floodplain into Pools 4 and 5.

Unique Attributes, Opportunities, and Constraints

A linkage between Pools 3 and 4 is in the form of a thermal plume from the Prairie Island Nuclear Power Plant. The desire is to have the thermal discharge from the Prairie Island Nuclear Power Plant meet State water quality standards. Private landowners will be encouraged and provided with incentives to protect and restore native plant communities on their riparian, blufftop and floodplain lands. Significant bald eagle roosting areas exist in upper Pool 4 and at the mouth of the Chippewa River. These areas will be protected from riparian development and environmentally harmful channel maintenance activities.

Tundra swans (US Army Corps of Engineers photo.)

The desired future includes reducing the rate of filling in Lake Pepin by 10 percent of its 20th century rate.

The Mississippi River in this area once supported more than 40 species of freshwater mussels, and migratory fish once moved through this reach on their way to spawning grounds and wintering areas. With improvements to water quality and the physical integrity of these rivers, the opportunity to reestablish populations of lost species presents itself and will occur in the future.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Often, the actions proposed and described below are interrelated, and specific actions will require overlapping solutions. The goal of these actions is to increase diversity in the pool. Increasing and sustaining a diverse aquatic and terrestrial habitat base in the pool is the key to improving the health of the Mississippi River. These actions, combined with others taken in adjacent pools, will improve the health of the Mississippi River.

1.) Increase Depth Diversity in Channels and Backwaters

Managing sediments in Pool 4 is important in stabilizing habitat for a variety a fish and mussel species. In the main channel, recommendations contained in the Channel Maintenance Management Plan must be followed. Dredged material may be used to construct islands in various locations. Historic dredged material placement sites would be planted to native plant communities.

Efforts will be made in the upper and lower sections of the pool to increase the quality and quantity of secondary and tertiary channel habitat. Maintenance and formation of these channels would consider a variety of factors aimed at providing for a diversity of habitats (undercut banks, mud banks, snags, etc.) and substrate types. Where feasible, channels should be defined by land features (i.e., islands) to further diversify the habitat these channels would provide. Dredging, directing flows, or other techniques may be used to optimize depth and substrate diversity.

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas within the pool are considered quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified

if long-term declines in habitat quality in the area were noticed.

3.) Protect and Restore Islands

Stabilization of islands in Pool 4 would be undertaken to reduce the rate of island erosion and island dissection. This would help maintain a diversity of depths, velocities, and substrate. It would also keep selected backwater areas free from flow. The structure provided by islands is also very important for the establishment and maintenance of aquatic vegetation.

Island formation will be evaluated to document where the potential exists to allow/promote "natural" accretion of islands. Where necessary, islands would be constructed to improve terrestrial and aquatic habitats. The constructed islands would be oriented to promote sediment deposition and scour to increase depth, velocity, and substrate diversity. The islands would improve water quality conditions (decrease sediment resuspension) and promote the establishment and maintenance of aquatic vegetation.

The primary locations where islands would be formed to recreate floodplain structure are the Indian Slough/Big Lake, Peterson Lake, Robinson Lake, and Beef Slough/Rieck's Lake areas. Islands in these areas would also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach.

A reduction in sediment resuspension in these areas would also reduce fine sediment input to Pool 5. Reduction in sediment resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Managing terrestrial plants will focus on maintaining, enhancing, and reestablishing healthy forest communities interspersed with grasslands and wet meadows. Management

Example Action: ***Manage Floodplain Forest and Prairie Communities for Diversity and Quality.*** **Forestry technician inspects swamp white oak transplant on river island.** (US Army Corps of Engineers photo.)

actions include topsoiling and planting historic dredged material placement sites with native plants; decreasing the dominance of reed canary grass; protecting and reestablishing prairie communities and managing for their continuance; and reducing or eliminating purple loosestrife by continuing control methods and implementing new ones. Privately owned property may be managed through landowner education and incentives, conservation easements, or purchase from willing sellers.

Efforts will be made to promote the development and maintenance of mud flat and sandbar habitat. Because of sediment input to the pool, sandbar habitat has a high potential of developing, but mud flat potential is low. If mud flat habitat does occur, it is quickly colonized by plants. Robinson Lake and Rieck's Lake have potential for mud flats -- essentially, the farther from the main channel and flowing side channels, the greater the likelihood of mud occurring. These habitats are important for shorebirds and turtles; have differences in plant germination dependent on substrate type; and

can be a good food and spawning resource for fish and wildlife.

The present forest community dominated by maple is not long lived nor is regeneration of the forest community occurring due to many factors (higher water table, reed canary grass, land elevation, etc.). Forest management would include measures to restore disturbances and control of reed canary grass in the Chippewa River Delta and elsewhere. However, consideration would be given to include management of some of the areas that are homogenous in species composition/age, but valuable for other species that need large tracts of unbroken forest. Another option may be to raise the elevation of landforms through the use of dredged material and improve site suitability for other native forest species. In addition, land management practices would take into consideration unique needs of State and Federal endangered and threatened species.

Connectivity for terrestrial species would be addressed through the management of habitats in optimal blocks to meet the needs of a variety of species. This may include the development of "travel" corridors between larger blocks of habitat or managing for large blocks of habitat. Areas in Pool 4 most suited for consideration of these measures include the deltas of the Cannon, Chippewa, and Zumbro Rivers.

Prairie restoration is proposed for the Chippewa River Delta and Zumbro River areas. A variety of measures would be implemented, including incentives for private landowners to restore prairie, easements, and acquisition from willing sellers.

5.) Manage Water Levels to Improve Aquatic Habitats

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management will be repeated as necessary to maintain aquatic plant abundance and diversity.

Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Managing aquatic plants will focus on maintaining, enhancing, and restoring healthy submergent, floating, and emergent plant communities with optimal distribution and high diversity. The 1939 aquatic vegetation conditions represent an optimal mosaic and assemblage of habitat desired for lower Pool 4. However, some areas now are more suitable for other purposes or communities. Any description of desired vegetation communities must consider that areas void of vegetation are also important. For lower Pool 4, it is reasonable to expect emergent vegetation to the 1-foot depth, mixed aquatic vegetation to 2.5 feet, and submersed vegetation down to 6 feet. The submersed vegetation would be a transition of almost 100 percent coverage in shallower depths (<3 feet) to less than 5 percent coverage at the 6-foot contour. The exact location of aquatic vegetation will vary due to substrate, water velocity, and wind fetch that in combination would affect species composition, density, and diversity.

It is proposed to enhance aquatic vegetation diversity and coverage in the Indian Slough/Big Lake, Peterson Lake, Robinson Lake, and Beef Slough/Rieck's Lake areas through modifying flow distributions, increased light penetration due to the formation of islands, and changes in sediment characteristics. Aquatic vegetation in the Pierce County Wildlife Management Area near Bay City, Wisconsin, could be improved through the construction of dikes to form moist soil management units. Aquatic vegetation in sections of Pool 4 below Lake Pepin would also be enhanced through periodic pool-wide summer drawdowns.

6.) Work Cooperatively with Private Property Owners

Several areas within the Mississippi River floodplain and the majority of the tributary watersheds are privately owned. Maintaining and improving habitat within the Mississippi River floodplain is dependent on a long-term commitment to provide resources to private landowners to improve water quality, reduce erosion and sedimentation, and improve habitat conditions on land within the floodplain. Various approaches and techniques will be evaluated and implemented to work cooperatively with private property owners. Some of the tools include: voluntary measures, landowner incentives, easements from willing owners, and purchase of land from willing sellers.

The opportunities for implementation of this tool in Pool 4 are located in the Zumbro River, Cannon River, and Chippewa River areas and in various locations along Lake Pepin.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

Human alterations have resulted in numerous changes to the water flows within Pool 4. Identification and modification of channel training structures to promote a diversity of aquatic habitat will be done. Modifications of the abandoned railroad grade in the Chippewa River Delta will be investigated to improve the hydraulic connectivity of the floodplain in this area.

Measures are proposed in all areas of the pool to restore and maintain aquatic and terrestrial connectivity to assure the habitats are available and accessible at the time fish and wildlife need them to meet life cycle needs. For aquatic organisms, this would entail modifying closing structures, promoting the formation of or creating channels, and removing any barriers to increase the spatial and temporal connectivity of habitats. Connectivity with Pools 3 and 5 would be improved through the implementation of structures or dam operation measures to increase fish passage at these dams.

The channel of the Zumbro River has been channelized and flows directly into the navigation channel of the Mississippi River. This has eliminated or degraded the natural processes, productivity, and connectivity of the historical Zumbro River Delta. One option for restoration of the Zumbro River Delta is depicted on the pool plan. Additional options will be identified and evaluated to determine the best mix of features to restore habitat in the Zumbro River Delta area.

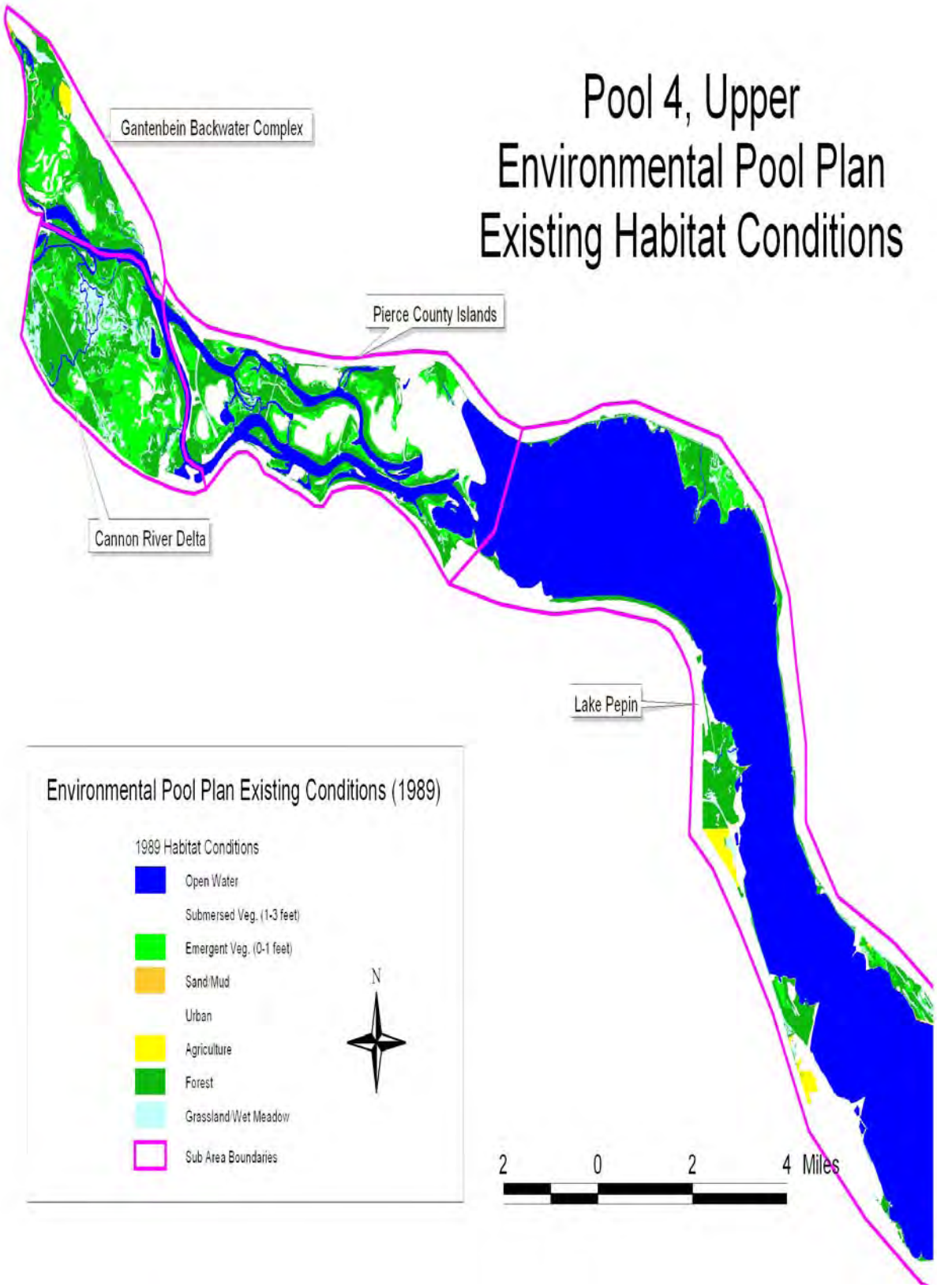
A portion of the Pierce County Wildlife Area should be managed as a moist soil unit to improve the quality and availability of wetland habitat in upper Pool 4 for wetland species. The development of the moist soil units would incorporate features that will improve the condition of the area for fisheries spawning habitat.

Modifications to provide for fish passage around or through Locks and Dams 3 and 4 will be evaluated. For example, recreating a permanent flowage through the Vermillion River bottoms may allow fish to move between Lock and Dam 3 tailwaters (Pool 4) and Pool 3 at Hastings, Minnesota.

8.) Support Watershed Management Programs

Positive land use in the tributary watersheds should be encouraged to reduce sediment, nutrient, and other pollutant inputs into Pool 4. Urban areas are also included within the watershed and along the river. Solutions to eliminating point source pollution should be supported and implemented.

Thermal inputs from the Prairie Island Nuclear Power Plant in Pool 3 will meet State water quality standards, and nuclear waste will be stored following Federal standards.


Pool 4, Upper
Environmental Pool Plan
Existing Habitat Conditions
Gantenbein Backwater Complex
Pierce County Islands
Cannon River Delta
Lake Pepin
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
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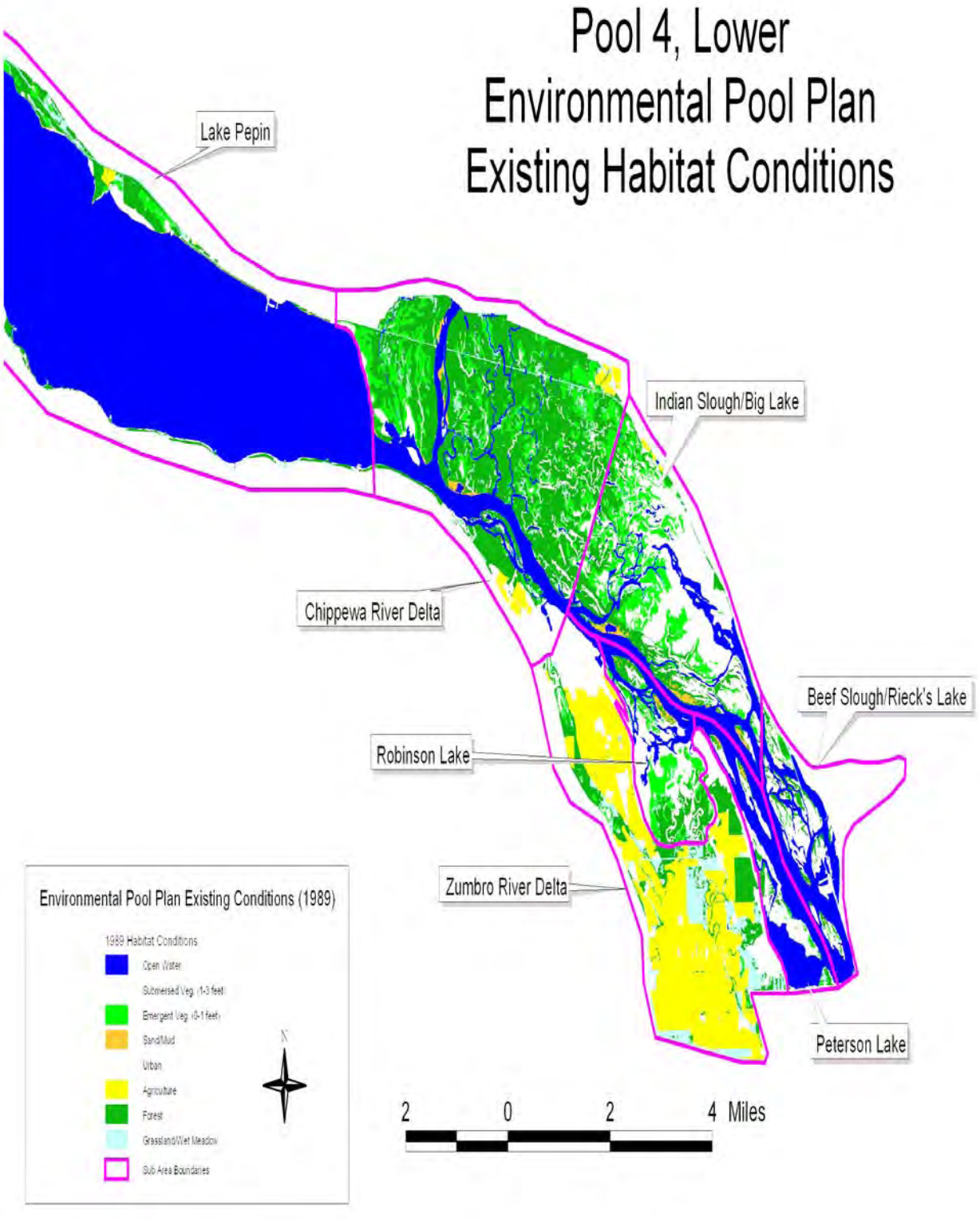
2 0 2 4 Miles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Existing Habitat Conditions
Lake Pepin
Indian Slough/Big Lake
Chippewa River Delta
Beef Slough/Rieck's Lake
Robinson Lake
Zumbro River Delta
Peterson Lake
Environmental Pool Plan Existing Conditions (1989)
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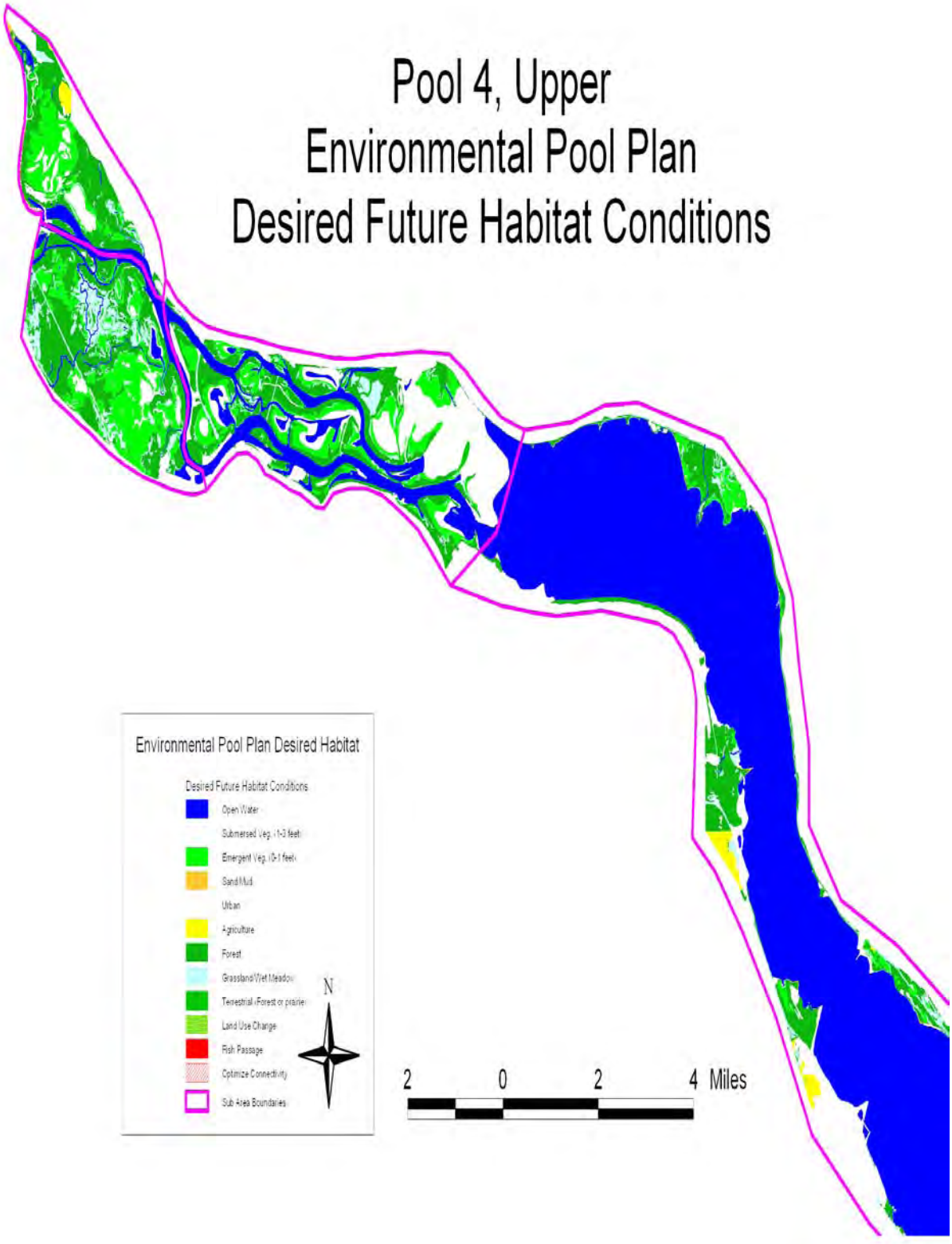
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N
2 0 2 4 Miles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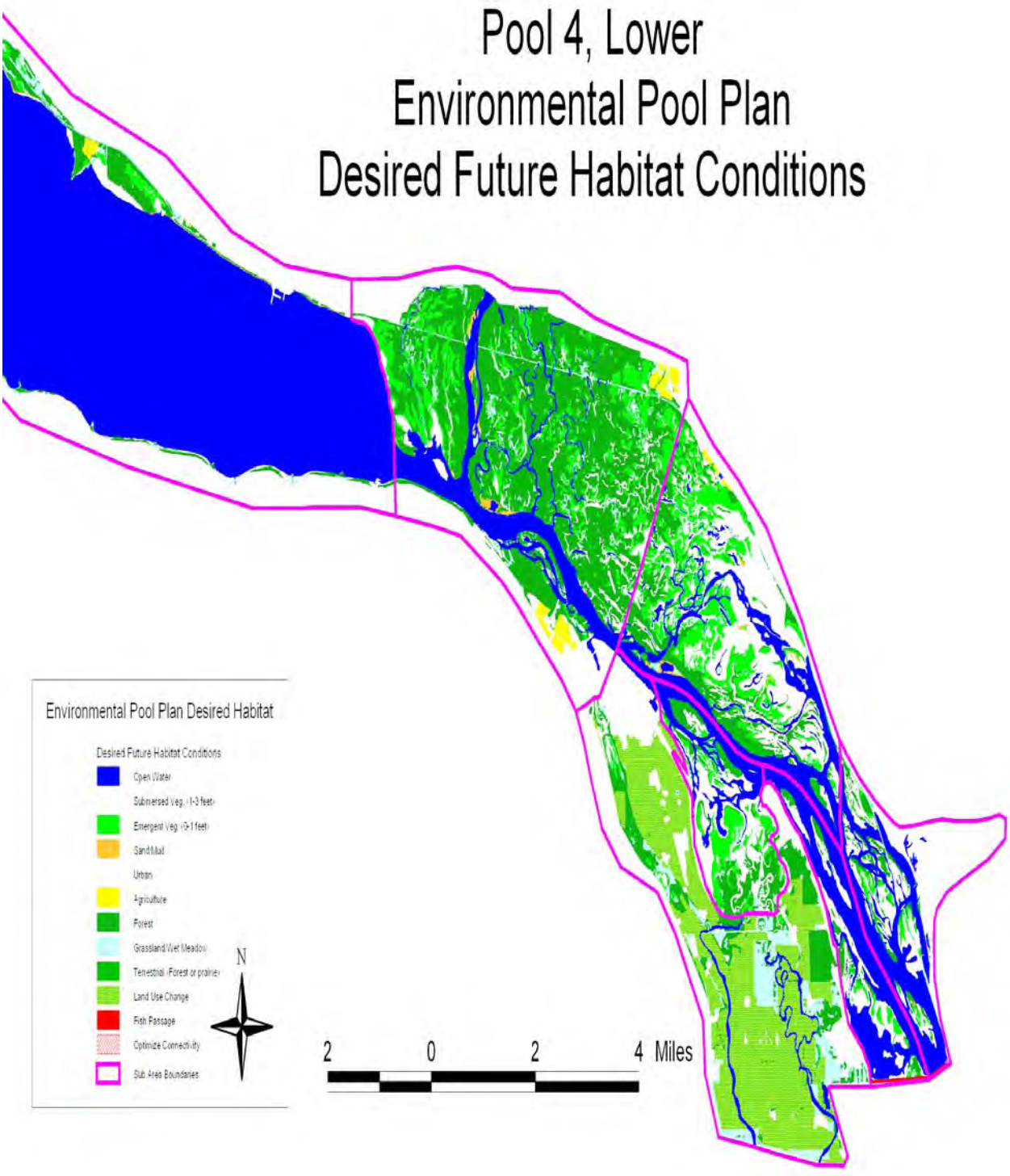
Environmental Pool Plan
Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
2 0 2 4 Miles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Desired Future Habitat Conditions
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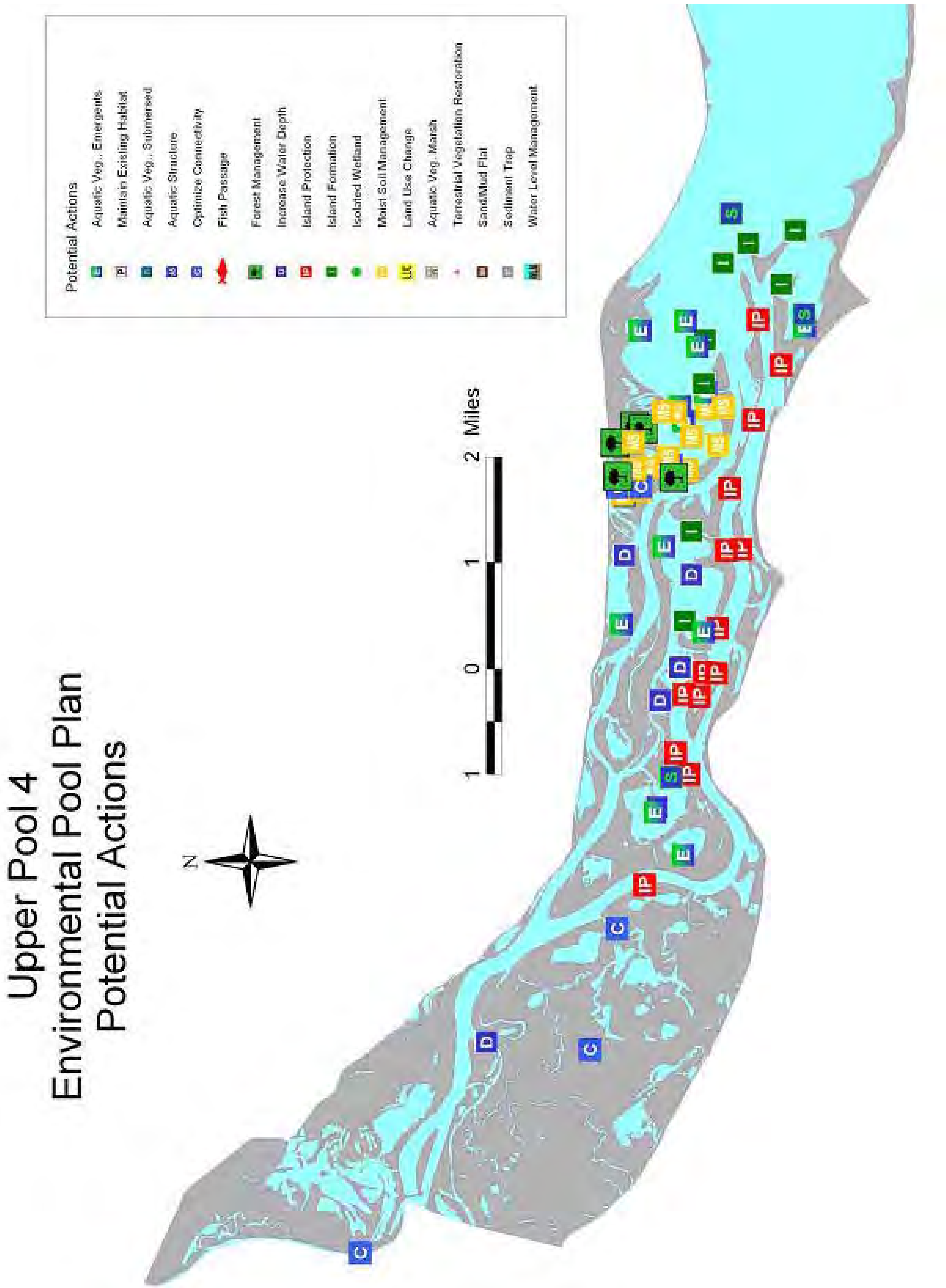
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
2 0 2 4 Miles


Upper Pool 4
Environmental Pool Plan
Potential Actions
N
1
0
1
2 Miles
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
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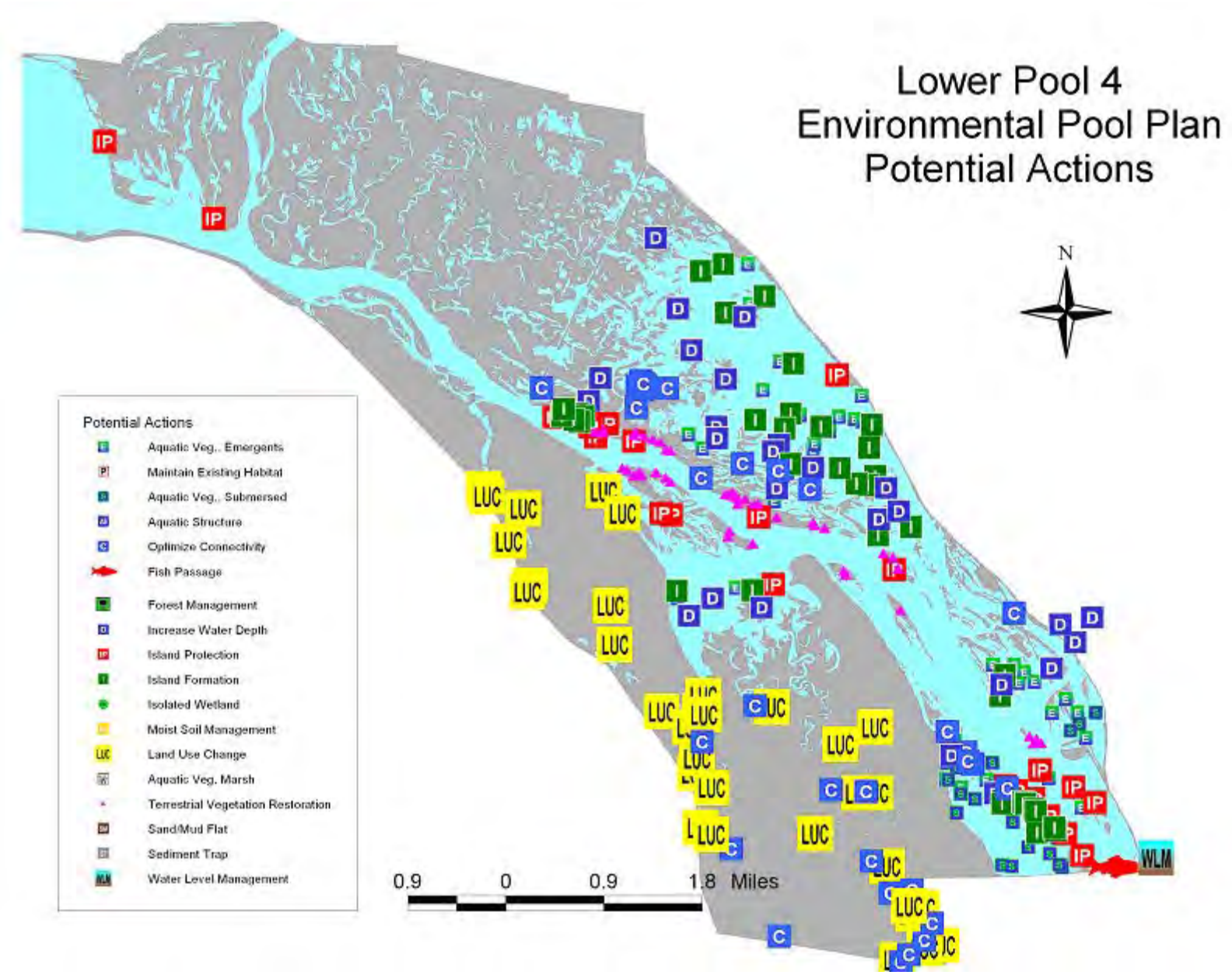
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management


Lower Pool 4
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Potential Actions
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Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
0.9 0 0.9 1.8 Miles
WLM

Desired Future Habitat Conditions In Pool 5, Mississippi River

Description of Pool 5

Pool 5 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 5. Construction of Lock and Dam 5 was completed in 1935 to support operation of the 9-foot-deep navigation channel. Pool 5, for the purposes of this plan, includes that reach of river from near Alma, Wisconsin, (river mile 752.8) downstream to Lock and Dam 5 below Minneiska, Minnesota (river mile 738.2). In general, the east and west boundaries of the Pool 5 planning area are the tops of the river bluffs on either side of the river including its floodplain and that of its tributaries where they enter the Mississippi River. The Pool 5 area encompasses 12,300 acres.

This pool, like Pools 3 through 9, forms the boundary between Wisconsin and Minnesota. The floodplain is relatively wide, with an extensive mosaic of floodplain lakes, channels, sloughs, and delta areas in the upper and middle portions of the pool, and more open water conditions in the lower end of the pool. Pool 5 represents a significant corridor of open space and habitat for both aquatic and terrestrial plants and animals.

Significant tributaries that enter Pool 5 include the Zumbro and Whitewater Rivers. The Zumbro River is the largest tributary to enter Pool 5, at approximately river mile 750. Much of the lower Zumbro River has been channelized and leveed. The Whitewater River, the second largest tributary, has been identified as the most significant source of sediment to the Mississippi River for a tributary of its size. Several small creeks also contribute flow, including three trout streams.

Considerable public lands exist in this area including U.S. Fish and Wildlife Service refuge lands, the Minnesota Department of Natural Resources' McCarthy Wildlife Management Area, and the Minnesota Department of Natural Resources' Weaver Dunes Scientific and Natural Area. Alma and Buffalo City, Wisconsin, are the only significant urban sites within the boundaries of the pool.

Description of Existing and Desired Future Habitat Conditions for Pool 5 Subareas

Several identifiable areas are present within Pool 5. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Finger Lakes/Upper Pool 5 - The Finger Lakes include six backwater lakes immediately below the dike at Lock and Dam 4. These lakes (Clear, Lower Peterson, First, Second, Third, Schmoker's) provide good habitat for fish and wildlife, with abundant aquatic vegetation throughout most areas. Finger Lakes was the site of an extensive HREP project completed in 1996 designed to improve overwintering habitat of centrarchids by introducing flow into several backwater lakes.

Finger Lakes (Looking northeast) (Wisconsin Dept. of Natural Resources photo.)

The desired future for this area acknowledges that sedimentation will continue to affect many of the backwater areas and some side channels.

Therefore, increasing the depth of several backwater lakes and increasing depth diversity of some secondary and tertiary channels have been proposed.

Mozeman's Slough/Lizzy Paul's Pond - This area is a series of small backwater lakes and sloughs that provide good habitat quality for fish and wildlife. Aquatic vegetation is abundant in some locations.

The proposed actions for this area primarily focus on maintaining the existing conditions and improving terrestrial habitats by promoting land use changes in the area. However, some locations where increasing depth would prevent the loss of overwintering sites for backwater fish species have also been identified.

Island 42 - Island 42 is bounded by the main channel to the east and West Newton Chute to the west. Numerous backwater lakes, sloughs, and flowing channels dissect the area, with abundant aquatic vegetation and excellent habitat for fish and wildlife throughout. Island 42 was the site of the first HREP project in the St. Paul District, which involved dredging and flow reduction to increase overwintering fish habitat.

During the late 1990's, a Pool 5 Channel Management Study that included the investigation of West Newton Chute was completed. The closing dam at the head of West Newton Chute was found to have deteriorated. The head of Island 42 was also found to have eroded. An analysis was conducted that showed rebuilding the closing dam would not provide sufficient habitat improvements. However, Island 42 was stabilized to prevent the further widening of West Newton Chute. We concur with the findings of the Channel Management Study.

The desired future for Island 42 identifies further increases in depth to offset the continuing effects of sedimentation in the backwater complex. Some of the material dredged may be used as topsoil on historic dredged material disposal sites that will then be planted to forest or prairie.

Island 42 (Looking south) (US Army Corps of Engineers photo.)

Zumbro River Delta - Historically, the Zumbro River floodplain was dissected by numerous channels and seasonally isolated lakes and ponds. Flows moved laterally within the floodplain, sometimes north toward what is now Pool 4, while at other times flowing south into what is now Pool 5. During flood events, the Zumbro River flowed in both directions across a diverse and natural floodplain. In the mid-1900's, approximately 4 miles of the lower Zumbro River was straightened and isolated from its floodplain by levees. Additionally, when Wabasha County 24 was elevated, it severely restricted floodplain and channel

Channelized section of the Zumbro River. (Minnesota Dept. of Natural Resources photo.)

connectivity with the Mississippi River. Remnant channels, floodplain depressions, and wetlands throughout the historic Zumbro River Delta are all that remain from what was once a very dynamic floodplain ecosystem. Now, the area is inundated only when Mississippi River water levels become high enough for water to

either back up or seep into these areas. There also has been a large net loss of floodplain forest, prairie, and wetland habitats because most of the area has been converted to agricultural use.

The proposed actions for the Zumbro River Delta focus on providing options for private landowners to improve terrestrial and aquatic habitat through land use changes. Working with the property owners in the area will also include discussions on options to improve the connectivity of the Zumbro River with its floodplain.

Weaver Bottoms - The Weaver Bottoms subarea is bordered by the main channel to the east and the Minnesota mainland to the north, west, and south. Historically, this 5,500+ acre complex was important for migrating waterfowl and wintering fish. This use was due in large part to extensive beds of emergent and submergent vegetation and a series of main channel border islands that protected the area from inflows from the main channel. Since the late 1960's, Weaver Bottoms has degraded to a large, windswept lake. A decline in vegetation severely reduces its value for fish and wildlife. Past channel maintenance efforts to improve habitat have shown little success in restoring aquatic vegetation in much of the Weaver Bottoms area. Further measures to improve aquatic vegetation in this area are warranted.

Management actions for this area focus on restoring aquatic vegetation, backwater fishery habitat, and terrestrial habitat. Proposed island locations represent a variety of island types – from those formed through sedimentation near the mouth of the Whitewater River and openings from the main channel, to islands constructed to provide environmental conditions suitable for the establishment and maintenance of lost aquatic vegetation beds. The desired future includes increasing emergent vegetation by over 65 percent while maintaining the present acreage of submersed vegetation through the beneficial effects of islands and water level management. Numerous locations have also been identified for potential development as overwintering habitat for backwater fish species. Sediment removed to recreate the overwintering habitat may be used for island construction, terrestrial habitat reestablishment, or topsoil for historic disposal sites.

Upstream end of Weaver Bottoms (Minnesota Dept. of Natural Resources.)

Whitewater River Delta - The Whitewater River enters the Mississippi River in the southwestern portion of Weaver Bottoms. Intensive agricultural use in the Whitewater River watershed resulted in severe erosion and sediment loading into Weaver Bottoms. Much of this sediment has accumulated at the mouth, expanding the Whitewater River Delta. This area is dissected by numerous distributary channels, and has a diversity of emergent and submergent aquatic vegetation and terrestrial plant communities.

The desired future for the Whitewater River Delta focuses on reconnecting the Whitewater River to its floodplain through levee removal and potential modifications to transportation features (i.e., road and railroad bridges) in its floodplain.

Belvidere Slough/Spring Lake - This is a large area with backwater lakes, sloughs, and flowing channels located near Buffalo City, Wisconsin. Belvidere Slough provides significant flow to the area. Following impoundment, the Spring Lake area was very diverse with numerous islands and deepwater areas, as well as abundant vegetation. It provided excellent fish and wildlife habitat. Currently, the Spring Lake area has lost much of its bathymetric and topographic diversity due to sedimentation and island loss.

Consequently, fish and wildlife habitat has also declined. Spring Lake was the site of an early HREP project designed to reduce flow and sedimentation into the area.

Within Pool 5, this area has the greatest amount of proposed island formation (more than twice the area of the Weaver Bottoms area). This extensive island proposal is designed to stabilize habitat conditions in this section of the pool and improve sediment transport and distribution. The islands would also provide environmental conditions for establishment and continued growth of aquatic vegetation. The desired future proposes actions (island construction and water level management) to increase the coverage of emergent vegetation by over 200 percent and maintain the coverage of submersed vegetation. Proposed actions also include increasing the depth and depth diversity of about 10 percent of the aquatic area in this vicinity. Other actions include proposals to provide for an increase in mud/sand flat habitat, isolated wetlands, and island protection to stabilize the connectivity between the main channel and backwaters in this area.

Lower Pool 5 - Lower Pool 5 includes the area from Spring Lake/Weaver Bottoms downstream to Lock and Dam 5A. This area is a large expanse of open water. Wind fetch is significant and has contributed to island loss in Spring Lake and Weaver Bottoms. As sediment continues to fill this area, some small islands are forming naturally in the upper reaches. Flow moves laterally through the area. Aquatic vegetation is present but much reduced from historical abundance.

The desired future for lower Pool 5 identifies a modest increase in the coverage of emergent and submersed vegetation primarily associated with island formation/construction.

Unique Attributes, Opportunities, and Constraints

The Zumbro River Bottoms area provides an opportunity for land use change to improve habitat conditions for a variety of plant and wildlife species. Private landowners will be encouraged, and provided with incentives, to reestablish and protect native plant communities on their riparian and floodplain lands, especially in the Zumbro River Bottoms area. An expansion of the sand prairies, somewhat unique to Pool 5, would improve habitat for Blanding's turtles and other wildlife.

The Mississippi River in this area once supported more than 40 species of freshwater mussels, and migratory fish once moved through this reach on their way to spawning grounds and wintering areas. With improvements to water quality and the physical integrity of these rivers, the opportunity to reestablish populations of lost species presents itself.

Checking wild rice beds in Mississippi River backwater. (Wisconsin Dept. of Natural Resources.)

Summary of Actions to Achieve Desired Future Habitat Conditions

Many of the proposed actions are interrelated. Often, solutions to problems will require implementation of more than one action. Likewise, single actions may address more than one problem. The overarching goal of these actions is to increase the productivity of the river ecosystem using all feasible means.

1.) Increase Depth Diversity in Channels and Backwaters

Island erosion and sedimentation have resulted in reduced bathymetric diversity in backwater areas. Dredging and island construction to concentrate flows, especially in the Weaver

Bottoms, Spring Lake, and lower pool areas, would improve bathymetric diversity. Dredging to increase depth for overwintering fish habitat at historical sites would be the preferred locations for obtaining topsoil for constructed islands.

2.) Maintain Existing Quality Habitats

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas within the pool are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

3.) Protect and Restore Islands

Islands would be constructed using 1941 aerial photographs as a template combined with current bathymetry and flow information. Floodplain structure in the form of islands will be restored and enhanced in the Weaver Bottoms, Krueger Slough, Lost Island, Spring Lake, and lower Pool 5 subareas. Measures to reduce sediment resuspension in these areas should reduce sediment input to backwaters located in upper Pool 5A. Reduction in sediment resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation. Islands can also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach. The desire is to convert a significant portion of area currently classified as impounded into contiguous backwaters and improve existing backwater communities.

Islands would be constructed on the basis of past HREP successes, and would be topped with substrate generated by dredging historical fish wintering areas. Islands would be seeded with native grasses and trees.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Much of the Zumbro River Bottoms area could be restored to native plant communities following acquisition or easements purchased from willing sellers. The feasibility of breaching the Zumbro River levee in several locations will be investigated in an effort to distribute sediment and nutrients more naturally throughout the floodplain during high flow events. Restoration of meandering, distributed channels would create permanent and seasonal wetlands. In addition, larger areas of floodplain forest and native prairie would become established. These areas would connect with the McCarthy Wildlife Management Area and the Weaver Dunes Scientific and Natural Area to the south, and U.S. Fish and Wildlife Service Refuge lands to the north, providing a several-thousand-acre complex of prairie, forest, and marsh, with intermittent agricultural areas. Another option may be to raise the elevation of landforms through the use of dredged material and improve site suitability for other native forest species.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species.

Example Action: *Work Cooperatively with Private Property Owners.* Inspecting trees planted in riparian area on private land. (USDA Natural Resources Conservation Service photo.)

Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Aquatic vegetation diversity and coverage would be enhanced in the Weaver Bottoms, Belvidere Slough/Spring Lake, and lower Pool 5 areas through modifying flow distributions, increasing light penetration due to the formation of islands and changes in sediment characteristics. Aquatic vegetation in sections of Pool 5 would also benefit through implementation of periodic pool-wide water level management.

6.) Work Cooperatively with Private Property Owners

Several areas within the Mississippi River floodplain and the majority of the tributary watersheds are privately owned. Maintaining and improving habitat within the Mississippi River floodplain is dependent on a long-term commitment to provide resources to private landowners to improve water quality, reduce erosion and sedimentation, and improve habitat conditions on land within the floodplain. Various approaches and techniques will be evaluated and implemented to work cooperatively with private property owners. Some of the tools include: voluntary measures, landowner incentives, easements from willing owners, and purchase of land from willing sellers. An area of Pool 5 that will be focused on for working with private property owners is the Zumbro River Delta.

Agricultural land within the Zumbro River floodplain. (Minnesota Dept. of Natural Resources photo.)

This is a long-term effort requiring acquisition or floodway easements from willing sellers on 5,000 acres primarily along the Zumbro River, of which approximately one-half are critical for project success and are of highest priority. Currently, 27 landowners farm in the project area. All of the land within project boundaries is floodplain and located along and adjacent to historic channels and floodplain depressions. Eventually, dike removal or installation of culverts, bridges, or spillways along the portion of the lower Zumbro River east of Kellogg through a township road and both Wabasha County 24 and 84 road embankments would be necessary.

This action is totally dependent on willing sellers and working cooperatively with private property owners. As such, funding mechanisms must be in place that allow flexibility and take advantage of unique opportunities such as major floods when landowners are more interested in selling. Partnerships with non-governmental agencies, such as The Nature Conservancy, would lend expertise and encourage development of a long-term program for acquisition, as well as leverage additional funding.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

Some of the best and most diverse habitat in the Upper Mississippi River is associated with the mosaic of small flowing channels, ponds, sloughs, embayments, natural levees, delta islands, and associated plant communities. Some backwater areas in Pool 5 receiving flow are developing these deltaic patterns at the mouths of side channels. There are several complete closing structures along the main channel and side channels that, if modified or removed, would increase flow into Weaver

Bottoms. These closing structures could be removed partially or entirely to increase flows, promoting the development of channels and eventually possibly producing the mosaic described above. If any flow reintroduction is found to be counterproductive, it could easily be reversed or modified. Island formation will also help to increase flow diversity, especially in Spring Lake, Weaver Bottoms, and the area immediately above Lock and Dam 5.

Flowing channels off the Zumbro River to connect floodplain habitats to channel areas in the Weaver Bottoms and north Zumbro River areas will be evaluated.

Alternatives to allow fish movement between Pools 4 and 5 will be evaluated. These include: restoration of the distributary channels of the Zumbro River, which will flow both north to Pool 4 and south in Pool 5 during high water events, and structures or operation of Lock and Dam 4. Fish passage alternatives between Pools 5 and 5A will be evaluated. These may include the addition of spillways in the existing dike separating the two pools, changes in the operation of Lock and Dam 5, and structure measures such as a fishway.

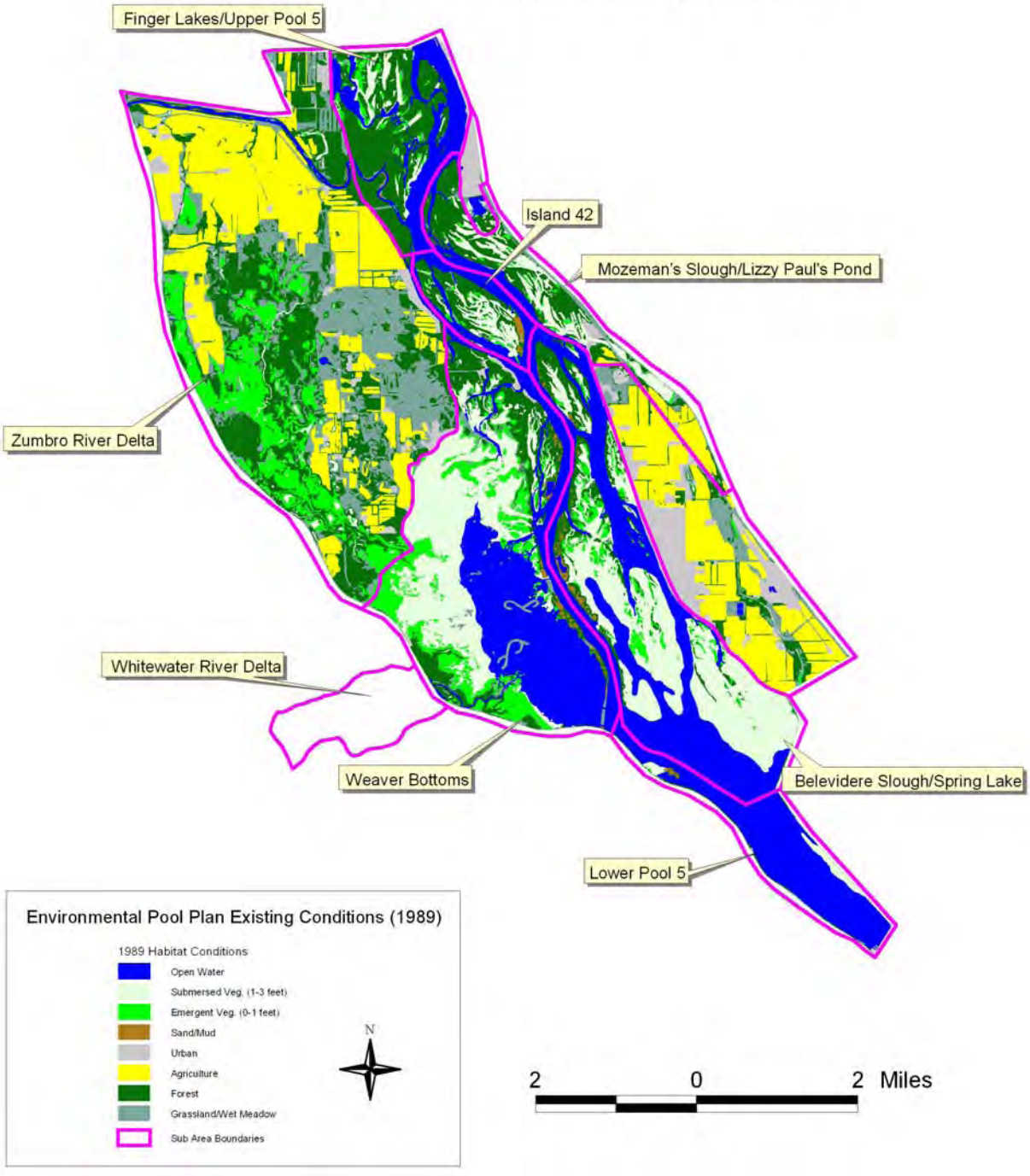
Modifications of the Lock and Dam 5 dike will also be evaluated to improve the distribution of flood flows in the Whitman Wildlife Management Area/Merrick State Park subarea of Pool 5A. Improving the distribution of flood flows in the upper end of Pool 5A should reduce sedimentation in these backwater systems.

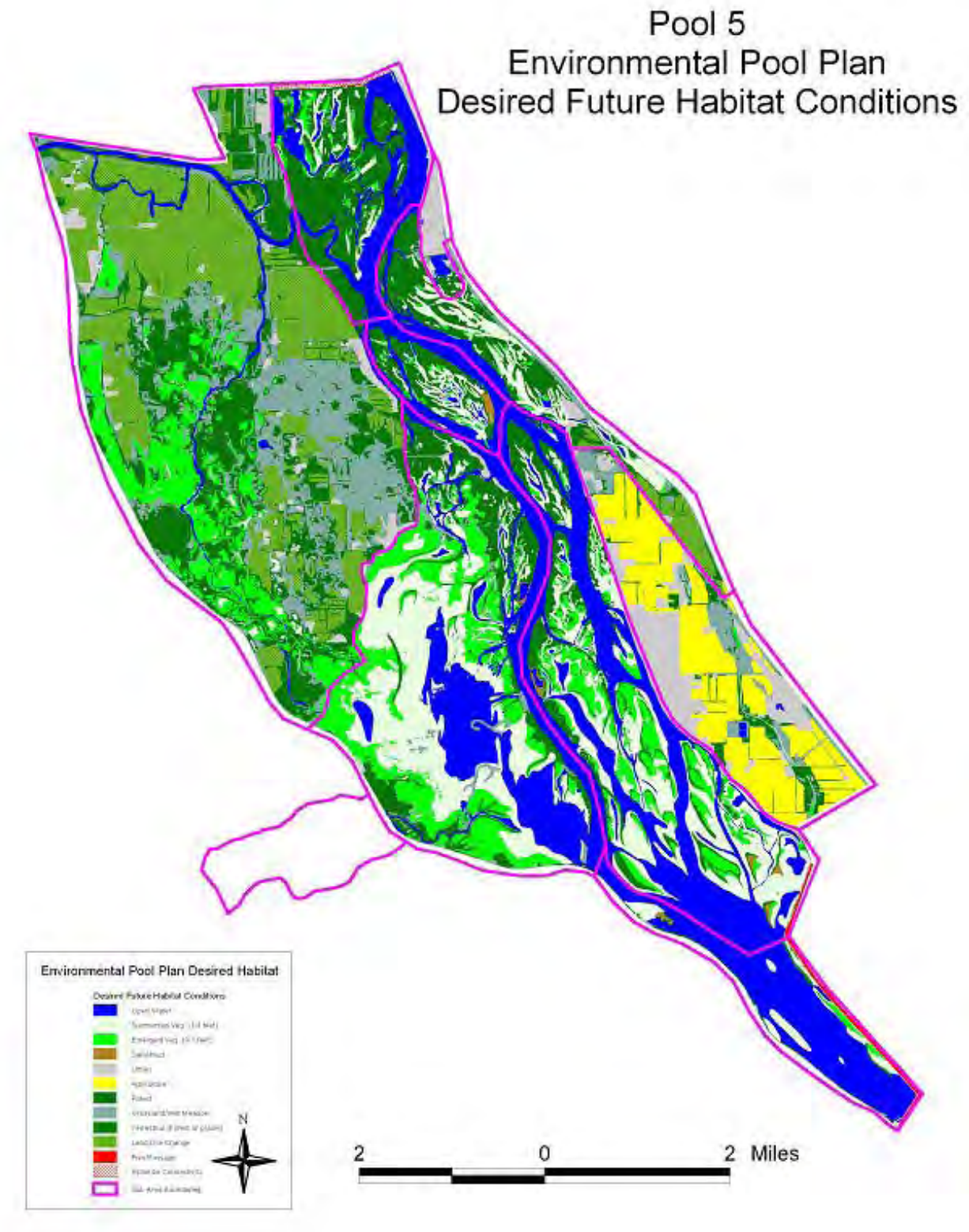
Hardwood forest in the Whitewater River watershed. (Minnesota Pollution Control Agency photo.)

8.) Support Watershed Management Programs

Watershed management programs, like the Whitewater Watershed Project, should be encouraged to promote good land use that will reduce sediment and nutrient inputs into the Mississippi River. Urban sewage and storm water treatment should be included in these programs.

Pool 5
Environmental Pool Plan
Existing Habitat Conditions




Pool 5
Environmental Pool Plan
Desired Future Habitat Conditions
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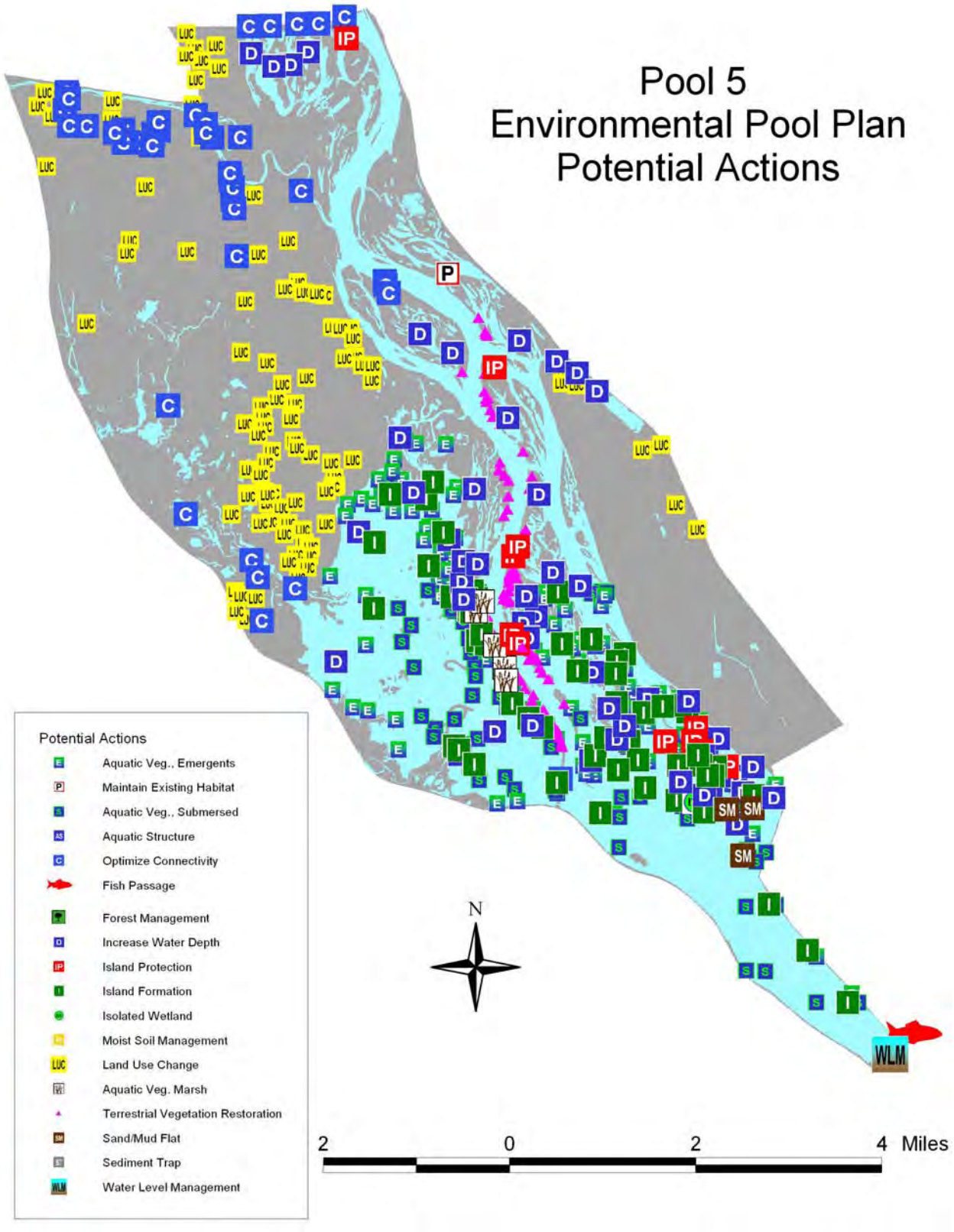

Pool 5
Environmental Pool Plan
Potential Actions
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
N
2 0 2 4 Miles

Desired Future Habitat Conditions In Pool 5A, Mississippi River

Description of Pool 5A

Pool 5A is an impoundment of the Mississippi River that resulted from the construction of Lock and Dam 5A. Construction was completed in 1936 as part of the 9-foot channel navigation project. The pool spans 9.7 miles between Lock and Dam 5A near Winona, Minnesota, (river mile (RM) 728.4) and Lock and Dam 5 near Minneiska, Minnesota (RM 738.1). Because the dike for Lock and Dam 5 extends northward from river mile 738.1, the pool extends on the Wisconsin side to river mile 740.8 near Buffalo City, Wisconsin. The mainland boundaries for the area are the I & M Rail Link railroad in Minnesota and the Burlington Northern Santa Fe railroad in Wisconsin.

Pool 5A and its floodplain encompass approximately 17,700 acres. The pool has a mix of aquatic habitat types that include tailwaters, contiguous and isolated backwaters, secondary and tertiary channels, and the main channel and main channel border. Most island areas are forested and are dominated by mature, even-aged stands of silver maple. There is little or no understory or seedling regeneration.

The aquatic habitat in Pool 5A provides a fishery and mussel resource with characteristics similar to other pools and one that also possesses unique features. The mix of game fish species includes walleye, sauger, smallmouth bass, largemouth bass, white bass, northern pike, channel catfish, bluegill, and black crappie. Non-game fish species are numerous and include many shiner, darter, and minnow species. Commercially sought species include common carp, buffalo, freshwater drum, channel catfish, and quillback carpsucker. Paddlefish are a unique fishery; along with other migratory fishes, they are positively influenced by the frequency that the Lock and Dam 5A gates are out of the water, allowing for easier inter-pool movements. Native mussel species composition in Pool 5A is similar to many other areas of the river. Native mussels continue to be threatened by zebra mussel colonization.

Pool 5A is part of the Mississippi River Flyway, a major migratory bird corridor. The spring and fall bring songbirds including warblers, vireos, and thrushes. Migratory waterfowl, including diving ducks, use open water areas for fall feeding and loafing. Smaller and more secluded areas serve as brood habitat for puddle ducks. Bald eagles concentrate in open water areas during the winter and nest at various locations during the summer. A heron rookery also exists.

Submergent and emergent aquatic vegetated areas are important for numerous wildlife species. Furbearers, amphibians, birds, and reptiles all rely on these areas.

Grasslands and forested areas harbor a myriad of animal species in Pool 5A. Grasslands are important for numerous birds, mammals, reptiles, furbearers, and amphibians. Forested areas include upland and bottomland hardwoods and are important habitat to birds and mammals.

Public land in Pool 5A includes two State wildlife areas and a Federal fish and wildlife refuge. The State of Wisconsin owns and manages the 2,173-acre Whitman Dam Wildlife Area. This area is a mix of open water wetlands, backwater lakes, rice ponds, running sloughs, and bottomland forests. The State of Minnesota owns and manages the 189-acre Thorp Wildlife Management Area. This area is a mix of bottomland forests, backwater lakes, and running sloughs. The pool is also part of the Upper Mississippi River National Wildlife and Fish Refuge that extends 261 miles from Wabasha, Minnesota, to just above Rock Island, Illinois. The refuge includes acreage acquired by the U.S. Fish and Wildlife Service and land acquired during the 1930's by the U.S. Army Corps of Engineers for the 9-foot channel navigation project.

Pool 5A has several sites routinely dredged to maintain a 9-foot navigation channel. Current dredged material placement sites, along with numerous historic placement sites, are located throughout the pool. Many historic sites are void of vegetation due to harsh growing conditions.

Another disturbance to Pool 5A is the amount of rock that is present. Rock is in the form of railroad grade protection, revetment, and wing dams. The pool has one of the highest numbers of wing dams per mile. Given this condition, the habitat in the main channel border is highly altered. Another feature associated with the navigation system is the U.S. Army Corps of Engineers' Service Base at Fountain City, Wisconsin. The area has high levels of polychlorinated biphenyls (PCBs) attributed to previous service base activities.

Lock and Dam No. 5 with the Whitman Bottoms to the right. (Minnesota Dept. of Natural Resource photo.)

Habitat diversity and habitat quality have been lowered due to island loss, especially in the lower portions of the pool. Island dissection and erosion continue to occur and contribute to declines in aquatic vegetation and floodplain forests.

Tributary influences on Pool 5A are relatively minor with regard to water quality. In Wisconsin, the Waumandee Creek watershed drains approximately 204 square miles, much of which is farmland. Suspended sediment sources include the Zumbro River in Pool 5, whereas bedload sediments can be traced to Pool 4 and the Chippewa River. Both suspended and bedload sediments contribute to losses of aquatic habitat. Several secondary and tertiary channels have seen significant sedimentation since impoundment with some completely filled in.

A portion of the Pool 5A floodplain is isolated from the river due to levees. The levees in the Winona area, constructed for flood control, were most recently reinforced in the mid-1960's.

Description of Existing and Desired Future Habitat Conditions for Pool 5A Subareas

Within Pool 5A, several subareas have been identified. These subareas are approximated on the basis of hydrology, with the boundaries usually being the main channel, a side channel, or the mainland of Wisconsin or Minnesota. The following subareas have been delineated to facilitate presentation of desired future habitat conditions.

Whitman Dam Wildlife Area/Merrick State Park (river mile 733.5-740.8) - The Whitman Dam Wildlife Area/Merrick State Park subarea is bordered by the main channel to the south, the Lock and Dam 5 dike to the west, and the Wisconsin mainland to the east and north. This State of Wisconsin-owned property is a mix of open water wetlands, backwater lakes, rice ponds, running sloughs, and bottomland forests. The area includes a stretch of almost 3 miles where the Lock and Dam 5 dike runs parallel to the main channel; this part of the subarea actually appears to be upstream of Lock and Dam 5. This results in much of the area above river mile 738.1 having water levels and floodplain features very similar to pre-impoundment conditions. However, the Whitman Dam Wildlife Area is still affected by fine sediment deposition.

Fresh water is brought into this subarea through two culvert systems in the Lock and Dam 5 dike, the Cochrane drainage ditch, and the Waumandee Creek. Another inflow to this subarea is Devil's Cut, a side channel at river mile 736.2. About 40 percent of the subarea's flow enters via this side channel.

Although some backwater areas near Merrick State Park are too shallow for overwintering centrarchids, a few continue to provide wintering habitat. The vegetated backwaters also provide rearing areas for bluegill, largemouth bass, and northern pike. However, island dissection has occurred and allows main channel water and its sediments to enter during high flows.

Future forest management actions would focus on increasing the diversity and quality of forested areas, and diversification of the floodplain forest through planting of mast trees on historic disposal sites. Aquatic habitat recommendations focus on maintaining the 1989 coverage of aquatic vegetation, maintaining existing and rehabilitating historic centrarchid overwintering sites, and optimizing the distribution of water flows in the subarea. Additional recommendations include implementation of environmentally beneficial land use changes, island protection, and an increase in forest and prairie habitat.

Thorp Wildlife Management Area/Snyder Lake (river mile 731.0-738.0) - The Thorp Wildlife Management Area/Snyder Lake subarea is bordered by the main channel to the north, the Minnesota mainland to the west, and Straight Slough to the east. Many secondary and tertiary channels in this subarea have been altered by side channel closures and sedimentation. The backwater areas continue to support a diverse aquatic vegetation community but are also experiencing sedimentation.

The desired future for the subarea is to maintain the majority in its present condition. The potential does exist in the future for increasing the depth of some backwater areas to maintain centrarchid overwintering habitat.

Minnesota City Bottoms (river mile 730.0-733.0) - This subarea is bordered on the west by the Canadian Pacific Railroad, on the north and east by Straight Slough, and on the south by the Prairie Island Dike and the community of Minnesota City, Minnesota. A diverse wetland complex known as "Denzer's Meadow" and an abandoned gravel pit occur west of Garvin Brook, a tributary that bisects the subarea. A unique stand of old growth bottomland hardwood trees east of Garvin Brook is known to provide habitat for cerulean warblers and other avian species associated with mature forests. The Minnesota City Boat Club, a private marina, is located in the southeast corner of this subarea. About 20 percent of the area is in private ownership.

Fountain City Bay and the Corps of Engineers Service Base (US Army Corps of Engineers photo.)

The desired future for the subarea is to maintain the majority in its present condition with some management to maintain the quality of the forest resources.

Twin Lakes (river mile 731.0-735.2) - The Twin Lakes subarea is bordered by Straight Slough to the south and west and by the main channel to the north and east. Island erosion has affected the distribution of aquatic vegetation in the downstream section. Island dissection has introduced flow into some backwater lakes in the upstream portion of the subarea. As with many other areas in Pool 5A, sedimentation is slowly reducing habitat quality for vegetation and its associated fish and wildlife.

The desired future for the Twin Lakes subarea identifies options for reversing the negative impacts of sedimentation at selected backwater locations by increasing depths to maintain or reestablish overwintering habitat for centrarchids.

Wilds Bend Placement Site with Polander Lake in the upper right. (US Army Corps of Engineers photo.)

Wild's Bend/Betsy Slough (river mile 729.7-732.5) - The Wild's Bend/Betsy Slough subarea is bordered by the main channel to the south, Pap Slough to the west, and the Wisconsin mainland to the north and east. The U.S. Fish and Wildlife Service manages the entire subarea as a closed area during the fall waterfowl migration. Much of the terrestrial habitat has been altered by placement of sand from main channel dredging.

Betsy Slough backwaters have experienced sedimentation, island erosion, and island dissection. The island erosion and dissection in this subarea have not affected habitat quality as they have in other areas of lower Pool 5A. Although a winter fishery exists near the lower end of Betsy Slough, shallow water limits most of this backwater to an open water fishery. The depths and vegetation also provide good habitat conditions for migratory waterfowl.

Proposed management actions for this area focus on addressing resource problems affecting habitat quality for overwintering fish and migratory waterbirds. The alternatives include increasing water depths, increasing emergent vegetation by approximately 30 percent above 1989 levels, and island protection. Several historic dredged material disposal sites have also been identified for future terrestrial vegetation improvements through the planting of forest and grassland communities.

Polander Lake (river mile 728.4-731.8) - The Polander Lake subarea is bordered by the Twin Lakes subarea to the west, the main channel to the north and east, and the Lock and Dam 5A dike and Winona flood control levee to the south. Straight Slough is a major depth feature of the Polander Lake subarea. Straight Slough runs parallel to the Winona flood control levee and exits via the Lock and Dam 5A spillway. This spillway does not carry the entire flow of Straight Slough; this causes an eddy flow pattern through Polander Lake. Erosion has eliminated many islands in Polander Lake. This has caused a loss of terrestrial habitat and played a role in the loss of submergent and emergent aquatic vegetation. The Polander Lake HREP (completed in 2002) protected the remaining islands, closed an island breach in Pap Slough, revegetated a historic disposal site, and constructed three islands. Research and monitoring have documented that the Polander Lake area provides important habitat for paddlefish.

The desired future for Polander Lake includes a 40 percent increase in emergent vegetation and a 10 percent increase in submersed vegetation (compared to 1989). The features identified to reach this coverage of aquatic vegetation are through a combination of islands construction and water level management. The completed

Habitat Island Complex in Polander Lake (US Army Corps of Engineers photo.)

HREP is depicted on the desired future map for Pool 5A. Additional proposals for the area include a small increase in water depth diversity, island protection, and management of water

flows to improve habitat conditions. Any future management in the area would be evaluated to assure that decisions do not degrade the quality of habitat for paddlefish.

Winona Backwaters (river mile 727.1-731.0 (river mile 728.4-731.0 in Pool 5A)) - The Winona Backwaters subarea is surrounded by a flood control levee with the cities of Goodview and Minnesota City, Minnesota, on the south and west and Winona, Minnesota, to the north and east. This area was isolated from the Mississippi River in 1967. Development, sand and gravel operations, and urban runoff affect the subarea and threaten habitat quality. However, present plant and animal communities are good, although the connection to the Mississippi River is limited.

Proposed actions for the Winona Backwaters focus on maintaining conditions by optimizing the connectivity of the habitat with the Mississippi River, habitat protection, and working with surrounding communities and landowners to reduce the impact of runoff from urban and commercial sites.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Our goal is to protect, enhance, or restore diversity. The diversity may be biological, affecting the presence or absence of plant and animal species and their populations. The diversity is also habitat related, affecting physical features found both above and below the water's surface.

1.) Increase Depth Diversity in Channels and Backwaters

Depth diversities may be maintained, reduced, eliminated, enhanced, or restored. Dredging, directing flows, or other techniques may be used.

Actions are proposed throughout the pool to increase secondary and tertiary channel habitat. Maintenance and formation of these channels will consider a variety of factors aimed at providing for a diversity of habitats (undercut banks, mud banks, snags, etc.) and substrate types. Where feasible, restored channels would be defined by land or islands to further diversify the habitat these channels would provide. Dredging, directing flows, or other techniques may be used to optimize depth diversity. Portions of the Twin Lakes, Betsy Slough, and Whitman Wildlife Management Area/Merrick State Park subareas will be evaluated to determine the feasibility of increasing depths in backwater lakes. The goal would be to improve overwintering habitat conditions for bluegills and largemouth bass. Dredged material may be used to improve terrestrial habitat or construct islands.

Example Action: *Maintain Existing Quality Habitat.* River agencies strive to protect and maintain high quality habitats on public land. (Wisconsin Dept. of Natural Resources photo.)

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas within the pool are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

The Whitman Wildlife Management Area/Merrick State Park subarea, for example, contains many habitats that will be maintained.

3.) Protect and Restore Islands

Island stabilization in Pool 5A may be undertaken to reduce the rate of island erosion and island dissection. This would help maintain a diversity of depths, velocities, and substrate. It would also keep selected backwater areas free from flow.

Island formation may be promoted in the Twin Lakes area and Polander Lake by allowing sandbar development or the positioning of "seed islands." Where necessary, islands would be constructed to improve terrestrial and aquatic habitats. The constructed islands would be oriented to promote scour and sediment deposition to increase depth, velocity, and substrate diversity. The islands would improve water quality conditions and promote the establishment and maintenance of aquatic vegetation.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Managing terrestrial plants may focus on maintaining, enhancing, and restoring forest and prairie communities. Management actions may include restoring historic dredged material placement sites with native plants; decreasing the dominance of reed canary grass; and reducing or eliminating purple loosestrife by continuing control methods and implementing new ones. Another option may be to raise the elevation of landforms through the use of dredged material and improve site suitability for other native forest species. Privately owned property may be managed through landowner education, incentives, and conservation easements.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

6.) Work Cooperatively with Private Property Owners

Several areas within the Mississippi River floodplain and the majority of the tributary watersheds are privately owned. Maintaining and improving habitat within the Mississippi River floodplain is dependent on a long-term commitment to provide resources to private landowners to improve water quality, reduce erosion and sedimentation, and improve habitat conditions on land within the floodplain. Various approaches and techniques will be evaluated and implemented to work cooperatively with private property owners. Some of the tools include: voluntary measures, landowner incentives, easements from willing owners, and purchase of land from willing sellers.

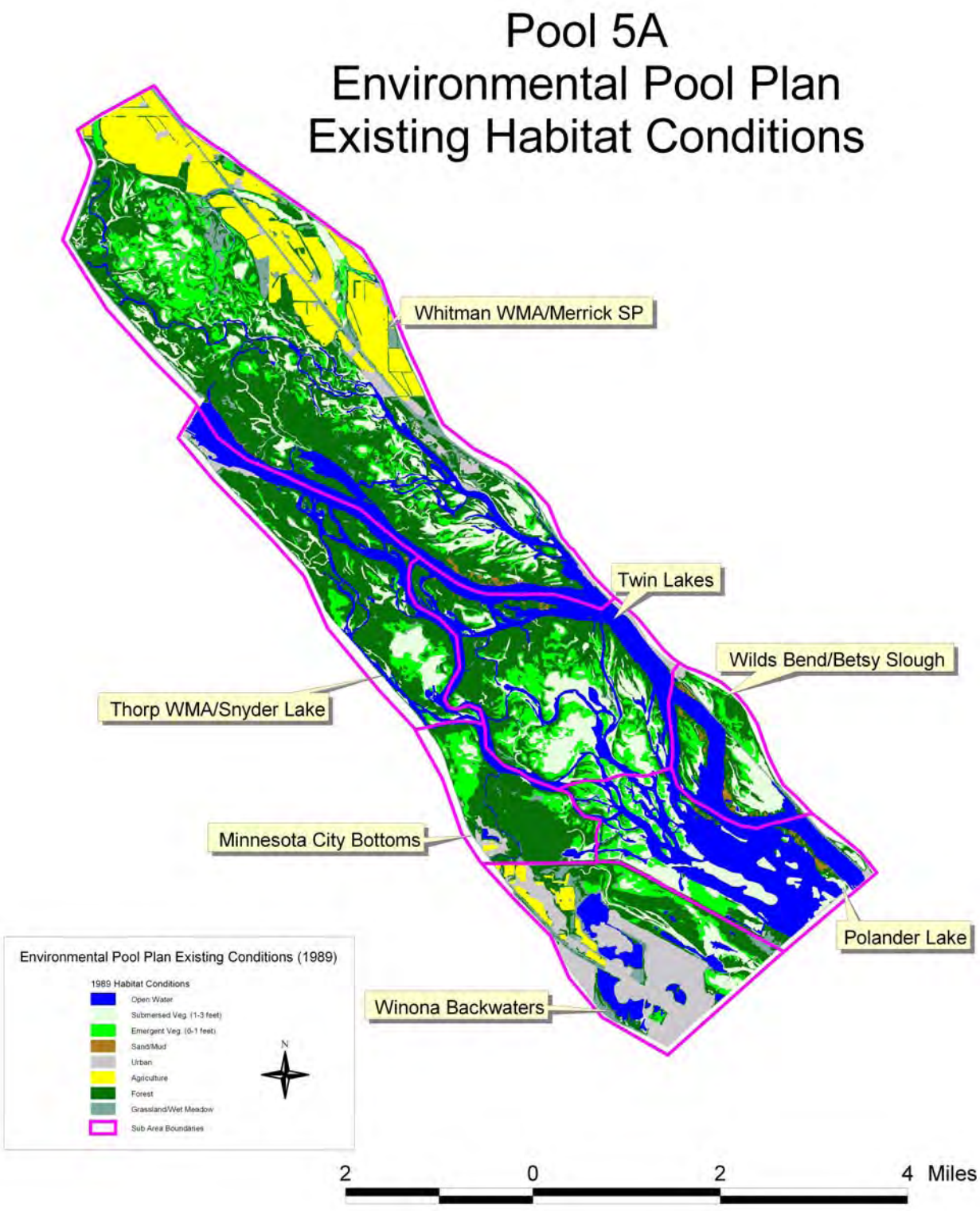
With respect to Pool 5A, lands may be acquired through purchase or conservation easements from willing owners within the project boundary of the Whitman Dam Wildlife Area.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

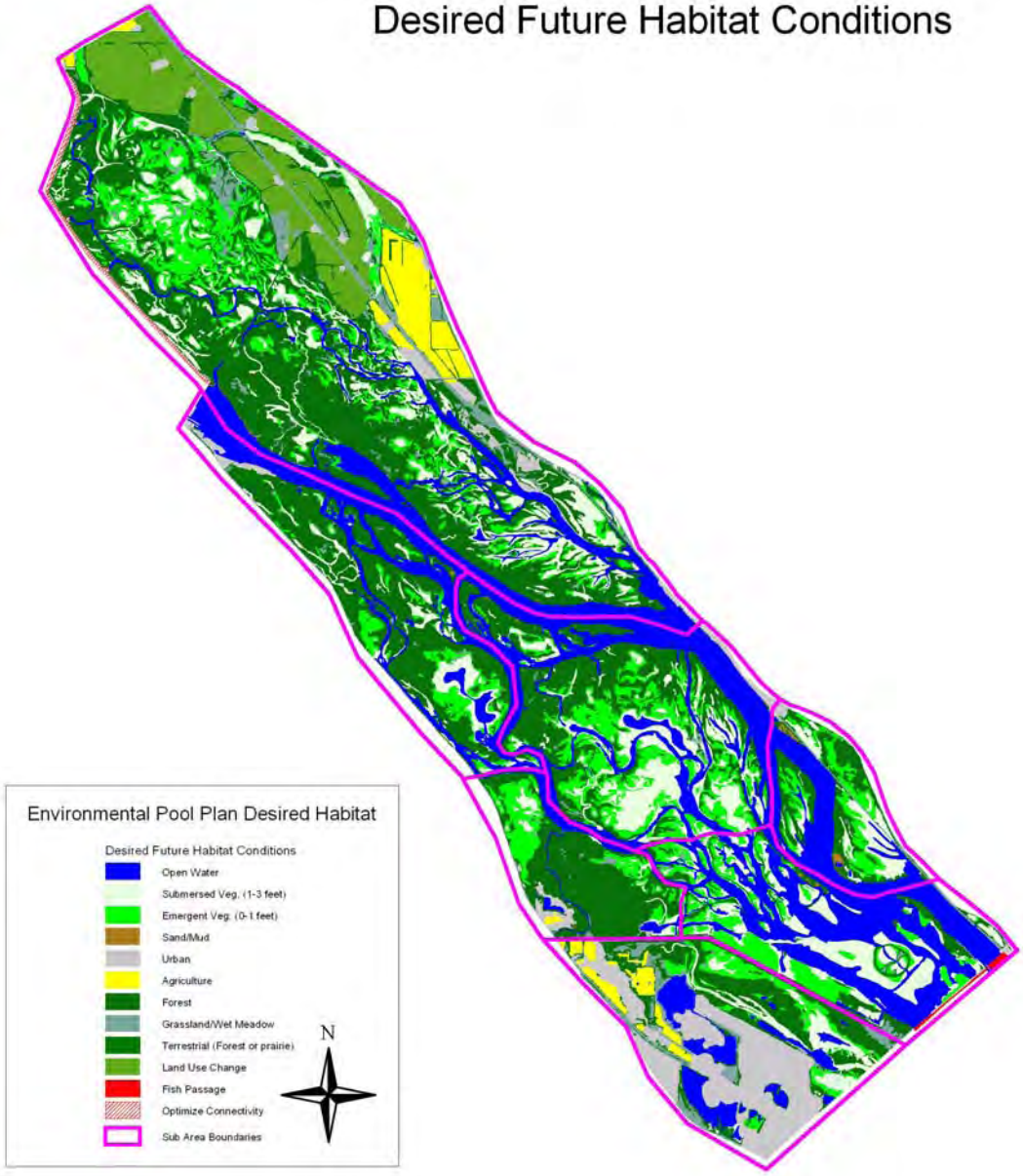
Side channel closures, wing dams, and other structures will be evaluated to determine if alterations should be made to modify flows to restore spatial connectivity of habitats.

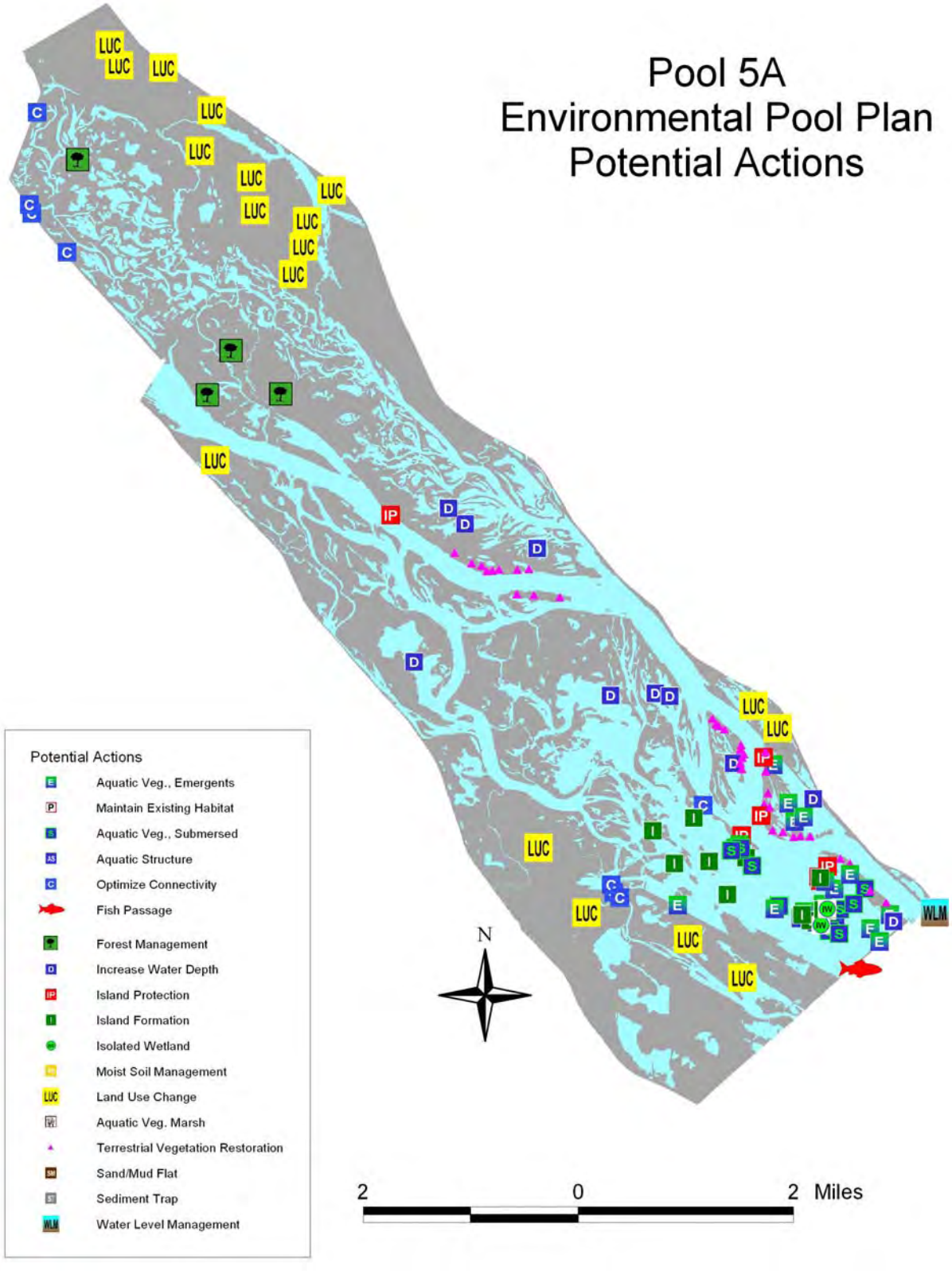
8.) Support Watershed Management Programs

Positive land use in the tributary watersheds may be encouraged that would reduce sediment, nutrient, and other pollutant inputs into Pool 5A. Urban areas may also be included.


Pool 5A
Environmental Pool Plan
Existing Habitat Conditions
Whitman WMA/Merrick SP
Twin Lakes
Wilds Bend/Betsy Slough
Thorp WMA/Snyder Lake
Minnesota City Bottoms
Polander Lake
Winona Backwaters
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N
2 0 2 4 Miles

Pool 5A
Environmental Pool Plan
Desired Future Habitat Conditions




Pool 5A
Environmental Pool Plan
Potential Actions
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
N
2 0 2 Miles

Desired Future Habitat Conditions In Pool 6, Mississippi River

Description of Pool 6

Pool 6 is an impoundment of the Mississippi River resulting from the operation of Lock and Dam 6 as part of the 9-foot channel navigation project. Construction of Lock and Dam 6 was completed in 1936. Pool 6 and its associated floodplain encompass approximately 22,000 acres from approximately river mile 714.2, near Trempealeau, Wisconsin, upstream to river mile 728.4 near Winona, Minnesota. In general, the landward boundaries of the Pool 6 planning area are the I & M Rail Link railroad on the Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River.

The connectivity of the floodplain in Pool 6 has been highly altered. Levees are present in much of the floodplain near Winona, Minnesota, and as part of the Trempealeau National Wildlife Refuge in Wisconsin. The levees in the Winona area were constructed in 1967 for the purpose of flood control. The levees surrounding the Trempealeau National Wildlife Refuge were once used for agricultural purposes and later as the Delta Game and Fish Farm. This area was acquired by the U.S. Fish and Wildlife Service in 1979 and has been operated as a refuge since then. Additionally, the Burlington Northern Santa Fe railroad embankment forms a portion of the Trempealeau National Wildlife Refuge levee system and further isolates additional floodplain area upstream of the refuge. Both of these features were present before the locks and dams were constructed, but have been upgraded and maintained over the years.

Transportation features further segregate the connectivity of the floodplain. Two active railroad embankments on the Wisconsin side of the river extend far out into the floodplain of the Mississippi River. This is unusual in that for most of the St. Paul District, the railroads run parallel to the river's floodplain at the base of the bluffs. Additional loss of connectivity has occurred due to the construction of roads across the floodplain in the Winona, Minnesota, area. These railroad embankments and roads in Pool 6 have "dissected" the floodplain into large, isolated backwater complexes with little or no connection to the Mississippi River. This limits the temporal and spatial connectivity of the floodplain for many aquatic organisms.

Pool 6 has a small area that is classified as impounded due to the constricted nature of the floodplain. The isolated and non-isolated backwater complexes display the braided channel system that is a common feature of much of the river floodplain in the St. Paul District.

The major tributary entering Pool 6 is the Trempealeau River. The wetland area at the confluence of the Mississippi and Trempealeau Rivers has experienced considerable sedimentation due to inputs from the Trempealeau River, constriction of its floodplain by the Trempealeau National Wildlife Refuge, and the constriction imposed by the narrow bridge opening where the Burlington Northern Santa Fe railroad crosses over the Trempealeau River. Other smaller tributaries enter on the Minnesota side and include Trout Creek and Gilmore Creek.

Pool 6 has a low frequency of dredging for maintenance of the main channel when compared to other pools in the St. Paul District. This means that the quantity of material removed is one of the lowest in the District as well.

Description of Existing and Desired Future Habitat Conditions for Pool 6 Subareas

Several identifiable areas are present within Pool 6. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate

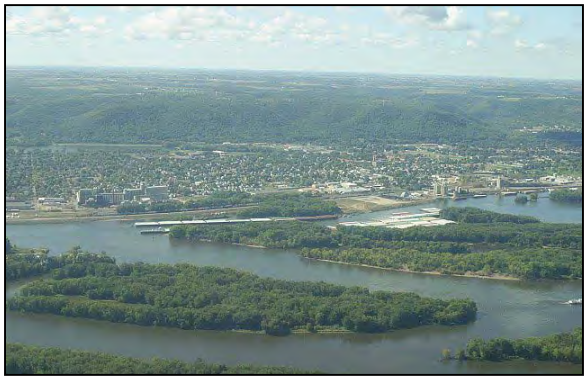
presentation of desired future habitat conditions in the pool.

Upper Pool 6 (river mile 726.2-728.4) - This area is bordered by Lock and Dam 5A on the upstream end (west), Winona on the south, and the main channel to the east and north. A spillway in Lock and Dam 5A provides water flow through Straight Slough, but flows to other water bodies in this area have been blocked by the Lock and Dam 5A dike. A large barge terminal is located in Yoeman's Pond. Shoreline erosion from recreational traffic is an issue in this area.

The desired future identifies potential actions to optimize connectivity of the backwaters in this area through the use of culverts placed in the Lock and Dam 5A dike.

Winona Backwaters (river mile 727.1-731.0 (river mile 727.1-728.4 in Pool 6)) - This area is surrounded by the Winona flood control levee with the cities of Goodview and Minnesota City on the south and west and Winona to the north and east. This area was isolated from the Mississippi River in 1967. Impacts from development, sand and gravel operations, and urban runoff threaten the habitat quality in this area.

Proposed actions for the Winona Backwaters include maintaining conditions, optimizing the connectivity of the habitat with the Mississippi River, and habitat protection.



Winona, MN and the upper end of Pool 6. (Minnesota Dept. of Natural Resources photo.)

Sam Gordy's Slough Backwater Complex (river mile 723.9-728.3) - The main channel forms the eastern, western, and southern boundaries, with the Wisconsin mainland (Burlington Northern Santa Fe railroad) being the northern boundary. The railroad severely limits connectivity to a vast amount of floodplain habitat in this area. Non-isolated backwaters of the Sam Gordy's complex have experienced moderate levels of sedimentation and island dissection. Within the complex are several centrarchid overwintering sites that vary in their quality of habitat with some becoming anoxic during severe or prolonged winters.

Increasing the diversity of water depths in the backwaters is one action identified for maintaining centrarchid overwintering. Several options for increasing the connectivity of the backwaters will be evaluated to improve the habitat quality of areas isolated by the various transportation structures in the subarea. The objectives for Mertes Slough and Betsy Slough are to maintain habitat conditions similar to those existing in 2002.

Blacksmith Slough Area (river mile 718.0-723.9) - The dominant aquatic features in this area are Blacksmith Slough, which parallels the Burlington Northern Santa Fe railroad, and the main channel of the Mississippi River. The habitat quality of the area appears good for riverine species of fish, but limited for backwater species due to losses in aquatic vegetation, island dissection, and island erosion. An area between the main channel and Blacksmith Slough was dredged as a borrow source for construction of dike A as part of the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project constructed from 1996 to 1999. During dredging operations in the fall of 1996, the contractor reported reduced productivity because of strong currents in the area, which they believed carried sediment (sand) downstream. After the flood of 1997, an island was formed in Pool 6 approximately 2.5 miles south of the dredging location. There may be some connection between the "loss" of productivity and the formation of a new island.

The desired future identifies several potential locations for the reestablishment of overwintering habitat for centrarchids, island formation through sedimentation and construction, island stabilization, management of flows into the backwaters, and potential features to restore connectivity of backwater areas.

Trempealeau National Wildlife Refuge Area (river mile 717.8-725.8) - Bordered on the north and east by the Wisconsin mainland and the Trempealeau River and on the west and south by the Burlington Northern Santa Fe railroad, the entire area is within a leveed area isolated from the main flow of the Mississippi River. This entire area is sequestered from the Mississippi River by dikes maintained to meet waterbird management objectives in the area. Water levels within the refuge are independent of river stages, but gravity dewatering of the area is dependent on having low river stages. Three interior dikes, three pumping stations, island stabilization, and one inlet from the Trempealeau River were constructed as part of the Trempealeau National Wildlife Refuge HREP in 1996-1999. These levees and pumping stations increased management flexibility within the refuge and provide for more consistent production of desirable waterfowl habitat during fall migration.

Trempealeau National Wildlife Refuge (US Army Corps of Engineers photo.)

The Trempealeau National Wildlife Refuge HREP is expected to increase the amount of wet meadow, emergent, and submersed vegetation within the refuge with a corresponding reduction in open water. Additional features to further improve habitat conditions for migratory waterbirds may include the construction of some islands within the refuge management units to break up wind fetch and reduce resuspension of bottom sediments. Improving connectivity of the refuge to the Mississippi River may be evaluated in the future to make the area accessible to fish for spawning.

Trempealeau River Delta (river mile 717.0-719.0) - The Trempealeau River Delta area is bordered to the north and east by the Wisconsin mainland, to the south by the Burlington Northern Santa Fe railroad, and to the west by the Trempealeau National Wildlife Refuge dike. The Wisconsin shoreline is owned by the State of Wisconsin and managed as Perrot State Park. Prior to construction of the levees and railroad embankment, these areas were connected to the Mississippi River from the upstream and downstream directions. The construction of the levees also rerouted the Trempealeau River from river mile 721.8 to its present location at river mile 717.0. This area has experienced rapid sedimentation from bed and suspended load contributed from the Trempealeau River watershed.

Sedimentation is expected to continue in this area, causing some conversion of aquatic habitat to land, due to the sediment load of the Trempealeau River. Modification of the railroad embankment by placing a culvert or an additional bridge may be evaluated as actions to improve sediment movement within the delta and restore a variety of habitats.

Lower Pool 6 (river mile 714.2-719.1) - The northern boundary is formed by the Burlington Northern Santa Fe railroad in Wisconsin, the southern boundary is the I & M Rail Link railroad on the Minnesota side, the eastern boundary is Lock and Dam 6, and the western boundary is the lower end of the Blacksmith Slough Area. Some island erosion has occurred in this area, which limits the distribution of aquatic vegetation. However, fine sediment deposition from Trout Creek watershed, sand

deposition from the Mississippi River, and water velocities combine to influence the distribution of aquatic vegetation. Sedimentation also is affecting some of the secondary channels within this area, to the extent of cutting some off from flow.

The desired future for lower Pool 6 proposes several actions aimed at improving depth diversity and increasing aquatic vegetation. For example, the potential exists for doubling the amount of emergent vegetation (compared to 1989) through island formation and periodic pool-wide water level management. It is expected that some island formation due to sedimentation will continue with other islands possibly being constructed as disposal sites for backwater dredging and diversification of flows in the lower section of the pool.

Trout Creek (river mile 714.5-715.5) - The lower section of Trout Creek is a mixture of bottomland forests and wetlands located on the south side of Highway 14/61. The desired future calls for management actions to improve the diversity and quality of forest resources in the subarea.

Unique Attributes, Opportunities, and Constraints

One opportunity, but also a constraint, is the presence of numerous transportation and flood control structures that reduce the connectivity of aquatic habitats in the pool. Any modifications of these structures will need to be intensively evaluated and include considerable opportunities for public involvement in the decision-making process.

A unique feature of Pool 6 is the narrow width (<1 mile) of the floodplain from Trempealeau Mountain to Lock and Dam 6. Also unique is that Lock and Dam 6 has a spillway. The total cross-sectional area of the spillway and dam gates relative to the width of the floodplain allows relatively natural flow conditions in this section of the pool during flood events. This "natural" flow condition appears to be contributing to island formation observed during the 1997 and 2001 floods.

A layer of floating duckweed covers the water surface in a flooded stand of bottomland hardwood trees. (Wisconsin Dept. of Natural Resources photo.)

Summary of Actions to Achieve Desired Future Habitat Conditions

Often, the actions proposed and described above are interrelated, and specific actions will require overlapping solutions. The goal of these actions is to increase diversity in the pool. This diversity may be biological, such as the number of fish or wildlife species affected. Meeting the goal may be reflected in habitat diversity, such as side channel reformation, acres of islands restored, or increased acres of emergent plants present. Increasing and sustaining a diverse aquatic and terrestrial habitat base in the pool is the key to improving the health of the Mississippi River.

1.) Increase Depth Diversity in Channels and Backwaters

Managing sediments in Pool 6 is important for maintaining, enhancing, and restoring habitat. In the main channel, recommendations contained in the Channel Maintenance Management Plan must be followed. The opportunity for using dredged material from the main channel to construct islands is limited. Historic dredged material placement sites should be restored to native plant communities.

Actions to maintain, enhance, or restore side channel and tertiary channel areas will be considered. Sediment scour in these channels may be promoted by directing flow. A diversity

of depths, velocities, and substrates should be carefully planned.

Sediment management in backwater habitats is also important. Depth diversities should be maintained, enhanced, or restored. Dredging, directing flows, or other techniques may be used to optimize depth diversity.

Many of the backwater habitats have experienced excessive inputs of flowing water and sediments. If this continues, especially during low flow conditions, it may be appropriate to close off this flow and sediment source.

Actions have been identified for the upper and lower sections of the pool to increase secondary and tertiary channel habitat. Maintenance and formation of these channels will consider a variety of factors aimed at providing for a diversity of habitats (undercut banks, mud banks, snags, etc.) and substrate types. Where feasible, restored channels would be defined by land and islands to further diversify the habitat these channels would provide. Maintenance and development of secondary and tertiary channel habitat are proposed for the Sam Gordy, Smith Slough, and lower Pool 6 areas. Backwater habitats in these same areas also include at least two centrarchid overwintering sites each as part of restoring the backwater communities.

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Some areas within the pool are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were detected.

3.) Protect and Restore Islands

Stabilization of islands in Pool 6 is proposed to reduce the rate of island erosion and island dissection. This would help maintain a diversity of depths, velocities, and substrate. It would also keep selected backwater areas free from flow.

Floodplain structure and islands are proposed to restore and enhance habitat and processes in lower Pool 6. Some island formation is occurring in lower Pool 6 due to sand deposition from the main channel and as a delta at the mouth of Trout Creek. This island formation would be encouraged, and if necessary, additional islands may be constructed in these areas. Where necessary, islands construction will be evaluated to improve terrestrial and aquatic habitats. The constructed islands would be oriented to promote scour and sediment deposition to increase depth, velocity, and substrate diversity. The islands would improve water quality conditions (decrease sediment resuspension) and promote the establishment and maintenance of aquatic vegetation.

The primary location where islands are proposed to restore and enhance floodplain structure is in the lower Pool 6 area. Islands in this area would also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Managing terrestrial plants would focus on maintaining, enhancing, and restoring healthy forest communities interspersed with grasslands and wet meadows. Management actions include restoring historic dredged material placement sites with native plants; decreasing the dominance of reed canary grass; protecting, restoring, and enhancing prairie communities and managing for their continuance; and reducing or eliminating purple loosestrife by continuing control methods and implementing new ones. Another option may be to raise the elevation of landforms through the use of dredged material and improve site suitability for other native forest species. Privately owned property may be managed through landowner education and incentives, conservation easements, or purchase from willing sellers.

The present forest community dominated by silver maple is not long lived nor is regeneration of the forest community occurring due to many factors (higher water table, reed canary grass, land elevation, etc.). Forest management will include measures to restore disturbances and control of reed canary grass (logging, maybe floodplain dynamics) in various locations throughout the pool. However, consideration will be given to include management of some of the areas that are homogenous in species composition/age, but valuable for other species that need large tracts of unbroken forest. In addition, land management practices will take into consideration unique needs of State and Federal endangered and threatened species.

Prairie restoration is identified for the Trempealeau National Wildlife Area and Perrot State Park. Measures to restore prairies include incentives for private landowners to restore prairie, easements, and/or acquisition from willing sellers.

Connectivity for terrestrial species will be addressed through the management of habitats in optimal blocks to meet a species' needs. This may include the development of "travel" corridors between larger blocks of habitat or managing for large blocks of habitat.

Habitats that are transitions between land and water are sand and mud flats. Efforts will be made to promote the development and maintenance of mud flat and sand bar habitat.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations

Example Action: ***Manage Water Levels to Improve Aquatic Habitat.*** **A water level reduction in Pool 8 stimulated the growth of aquatic vegetation and increased habitat quality.** (US Fish and Wildlife Service photo series.)

to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Management of water levels within the Trempealeau National Wildlife Refuge will focus on providing environmental conditions suitable for the establishment and growth of wet meadow, emergent, and submersed aquatic vegetation. Some additional subunits may be constructed in the future to further increase flexibility of management and increase habitat diversity by focusing efforts on moist soil plant production.

6.) Work Cooperatively with Private Property Owners

Several areas within the Mississippi River floodplain and the majority of the tributary watersheds are privately owned. Maintaining and improving habitat within the Mississippi River floodplain is dependent on a long-term commitment to provide resources to private landowners to improve water quality, reduce erosion and sedimentation, and improve habitat conditions on land within the floodplain. Various approaches and techniques will be evaluated and implemented to work cooperatively with private property owners. Some of the tools include: voluntary measures, landowner incentives, easements from willing owners, and purchase of land from willing sellers.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

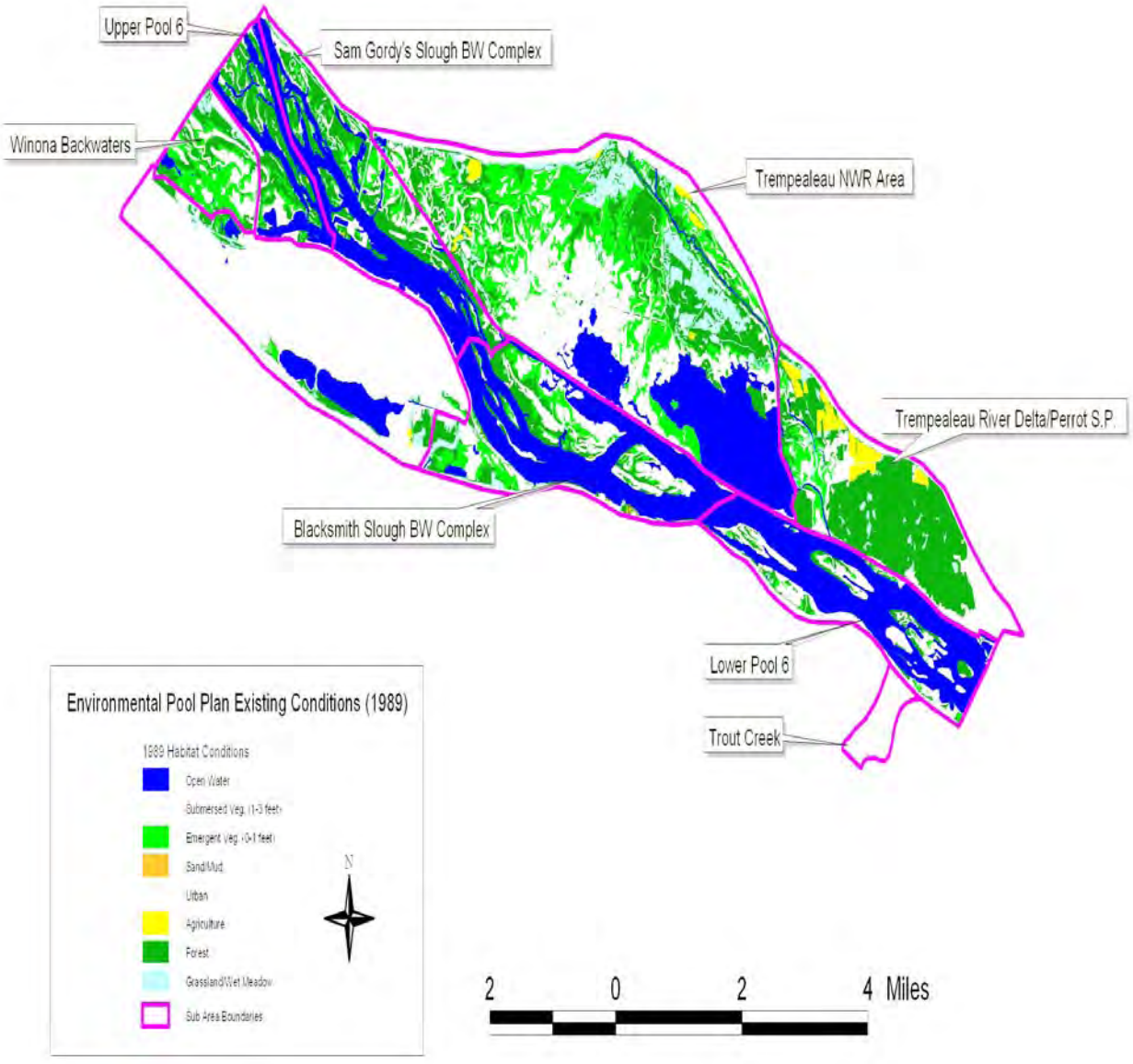
Human alterations have resulted in numerous changes to the water flows within Pool 6. Identification and modification of channel training structures to promote a diversity of aquatic habitat will be done. Modifications of the various structures within the floodplain (road and railroad embankments, levees) will be investigated to improve the hydraulic connectivity of the floodplain in this area without compromising their intended purpose.

Measures are proposed in all areas of the pool to restore and maintain aquatic and terrestrial connectivity to assure the habitats are available and accessible at the time fish and wildlife need them to meet life cycle needs. For aquatic organisms, this would entail modification of closing structures, promoting the formation of or creating channels, and removals of any barriers to increase the spatial and temporal connectivity of habitats. Connectivity with Pools 5A and 7 would be improved through the implementation of structures or dam operation measures to increase fish passage at the dams.

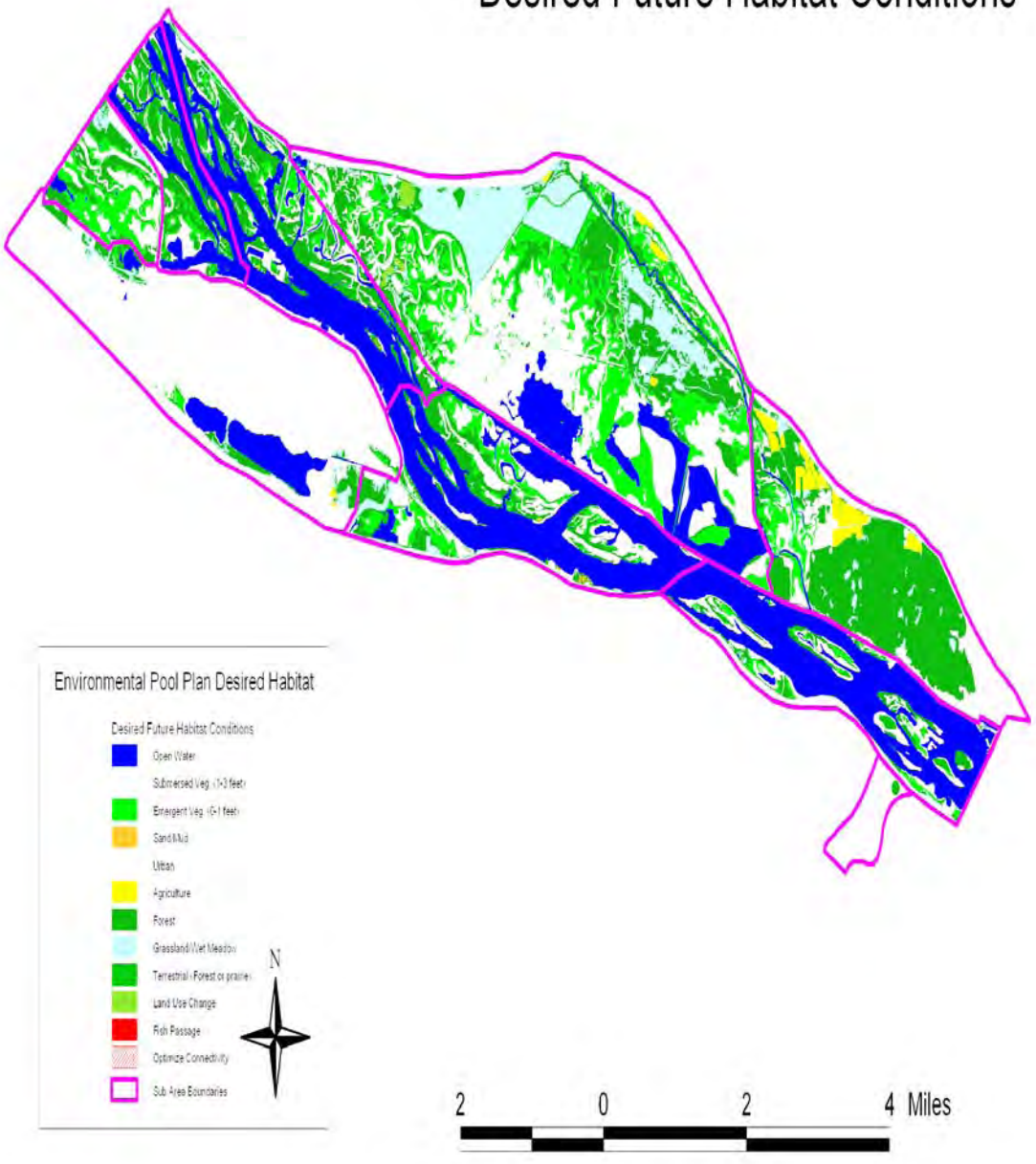
8.) Support Watershed Management Programs

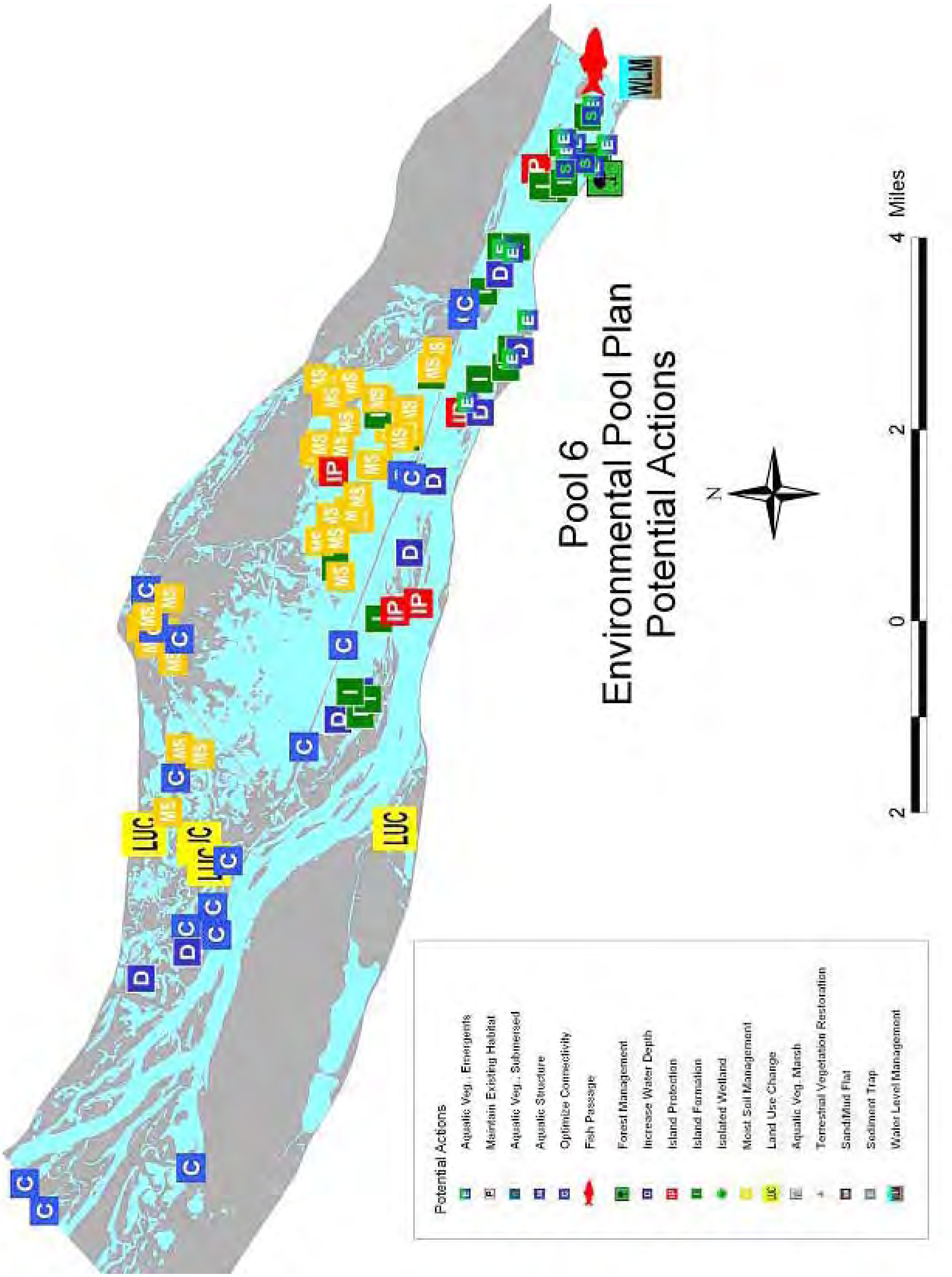
Positive land use in the tributary watersheds should be encouraged that will reduce sediment, nutrient, and other pollutant inputs into Pool 6. Urban areas are also included within the watershed and along the river. Solutions to eliminating point source pollution should be supported and implemented.

Pool 6
Environmental Pool Plan
Existing Habitat Conditions



Pool 6
Environmental Pool Plan
Desired Future Habitat Conditions




Pool 6
Environmental Pool Plan
Potential Actions
N
2 0 2 4 Miles
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
WLM
LUC

Desired Future Habitat Conditions In Pool 7, Mississippi River

Description of Pool 7

Pool 7 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 7 as part of the 9-foot channel navigation project. Construction of Lock and Dam 7 was completed in 1937. The Pool 7 area discussed in this report encompasses 58,000 acres, from approximately river mile 702 at Dakota, Minnesota, to river mile 714 near Trempealeau, Wisconsin.

In general, the landward boundaries of the Pool 7 planning area are the Canadian Pacific Railway railroad on the Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River. On the Minnesota side, the Mississippi River Valley is confined to a narrow bedrock gorge, which is a dominant feature of geomorphic reach 3. The interface between the river floodplain and bluffs is generally abrupt on the Minnesota side. On the Wisconsin side, the relatively flat sand terraces and the Black River Bottoms serve as a buffer between the Mississippi River and nearby bluffs. These terraces, known locally as Amsterdam Prairie and Brice Prairie, are undergoing rapid urbanization. The City of Onalaska, Wisconsin, borders Pool 7 in the extreme southeastern corner of the pool.

Major tributaries to the Mississippi River within Pool 7 are the Black River (Wisconsin, river mile 709) and its distributaries Tank Creek (Wisconsin, river mile 712) and Shingle Creek (Wisconsin, river mile 710), and Halfway Creek (Wisconsin, river mile 706). The watersheds of these tributaries are predominantly agricultural. Increasing urbanization is occurring in the Halfway Creek watershed and on the bluffs bordering the pool. Runoff from agricultural land and sites under construction contributes to significant loading of suspended sediment to the river. This sediment contributes to loss of depth diversity and decreased light penetration within the water column.

Typical of most navigation pools of the Upper Mississippi River, the water to land ratio changes from south to north. The lower reach of the pool is predominantly open water from river mile 702 to 708. This impounded area is known as Lake Onalaska. The Sommers Chute Delta, located on the west side of Lake Onalaska near river mile 706.5, is an important habitat feature. The amount of land increases in the middle portion of the pool, with more islands separated by multiple river channels and backwater wetlands. The Black River Delta influences the water to land ratio in this section of the pool. The upper reach of Pool 7 includes several large islands located along the main channel, backwater lakes, and several large, shallow wetlands. Mud Lake and Big Marsh are examples of these shallow wetlands.

In 1983, Lake Onalaska contained more than 3,320 acres of wild celery (*Vallisneria americana*) beds. Wild celery beds provide habitat for panfish. While all parts of the plant are consumed by waterfowl, the winter buds and rootstocks are relished the most. Wild celery plants also provide cover for the larvae of aquatic invertebrates, which are important foods for fish and waterfowl. Wild celery beds in Lake Onalaska were affected by the drought that occurred in the late 1980's. By 1990, less than 300 acres of wild celery beds were found on the lake. Beginning in 1994, the recovery of wild celery beds began and continues today. Lake Onalaska also supports a variety of macroinvertebrates, including midges, burrowing mayflies, and fingernail clams. Densities of fingernail clams averaged nearly 2,000 per meter ^{2} in 1993. In 2000, the per meter ^{2} average number dropped to about 500. Surveys of macroinvertebrates at selected sites in Lake Onalaska in 2000 found densities of zebra mussels approaching 5,000 per meter^2.

Description of Existing and Desired Future Habitat Conditions for Pool 7 Subareas

Several identifiable areas are present within Pool 7. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Upper Pool 7 - This diverse area is bounded on the north by Lock and Dam 6 and to the south by the Black River Delta. This area consists of many backwater lakes, including Long and Round Lakes and the three lakes known as the Trempealeau Lakes. Also located within this area are Mud Lake and Big Marsh, which are large, shallow wetlands. In recent years, both Mud Lake and Big Marsh have supported dense beds of wild rice. Several large islands, surrounded by relatively deep channels, are located along the main channel.

Under the authority of the Environmental Management Program (EMP), a Habitat Rehabilitation and Enhancement Project (HREP) was completed at Long Lake in 2000. This 15-acre backwater lake is used by panfish as an overwintering site. A diversion channel, complete with a water control structure, was constructed to allow oxygenated water to flow into Long Lake to alleviate low dissolved oxygen levels in late summer and winter. The 2001 flood severely damaged the water control structure and channel and deposited an estimated 20,000 cubic yards of sand in Long Lake. Options ranging from abandonment to rehabilitation were considered. As a result of agency and public meetings, a decision was made to rehabilitate the project. The water control structure was replaced, most sand was removed from the lake, and a flood spillway was added. Construction was completed in 2003.

About 900 feet of shoreline along the main channel on Richmond Island was stabilized in 1997 by the U.S. Army Corps of Engineers to minimize further erosion and protect a small backwater bay located in the interior of the island. Additional bank stabilization is needed at several sites on islands located along the main channel. Portions of Mud Lake and Big Marsh are becoming degraded due to sedimentation.

Proposed future habitat management measures for upper Pool 7 include increasing the quality of habitat conditions for a variety of fish and wildlife species by increasing depth diversity, counteracting the effects of sedimentation by dredging in selected areas, further island stabilization, and revegetation of historic disposal sites. Several locations have also been identified for evaluation of structures to control inflows of water to backwater channels and wetlands to maintain existing habitat.

Black River Bottoms (US Army Corps of Engineers photo.)

Black River Bottoms and Delta - This 10,130-acre block of nearly contiguous bottomland forest, extending almost 10 miles up the Black River, is bounded by the Highway 53 bridge on the north and the delta on the south. The width of this area is sharply defined by the floodplain/terrace interface. Land ownership within this area includes a mixture of private and public land, both State and Federal. Public land includes the Upper Mississippi River National Wildlife and Fish Refuge. The Van Loon Wildlife Management Area, owned and managed by the Wisconsin Department of Natural Resources, is located at the upper end of the Black River Bottoms. Browns Marsh is a backwater wetland located near the delta.

Gibbs Chute and Upper Lake Onalaska (Wisconsin Dept. of Natural Resources.)

In the past 60 years, a number of habitat changes have taken place in the Black River Bottoms. Immediately after the lock and dam system went operational in the 1930's, a complex that included forest, wet meadows, terraced wetlands, flowing channels, and oxbow lakes dominated the landscape. Timber cutting, grazing, haying, fire, and farming were all used in varying degrees to manage sites within this area. In the years since, many of these practices were subsequently discontinued as landowners changed, farming operations were discontinued, or sites became too wet due to hydrologic changes. Sedimentation continues to be a factor in the Black River Bottoms and Delta. Today, the bottomland forest is aging. The invasive plant, reed canary grass, is present and may expand into formerly forested areas. Moreover, urbanization, moving north from the La Crosse/Onalaska metropolitan area, threatens to isolate the Bottoms.

A private/public partnership has been formed and is interested in working together to protect the Black River Bottoms. Management tools available to this partnership include working with private landowners on wildlife habitat improvement projects, purchase of conservation easements, or fee title acquisition from willing sellers. Purchasing land from willing sellers within approved acquisition boundaries in both the Van Loon Wildlife Management Area and the Upper Mississippi River National Wildlife and Fish Refuge has also been identified. Inventorying the forest within this complex, using the protocol established by foresters from the U.S. Army Corps of Engineers, is needed. There is also increased interest in this area because of the presence of the eastern massasauga rattlesnake, a candidate species under the Federal Endangered Species Act.

Other proposed management actions focus on improving the diversity and quality of the bottomland forests in the Black River Delta and evaluating water flow distribution throughout the delta. Future sedimentation is expected to result in an increase in the amount of emergent vegetation in the subarea.

Lake Onalaska Barrier Island Complex/Sommers Chute Delta - This buffer between the main channel and Lake Onalaska extends from the Black River Delta (river mile 709) south to Lock and Dam 7 (river mile 702.5). Many of the islands are forested. The main channel interface is abrupt; wetland complexes are found on the Gibbs Lake and Lake Onalaska sides of these barrier islands. Several chutes permit the flow of water from the main channel through this backwater complex. The chutes include Bullet, No Name, Gibbs, Goose, Sommers, Proudfoot, and Millers. Gibbs Chute south to Lock and Dam 7 is part of the Lake Onalaska Closed Area. During the 1999 fall migration, this important closed area supported nearly 6 million waterfowl use days. The majority of the total tundra swan/Canada goose/puddle duck use days, nearly 1,330,000,

Sommers Chute and Lake Onalaska (Minnesota Dept. of Natural Resources photo.)

and a portion of the nearly 3.6 million diving duck use days, occurred in the shadow of this barrier island complex, or on the Sommers

Chute Delta. A nearly 450-acre delta is located at the mouth of Sommers Chute and provides habitat for a variety of fish and wildlife species. Increasing outflows from the main channel into Sommers Chute resulted in the construction of a closing structure in 1994 by the U.S. Army Corps of Engineers and their channel maintenance program. Since the completion of this closing structure, accretion of sand in the delta appears to have slowed. Rock liners were also placed in Gibbs, Goose, and Proudfoot Chutes as part of the Sommers Chute Project. Bullet and No Name Chutes were armored through the channel maintenance program in 1989 as part of the Winters Landing Project.

One area where accretion is occurring along the barrier island complex is near Proudfoot Slough. This site is located on the river side of the barrier islands and just below Sommers Chute.

Because of the importance of these barrier islands in protecting wetland complexes, nearly 1,400 feet of shoreline was protected in 1998 on Islands B and C located just upriver from Lock and Dam 7. The complex of three barrier islands at this location protects an estimated 200 acres of submersed aquatic plants, mainly wild celery, in Lake Onalaska.

Sedimentation and island dissection have also had negative impacts on fish habitat in the area. Historic centrarchid overwintering sites in the subarea have been lost due to these processes.

The desired future habitat for this area is to improve conditions for a variety of species through the implementation of several measures. It also acknowledges that sedimentation and delta formation are likely to continue in the Sommers Chute and Proudfoot Slough areas. This delta formation, along with some potential island construction to improve aquatic vegetation and reestablish centrarchid overwintering habitat, would result in increased land. If implemented, these features, in combination with potential water level management actions, may more than double the amount of emergent vegetation in the subarea (compared to 1989 conditions). The potential for increasing water depths and diversity has been identified to reestablish centrarchid overwintering habitat in the subarea.

Dresbach Island/Island 91Complex/Dakota Island - Dresbach Island is nearly 135 acres and was formerly a dredged material placement site. The Island 91 Complex consists of two islands, totaling nearly 19 acres. Dakota Island is currently a dredged material placement site. All three sites border the main channel; wetland complexes are associated with each site.

Habitat work was completed at Dresbach Island and the Island 91 Complex in 1997. The upper end of Island 91 was armored to protect the wetland located within the horseshoe. At Dresbach Island, a portion of the sand placement site was restored by first adding fine material to the site and then planting trees. A seed island was also constructed at the upper end of Dresbach Island to help protect it. An opportunity exists on the eastern leg of Dresbach Island to complete additional habitat restoration.

Dakota Island is currently a dredged material placement site. However, the use of this site for that purpose may change in the future because of the demand for accessible sand. Rather than placing sand in this inaccessible location, sand excavated through channel maintenance activities may be barged directly to the Hot Fish Shop Placement Site (river mile 713.1, Minnesota). If this scenario occurs, there may be an opportunity to restore habitat on part of Dakota Island.

The proposed actions for the subarea include consideration of sedimentation occurring near the head of Dresbach Island, resulting in the formation of "exposed" sandbars. Several small bays exist within the Dresbach Island complex that may be dredged to improve fish habitat. Some of the dredged material could be used as topsoil for revegetation of sections of Dresbach Island. The desired future also includes evaluation of measures to maintain depth diversity for riverine fish habitat in the old main channel located on the east side of Dresbach Island.

Lake Onalaska - This nearly 7,400-acre backwater complex provides habitat that supports one of the premier centrarchid fisheries on the Upper Mississippi River. Further, Lake Onalaska provides excellent habitat for wildlife, including significant percentages of the continental population of canvasback ducks and tundra swans. With the exception of the southeast corner, much of Lake Onalaska is part of the 7,330-acre Lake Onalaska Closed Area. In an effort to minimize disturbance to migrating waterfowl, the Lake Onalaska Voluntary Waterfowl Avoidance Area was established in 1986 and encompasses nearly 3,250 acres within the closed area. Red Oak Ridge Island (55 acres) and Rosebud Island (178 acres) are the two largest islands located on the lake. Several smaller islands are located in proximity to these two larger islands. Considerable habitat restoration work has been completed on Lake Onalaska in the past 15 years.

Site of dredged channels in Lake Onalaska. (Wisconsin Dept. of Natural Resources photo.)

The Lake Onalaska EMP-HREP was completed in 1989-90. Sedimentation and aquatic plant growth had nearly eliminated water flow through a major centrarchid overwintering area, creating dissolved oxygen problems. Islands in Lake Onalaska had also eroded, leaving the lake subject to increased wave action and turbidity problems. Restoration included dredging parallel channels behind Rosebud Island to provide wintering panfish habitat. Three crescent-shaped islands were also constructed in the middle of Lake Onalaska. Aquatic plants, including wild celery, grow in the shadow of each island, and they provide excellent mallard nesting habitat. A sediment trap was also dredged at the mouth of Halfway Creek. Material dredged from the habitat channels and not suitable for the Highway 53 project was pumped to containment basins on Rosebud Island. Reforesting part of the primary containment basin is a priority.

Water flow through the dredged channels has increased from minimal flow before the project to 600 cubic feet per second (cfs) measured during the winter of 1992 and in subsequent winters. The project design was 100 cfs. Winter flows have been reduced through the dredge cuts by controlling the flow at the Onalaska Spillway.

In 1992, a breach that had developed at the tip of the Brice Prairie Barrier Island was repaired. This island was formed in the late 1960's from material removed during the dredging of the adjoining Brice Prairie Channel. The channel provides boat access to Lake Onalaska from the Brice Prairie Channel and also provides centrarchid wintering habitat.

The Red Oak Ridge Island bank stabilization project was completed in 1995. This island is vegetated with high quality forest habitat containing hickory and oaks. Over time, wave erosion at both ends of the island resulted in significant loss of shoreline and forest. Rock mounds constructed at each end of the island have been successful in stabilizing the shorelines. Project funding was provided by the U.S. Army Corps of Engineers.

Additional habitat restoration work identified for Lake Onalaska and associated islands includes bank stabilization on Bell Island and the smaller islands located in the southeastern corner of the lake (these islands were stabilized by the U.S. Fish and Wildlife Service in 2003); deepening the Sailboat Club bay and the upper and lower ends of the Brice Prairie Channel for additional centrarchid habitat; island restoration in the upper end of the lake near Blackdeers Cut; and bank stabilization and reforestation work on Rosebud Island. A long-term schedule of water level management will also be evaluated for Lake Onalaska and Pool 7. If applicable, water

level management would be implemented to benefit shallow wetland habitat and other fish and wildlife habitat. The implementation of water level management and island features will contribute to reaching the desired distribution and coverage of aquatic and submersed vegetation in this subarea (330 percent increase in emergents and 120 percent increase in submersed vegetation over 1989 conditions). These actions will be done in cooperation with the public, industry, local units of government, and local, State, and Federal agencies. Cumulatively, these actions will increase the quality and quantity of habitat for a variety of species.

Halfway Creek/Sand Lake Coulee Creek Watersheds - These two watersheds, located in La Crosse County, Wisconsin, drain approximately 28,000 acres to Lake Onalaska. Much of the current land use in these watersheds is in agriculture and wooded; however, residential and commercial development is rapidly expanding. Flooding in 1993 and ongoing concerns with sedimentation prompted the Town of Onalaska in 1994 to evaluate causes and possible solutions to these watershed problems. This analysis documented current and projected sediment loads and storm water runoff in the basin, and identified associated water quality impacts at Halfway Creek Marsh and Lake Onalaska. The resulting report also provided development density, storm water, and sediment management recommendations. Land use planning and best management practices, both structural and nonstructural, are currently being implemented by partnerships involving individuals, landowners, organizations, local units of government, and State and Federal agencies.

Implementation of the plan began with the construction of the Upper Halfway Creek Marsh Project in 1999. Among the goals of this project, completed in 2000, is reduction of the amount of sediment reaching Halfway Creek Marsh and Lake Onalaska. Toward that end, an inlet structure was constructed on Halfway Creek that will divert part of the flow into an upland sediment trap during high flow events. In the process, this sediment trap will also be managed as a moist soil unit, benefiting a variety of waterfowl, shorebirds, and other wetland-dependent wildlife. Two other impoundments, totaling nearly 56 acres, were constructed as part of this project and will be managed as temporary-seasonal wetlands.

Nearly 2,200 lineal feet of eroding streambanks on Halfway Creek were stabilized in 2000. This work was done on private land on sites identified as high priority. Additional bank stabilization is planned in the future. Sediment detention basins have also been designed on Halfway Creek and Sand Lake Coulee Creeks as part of the overall effort.

In a related effort, the Town of Onalaska developed a Storm Water Management Plan for Brice Prairie in 1999. The purpose of this plan is to develop storm water management guidelines and policies to prevent flooding and environmental degradation. This effort was prompted by the development occurring on Brice Prairie and in the surrounding area.

Woody debris makes good fishing habitat. (Wisconsin Dept. of Natural Resources photo.)

Unique Attributes, Opportunities, and Constraints

One opportunity is the considerable public interest in the environmental health and habitat quality of the pool, particularly Lake Onalaska and the Black River Bottoms. Private-public partnerships have resulted in a number of successful projects. Among the examples are the Lake Onalaska EMP Project, the Lake Onalaska Voluntary Waterfowl Avoidance Area

Program, and watershed planning and implementation in the Halfway and Sand Lake Coulee Creek watersheds. There is also interest in doing additional work.

Lake Onalaska and the Black River Bottoms are unique attributes.

The Midway Railroad Prairie State Natural Area, located along the Great River State near the City of Onalaska, is owned by the U.S. Fish and Wildlife Service and managed as part of the Upper Mississippi River National Wildlife and Fish Refuge.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Often, the actions proposed and described below are interrelated, and specific actions will require overlapping solutions. The goal of these actions is to increase diversity in Pool 7. This diversity may be biological, such as the number of fish or wildlife species affected, or may be reflected in habitat diversity, such as side channel reformation, acres of islands restored, or increased acres of emergent plants present. Increasing and sustaining a diverse aquatic and terrestrial habitat base in Pool 7 is the key to improving the health of the Mississippi River.

Example Action: *Increase Depth Diversity in Channels and Backwaters.* Small hydraulic dredge being used to restore fisheries habitat and provide topsoil for revegetation work. (US Army Corps of Engineers photo.)

1.) Increase Depth Diversity in Channels and Backwaters

Sedimentation at various locations has affected the habitat quality for many species. Several locations have been identified for actions designed to improve habitat in selected backwaters for riverine and backwater communities. Among the tools that may be used are dredging, construction of closing structures, island restoration, shoreline stabilization, and improved connectivity.

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Many areas in Pool 7 are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

3.) Protect and Restore Islands

A number of islands need protection. Among them are Belle Island, several small islands off Rosebud Island on Lake Onalaska, and islands located on or near the main channel in the upper and middle sections of the pool.

Island restoration projects have been recommended for the lower barrier island chain located above Lock and Dam 7 and for the upper end of Lake Onalaska. There may be other opportunities as well to break up wind fetch on Lake Onalaska.

Measures to reduce sediment resuspension in the pool using islands and other actions may reduce sediment input to backwaters located in upper Pool 8. Reduction in sediment resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation in Pool 7. Islands can also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Terrestrial habitat maintenance and restoration are proposed for the Black River Delta and the Black River Bottoms. Projects may include measures to reduce or manage the sediment being transported by the Black River; revegetation of former channel maintenance disposal sites; conversion of sites currently dominated by reed canary grass to bottomland forest or prairie; and raising the elevations of landforms through the use of dredged material.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Moist soil management will be implemented at the Upper Halfway Creek Marsh Project to improve environmental conditions for wet meadow establishment and growth.

6.) Work Cooperatively with Private Property Owners

Private-public partnerships are needed for such tasks as promoting, acquiring, and managing buffers around key features such as Brice Prairie, the Black River Bottoms, and the Trempealeau Lakes area. Assisting the Town of Onalaska in implementing the Brice Prairie Storm Water Management Plan is another opportunity. A variety of tools are available to acquire and manage these buffers, including purchase of development rights, purchase of conservation easements, donations, and fee title acquisition from willing sellers.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

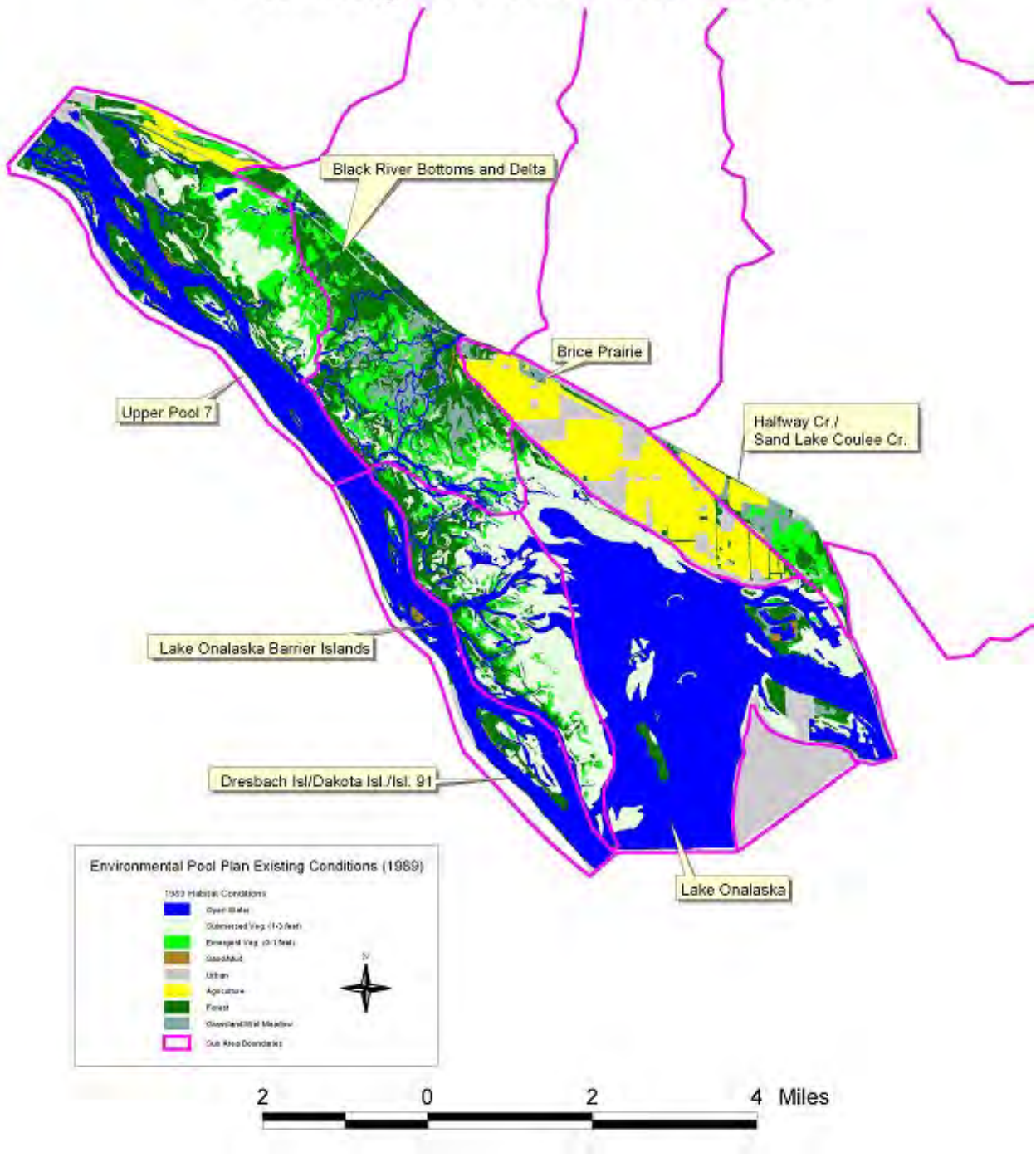
Some of the best and most diverse habitat in the Upper Mississippi River System is associated with the mosaic of small flowing channels, chutes, sloughs, embayments, deltas, barrier islands, natural river levees, and associated plant communities. Flow regimes in a number of areas in Pool 7 have been altered by channel maintenance training structures. All structures within Pool 7 should be reviewed to determine those that may be adjusted to make them more compatible with both wildlife and navigation needs. Connectivity with Pools 6 and 8 would be improved through the implementation of structures or dam operation measures to increase fish passage at the dams.

8.) Support Watershed Management Programs

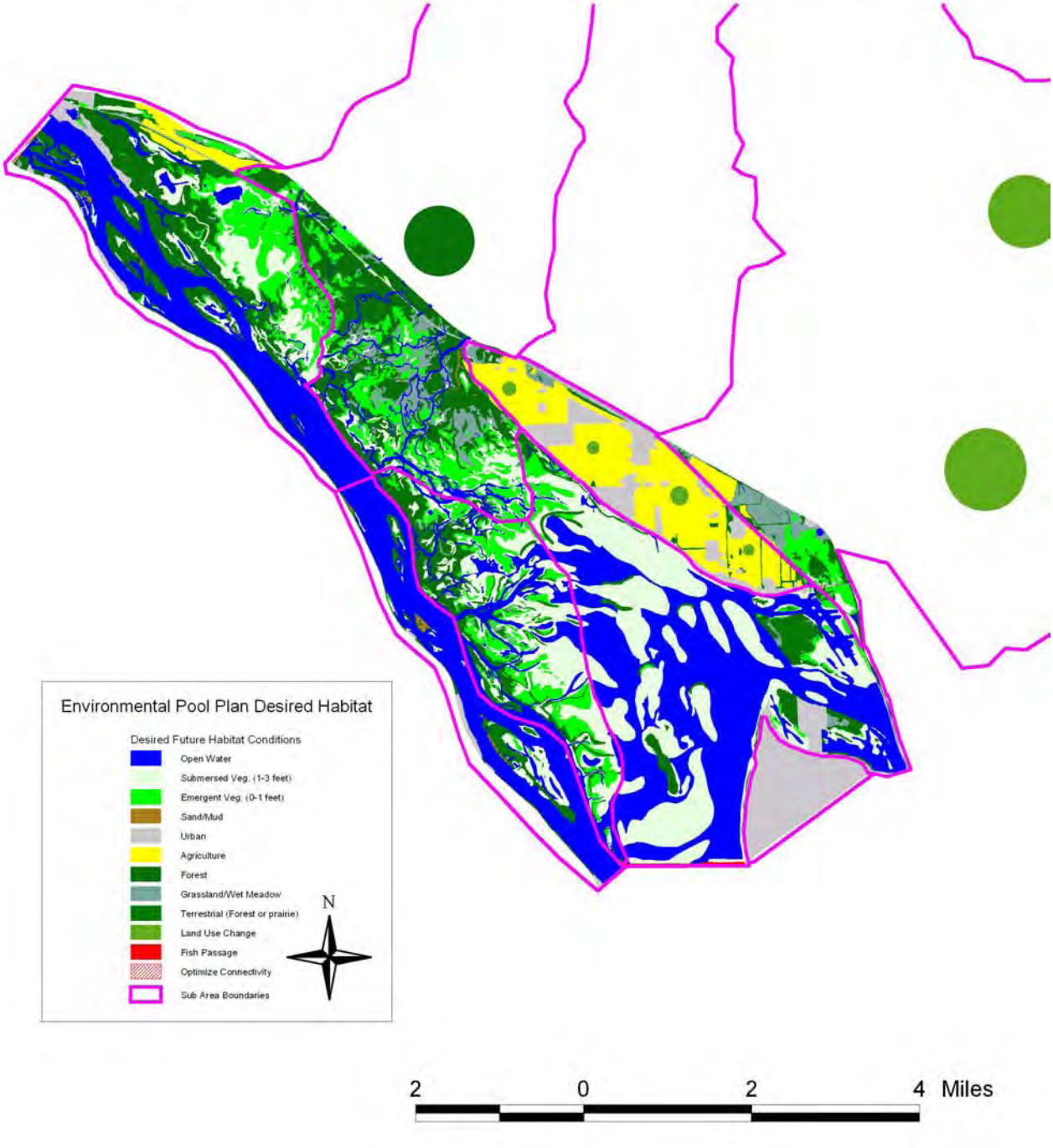
Watershed management initiatives such as the Halfway Creek/Sand Lake Coulee Creek initiative should be exported to other tributaries, such as the Black River, to reduce sediment and nutrient inputs into the Mississippi River.

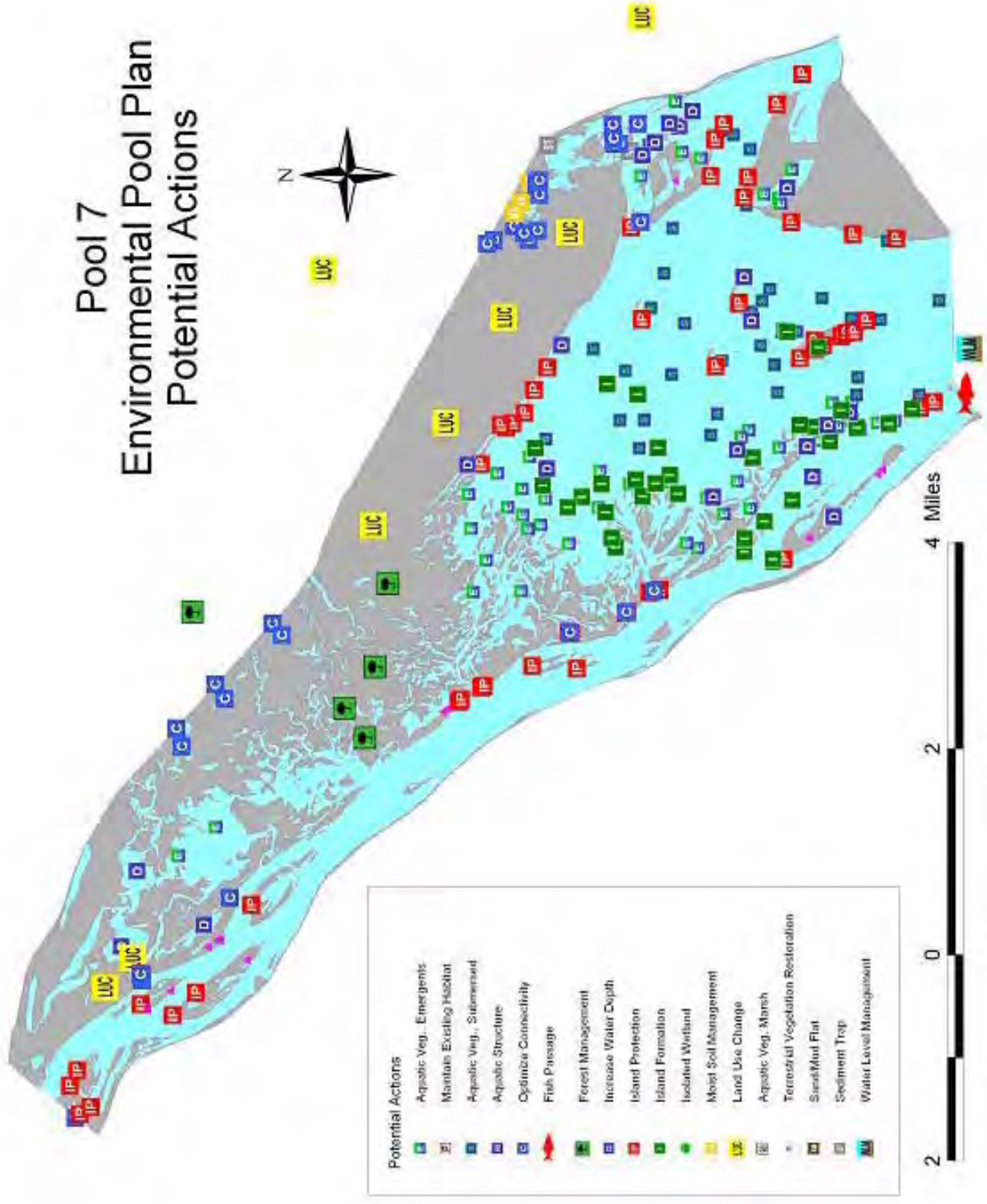
Turtle loafing habitat on the Trempealeau National Wildlife Refuge in Pool 6. (US Army Corps of Engineers photo.)

Pool 7
Environmental Pool Plan
Existing Habitat Conditions



Pool 7
Environmental Pool Plan
Desired Future Habitat Conditions




Pool 7
Environmental Pool Plan
Potential Actions
N
LUC
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
2
0
2
4 Miles

Desired Future Habitat Conditions In Pool 8, Mississippi River

Description of Pool 8

Pool 8 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 8 as part of the 9-foot channel navigation project. Construction of Lock and Dam 8 was completed in 1937. Pool 8 areas discussed in the report encompass 44,300 acres, from approximately river mile 680 at Genoa, Wisconsin, to river mile 703 at Dakota, Minnesota.

In general, the boundaries of the Pool 8 planning area are the Canadian Pacific Railway and Iowa, Chicago and Eastern railroads on the Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River. Areas where the planning boundaries have been widened include the lower reach of the Root River Valley (Highway 26 west to Highway 25 near Mound Prairie) and the lower reach of the La Crosse River Valley (confluence north and east to Interstate Highway 90). Throughout much of Pool 8, the Mississippi River valley is confined to a narrow bedrock gorge that is a dominant feature of geomorphic reach 3. Urban areas occur where relatively flat terraces provide a buffer between the river and bluffs. In Wisconsin, these urban areas include the Cities of Onalaska and La Crosse and the Villages of Stoddard and Genoa. The Cities of La Crescent and Brownsville are located on the Minnesota side.

Major tributaries to the Mississippi River within Pool 8 are the Black River (Wisconsin, river mile 698.5), La Crosse River (Wisconsin, river mile 698), Root River (Minnesota, river mile 694), and Coon Creek (Wisconsin, river mile 684). Smaller tributaries include Pine Creek (Minnesota, river mile 697.5), Pammel Creek (Wisconsin, river mile 693.5), Mormon Coulee Creek (Wisconsin, river mile 692.5), and Wildcat Creek (Minnesota, river mile 688). With the exception of the lower reach of the Black River and Pammel Creek, the watersheds of most of these tributaries are predominantly agricultural, which contributes to significant loading of suspended sediment to the river. The lower reach of the Black River is surrounded by the Onalaska and La Crosse metropolitan area. Urbanization is also occurring within most of these watersheds. Watersheds receiving the most urban growth at this time include the La Crosse River and Pine and Mormon Coulee Creeks. Sediment originating from both agricultural land and urbanizing areas contributes to the loss of depth diversity and decreased light penetration within the water column.

Typical of most navigation pools of the Upper Mississippi River, the water to land ratio changes from south to north. The lower reach of the pool is predominantly open water from river mile 680 to 690. This area has experienced a significant reduction in the number of islands since the river was impounded. The amount of land increases in the middle portion of the pool, with more islands separated by multiple river channels and backwater wetlands. The upper reach of Pool 8 is predominantly forested islands with many small river channels and shallow wetlands located throughout. Lower Pool 8 exhibits high turbidity caused by resuspension of sediment from current, wind, and wave action, which tend to limit aquatic vegetation growth. Typically, vegetation in lower Pool 8 in the recent past was restricted to shallow areas adjacent to shorelines. However, in the past few years, a resurgence in aquatic vegetation in the lower pool has occurred. This rebound of vegetation has not been fully explained. Several theories have been offered. One theory attributes the improved water clarity to the rapidly increasing populations of zebra mussels. Another ascribes the improvement in the density and distribution of submersed aquatic plants to ongoing efforts to restore/protect islands. An interesting sidenote, biologists noticed a sharp increase in the number of macroinvertebrates, especially fingernail clams, immediately

preceding the increase in aquatic vegetation in the lower pool.

Description of Existing and Desired Future Habitat Conditions for Pool 8 Subareas

Several identifiable areas are present within Pool 8. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Black River Area - The area is located between the Onalaska Spillway and the confluence with the Mississippi River at river mile 703. Much of this section of river is bordered by residential, industrial, and commercial development. One exception is the 180-acre Wittenberg Marsh located below the Onalaska Spillway, and still largely undeveloped. This wetland is located within the acquisition boundary of the Upper Mississippi River National Wildlife and Fish Refuge. A public-private partnership is working to acquire part of the wetland from willing sellers. One goal of the acquisition is to develop part of the marsh into an outdoor classroom. Recreational boat traffic is heavy on the Black River through much of the open water season. Sections of the Black River are extensively used by paddlefish.

The desired future planning for the subarea identifies potential locations where reestablishment of historic centrarchid overwintering sites will be evaluated. The desire is to maintain at least two overwintering sites in the subarea.

French Slough Area - The French Slough Area extends from Lock and Dam 7 (river mile 702.5) south to the confluence with the Black River at river mile 699. The east side of French Slough is largely urban with residential, commercial, and industrial development. The west side is a mixture of bottomland forest, channels, and backwaters. This mix of types provides habitat for a variety of fish and wildlife species. Sedimentation is a concern at the mouth of Smith Slough and in the lower end of French Slough.

The upper end of French Slough was dredged for material to construct Interstate Highway 90, which bisects this subarea. This area experienced severe oxygen depletion, which occasionally led to winterkill of the fisheries in the upper sections of French Slough. A culvert was installed in Lock and Dam 7 that allows oxygenated water to flow into French Slough from Lake Onalaska. The flow of water provided by this culvert has alleviated dissolved oxygen problems.

Island erosion and dissection is a resource problem in some locations of the subarea. These sites have been identified for evaluation of measures to optimize connectivity for the maintenance of habitat conditions in the area. In addition, some potential locations for increasing depth to benefit fish habitat have been identified in the subarea.

Main, East, and West Channels and Associated Islands - The East Channel begins near river mile 702 and rejoins the main channel near river mile 699.5. The West Channel begins near river mile 699 and rejoins the main channel near river mile 697. These side channels provide important habitat for a variety of fish and mussel species.

The islands are located between river mile 702.5 and 697. Among the islands included are the Head of East Channel, Lower 98, Minnesota, Barron, Taylor, and several other unnamed islands. Forest is the dominant cover type on most of these islands. Because of their location along the main channel and the East and West Channels, dominant cottonwood trees along the shoreline are extensively used as perch sites by bald eagles. Bald eagle nests are also located on these islands. A heron/great egret/double-crested cormorant rookery is located near river mile 701. The island complex located on the east side of the East Channel and north of Smith Slough is a mixture of private and public ownership. Shoreline erosion is occurring at a number of locations and has been identified in

the plans for potential stabilization. Maintaining the forest cover type on these islands is a goal. The forest should be inventoried using U.S. Army Corps of Engineers protocol. Revegetation of historic disposal sites to forest is identified as another measure to improve the forest community. Revegetation would require dredging backwaters in the vicinity for topsoil.

The upper tip of Lower Island 98 and Minnesota Islands were armored in 1996 as part of the East Channel EMP-HREP.

Another feature, I-90 Peninsula and Bay, located near river mile 701.7, protects an important walleye and sauger staging area. Much of the peninsula eroded away, jeopardizing this staging area. The peninsula was extended through the construction of a rock mound in 1996 under the authority of the EMP-HREP.

La Crosse River Valley - This area is bounded on the west by the confluence of the La Crosse River with the Mississippi River (near river mile 698.2) and to the north by Interstate Highway 90, a distance of nearly 7 miles. The width is dictated by the interface with the floodplain boundary and the road net. Many of the wetlands and wet meadows within this area have been affected by drainage or fill or have been diked during road construction. Reed canary grass is the dominant plant over many acres of wet meadows. Purple loosestrife is also present. Although surrounded by development, wetlands are used by waterfowl, wading birds, and other wetland-dependent species. Northern pike also use the flooded meadows for spawning.

A private-public partnership is working toward acquiring portions of this complex from willing sellers and through donations. Conservation easements may also be used to protect important resources. Restoration activities may include construction of ditch plugs to restore wetlands, removal of sections of dike, and active wet meadow management.

Blue Lake Area - This nearly 2,190-acre area located in Minnesota, extending from near river mile 701 to river mile 697, includes a mixture of private and public-owned land. Wetland filling has occurred in the past in and around the City of La Crescent. With the exception of the strip development along Highway 14/61 and at the edge of La Crescent, most of the remaining areas within the Blue Lake Area were designated Resource Classification A, the highest value possible, in the 1987 Upper Mississippi River National Wildlife and Fish Refuge Master Plan under Wildlife Management Objectives. Resource Classification A means these wetlands provide high value fish and wildlife habitat, which is unique and irreplaceable on a national basis or in the ecoregion. This designation applies in part because of the habitat provided for waterfowl, wading birds, coot and common moorhen nesting, and a black tern nesting colony. Least and American bitterns have been observed using Blue Lake. Since the 1993 flood, robust beds of wild rice have been common on Blue Lake in most years. Several Federal- and State-listed species of concern have been documented using these wetlands in the past.

Because of increasing urbanization in the La Crescent area, several of the privately owned sites within the Blue Lake Area have been identified as meeting the needs for future commercial or industrial development. The interest in developing these sites is expected to continue. Acquisition of key sites from willing sellers has been identified as a priority. Wetlands north of Highway 14/61 have lost connectivity with the Mississippi River at lower river stages because of highway construction or residential development. Higher sites within this

Isle LaPlume, Target Lake and the Root River Valley. (US Army Corps of Engineers photo.)

area also support an aging bottomland forest. There is a need to inventory this forest using the protocol developed by the U.S. Army Corps of Engineers. Sedimentation is also a concern within the Blue Lake Area.

A nearly 0.25-mile section of road and embankment was removed in 1998 near the Shore Acres residential development and the site restored. Japanese knotweed is present along the Shore Acres road and may be of management concern in the future.

The desired future for the Blue Lake area focuses on protecting and maintaining existing habitat. Some management measures to further improve habitat conditions in the area have been identified for future consideration. These actions include: optimizing connectivity of aquatic and terrestrial habitat, improving centrarchid overwintering habitat, and forest management.

Target Lake - This backwater lake with an extensive emergent plant buffer is located in Minnesota between river mile 697 and 696. Walleye and northern pike spawning have occurred in the past. Waterfowl and other wetland dependent wildlife extensively use this

Dredging the new channel for the Root River commenced in 1917 and was completed in 1919. (Photo courtesy of Houston County Historical Society.)

complex throughout the annual cycle. Sedimentation is a concern. The Mississippi River, Pine Creek, and Mink Slough all connect with Target Lake. The lower reach of Pine Creek is experiencing rapid urbanization as growth from the City of La Crescent moves out into this watershed. As the conversion from agriculture to urbanization occurs, coordinated planning is needed to link initiatives and resources throughout the watershed.

The former Root River channel as it now appears. (US Fish and Wildlife Service photo.)

Management actions proposed for Target Lake focus on maintaining the 1989 habitat structure in the area. Opportunities for improving fisheries habitat by increasing depth are proposed for consideration in open water areas of the Target Lake area.

Root River Bottoms – The Lower Root River Bottoms is a 9,030-acre area along the Root River from Mound Prairie east to the confluence of the Root River and the Mississippi River near river mile 694. These bottomlands provide important habitat for a variety of fish and wildlife species. Most of the area is privately owned. Public-owned land includes two sites managed by the Minnesota Department of Natural Resources and the Upper Mississippi River National Wildlife and Fish Refuge. The areas are located near the confluence with the Mississippi River. Management of wet meadow habitat is occurring on the Refuge land. The lower Root River was designated Houston County Judicial Ditch No. 1 in 1916. Dredging a new river channel commenced in 1917 and was completed in 1919. This channel is still legally considered an active Judicial Ditch. Material from the dredging operation was placed along the banks of the river. These spoilbanks, which serve as agricultural levees to keep Root River flows contained in the channel, have

deteriorated and now require considerable maintenance. Many serious floods have occurred in the lower Root River, including those in 2000 and 2001, when breaches occurred in the levees at a number of sites. The Root River also carries an estimated 10 to 15 percent of the bedload sediment received into Pool 8. Sediment from the Root and Mississippi Rivers has resulted in the loss of fish habitat in the subarea. Increasing the water depths in selected locations of the subarea may be implemented to maintain fish overwintering sites.

A private-public effort is needed to find ways to protect and enhance important riparian habitats along the Root River, while at the same time providing a solution to the flooding problems that periodically occur in the lower reach of the river. Among the activities this effort may use to reach the goals are: a private lands program emphasizing buffer strips or upland and wetland restorations; wet meadow management; construction of sediment traps; breaching of the levees at selected locations; purchase of conservation easements; or land acquisition from willing sellers.

Near the confluence of the Root and Mississippi Rivers is a relatively solid block of bottomland forest and marsh bisected by numerous channels. There is concern that this forest, like much of the forest along the Mississippi River, is not regenerating because of higher river levels, excessively saturated soils, the presence of reed canary grass, or little site disturbance. An inventory of this bottomland forest is needed, using the protocol developed by the U.S. Army Corps of Engineers. Management options to maintain the forest would be developed and implemented following the inventory.

Lawrence Lake - This 1,500-acre backwater extends from river mile 693 to 690. Lawrence Lake is a well-protected, shallow backwater lake that provides habitat to a wide variety of fish and wildlife species. The lake is a natural depositional area for fine sediments and is likely to become shallower as time passes. Lawrence Lake is relatively isolated from the Root and Mississippi Rivers during low flow periods. During these periods, the lake is only open to the river at the lower end. As the river rises, the intervening bottomland forest areas become inundated and water flows into and through Lawrence Lake. In time, the lake could become more of a marsh than a lake. One factor that could accelerate this process would be if the Root or Mississippi River were to create a breach in the surrounding higher ground and would allow more flow into Lawrence Lake.

The goal is to maintain the lake in a highly productive state for as long as practical. Over the long term, the lake is threatened by sedimentation and/or increased flows entering from the river. Measures that would reduce sedimentation would assist in maintaining the lake as a highly productive resource. If future sedimentation results in a loss of fish habitat in the lake, measures for increasing depth diversity may be considered to maintain the lake as high quality backwater fish habitat.

A project designed to stabilize and protect Island 116 and reduce the flow down the secondary channel between Island 116 and Lawrence Lake was completed in 2000. Island 116 is located at the entrance to Lawrence Lake (river mile 690.1). A gap was left in the channel closure to maintain flowing water down the secondary channel. Completion of this project implemented one of the recommendations identified in the Lower Pool 8 Channel Management Plan.

The Lawrence Lake area also contains over 400 acres of bottomland forest. These forested areas are a continuation of those found in the Root River area. The desired future is to improve and maintain the habitat quality of these forested areas.

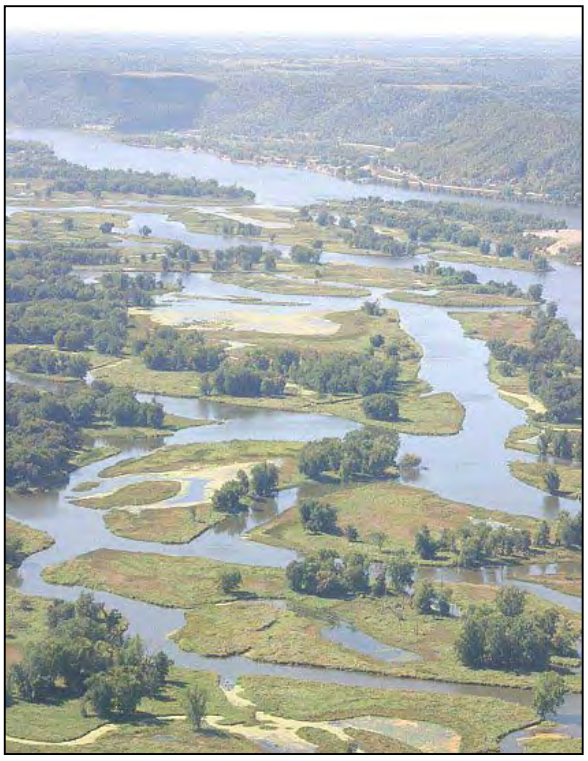
Running Slough Complex - This complex is located between river mile 695 and 690. About 5,015 acres of running and dead-end sloughs and other backwater habitats are included. The Running Slough Complex provides habitat for a variety of fish and wildlife species. Sedimentation is a concern, as filling-in of protected backwater sloughs and ponds is occurring. As this sedimentation continues, successional changes will occur as aquatic

habitat converts to marsh habitat or bottomland forest. Island dissection is also occurring.

The WKTY Towers are located along the perimeter of the Running Slough Complex and along Highway 35. Five towers, used for AM radio transmission, are located at this site. Current land management involves mowing/haying to maintain this tower complex in a herbaceous plant cover type. Converting this site to bottomland forest is a consideration.

Mormon Coulee Creek enters the Mississippi River near the WKTY Towers site. Streambank stabilization and fish habitat improvement are occurring in this watershed. Continuation of this work should be encouraged.

Numerous actions may be considered to maintain and restore habitat conditions in the Running Slough Complex. These actions would be evaluated for their effectiveness at reversing and stopping sedimentation and island erosion/dissection occurring in the area. These actions would collectively increase backwater and channel water depth diversity, restore lost island habitat, increase forested habitat, reestablish centrarchid overwintering habitat, and increase emergent vegetation coverage.



Backwater complex west of Goose Island. (Minnesota Dept. of Natural Resources photo.)

Goose Island Complex - This subarea includes Goose Island itself, a backwater lake known locally as Shady Maple, and the Goose Island No Hunting Zone. Much of the upland located on the island is managed as a park by La Crosse County. Controlling the spread of locust trees in upland locations is a management goal. Two small tributaries, Mormon Coulee Creek and Pammel Creek, enter the subarea.

The desired future for the area is to provide and maintain a diverse backwater complex for waterfowl and other backwater species. The Shady Maple/Beiers Lake area at one time supported overwintering habitat for panfish. Use of this site for overwintering by fish has been diminished as a result of flow changes and sedimentation. The desire is to return the backwater habitat community to the diversity and productivity present prior to the mid-1970's. This would require detailed evaluation of proposed measures and consideration of future uses of the area.

Potential actions that have been identified for the area to improve habitat conditions include: forest management, island construction, bank stabilization, increased water depth in channels and backwaters, and pool-wide water level management.

Lower Pool 8 - Lower Pool 8 includes a transitional area, located between river mile 690 and 685, and the open lake-like area of lower Pool 8, extending between river mile 685 and Lock and Dam 8 (river mile 680). Fish and wildlife habitat conditions in lower Pool 8, particularly in the open lake-like area, have deteriorated considerably due to loss of islands, a decline in aquatic vegetation, and a decline in depth diversity. In the transitional area, habitat loss has not been as severe, but is being affected by sedimentation. Within the transitional area, there has been some loss of islands that is partially being offset by delta formation occurring in the Crosby Slough/Little Crosby Slough area. In the open lake-like area, nearly

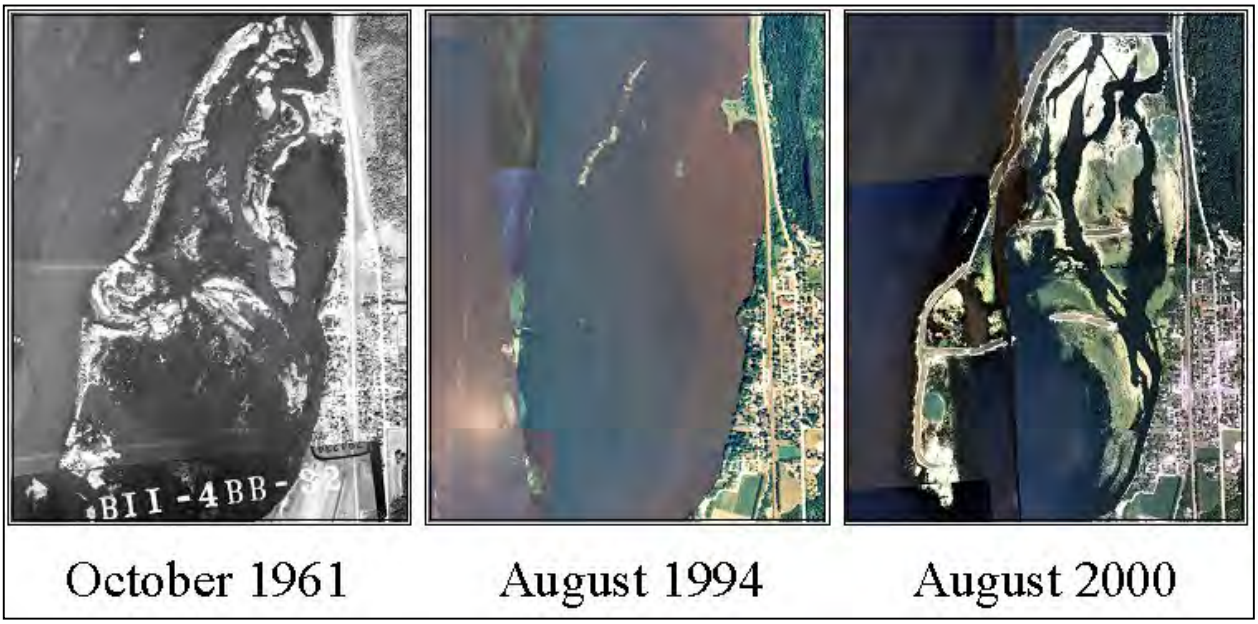
all the islands have been lost and there has been a significant decline in aquatic vegetation. Purple loosestrife and crown vetch are invasive plants occurring on many islands in the transitional area. Zebra mussels are abundant, particularly along the main channel. Without proactive measures to improve habitat quality, conditions are expected to continue to decline. Some islands have been restored through Phases I and II of the Pool 8 Islands EMP-HREP and through other programs. Eight seed islands also have been constructed. Planning for Pool 8 Islands, Phase III, is complete and the project should be constructed sometime between 2005 and 2010.

The desired future conditions for lower Pool 8 include an increase in the acreage of islands, restoration of backwater habitat for fish and wildlife, and a 350 percent increase in emergent vegetation while maintaining the 1989 coverage of submersed vegetation. The cumulative impacts of projects and actions in the pool area already show results. Construction of Pool 8 Islands, Phases I and II (completed in 1993 and 1999, respectively) has improved conditions for aquatic vegetation and fish and wildlife. These island projects, combined with water level reduction done in Pool 8 during the summers of 2001 and 2002, are having a cumulative positive impact on vegetation in this section of the pool. Additional proposed islands in lower Pool 8 would further improve habitat conditions by diversifying velocities and microhabitats along with restoration of habitat for numerous fish and wildlife species.

The Wisconsin Islands Closed Area is located within lower Pool 8. Coon Creek empties into the Mississippi River near river mile 684.5. Considerable watershed planning and project implementation have been completed in this watershed over the past 60+ years. Additional work is also planned.

Unique Attributes, Opportunities, and Constraints

The features of several pre-impoundment backwater complexes still exist today in the upper pool, yet in a degraded state. The changed hydrology has caused acceleration in sedimentation and reduced water velocities throughout much of the backwater areas during



The Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project successfully restored habitat that was almost completely lost over a 30+ year time period. (US Army Corps of Engineers photos. Time series created by Wisconsin Dept. of Natural Resources.)

all discharge levels. The forest community in the pool is relatively homogenous with silver maple dominating. However, a lack of regeneration of the forest is resulting in a conversion of much of the forest area into reed canary grass.

Waterfowl hunter near Slingshot Island. (US Fish and Wildlife Service photo.)

The tributaries entering this portion of the Mississippi River contribute significant amounts of suspended sediment. Measures in the watersheds to reduce runoff will be encouraged, and over time, would result in a reduction of sediment delivery to Pool 8. However, this sediment also provides an opportunity in some areas to promote deposition of the sediment to enhance desirable habitat. These areas include: behind selected islands to promote the establishment of emergent vegetation and to promote expansion of the deltas and diversification of habitat.

Summary of Actions to Achieve Desired Future

Often, the actions proposed and described below are interrelated, and specific actions will require overlapping solutions. The goal of these actions is to increase diversity in Pool 8. This diversity may be biological, such as the number of fish or wildlife species affected. Meeting the goal may be reflected in habitat diversity, such as side channel reformation, acres of islands restored, or increased acres of emergent plants present. Increasing and sustaining a diverse aquatic and terrestrial habitat base in Pool 8 is the key to improving the health of the Mississippi River.

1.) Increase Depth Diversity in Channels and Backwaters

Sedimentation at various locations has affected the habitat quality for many species. Several locations have been identified for actions designed to improve habitat in selected backwaters for riverine and backwater communities. Among the tools that may be used are dredging, construction of closing structures, island restoration, shoreline stabilization, and improved connectivity.

2.) Maintain Existing Quality Habitat

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Many areas in Pool 8 are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed. Some areas in Pool 8 that are considered quality habitat and should be maintained are Lawrence Lake, Blue Lake, and Target Lake and the forest community located in the Root River Delta.

3.) Protect and Restore Islands

Protection and restoration of islands have occurred at several locations in the pool (head of East Channel, Island 116, Trapping/Heron/East Island, and Pool 8 Islands Phases I and II). Additional island restoration projects have been recommended for construction as part of the Pool 8 Islands, Phase III, HREP, and are being proposed for other locations in the Lower Pool 8 and Goose Island areas. There may be opportunities to restore or build islands in other locations of the pool such as the Running Slough complex.

Measures to reduce sediment resuspension in the pool using islands and other actions should reduce sediment input to backwaters located in upper Pool 9. Reduction in sediment

resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation in Pool 8. Islands can also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach.

4.) Manage Floodplain Forest and Prairie Communities for Diversity and Quality

Terrestrial habitat maintenance and restoration may occur along the main channel, in the Goose Island area, in the Root River Bottoms, or at other locations. Projects may include measures to reduce or manage the sediment being transported by tributaries; revegetation of former channel maintenance disposal sites; conversion of sites currently dominated by reed canary grass to bottomland forest or prairie; and raising the elevations of landforms through the use of dredged material.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels was implemented in the summers of 2001 and 2002 as a method to restore aquatic plant communities, especially emergent species. Approximately 2,000 acres were exposed during each year of the drawdown. The changes in water levels provided environmental conditions that increased the coverage of emergent vegetation in the lower and middle parts of Pool 8. Water level management is proposed to be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

Some locations in the Root River subarea have been identified as having a potential for the construction of moist soil units. These units would provide for an increase in wet meadow and emergent vegetation in the Root River subarea.

6.) Work Cooperatively with Private Landowners

Private-public partnerships are needed for such tasks as to promote, acquire, and manage buffer areas in the lower reach of the La Crosse and Root Rivers and Mormon Coulee, Coon, and Pine Creeks. A variety of tools are available to work with landowners, such as programs administered by the U.S. Department of Agriculture, purchase of conservation easements or development rights, donations, and fee title acquisition from willing sellers.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

Some of the best and most diverse habitat in the Upper Mississippi River System is associated with the mosaic of small flowing channels, chutes, sloughs, embayments, deltas, barrier islands, natural river levees, and their associated plant communities. Flow regimes in a number of areas of Pool 8 have been altered by channel maintenance training structures. All structures within upper Pool 8 should be reviewed to determine those that may be adjusted to make them more compatible with both wildlife and navigation needs. This evaluation has already been completed in lower Pool 8 through the Lower Pool 8 Channel Management initiative. Several training structures were altered as a result of this effort.

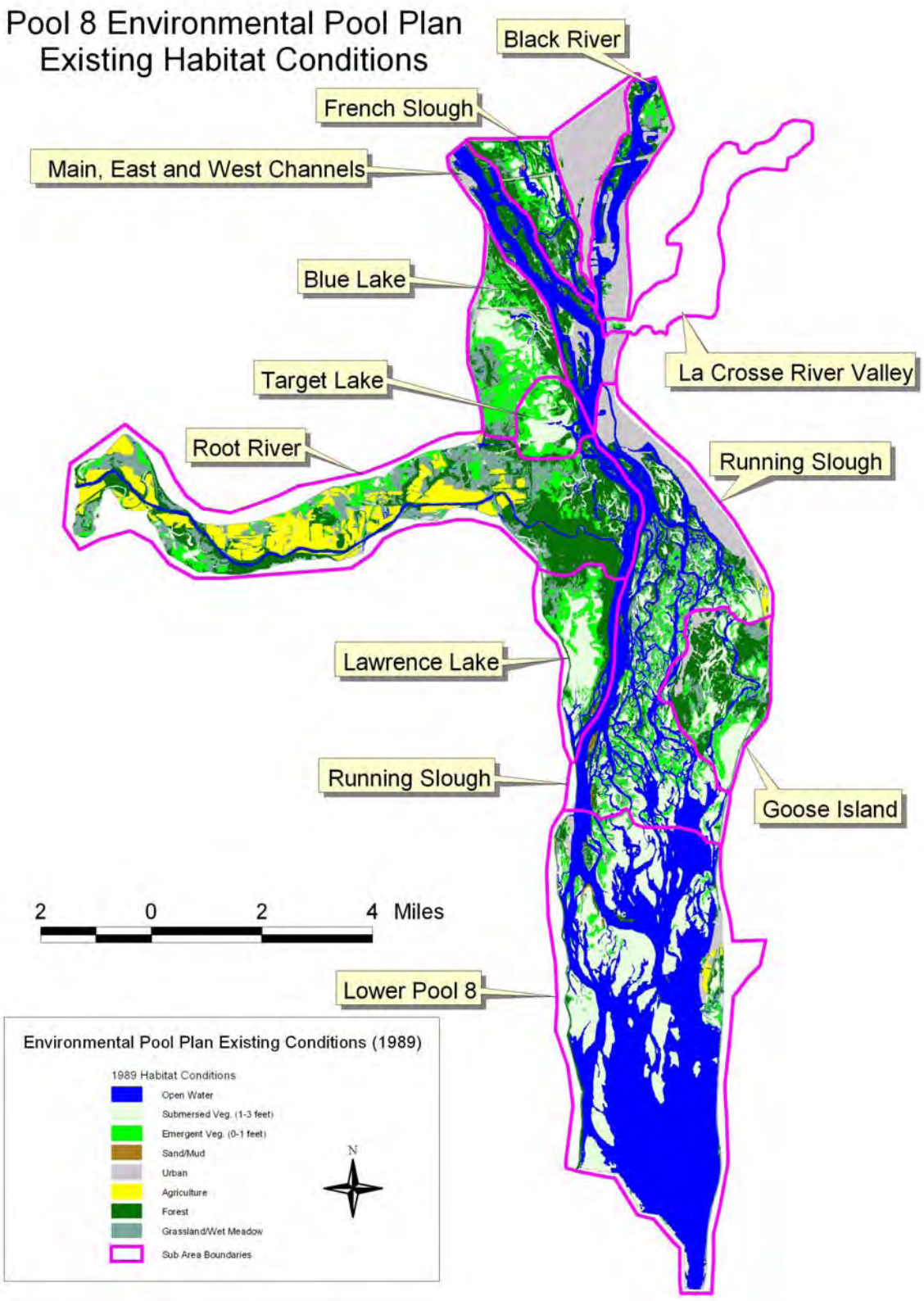
Island dissection has also been identified as a resource problem in many areas of Pool 8. The development of new channels through some of the island has introduced flowing water and sediments into backwater areas that once had no flow through them. These areas may benefit from closing off channels to eliminate flows into them and reduce sedimentation rates.

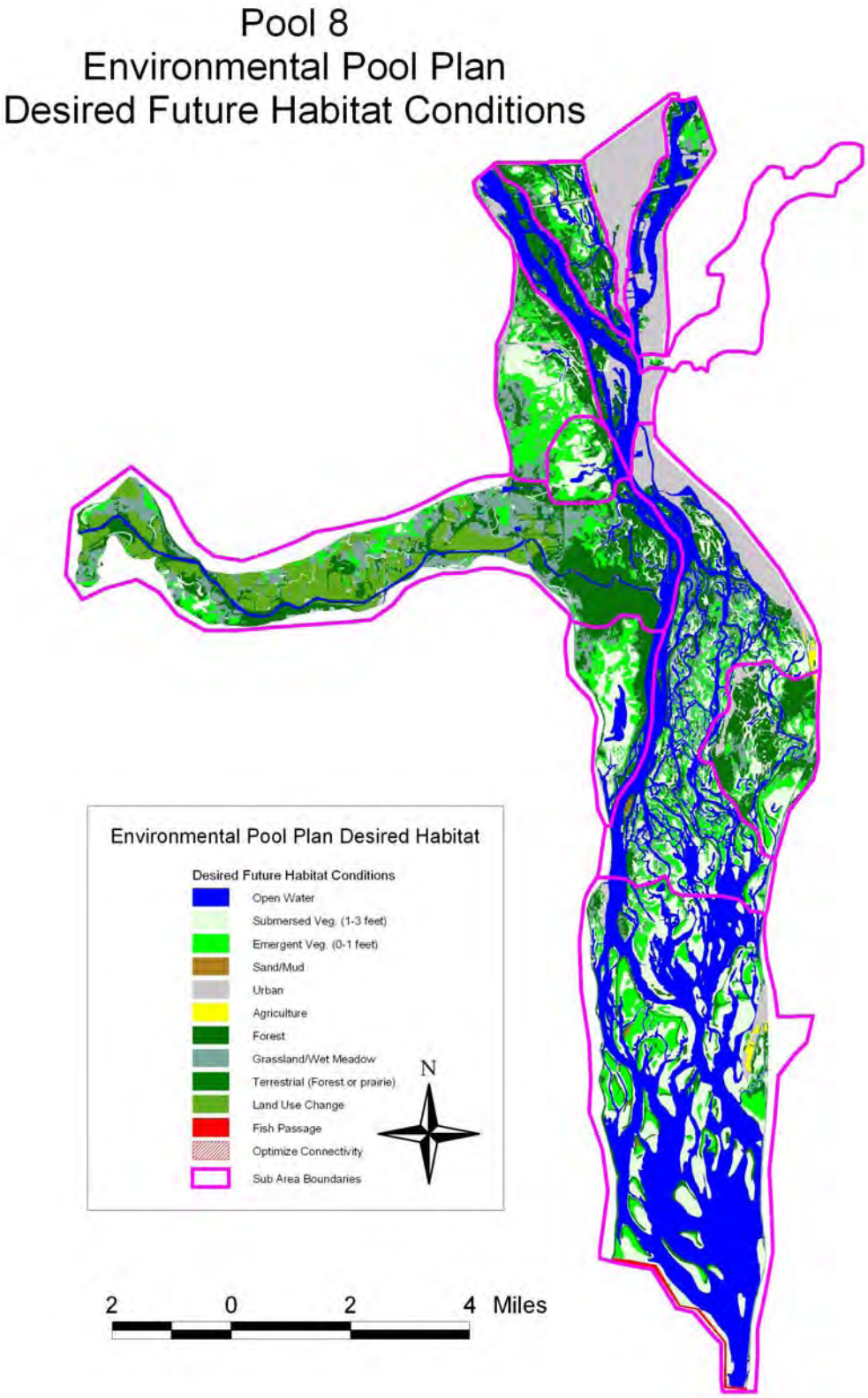
Connectivity with Pools 7 and 9 would be improved through the implementation of structures or dam operation measures to increase fish passage at the dams.

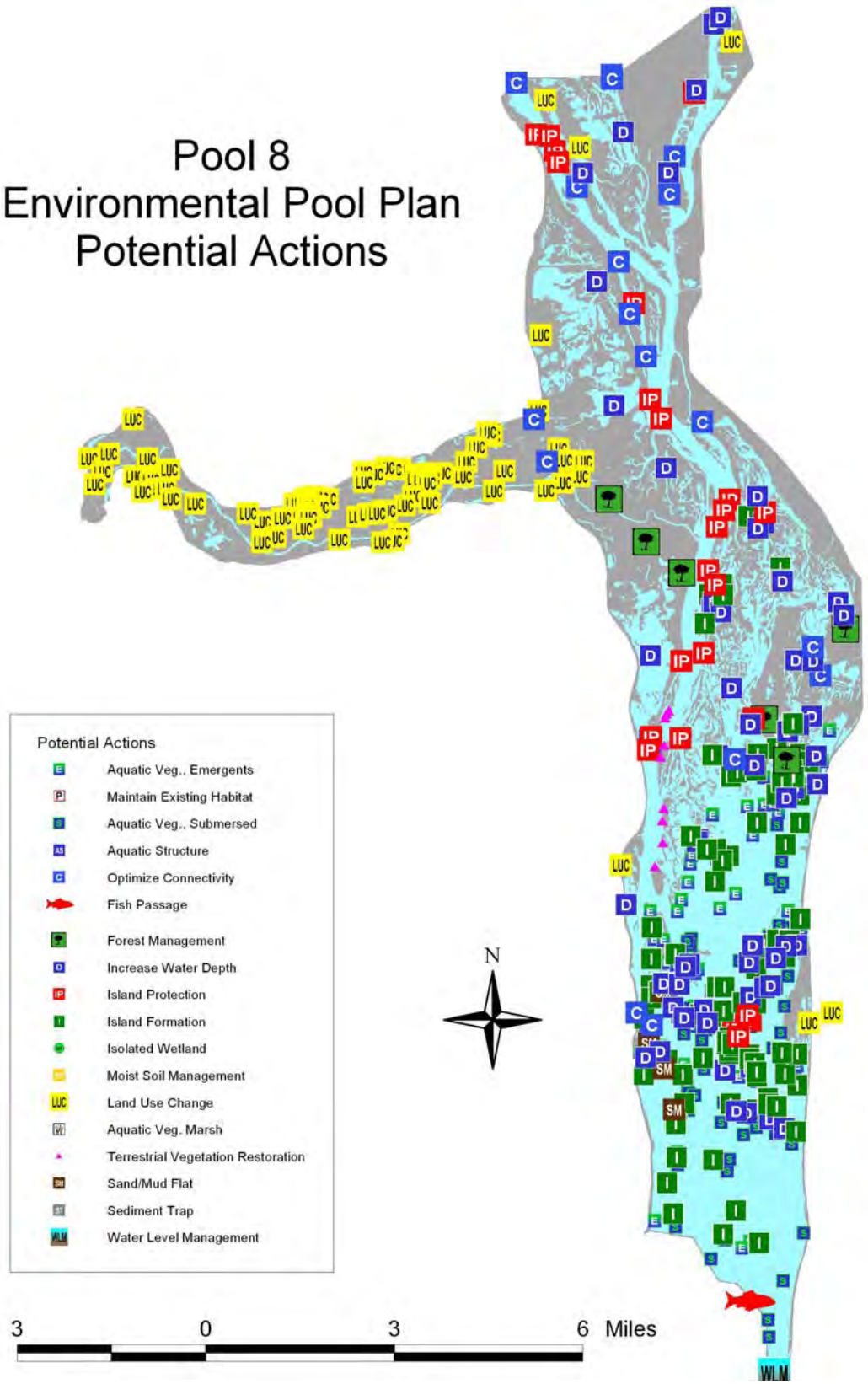
8.) Support Watershed Management Programs

Watershed management initiatives such as the work being done on Coon Creek in Wisconsin should be implemented on a number of other Pool 8 tributary streams, including the La Crosse River and Mormon Coulee Creek in Wisconsin, and the Root River and Pine Creek in Minnesota. The primary goal of this effort is to reduce sediment and nutrient inputs into the Mississippi River.

The Root River enters the Mississippi in Pool 8. (Minnesota Dept. of Natural Resources photo.)


Pool 8 Environmental Pool Plan
Existing Habitat Conditions
Black River
French Slough
Main, East and West Channels
Blue Lake
Target Lake
Root River
La Crosse River Valley
Running Slough
Lawrence Lake
Running Slough
Goose Island
Lower Pool 8
2 0 2 4 Miles
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N


Pool 8
Environmental Pool Plan
Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
2 0 2 4 Miles


Pool 8
Environmental Pool Plan
Potential Actions
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
N
3 0 3 6 Miles

Desired Future Habitat Conditions In Pool 9, Mississippi River

Description of Pool 9

Pool 9 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 9 as part of the 9-foot channel navigation project. Construction of Lock and Dam 9 was completed in 1937. Pool 9 encompasses 52,166 acres, from approximately river mile 648, near Harpers Ferry, Iowa, north to river mile 680.5, near Reno, Minnesota. In general, the east and west boundaries of the Pool 9 planning area are the I & M Rail Link railroad on the Iowa/Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River.

Typical of most navigation pools of the Upper Mississippi River, the water to land ratio changes from south to north. The lower reach of the pool is predominantly open water stretching from river mile 648 to 661. The amount of land increases in the middle portion of the pool, with more islands separated by multiple river channels and backwater wetlands. The upper reach of Pool 9 is predominantly forested uplands, with many small river channels and shallow wetlands throughout.

Nearly 44 percent of Pool 9 is considered open water habitat consisting of the main navigation channel or backwaters and side channels with no vegetation. Aquatic vegetated habitat and forested habitat are nearly equally divided at 22 percent each and account for over 11,000 acres, respectively. The final dominant habitat consists of trees and shrubs at nearly 6 percent of Pool 9 habitat (~3,000 acres). Agricultural ground and urban areas also comprise nearly 3,000 acres in Pool 9.

Major tributaries to the Mississippi River within Pool 9 are the Bad Axe River (Wisconsin side, river mile 675), Rush Creek (Wisconsin side, river mile 661) the Upper Iowa River (Iowa side, river mile 671) and Winnebago Creek (Minnesota side, river mile 675). The lower end of Rush Creek is owned and managed by the Wisconsin Department of Natural Resources as a State Natural Area. The Rush Creek area contains bottomland forests, upland forests, and prairie on the bluff faces. The Upper Iowa River has been channelized within the Mississippi River floodplain.

Description of Existing and Desired Future Habitat Conditions for Pool 9 Subareas

Several identifiable areas are present within Pool 9. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Reno Bottoms below the Lock & Dam 8 embankment. (Wisconsin Dept. of Natural Resources photo.)

Reno Bottoms/Minnesota Slough (river mile 671-681) - The Reno Bottoms/Minnesota Slough area is bounded on the west by the railroad, on the east by the navigation channel, on the north by the Lock and Dam 8 dike, and on the south by the Upper Iowa River. It is predominantly a contiguous backwater complex with a mixture of secondary and tertiary channels, isolated backwaters, marshes, and wooded islands. Two spillways in the Lock and Dam 8 dike and one slough off the main channel provide the majority of flow into this system.

The main feature in the Reno Bottoms is Minnesota Slough. This slough gathers waters from the various secondary channels, spillways, and backwater complexes in the Reno Bottoms and exits back into the main channel near the mouth of the Upper Iowa River. Winnebago Creek also empties into the Reno Bottoms near the Iowa/Minnesota border and greatly influences the water quality of the lower reaches of the Reno Bottoms.

Lansing Big Lake (US Army Corps of Engineers photo.)

Sediment inflow into the Reno Bottoms area occurs during flood events on the Mississippi River via inflows through the spillways. The spillways are located at the bottom end of the impounded section of Pool 8. Significant inputs of suspended sediments from the Pool 8 impounded area can occur due to wind resuspension of bottom sediment and transport over the spillways into the Reno Bottoms complex.

Proposed actions in lower Pool 8 would have beneficial impacts to the Reno Bottoms subarea of Pool 9 by reducing the input of suspended sediments. The main goal for management would be to maintain the present (1989) conditions for much of the Reno Bottoms subarea. This would require actions to improve the diversity and structure of the forests in the area. Some areas have been identified for potential reestablishment and maintenance of centrarchid overwintering sites through increasing depth to offset the effects of sedimentation. Locations in the Upper Iowa Delta near New Albin, Iowa, have also been proposed for moist soil management. One site (Pool Slough) is currently being planned as an HREP for moist soil management. Areas for potential island stabilization have been identified along the main channel. The desired future also identifies land use change alternatives for evaluation and potential implementation.

Big Slough/Lansing Big Lake Area (river mile 663.5-675) - This area is bounded on the west by Highway 26, on the east by the navigation channel, to the north by the Upper Iowa River, and on the south by the junction of Lansing Big Lake and the navigation channel, near the City of Lansing, Iowa.

Much of the northern portion of the area is currently farmed. The Upper Iowa River is confined to a straightened, bermed channel through its delta. Numerous secondary and tertiary channels, wetlands, and forested islands occupy much of the remaining area.

A main feature of the southern portion of this area is Lansing Big Lake (river mile 664-671). This area is composed of a mix of tertiary channels, isolated and contiguous backwaters, and a large expanse of water referred to as Big Lake.

Conway and Phillipi Lakes (Wisconsin Dept. of Natural Resources photo.)

Increased flow velocities and sedimentation are major resource issues within the area. The Upper Iowa River and Mississippi River channel contribute a majority of the sediment. The Upper Iowa River delivers high sediment loads

directly into the Mississippi River main channel, particularly during high flow events. Upper Iowa River sediments are entrained along the western shore of the Mississippi River main channel. Erosion of the island chain, which previously protected Big Lake from significant, direct flows of the Mississippi River, allows increased flows of Upper Iowa River and Mississippi River sediment-laden waters into the area in numerous places. These breaches continue to increase in size and have reduced habitat quality for some species due to both current scour and increased sediment deposition. A Lansing Big Lake project was completed in 1994 to stabilize several of the channels into the Big Lake complex and reduce current velocities.

Proposed actions for the Big Slough/Lansing Big Lake area focus on offsetting island dissection/erosion and sedimentation trends that are causing a loss in habitat quality for a variety of species. The proposed actions are intended to be used in combination to provide the greatest environmental benefits. Proposed island construction, island stabilization, and flow modifications would improve fish and wildlife habitat by increasing depth diversity, flow diversity, and conditions favorable for the establishment and maintenance of aquatic vegetation. The cumulative effects of the features are predicted to increase emergent vegetation coverage by 40 percent (compared to 1989 coverage) and maintain submersed vegetation coverage. The desired future also includes recommendations for improving terrestrial habitat by increasing the quality and diversity of the floodplain forest and promoting land use practices that are ecologically beneficial.

Walter's Lake/Bad Axe River (river mile 674-678) - These are backwater areas east of the main channel in the upper sections of the pool and include the Thief Island area. Much of this area has been significantly affected by sedimentation because of its proximity to the Bad Axe River. Walter's Lake and the other aquatic areas are not directly affected by the Bad Axe River but have also experienced significant sedimentation. The desired future acknowledges that sedimentation in the subarea will most likely result in an increase in mud flat habitat for shorebirds. Potential locations for maintenance of water depths have been identified to maintain overwintering habitat for centrarchids. Terrestrial habitat may be improved through implementation of projects to revegetate historic disposal sites with trees and manage the existing forest to maintain diversity and quality.

Blackhawk Park (river mile 668-672) - This area is bordered on the north, west, and south by the main channel and to the east by the railroad. Most of the inflows into this backwater complex have been modified to improve aquatic habitat conditions for fish. Much of the higher elevation lands within the complex are occupied by developments associated with the Corps of Engineers' Blackhawk Park Recreation Area and

Blackhawk Park and DeSoto Bay (US Army Corps of Engineers photo.)

privately owned recreational structures. The remaining land area is a mixture of floodplain terrestrial communities.

Some of the backwaters of the Blackhawk Park subarea were part of an HREP completed in 1989 and a Corps of Engineers project to provide flows into the lakes to enhance fish overwintering habitat. These measures appear to have stabilized habitat conditions in the backwater, and no additional work is currently proposed for the area. However, future sedimentation or island dissection may require

consideration of increasing backwater water depths or island stabilization.

Winneshiek Slough/Big Slough Backwaters (river mile 659-667) - This area is bounded on the west and north by the main channel, on the east by the railroad, and on the south by the Rush Creek Delta and the northern portion of Lake Winneshiek. This complex is bisected by Wisconsin State Highway 82 at approximately river mile 663.4. Four bridged openings along the road restrict water flow into the complex from the north. A fifth opening on the northwest corner of the area is the Mississippi River main channel, near Lansing, Iowa. Main channel water flows into the area through several channels along its west side. The first inlet for main channel flow into the complex below Highway 82 is at river mile 661.

The largest aquatic features are Winneshiek Slough and the Goose Carcass Lake backwater complex. The hydraulic conditions caused by the Highway 82 causeway have resulted in increased sedimentation rates of backwater areas immediately above and below the highway. The locations of the bridges have also influenced the physical habitat of the various channels and sedimentation in the system. Some of the channels within the complex are filling due to sand deposition at the lower end of the defined area. Backwater lakes in this area have also received considerable deposition of fine sediments and sand.

Proposed management actions for this complex focus on methods to reverse the impacts of sedimentation in many of the backwater lakes and channels by increasing depth. Other approaches may include changes that would promote better sediment transport through the area via modifications of features (bridges and closing dams) that have affected sedimentation rates in the Winneshiek Slough/Big Slough complex and perhaps the Lansing Big Lake subarea. Island formation is proposed for the downstream portion of the Winneshiek Slough area. The purpose of the islands would be potential disposal sites for any backwater dredging, diversification of water flows and velocities to restore sediment transport in the area, and as barriers to wind/wave erosion occurring from the south.

Lake Winneshiek/Capoli Slough Area (river mile 652-659) - The area is defined by the main channel on the west, with the east side bordered by the railroad and south nearly to Lynxville, Wisconsin. The physical features of this mammoth area are Rush Creek, which enters at its northeastern corner, and the large, stump-filled Lake Winneshiek. Capoli Slough and the associated island/side channel/wetland complex occupy the northwest corner of this area. The Cold Springs backwater is also included in this subarea. Cold Springs is the site of an HREP completed in 1992.

Habitat degradation is occurring in this area, including the loss of remaining islands (i.e., near Capoli Slough and Rush Creek), sedimentation in protected areas and wave resuspension of bottom sediments (i.e., in Lake Winneshiek proper). Immediately following impoundment, Lake Winneshiek had several hundred acres of low elevation and shallowly flooded islands. These supported a mix of flood tolerant terrestrial and emergent vegetation. The Pool 9 Habitat Rehabilitation and Enhancement Project was implemented in a portion of this area to improve environmental conditions for the establishment and maintenance of aquatic vegetation for migratory waterfowl. This project, completed in 1994, protected approximately 400 acres from wave action and main channel flows. This protection resulted in the reestablishment of over 400 acres of submersed vegetation in the shadow zone of the rock island.

The desired future for this subarea includes a more than doubling of emergent vegetation coverage and a 45 percent increase in submersed vegetation coverage (when compared to 1989 conditions). These increases in aquatic vegetation coverage would be accomplished through the cumulative environmental response of several management techniques (island construction, water level management, mud/sand flat construction, island protection, etc.). Proposed island features would increase the amount of terrestrial habitat in the subarea by

more than 75 percent. The physical presence of the islands and any associated dredging for their construction would increase depth diversity in 5 percent of the aquatic area.

Harper's Slough Area, Pool 9 (river mile 648-655) - The Harper's Slough Area, Pool 9 is bounded on the east and north by the main channel, on the west by the railroad, and on the south by the Lock and Dam 9 dike. Immediately following impoundment, this area had several hundred acres of low elevation and shallowly flooded islands, which supported a mix of flood tolerant terrestrial and emergent vegetation. Over time, many of these floodplain features were lost due to erosion. The majority of landmass in this area of Pool 9 is found at the Wexford Creek Delta and at an island group located at river mile 652.2 to 653. One phase of the Bank Stabilization HREP was constructed in this area to stabilize the remaining islands and protect remaining emergent vegetation beds (completed in 1997). The Harper's Slough Islands HREP is currently being planned.

Harper's Slough is a submerged secondary channel that is still evident on bathymetric maps of Pool 9. This secondary channel is not well defined by terrestrial boundaries but is considered the main resource for fish in this area. Harper's Slough is documented to have significant freshwater mussel populations that may now be threatened due to zebra mussels. The Harper's Slough, Pool 9 area is managed by the U.S. Fish and Wildlife Service as a closed area during the fall for migratory waterfowl.

The desired future for this subarea includes a 670 percent increase in emergent vegetation coverage (when compared to 1989 conditions). These increases in aquatic vegetation coverage would be accomplished through the cumulative environmental response of several management techniques (island construction, water level management, mud/sand flat construction, island protection, etc.). Proposed island features would more than double the amount of terrestrial habitat in the subarea (compared to 1989). The physical presence of the islands and any associated dredging for their construction would increase depth diversity in 5 percent of the aquatic area. The desired future also includes proposals to improve habitat conditions for freshwater mussels through the construction of features that would provide microhabitat needs for a variety of mussel species.

Unique Attributes, Opportunities, and Constraints

The Reno Bottoms complex is one of the largest remaining areas with floodplain features and geomorphology similar to those existing prior to lock and dam construction. The Lock and Dam 8 Dike has greatly altered the hydrology through the area during normal and low flow events. Modified hydrology has caused acceleration in sedimentation and reduced water velocities throughout much of the area during all discharge levels. The forest community in this area is relatively homogenous, with silver maple dominating. Greatly reduced regeneration of tree species is resulting in a conversion of much of the forest area into reed canary grass dominated grassland.

The navigation channel was "straightened" at river mile 652 to 653. The spoil from the channel realignment created two large islands at this location. These islands comprise the majority of terrestrial habitat from river mile 648 to 661 and should be maintained.

The Rush Creek natural area is another unique feature within Pool 9. This area is managed and protected to provide prairie, upland forest, and bottomland forest communities.

The lower reach of the Upper Iowa River has been mainly severed from its floodplain, and future opportunities exist to breach federally owned levees. Additional areas may be purchased from willing sellers to further reconnect the straightened portions of the Upper Iowa River with its natural floodplain.

Although considerable habitat degradation has occurred within Pool 9, this navigation pool contains some of the best remaining habitat for fish and wildlife resources on the Upper Mississippi River. For example, large numbers

of waterfowl use most of Pool 9, including several hundred thousand diving ducks that feed on aquatic vegetation and benthic invertebrates in the southern areas of Pool 9 during spring and fall migration. These include a significant proportion of the continental canvasback duck population.

Trempealeau National Wildlife Refuge (US Army Corps of Engineers photo.)

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

The actions proposed below are interrelated, and specific actions may require overlapping solutions. The goal of all these actions will be to increase diversity in Pool 9. This diversity may be biological such as the number of fish or wildlife species, or habitat features such as flow regimes, bottom bathymetry, or island elevation. Maintaining and developing diverse aquatic and terrestrial habitat in Pool 9 is the key to promoting a healthy ecosystem.

1.) Increase Depth Diversity in Channels and Backwaters

The desired future for habitat in the Reno Bottoms, Upper Iowa River Delta, Lake Winneshiek Bottoms, and Walter's Lake/Bad Axe River and Harper's Slough areas includes improved habitat for riverine and backwater communities. Measures likely to be taken include selected dredging, closures, island restoration, shoreline stabilization, and improved connectivity in selected areas. Various other features (i.e., islands, seed islands, and "channels") will be evaluated to diversify flow within areas to improve fish and wildlife habitat conditions. In the impounded reach, the need is to convert a significant portion of area currently classified as impounded into contiguous backwaters.

2.) Maintain Existing Quality Habitats

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Many areas in Pool 9 are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed. The Reno Bottoms area is one portion of the pool that is considered good habitat quality throughout much of its area.

3.) Protect and Restore Islands

The formation of islands (either using the forces of the river, or through construction) will increase the diversity of terrestrial habitat in the impounded section of Pool 9. Reduction in sediment resuspension due to island formation would improve environmental conditions for the establishment and maintenance of aquatic vegetation in Pool 9. Measures to reduce sediment resuspension in the Winneshiek Bottoms and Harper's Slough Islands area would most likely be accomplished by building island or berm structures. The reduction in sediment resuspension would improve

Example Action: *Protect and Restore Islands.* Island construction through the Environmental Management Program. (US Army Corps of Engineers photo.)

environmental conditions for aquatic vegetation and reduce sediment input into upper Pool 10.

Islands would also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the impounded reach.

4.) Actively Manage Forest and Prairie Communities for Diversity and Quality

The majority of terrestrial habitat maintenance and restoration is proposed to occur in the Reno Bottoms, Upper Iowa River Delta, Lansing Big Lake areas, and the Winneshiek Backwaters. Projects may include: converting areas of reed canary grasses into forest or prairie, revegetating channel maintenance disposal sites, and raising the elevations of selected land masses through the use of dredged material from backwaters.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions will be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may also be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band. Improved conditions would be expected in the Lake Winneshiek and Harper's Slough areas.

Areas near New Albin, Iowa, have been identified as having the potential for development as moist soil units to provide for consistent high quality habitat for migratory waterbirds. Moist soil units may also incorporate features to improve the condition of the area for fisheries spawning habitat.

6.) Work Cooperatively with Private Landowners

This would be a long-term effort requiring acquisition or floodway easements from willing sellers. This effort would focus primarily on the Upper Iowa River Bottoms, but other areas, such as Crooked Creek, Winnebago Creek, and Wexford Creek, may provide future opportunities. There are several landowners within the Upper Iowa River Bottoms area. All of the land of interest is floodplain and located along and adjacent to historic channels and floodplain depressions. The project does not require fee title acquisition. Long-term easements and other agriculturally compatible initiatives may satisfy habitat goals.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

Flow regimes in numerous areas have been greatly altered, mostly by channel maintenance structures (i.e., wing dams and closing dams). In some cases, the structures can be removed or modified to promote diverse flow patterns without damaging navigation priorities. In other areas, habitat will benefit by reducing or eliminating flow from or to an area.

The Upper Iowa River has been channelized, and flows have been rerouted directly into the Mississippi River navigation channel. This has eliminated or degraded the natural processes and productivity of the historic Upper Iowa River Delta. An action proposed for evaluation is to remove the berm currently confining the Upper Iowa River (where it flows across public lands) near its confluence with the Mississippi River and restore flows to historic channels as appropriate and feasible.

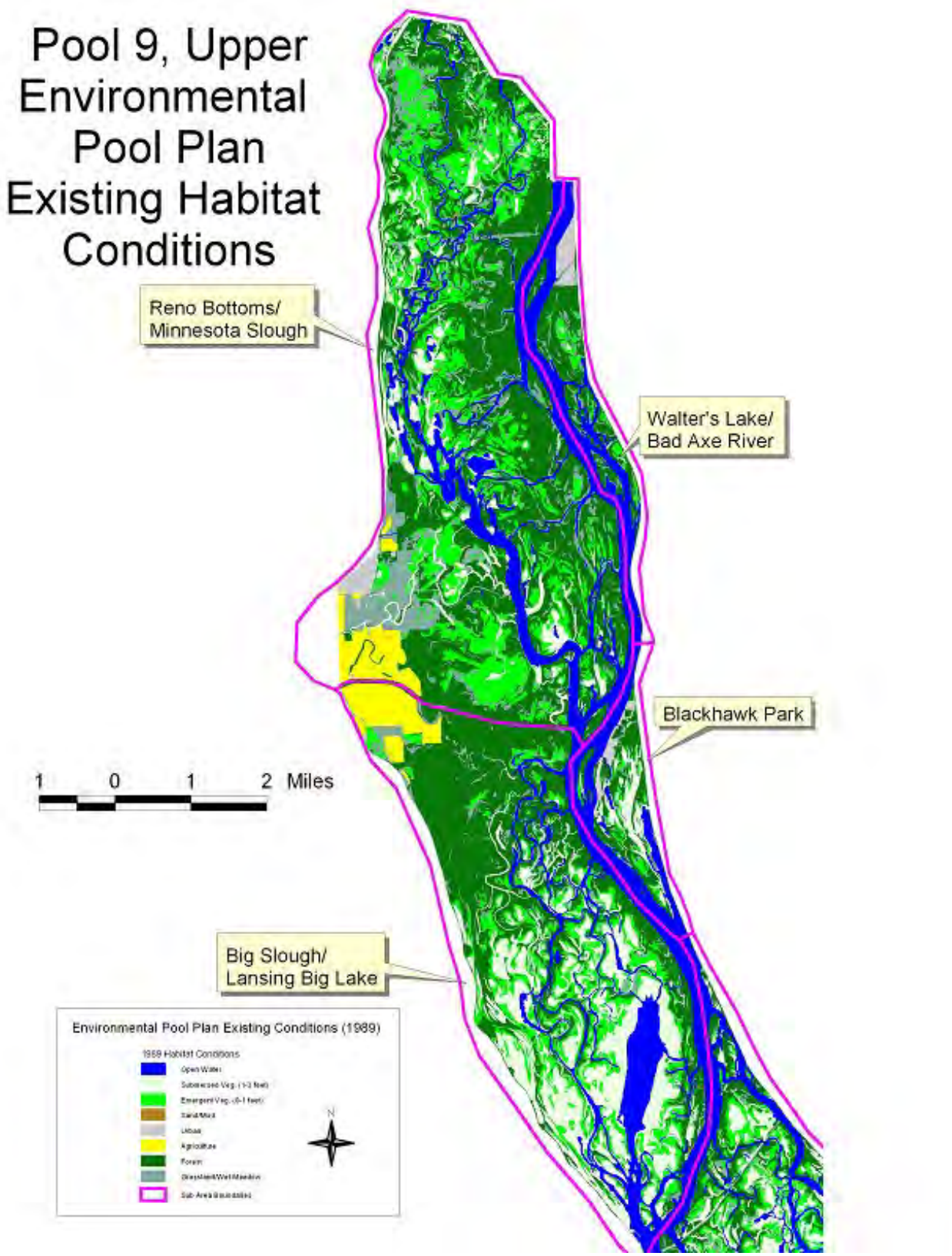
All structures within Pool 9 should be reviewed to determine how they can best be compatible with both wildlife and navigation concerns. One of the main areas of concern is the increase of inflows into the Lansing Big Lake area. Controlling the amount of inflow is critical to improving fisheries habitat conditions in the Lansing Big Lake Area. Alternatives to provide

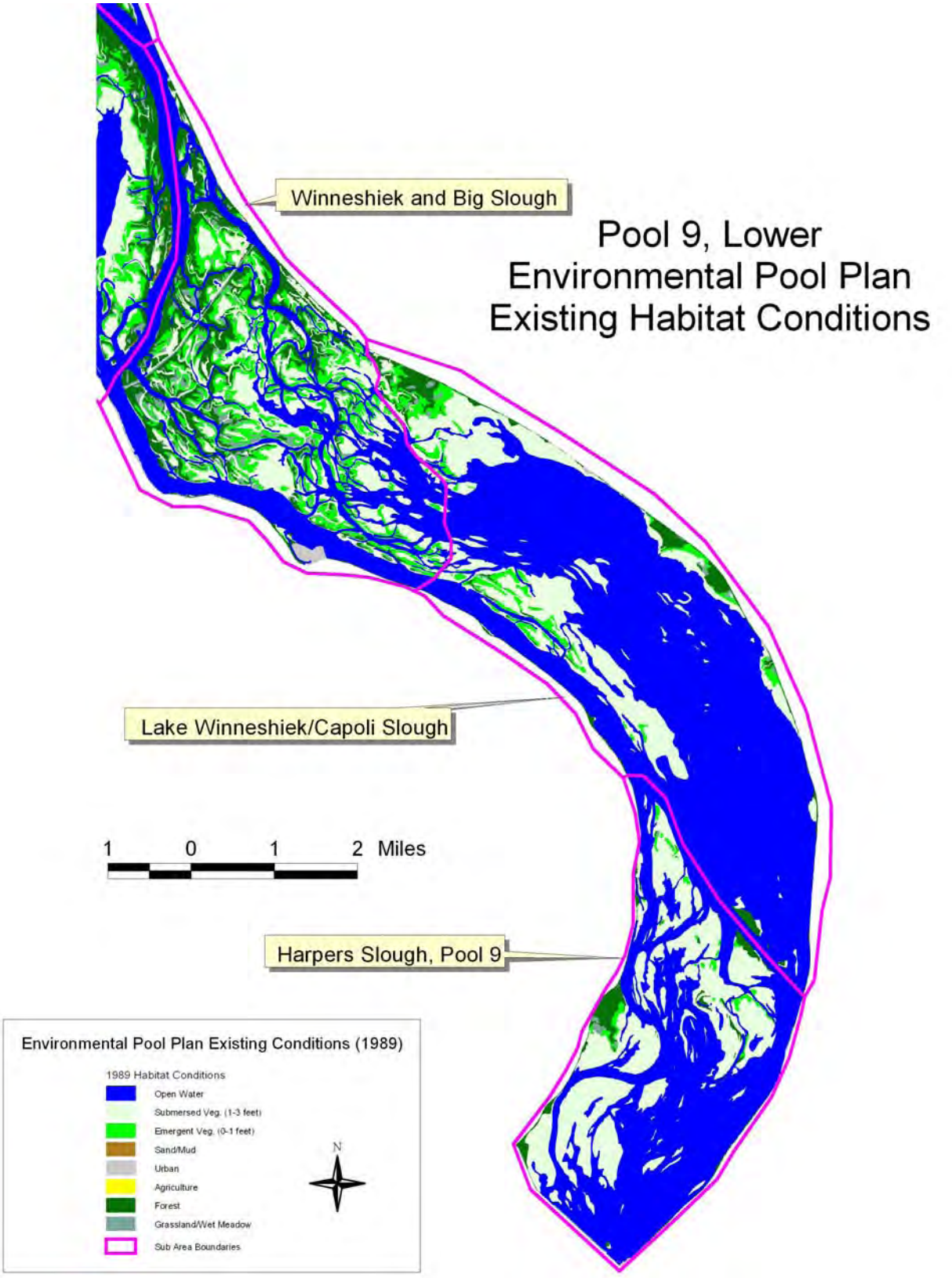
fish passage at Locks and Dams 8 and 9 will be evaluated.

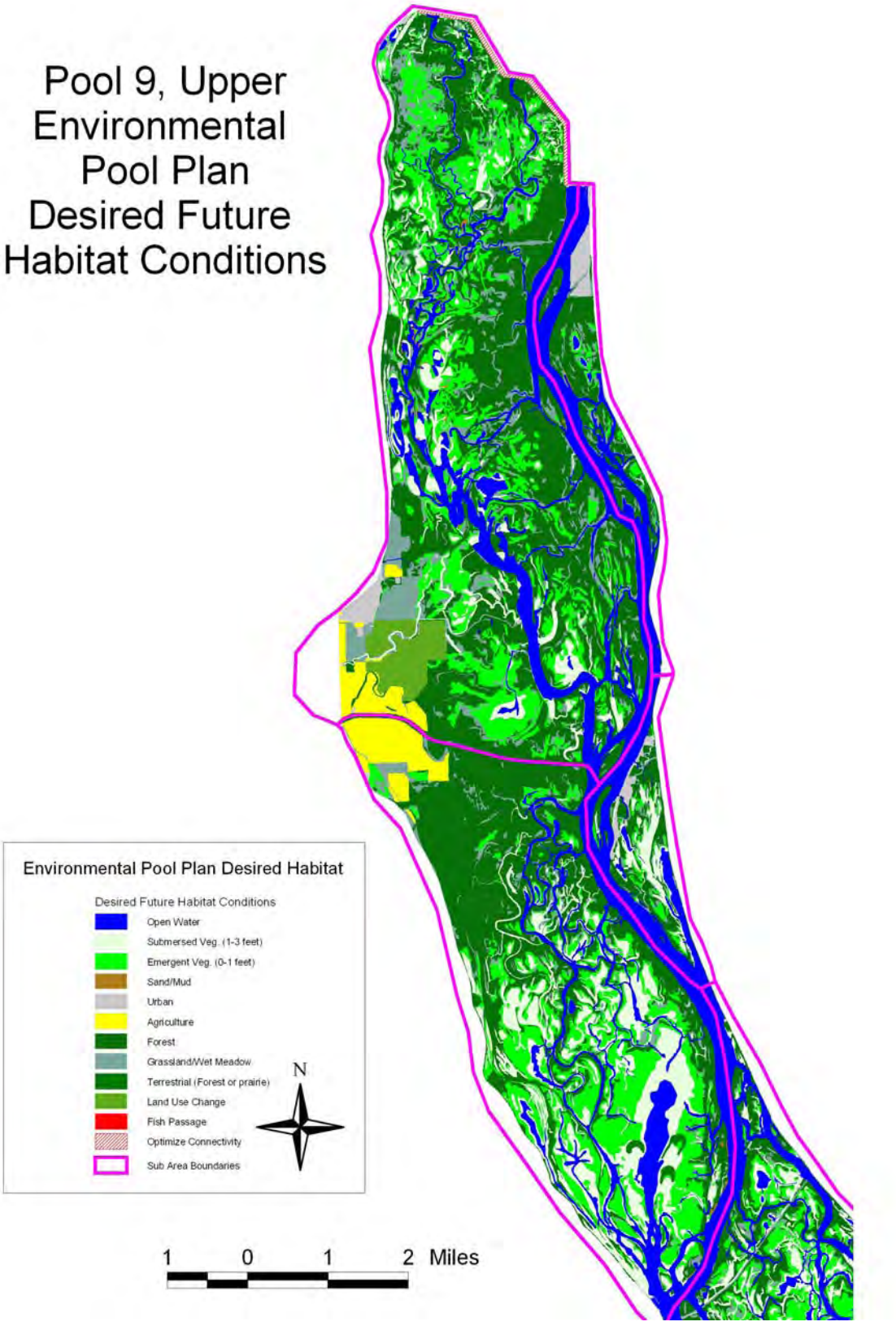
8.) Support Watershed Management Programs

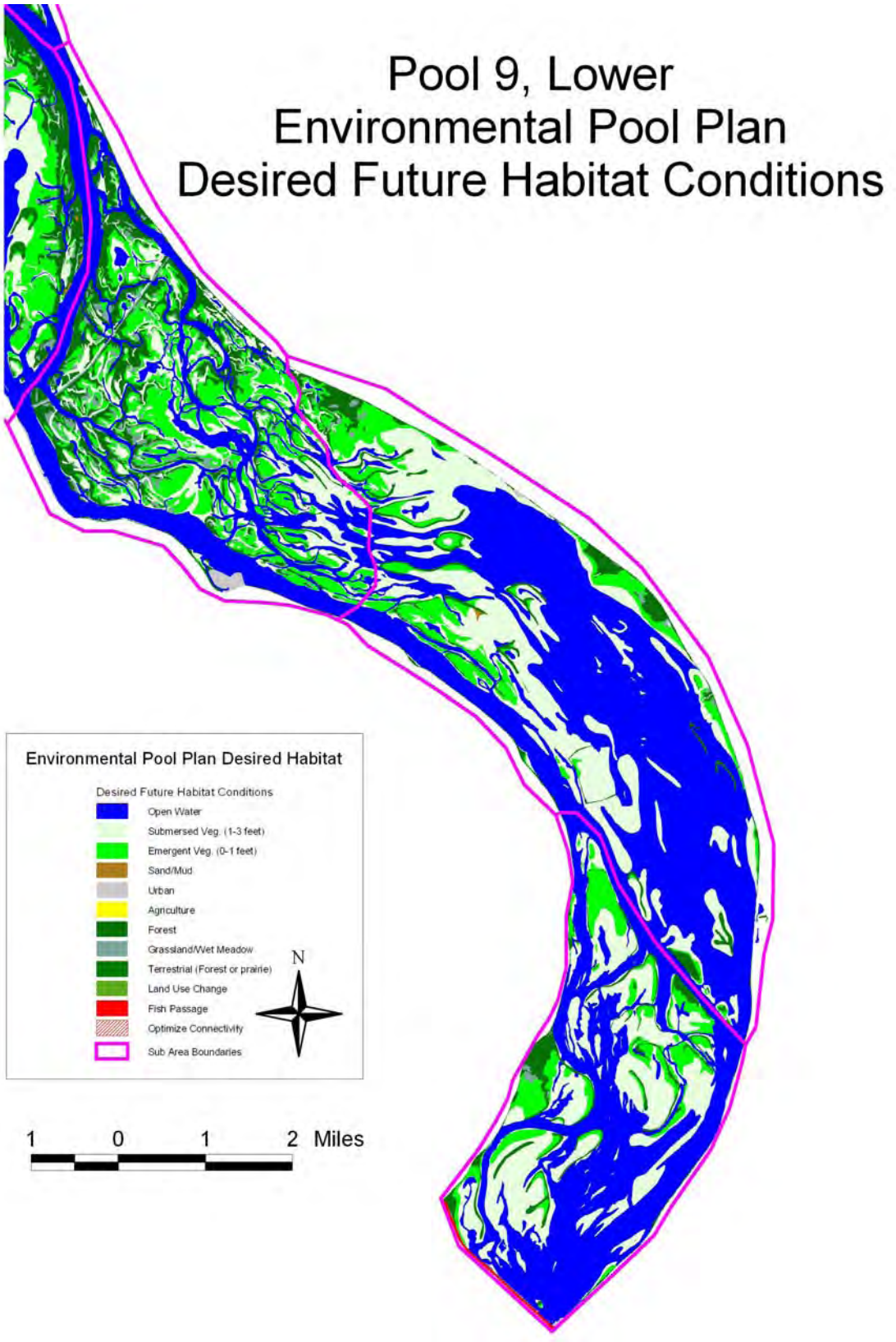
Watershed management programs such as the Upper Iowa River Alliance should be encouraged to promote good land use to reduce sediment and nutrient inputs into the Mississippi River. Agencies are encouraged to participate in such programs when possible. Additional programs are needed on other tributaries of Pool 9. These programs should address urban sewage and storm water treatment.

Rock vane constructed at Hummingbird Slough to stabilize eroding shoreline in Pool 9. (US Army Corps of Engineers photo.)


Pool 9, Upper Environmental Pool Plan Existing Habitat Conditions
Reno Bottoms/ Minnesota Slough
Walter's Lake/ Bad Axe River
Blackhawk Park
Big Slough/ Lansing Big Lake
1 0 1 2 Miles
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Forest
N


Pool 9, Lower
Environmental Pool Plan
Existing Habitat Conditions
Winneshiek and Big Slough
Lake Winneshiek/Capoli Slough
Harpers Slough, Pool 9
1 0 1 2 Miles
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N


Pool 9, Upper Environmental Pool Plan Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
1 0 1 2 Miles


Pool 9, Lower
Environmental Pool Plan
Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
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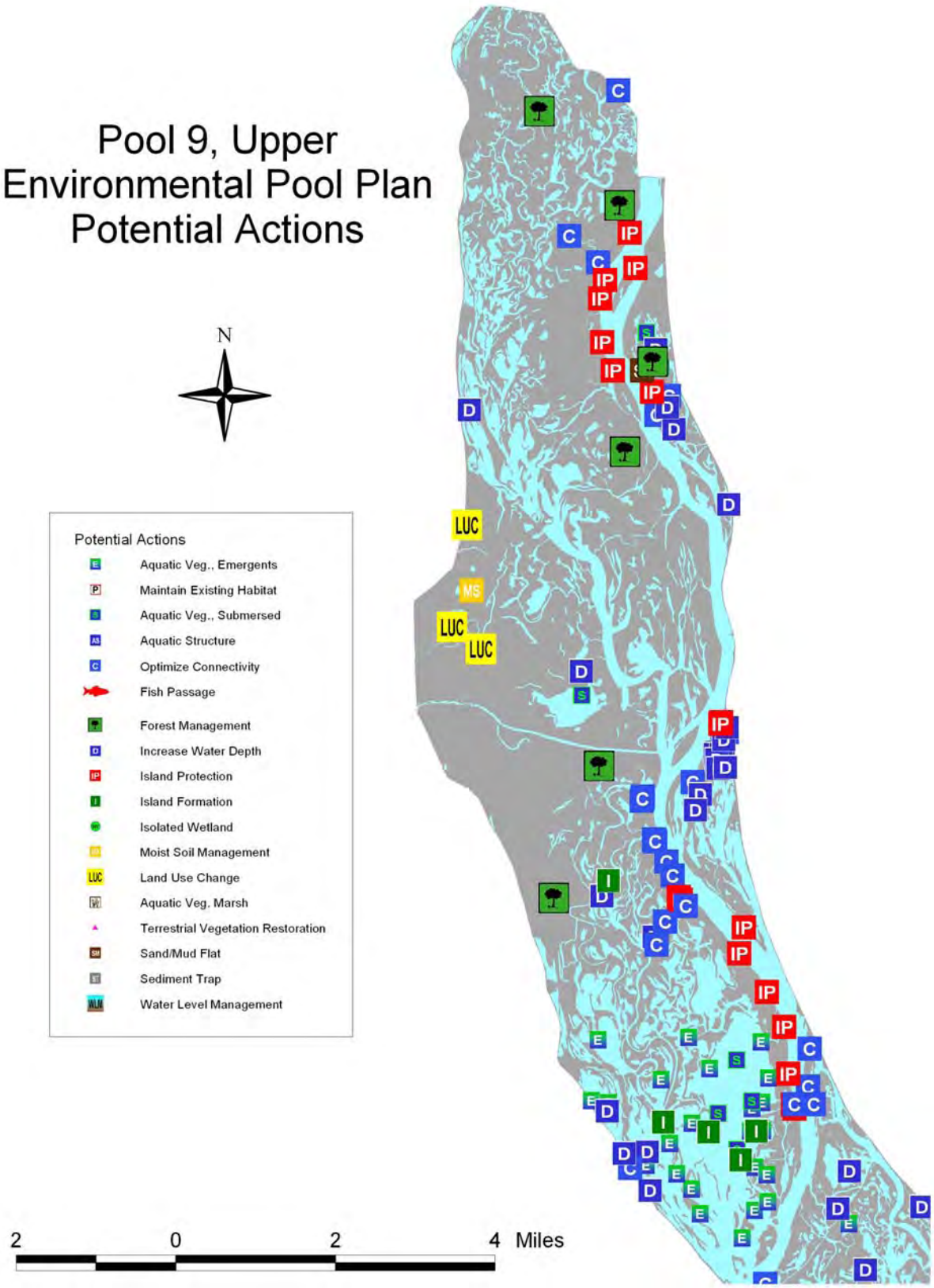
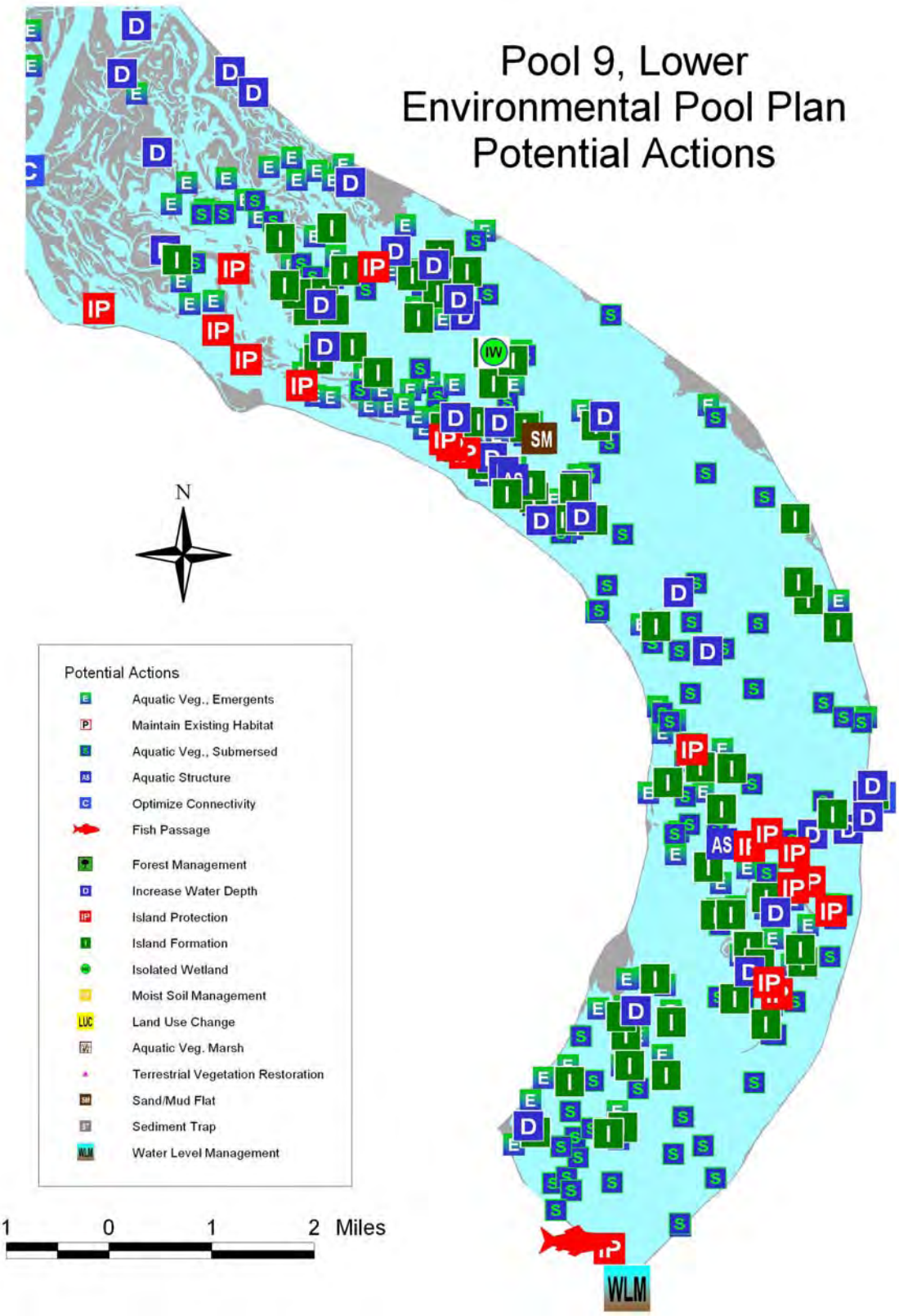
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
1 0 1 2 Miles


Pool 9, Upper
Environmental Pool Plan
Potential Actions
N
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
2 0 2 4 Miles


Pool 9, Lower
Environmental Pool Plan
Potential Actions
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Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
1 0 1 2 Miles
IW
SM
WLM

Desired Future Habitat Conditions In Pool 10, Mississippi River

Description of Pool 10

Pool 10 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 10 as part of the 9-foot channel navigation project. Construction of Lock and Dam 10 was completed during 1937. Pool 10 encompasses 39,863 acres, from approximately river mile 615 near Guttenberg, Iowa, north to river mile 648, near Harpers Ferry, Iowa. In general, the east and west boundaries of the Pool 10 planning area are the I & M Rail Link railroad on the Iowa/Minnesota side and the Burlington Northern Santa Fe railroad on the Wisconsin side of the Mississippi River.

Typical of most navigation pools of the Upper Mississippi River, the water to land ratio changes from south to north. The lower reach of the pool is primarily open water stretching from river mile 615 to 619. However, the lower portion of Pool 10 contains more islands than similar areas in other pools within this reach of the river. The amount of land increases in the middle portion of the pool, with more islands separated by multiple river channels and backwater wetlands. The upper reach of Pool 10 is predominantly forested uplands, with many small river channels and shallow wetlands throughout.

Major tributaries to the Mississippi River within Pool 10 are the Yellow River (Iowa side, river mile 638) and Wisconsin River (Wisconsin side, river mile 631). The land use within the Yellow River watershed is predominantly agricultural. Upland runoff and stream flows within watersheds such as the Yellow River typically contribute significant suspended sediment loads to the Mississippi River, particularly during high precipitation events. The Wisconsin River is one of the larger tributaries to the Upper Mississippi River. The delta formed by the Wisconsin River has encroached into the Mississippi River floodplain so that the total flow of the Mississippi River is constricted into a single channel approximately 350 yards wide.

Aquatic vegetation coverage and distribution present in 1989 were better than in the other pools within the St. Paul District. Because of this, the 1989 conditions were selected as the target coverage for the desired future. However, some areas of Pool 10 (i.e., Harper's Slough) have seen dramatic declines in aquatic vegetation from 1989 to 2001.

Although privately owned lands exist within the Pool 10 Mississippi River floodplain, primarily near adjacent towns, most of the floodplain is owned by the Federal Government and managed as part of the Upper Mississippi River National Wildlife and Fish Refuge. Additional areas are also in public ownership by the State of Wisconsin, the National Park Service, and the State of Iowa.

Lower Pool 9 and Harpers Slough in Pool 10 (US Army Corps of Engineers photo.)

Description of Existing and Desired Future Habitat Conditions for Pool 10 Subarea

Several identifiable areas are present within Pool 10. The boundaries of these areas can be roughly defined on the basis of hydrologic units (i.e., main channel, tributary deltas, or bluffs). The following areas have been delineated to facilitate presentation of desired future habitat conditions in the pool.

Harper's Slough (river mile 641-648)
Harper's Slough is bounded on the west by the railroad, on the east by the main channel, on the north by Lock and Dam 9, and on the south at the confluence of Harper's Slough and the main channel. The pre-lock and dam Harper's Slough complex spanned much of what is now lower Pool 9 and upper Pool 10. In what is now the Pool 9 portion, all trees were removed and most land and water features were submerged by river impoundment (north of Dam 9). The Pool 10 portion of the Harper's Slough complex is typical of most upper pool habitats. Predominant features include forested islands, with many backwater lakes and marshes. Secondary and tertiary river channels flow through the area, the largest being Harper's Slough, which flows along the western boundary of the area. Water inflow to the area is through a spillway in Dam 9, on the historic Harper's Slough, and several side channels entering from the main channel.

Major habitat concerns for the area include excessive sedimentation rates of backwater areas, excessive shoreline erosion, and decreased productivity of aquatic and upland habitats.

This complex of backwaters also includes a small complex on the Wisconsin side of the main channel locally called Bachelor's Pond and Gordon's Bay (river mile 646-647). This is a small backwater area bounded on the west by the main channel and on the east by the railroad on the Wisconsin shore. Resource problems in this area include fine sediment deposition in Bachelor's Pond and sand deposition and increased flows into Gordon's Bay because of island erosion. This adversely affects fishery habitat quality.

The desired future for the Pool 10 Harper's Slough subarea includes several proposed actions to reestablish aquatic habitat quality. Numerous sites have been identified for potentially increasing water depth, managing flows into backwater areas, and island stabilization. Managing water flows into the backwater areas would include consideration of island construction, closing or partial closing dams, culverts, and bio stabilization (i.e., tree drops, log structures, willow plantings, etc.). Terrestrial habitat would benefit from management actions aimed at increasing the diversity and quality of the forests. Aquatic vegetation goals are to return, then maintain, approximately the same coverage and distribution present in 1989. Additional options that would be considered for the area are actions that would improve habitat conditions for migratory waterbirds and backwater fish.

Ambrough Slough/Gremore Lake (river mile 636-643) - This area is bounded on the west by the main channel and on the east by the Burlington Northern Santa Fe railroad or the easternmost backwater shoreline. The northern boundary is a point along the Wisconsin shore near river mile 643. The southern boundary is the confluence of Roseau Channel and East Channel.

This is a backwater complex of primarily forested uplands, backwater lakes, and marshes. Two backwater channels, Ambrough Slough and

Fish Lake and Ambrough Slough (US Army Corps of Engineers photo.)

Black Slough, which enter from the main channel on the area's north and west side, respectively, are the primary sources of water flow through the area.

Major habitat concerns include increased sedimentation of backwater channels and wetlands and decreased productivity of aquatic habitats.

Gremore Lake (US Army Corps of Engineers photo.)

Construction to achieve some features of the desired future began in 2002 as part of the Ambrough Slough HREP. Completion of the project will meet some of the objectives proposed for the desired future in Gremore Lake, Tilmont Lake, Big Missouri, Upper Doubles, Spring Lake, and Black Slough. The project's primary purpose is to offset the negative effects of sedimentation and island dissection/erosion in these lakes and sloughs and will result in improved aquatic habitat for a variety of backwater fish species. Additional actions proposed for the desired future include further diversification of water depths in some backwater lakes and sloughs, potential island construction, and the need for active management of the forest resources to maintain their diversity and quality.

McGregor Lake/East Channel (river mile 633-636) - This area is a mid-river island with backwater ponds/lakes and small channel complex. It is bounded by East Channel on the east and south sides, by the junction of East Channel and the main channel on the north, and by the main channel on the west side.

Excessive sedimentation and long-term static water levels have decreased productivity of the aquatic habitats for fish and water birds. The narrow island that separates McGregor Lake from East Channel is subject to excessive erosion from a variety of sources. A breach of the island would allow East Channel flow through McGregor Lake. Another resource problem in the area is the degradation of terrestrial habitat due to long-term increased water levels, sedimentation, island erosion, and lack of forest regeneration.

Proposed features that would be evaluated for this subarea will focus on improving environmental conditions for fish and aquatic wildlife. The desire is to increase emergent vegetation by 15 percent and maintain the coverage of submersed vegetation (when compared to 1989 conditions). Island construction and stabilization may be done to protect and improve terrestrial and aquatic habitat conditions. Increasing the water depths in several backwater areas has been identified as another need for providing quality habitat for a variety of species. Evaluation of forest and upland management options to promote the regeneration of forests and diversification of upland vegetation has also been identified as a future action for the subarea.

Gerndt Lake/Wisconsin River Delta North (river mile 631-633) - This area is an island/backwater wetland complex within the Wisconsin River Delta north of the main stem of the Wisconsin River, including Hunter Island and Indian Isle in the northern portion of the area. The area is bounded on the east by the river shore on the Wisconsin side and road grade of the Burlington Northern Santa Fe railroad, on the north by the East Channel, on the west by the main channel, and on the south by the Wisconsin River.

Excessive sedimentation and long-term static water levels have adversely influenced the backwater lakes within Hunter Island and Indian Isle.

The Wisconsin River and its delta at the confluence of the Mississippi River greatly constrict the Mississippi River channel. The Wisconsin River carries a substantial sand bedload. This delta is the northern demarcation of a relatively narrow Mississippi River valley due to the erosion-resistant limestone and dolomite formations through which the river flows.

This subarea has several large tracts of land in private ownership. The desired future is to work cooperatively with the landowners to maintain the quality of the terrestrial habitat. An increase in the habitat quality of aquatic resources in the area may be met through increases in water depth, return to 1989 aquatic vegetation coverage, island construction, and emulation of the historical distribution of water flows by increasing the number of "openings" in the railroad embankment.

Glen Lake/Wisconsin River Delta South (river mile 628-631) - This area is the southern portion of the Wisconsin River Delta, composed of forested upland, old channels of the Wisconsin River, and backwater lakes and marshes. The bounds of the area are the main stem of the Wisconsin River on the north, the railroad grade on the east, and the Mississippi River main channel on the west and south. This area is extensively used by migrating songbirds. Aquatic habitat in this complex is influenced mainly by water quality and sediment delivery from the Wisconsin River. Some of the channels in this complex have suffered from sand deposition.

The desired future for this subarea focuses primarily on maintaining conditions present in 1989. Sedimentation is expected to continue in the subarea and may result in evaluating alternatives to reduce its impact, or removal by dredging. Maintenance of existing conditions would require active forest management to promote germination and growth of desired forest components.

Methodist/Norwegian Slough (river mile 625-630) - This area is bounded on the west by the I & M Rail Link railroad and on the north, east, and south by the Mississippi River main channel. This is a mid-pool complex of forested islands, backwater lakes and marshes, intersected by several secondary and tertiary side channels. The largest side channels include Johnson Slough, which enters from the main channel near river mile 630 and flows through the area, joining Wyalusing Slough near the confluence of Sny McGill Creek. Wyalusing Slough enters the area near river mile 627.5, joins Johnson Creek, then continues through the central portion of the area before rejoining the main channel near river mile 625.

Several backwater lakes within the area have deeper water portions that provide very good winter fish habitat.

The desired future for the Methodist/Norwegian Slough subarea aquatic vegetation is similar to many other subareas in Pool 10 – return to and maintain at 1989 conditions. Numerous backwater areas have been identified for potential increases in depth to stabilize habitat conditions for backwater fish communities. Several locations have also been identified for potential bank stabilization and island construction to maintain existing quality habitats. Resource managers have identified this area as one where forest management is critical for maintenance of current and future terrestrial habitat quality. The desired future also includes maintenance of Johnson Slough as a critical component for maintaining habitat quality in this backwater complex. This may be accomplished through a variety of actions, which might include: dredging, wing dam modifications, closing dams, and other features that allow for management of flows into and through Johnson Slough.

Bagley Bottoms/Jays Lake (river mile 621-627) - This area is bounded by the Burlington Northern Santa Fe railroad on the east, the main channel and State Line channel on the north and west, and Sandy Creek on the south. Bagley Bottoms is a large forested upland, old side channel, backwater wetland complex. Wetlands include several larger shallow lakes, including: Gassner, Glass Haville, Ferry, and Hoosier Lakes. Jays Lake and an associated area of open water with scattered islands and side channels occupy the southern portion of this general area.

Similar to many backwater lake areas along the Mississippi River, the lakes and other shallow wetlands of the area are experiencing reduced habitat productivity/suitability for many fish and wildlife species because of excessive sedimentation, island erosion, and long-term static water levels.

Proposed future actions for this subarea focus on reversing the loss in aquatic habitat quality due to sedimentation. Several backwater lakes and sloughs have been identified for evaluation with regard to increasing water depths and managing the input of water flows using closing or partial closing structures.

French Island/Duck Lake (river mile 619-623) - The French Island/Duck Lake area is bounded by the main channel on the west, the junction of State Line Slough and main channel on the north, the junction of State Line/Cassville Slough and main channel on the south, and Burlington Northern Santa Fe railroad on the east. This area occupies the northern portion of lower Pool 10. It is a complex of linear islands, adjacent shallow marshes, side channels, and increased open water areas. The largest backwater lakes include Duck, Jimore, and Otis Lakes. State Line Slough is a large secondary channel of the Mississippi River that departs from the main channel at river mile 624 and flows through the central and eastern portions of this subarea.

Excessive sedimentation in backwater areas, including lakes and channels, and loss (erosion) of islands are among the major problems of the area.

The desired future for the French Island/Duck Lake subarea focuses on the potential of reestablishing water depths in some of the backwater lakes and sloughs, island stabilization, and island construction. The combination of these actions would restore habitat quality throughout much of the subarea.

Frenchtown Lake/Bussey Lake (river mile 615-621) - This area is bounded by the main channel and west shore of Abels and Esman Islands on the east and the I & M Rail Link railroad on the west. An access road from the Iowa side of the river to Abel Island bisects the area.

Abel and Esman Islands, now joined as one island, are privately owned. The area is extensively developed with single-family, recreation, and full-time cabins and homes.

Bussey Lake and Willow Island (US Army Corps of Engineers photo..)

Frenchtown Lake is a major feature of the northern portion of the area. Buck Creek enters the Mississippi River floodplain and flows into Frenchtown Lake. Buck Creek's terminal delta, a complex of lowland forest and marsh, is the major landscape feature between the Abel Island access road and Frenchtown Lake.

Fishery resources in Frenchtown Lake have deteriorated to the point of being nonexistent due to excessive sedimentation in this backwater lake.

A portion of Buck Creek flows south through a water control structure beneath the Abel Island access road. This structure was constructed as part of the Bussey Lake HREP. The structure supplies/controls consistent, low volume water flow to benefit the winter fishery in adjacent Bussey Lake.

Bussey Lake occupies the southern portion of this area. Bussey Lake is the site of an EMP/HREP project, completed in 1995. Project features included dredging and improving winter water flow within Bussey Lake to improve winter habitat for fish. This project is depicted on the desired future map for Pool 10.

Other measures identified for potential implementation include island construction, increasing water depths in Frenchtown Lake, and shoreline stabilization. Increasing water depths in Frenchtown Lake and Bussey Lake

will result in a slight decline in the 1989 coverage of emergent and submersed vegetation.

Lower Pool 10 (river mile 615-619) - Lower Pool 10 is bounded by the Burlington Northern Santa Fe railroad on the east, the northern portion of Cassville Slough on the north, the main channel and eastern shore of Abel Island on the west, and Lock and Dam 10 on the south. This area is the southernmost portion of Pool 10. The prominent landscape features include a complex of relatively slender, linear and horseshoe shaped islands within the broad open water expanse typical of this portion of most navigation pools. The physiography of lower Pool 10 is notable in that more islands remain, compared to other pools in the Upper Mississippi River. However, the remaining islands have been/are subject to excessive erosion because of river currents and wind caused wave action. Current and wave action and the resultant sediment transport subject the area to excessive water turbidity and sedimentation. These factors adversely affect emergent and submerged vegetation in the area.

Island stabilization and construction are the main features identified for maintaining habitat quality in the lower Pool 10 subarea. Some areas have also been identified as having the potential for reestablishing aquatic habitat quality to historic conditions through increased water depth diversity.

Lower Pool 10 and the Guttenberg Waterfowl Ponds
(Wisconsin Dept. of Natural Resources photo.)

Unique Attributes, Opportunities, and Constraints

A predominant characteristic of Pool 10 is the series of backwater channel/lake/forested upland complexes that occupy the northern two-thirds of the pool. Though the proportion of open water increases in the southern (lower) one-third of Pool 10, a significant number of islands persist to Lock and Dam 10. These areas provide opportunities to improve and restore habitats more typical of an unimpounded river, such as improving/restoring backwater wetlands for fish or water birds, improving connectivity of aquatic habitats, manipulating water levels to benefit wetland and upland habitat, and increasing upland elevations to improve forest diversity.

The geologic features of Pool 10 generally limit disposal of dredged sediment to areas within the floodplain. Removal of dredged materials is typically accomplished by special projects such as at Macmillan where stockpiled dredged materials were hydraulically removed from the floodplain.

Summary of Potential Actions to Achieve Desired Future Habitat Conditions

Many of the proposed actions are interrelated. Often, solutions to problems will require implementation of more than one action. Likewise, single actions may address more than one problem. The overarching goal of these actions is to increase the productivity of the river ecosystem using all feasible means.

1.) Increase Depth Diversity in Channels and Backwaters

Sedimentation has affected habitat throughout Pool 10. Areas throughout the pool will be evaluated for implementation actions to increase water depths in backwaters and flowing channels. Among the tools that may be used are dredging, construction of closing structures, island restoration, shoreline stabilization, and restoration of connectivity.

2.) Maintain Existing Quality Habitats

A key to the desired future is to protect and maintain existing terrestrial and aquatic habitat. Many areas in Pool 10 are considered as quality habitat for a variety of species. Maintenance of existing quality habitat may be as simple as leaving it alone and monitoring its condition. Specific actions would be identified if long-term declines in habitat quality in the area were noticed.

3.) Protect and Restore Islands

Unlike many other navigation pools, existing islands are distributed throughout Pool 10. This feature provides the benefit of high habitat

Submersed vegetation attracts fish. (Wisconsin Dept. of Natural Resources photo.)

diversity. Maintaining or enhancing existing islands throughout Pool 10 will maintain the productivity of this area.

Floodplain structure is proposed to be restored and enhanced in the French Island/Duck Lake and lower Pool 10 areas. Measures to reduce sediment resuspension in these areas would reduce sediment input to lower Pool 10 and upper Pool 11. Reduction in sediment resuspension would improve environmental conditions for the establishment and maintenance of aquatic vegetation in lower Pool 10. Projects in these areas would also improve habitat diversity and quality through the promotion of secondary and tertiary channel development and diversification of water velocities in the open water reach.

4.) Actively Manage Forest and Prairie Communities for Diversity and Quality

Potential for terrestrial habitat maintenance and restoration exists in the Harper's Slough, Ambrough Slough, McGregor Lake, Gerndt Lake/Wisconsin River Delta/Glen Lake, Methodist/Norwegian Slough, Bagley Bottoms/Jays Lake, and French Island/Duck Lake areas. Measures to be taken may include: conversion of areas currently dominated by reed canary grass into forest; revegetation of historic selected channel maintenance disposal sites; and raising the elevations of selected land areas through the use of material dredged from adjacent backwaters to improve aquatic habitats.

5.) Manage Water Levels to Improve Aquatic Habitat

Restoring periodic low water levels will be investigated as a method to restore aquatic plant communities, especially emergent species. Where feasible, summer water level reductions would be implemented to expose substrates and stimulate aquatic plant growth. Water level management would be repeated as necessary to maintain aquatic plant abundance and diversity. Other pool-wide water level management options that may be investigated include, but are not limited to: increasing the operation band of the pool to allow for greater flexibility in pool water elevations; more frequent gate operations to minimize daily water level fluctuations; and the benefits of occasionally managing water levels at the high end of the operating band.

6.) Work Cooperatively with Private Landowners

Several areas within Pool 10 are privately owned. Purchase of these lands from willing sellers would assure long-term protection, connectivity, and ability to manage habitats within the river corridor and adjacent tributaries.

7.) Manage River Flows and Connectivity to Improve Aquatic Habitat

Flow regimes in numerous areas have been greatly altered, mostly by channel maintenance structures (i.e., wing dams and closing dams). In some cases, the structures can be removed or modified to promote diverse flow patterns without damaging navigation priorities. In other areas, habitat would benefit by reducing or eliminating flows. All structures within Pool 10 should be reviewed to determine how they can best be compatible with both wildlife and navigation concerns.

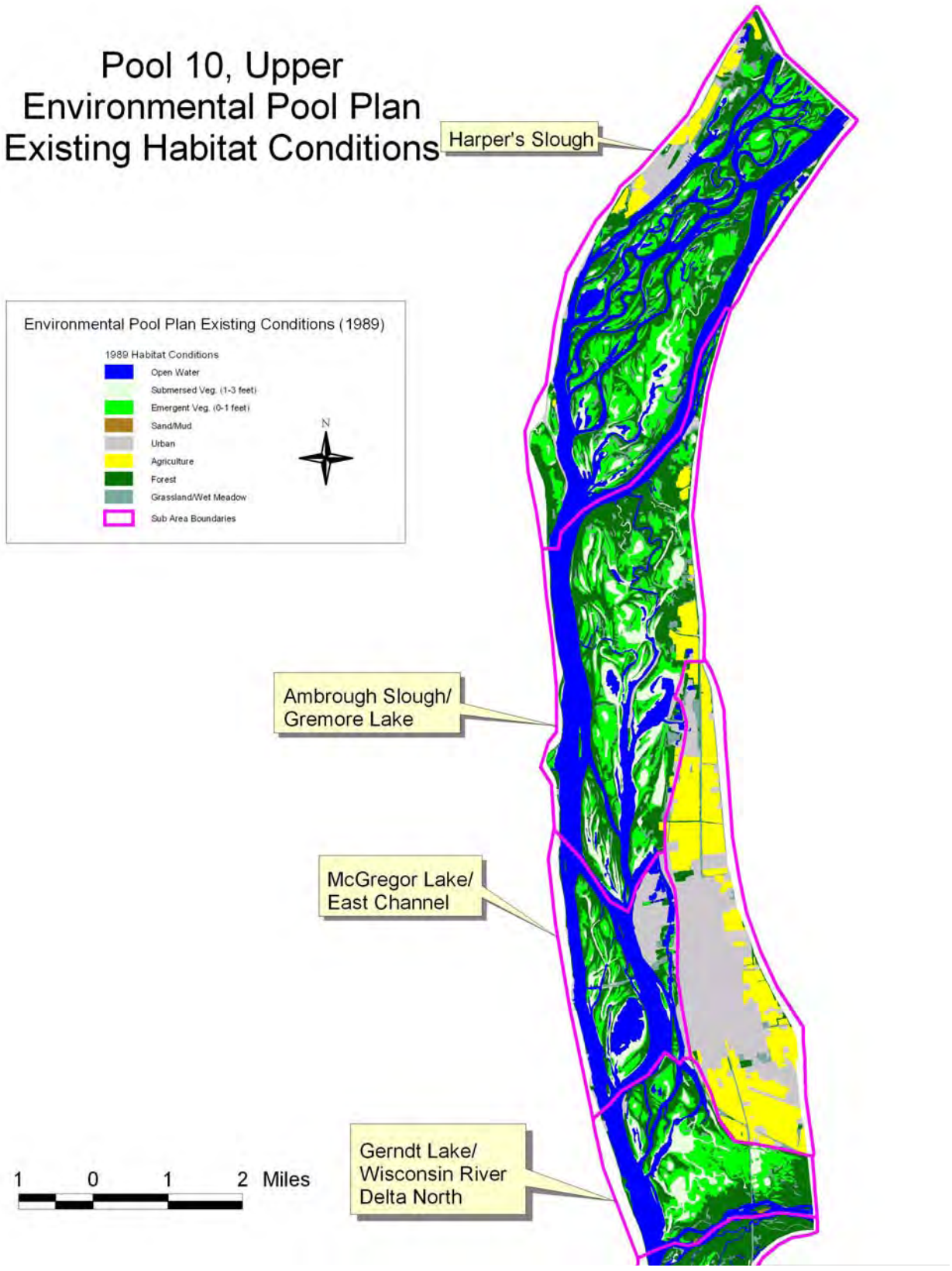
Projects are proposed for evaluation and potential implementation in the Harper's Slough, Ambrough Slough, McGregor Lake, Gerndt Lake/Wisconsin River Delta/Glen Lake, Methodist/Norwegian Slough, Bagley Bottoms/Jays Lake, French Island/Duck Lake, and Lower Pool 10 areas to improve habitat for riverine and backwater communities. Management of river flows and connectivity of aquatic habitats will require the use of several different approaches based on the specific habitat needs in an area.

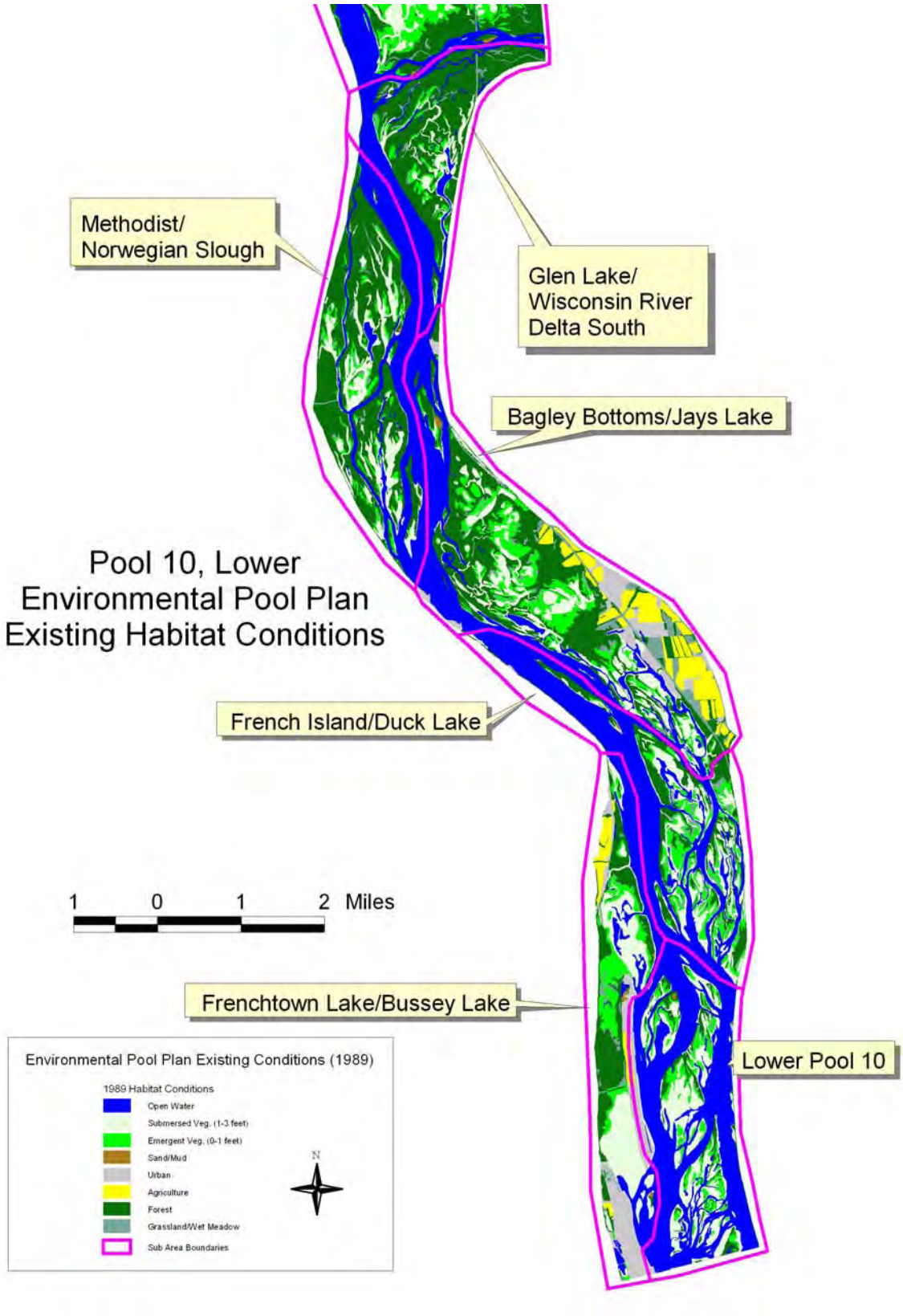
Example Action: *Manage River Flows and Connectivity to Improve Aquatic Habitat.* The Island 116 Project diverts main channel flow to protect important habitat in Lawrence Lake. (US Army Corps of Engineers photo.)

Connectivity with Pools 9 and 11 would be improved through the implementation of structures or other measures to increase fish passage at these dams.

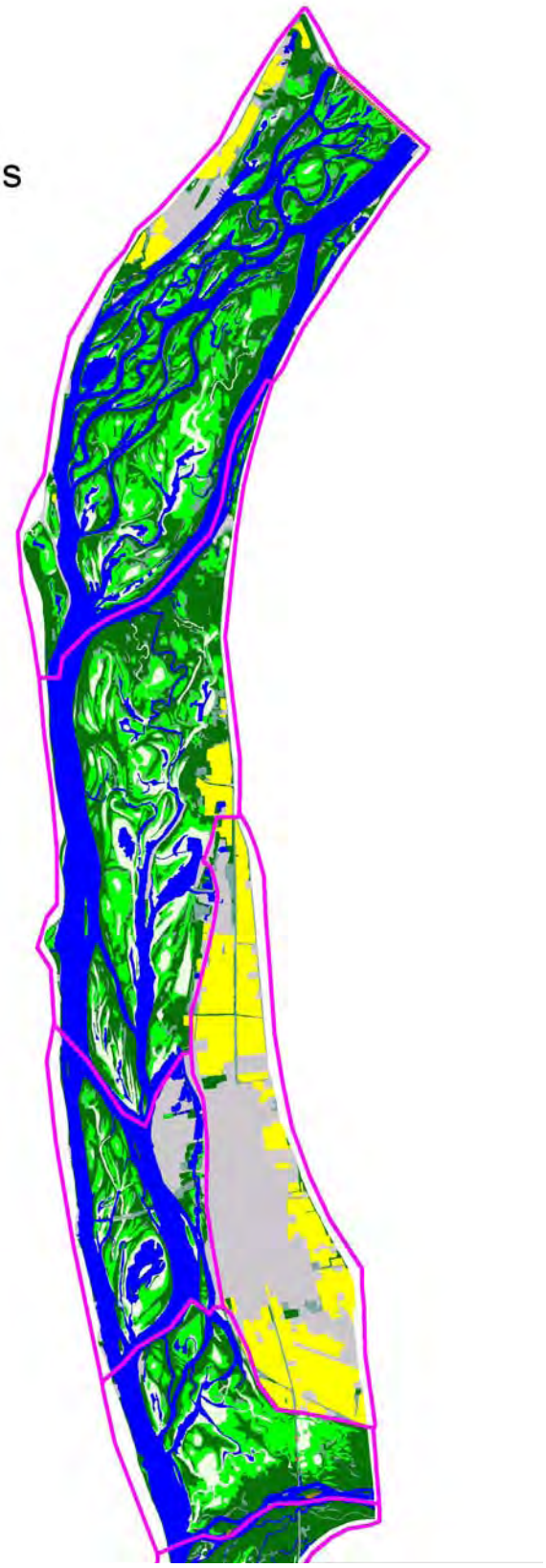
8.) Support Watershed Management

Agencies involved with resources on the Mississippi River should cooperate with the State of Wisconsin and other agencies involved in management issues on the Wisconsin River, the largest tributary to the Mississippi River in Pool 10 and a major contributor of sand (bedload) to the Mississippi River system. The Yellow River and several other small streams, such as Sny McGill Creek, empty into Pool 10. Though these smaller rivers contribute proportionately less sediments and pollutants, they suffer from adverse watershed management issues and cumulatively add significant sediment and excess nutrient loads to the Mississippi River.

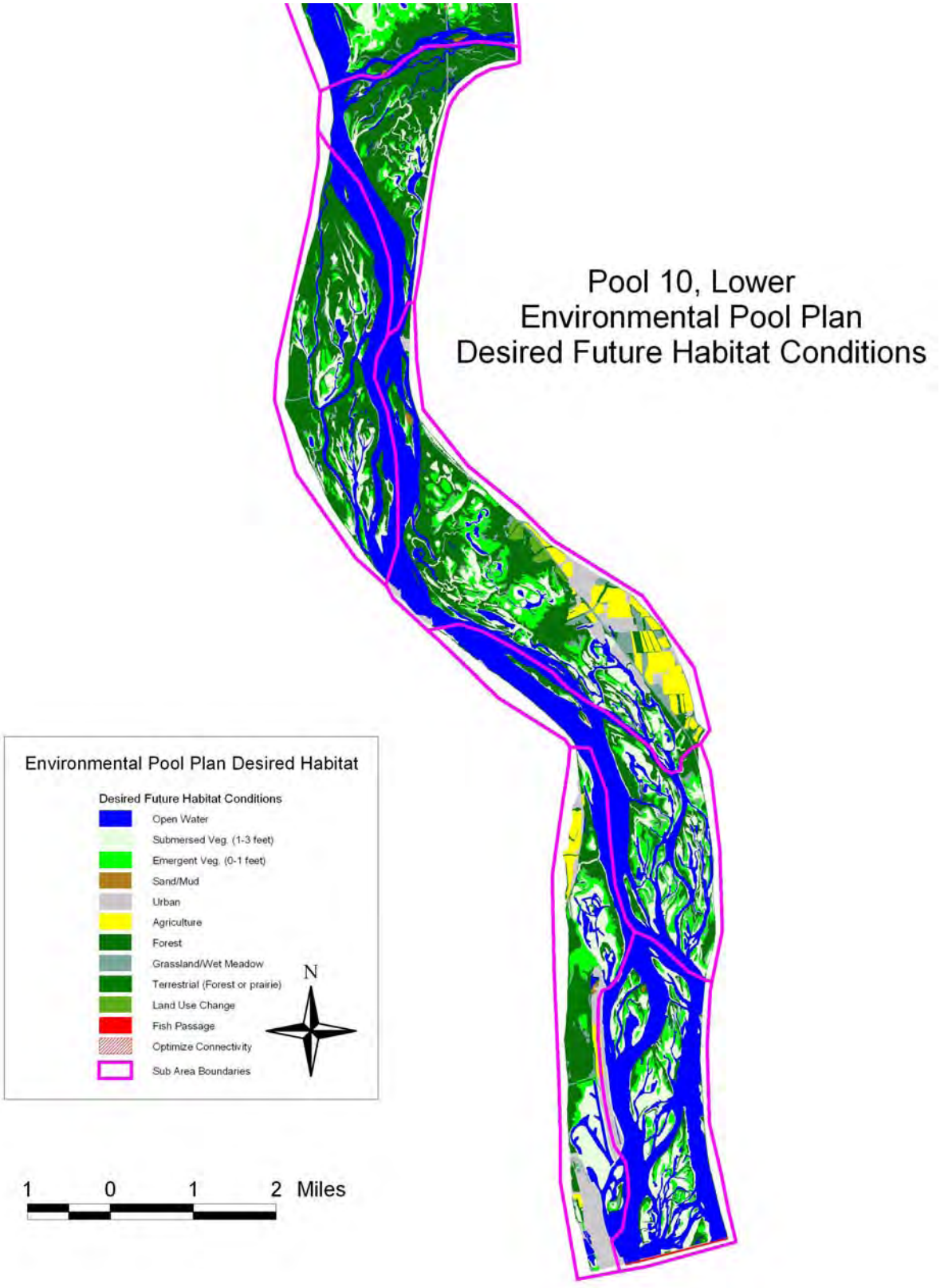

Pool 10, Upper
Environmental Pool Plan
Existing Habitat Conditions
Harper's Slough
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N
Ambrough Slough/
Gremore Lake
McGregor Lake/
East Channel
Gerndt Lake/
Wisconsin River
Delta North
1 0 1 2 Miles

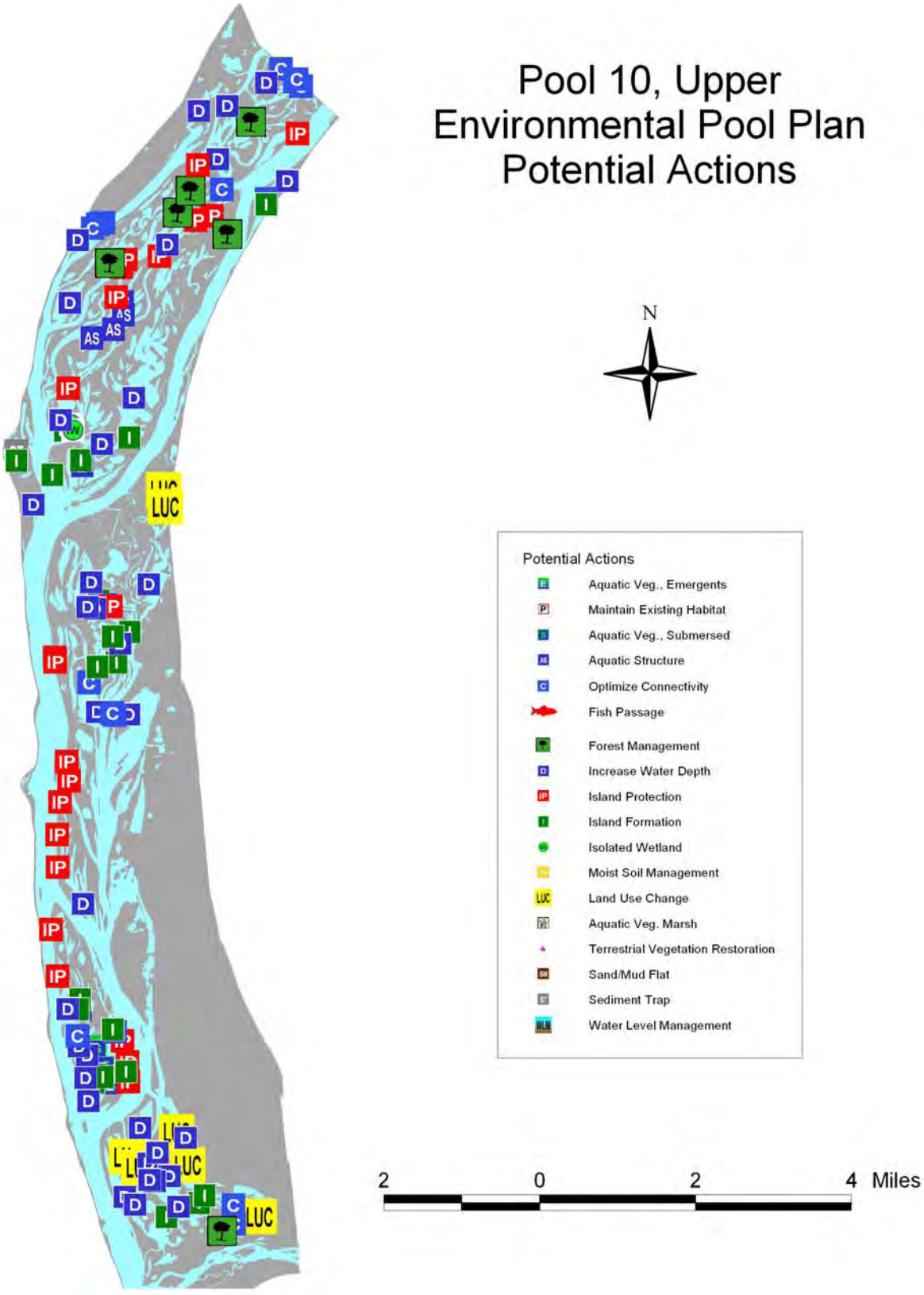

Methodist/
Norwegian Slough
Glen Lake/
Wisconsin River
Delta South
Bagley Bottoms/Jays Lake
Pool 10, Lower
Environmental Pool Plan
Existing Habitat Conditions
French Island/Duck Lake
1 0 1 2 Miles
Frenchtown Lake/Bussey Lake
Lower Pool 10
Environmental Pool Plan Existing Conditions (1989)
1989 Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Sub Area Boundaries
N

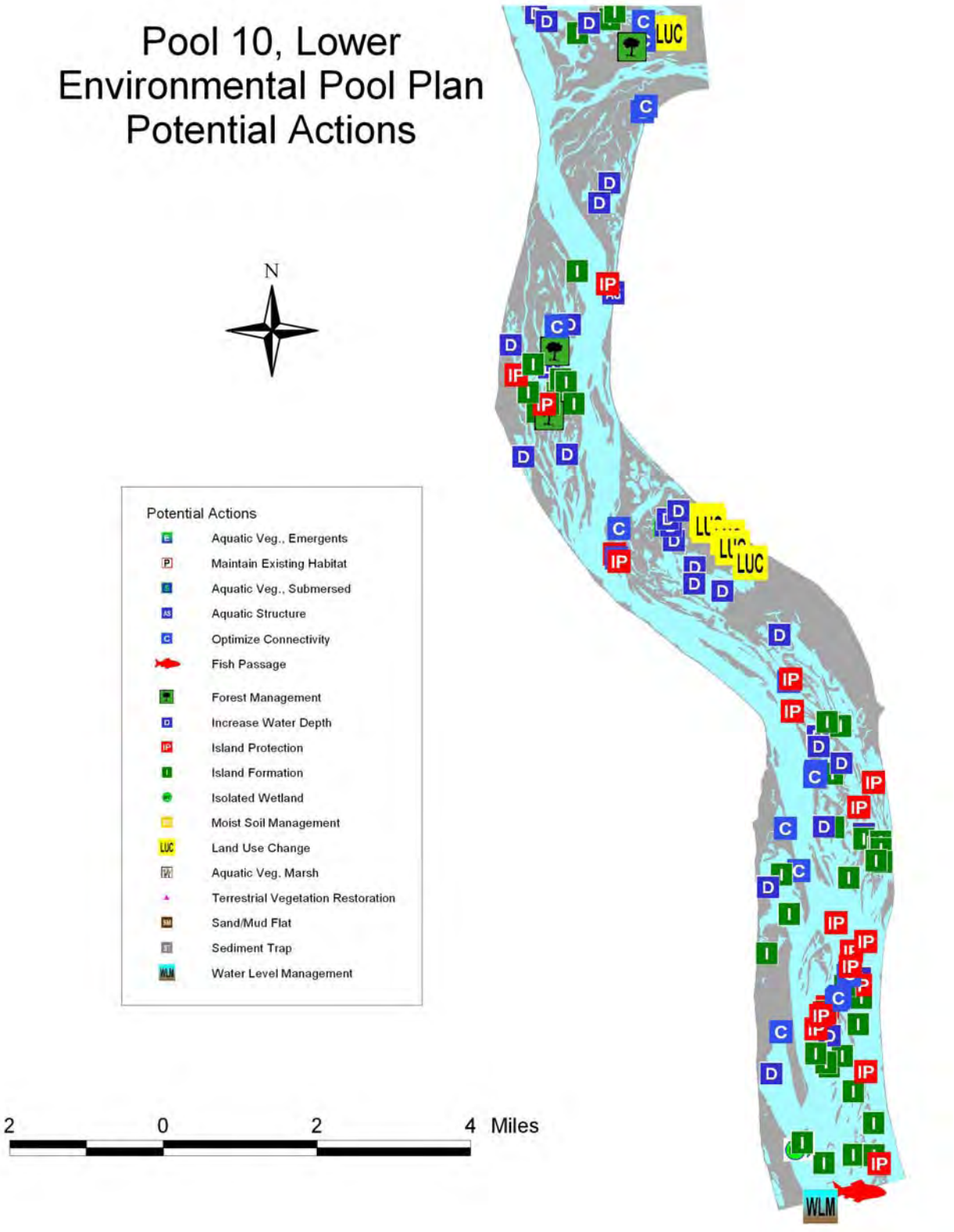
Pool 10, Upper
Environmental Pool Plan
Desired Future Habitat Conditions



1 0 1 2 Miles

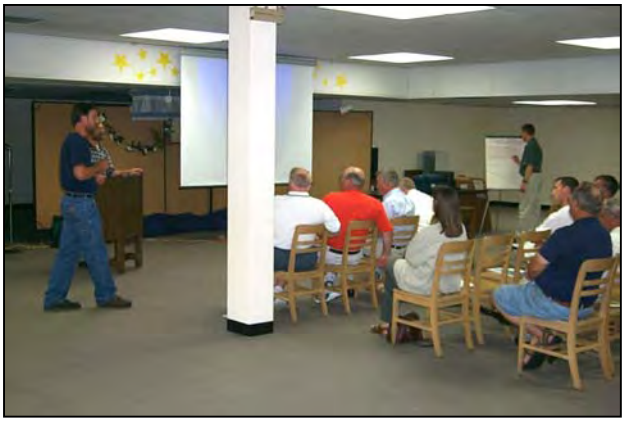

Pool 10, Lower
Environmental Pool Plan
Desired Future Habitat Conditions
Environmental Pool Plan Desired Habitat
Desired Future Habitat Conditions
Open Water
Submersed Veg. (1-3 feet)
Emergent Veg. (0-1 feet)
Sand/Mud
Urban
Agriculture
Forest
Grassland/Wet Meadow
Terrestrial (Forest or prairie)
Land Use Change
Fish Passage
Optimize Connectivity
Sub Area Boundaries
N
1 0 1 2 Miles


Pool 10, Upper
Environmental Pool Plan
Potential Actions
N
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
2 0 2 4 Miles


Pool 10, Lower
Environmental Pool Plan
Potential Actions
N
Potential Actions
Aquatic Veg., Emergents
Maintain Existing Habitat
Aquatic Veg., Submersed
Aquatic Structure
Optimize Connectivity
Fish Passage
Forest Management
Increase Water Depth
Island Protection
Island Formation
Isolated Wetland
Moist Soil Management
Land Use Change
Aquatic Veg. Marsh
Terrestrial Vegetation Restoration
Sand/Mud Flat
Sediment Trap
Water Level Management
2 0 2 4 Miles

Acknowledgments

Special thanks to the many interested citizens and partner organizations that participated in the public involvement process and provided important perspectives on future management of the Upper Mississippi River.



Environmental Pool Plan Public Meeting in Red Wing, MN (US Army Corps of Engineers photo.)

Environmental Pool Plan Public Meeting in Lansing, IA (US Army Corps of Engineers photo.)

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Interagency tree planting crew on Polander Island
(US Fish and Wildlife Service photo.)

River managers head to the landing at the end of the day.
(US Army Corps of Engineers photo.)

The Environmental Pool Plans for the Mississippi River Pools 1-10 are a cooperative effort of public interests and the State and Federal agencies represented by their logos below. The report is published by the River Resources Forum, an interagency forum serving as an advisory group to the St. Paul District, Corps of Engineers. The citation and contact information provided below is intended only to make the document easily accessible through a single point of contact.

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