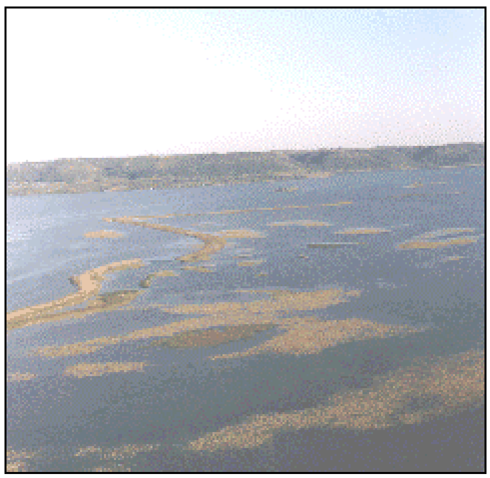
U.S. Army Corps of Engineers
St. Paul District
190 Fifth Street East
St. Paul, MN 55101-1638

September 2004

FINAL DRAFT
POOL 8 ISLAND CONSTRUCTION - PHASE I
PROJECT COMPLETION REPORT

September 2004



U.S. Army Corps of Engineers
St. Paul District
190 Fifth Street East
St. Paul, MN 55101-1638

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 HABITAT REHABILITATION AND ENHANCEMENT PROJECTS

Section 1103 of the 1986 Water Resources Development Act authorized a multi-element program designed to protect, restore, and balance the resources of the Upper Mississippi River System (UMRS). The Habitat Rehabilitation and Enhancement Project (HREP) construction is one element of the Environmental Management Program (EMP) (USACE 1989). Construction of the Pool 8 Island Construction-Phase I project was initiated as an HREP in 1989 and completed in June 1993 (USACE 1993).

The planning, design, and construction of the project were the result of a cooperative effort by the involved Federal and State agencies and the public. The continuation of this cooperation and coordination as part of the operation and maintenance of the project was strongly recommended (USACE 1993).

1.2 PURPOSE OF HABITAT PROJECT COMPLETION REPORTS

The purposes of this habitat project completion report for the Pool 8 Island Construction-Phase I project are to:

- Document the pre- and post-construction monitoring activities for the project.
- Evaluate project performance on the basis of project objectives and goals.
- Evaluate the project relative to other issues such as operation and maintenance.
- Make recommendations concerning future project performance evaluation.
- Make recommendations concerning the planning and design of future habitat rehabilitation and enhancement projects.

This report summarizes all available monitoring data, operation and maintenance information, and project observations made by the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (USFWS), and the Wisconsin Department of Natural Resources (WDNR) for the period August 1990 through February 2001. It also includes other agency and public input.

2.0 PROJECT OBJECTIVES

2.1 GENERAL GOALS

The goal of the Pool 8 Island Construction-Phase I project is to preserve and enhance aquatic plant beds for fish and wildlife habitat (USACE 1989).

2.2 SPECIFIC HABITAT OBJECTIVES

Many of the islands in Pool 8 that historically provided valuable habitat had been reduced in size through erosion or were no longer present. Increased wind fetch and associated turbidity from river flows were potential causes for this loss of valuable aquatic plant beds, particularly wild celery (*Vallisneria americana*), which are used by fish and migratory waterfowl (USACE 1989).

On the basis of design criteria and future project assessment, the following specific habitat objectives for Pool 8 Island Construction-Phase I have been identified:

- Reestablish 15 acres of stabilized island from the head of the Raft Channel at river mile (R.M.) 687.7 to R.M. 685.3.

- Reestablish a grass/shrub/herbaceous vegetative cover on the island in order to provide secondary wildlife benefits (especially waterfowl nesting).

- Increase sheltered shallow habitat (typically 2.5 feet deep or less) by at least 100 acres, and increase sheltered deep habitat (typically 2.5 to 6.5 feet deep) by a minimum of 30 acres. These habitats should be interspersed with flowing channels.

- Reduce the main channel flow into the project area by 75 percent (measured during periods of less than 10-year flood flow) to decrease sediment loading and thereby reduce backwater aquatic habitat loss from sedimentation.

2.3 TARGET SPECIES AND HABITATS

The following target species and habitat types were identified in the Pool 8 Island Construction-Phase I Definite Project Report/Environmental Assessment (USACE 1989).

2.3.1 Islands

Approximately 26 acres of islands were identified within the project area. The top elevation of these islands ranged up to 5 feet above the average water surface. However, the top elevation of these islands was typically about 1 to 2 feet above the average water surface, with only 0.3 acre at or above the level of the 10-percent frequency flood event.

Vegetation on these islands was described as typical northern floodplain forest. Dominant species included silver maple (*Acer saccharinum*), cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), river birch (*Betula nigra*), and green ash (*Fraxinus pennsylvanica*), with varying numbers of swamp white oak (*Quercus bicolor*), slippery elm (*Ulmus rubra*), and hackberry (*Celtis occidentalis*). Mixed stands of black willow (*Salix nigra*) and sandbar willow (*Salix exigua*) dominated areas closer to water and were subject to greater flooding. Shrub communities occupied ecotonal positions between emergent aquatic communities and those of floodplain forest. Wet shrub communities were dominated by buttonbush (*Cephalanthus occidentalis*), red osier dogwood (*Cornus sericca*), panicled dogwood (*Cornus racemosa*), silky dogwood (*Cornus amomum*), and false indigo (*Amorpha fruticosa*). Dry shrub communities were dominated by staghorn sumac (*Rhus typhina*), smooth sumac (*Rhus glabra*), and honeysuckle (*Lonicera* L.). Herbaceous layers, when present, were dominated by poison ivy (*Toxicodendron radicans*) and wood nettle (*Urtica dioica*). Reed canary grass (*Phalaris arundinacea*) occurred in the areas where silt, deposited during high water, remained dry during most of the summer.

2.3.2 Sheltered Shallow Habitat

The sheltered shallow habitat was the dominant habitat type present in the project area. Approximately 300 acres were present in the Phase I project area. These habitats occurred behind the barrier islands in relatively low-velocity areas, had a typical water depth of 2.5 feet or less, and consisted mainly of the emergent arrowhead (*Sagittaria latifolia*) and the floating-leaved water lily (*Nuphar microphylla*). Additional species often present included river bulrush (*Scirpus fluviatilis*), giant bur reed (*Sparganium eurycarpum*), lotus (*Lotus L.*), coontail (*Ceratophyllum dermersum* L.), and elodea (*Elodea canadensis*).

2.3.3 Sheltered Deep Habitat

Approximately 125 acres of sheltered deep habitat were identified in the Phase I project area. This habitat occurred in areas too deep to support emergent vegetation (typically 2.5 to 6.5 feet), behind shallow ridges or islands, and usually had higher currents than protected shallow zones. Dominant species present were wild celery, pondweeds (*Potamogeton* L.), coontail, and water stargrass (*Heteranthera dubia*). Often, lotus and elodea were also present.

2.3.4 Unprotected Shallow Habitat

Approximately 225 acres of unprotected shallow habitat were identified in the project area. This habitat occurred mainly in the lower east half of the Phase I area. The same vegetation as in the protected shallow zone was found here, but in less vigorous stands, because the area was exposed to river current, wind, and barge-induced wave action.

2.3.5 Unprotected Deep Habitat

Approximately 175 acres of unprotected deep habitat were identified in the project area. This habitat occurred at side channel openings, at expanding sloughs, and at the confluence of several sloughs/side channels near the downstream portion of the project area. Such areas were subject to high flows and suspended sediment from the main channel and provided a means for suspended sediment to enter off-channel areas. Vegetation was generally lacking or consisted of sparse wild celery, pondweeds, and water stargrass, depending on flow velocities.

2.3.6 Side Channels/Sloughs

Approximately 175 acres of side channels/sloughs were identified within the project area. These were deeper areas (typically 4 to 8 feet deep) that were usually present before river impoundment, lacked rooted vegetation except along margins, and usually had some flow under normal pool discharges. Velocities decreased as the channel branched away from its primary source of flow, the main channel. These channels were important for maintaining an interspersion and diversity of habitat types and contributing to the redistribution of organic matter and dissolved oxygen (DO).

2.3.7 Fish and Wildlife

The project area was described as providing valuable habitats for wildlife including waterfowl, muskrats, wading birds, eagles, and fish from the sunfish family (*Centrarchidae*), the perch family (*Percopsidae*), and the freshwater catfish family (*Ictaluridae*). It was cited as especially important as a resting and feeding area to migratory waterfowl. This was primarily due to the presence of emergent and submergent aquatic vegetation on the downstream side of the remaining islands (USACE 1993). An extensive list of species using this type of habitat can be found. The project area was especially important as a resting and feeding area during migration for many species of waterfowl. Because of the great importance of the area to migratory waterfowl, the USFWS designated the backwater south of the main channel as a closed area during the hunting season. Use of the area by waterfowl can vary dramatically as habitat conditions change.

2.3.8 Threatened and Endangered Species

At the time of project construction, it was noted that the project was located within the historical range of the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and Higgins eye mussel (*Lampsilis higginsii*). One historical record and one recent record of Higgins eye mussel, a federally listed endangered species, were known in the project vicinity. A mussel survey conducted on May 3 and 4, 1989, in areas to be affected by construction activities indicated no impacts to the Higgins eye mussel from the project. The bald eagle (*Haliaeetus leucocephalus*), a federally listed threatened species, could be sighted in the area during migration, and also may use adjacent areas for roosting. The nearest bald eagle nest upstream of the project area was located near R.M. 692 and downstream was located near R.M. 679.5 in Reno Bottoms. The peregrine falcon was a federally listed species at the time of construction but has since been delisted. It remains listed as an endangered species by the State of Wisconsin and as a threatened species by the State of Minnesota.

3.0 PROJECT DESCRIPTION

3.1 LOCATION

The project area for Pool 8 Island Construction-Phase I covers approximately 5,000 acres in lower Pool 8 (Figure 1). It encompasses the entire stretch of the Mississippi River west of the navigation channel between R.M. 684 and R.M. 688. The project area is within the Upper Mississippi River National Wildlife and Fish Refuge and is located in Vernon County, Wisconsin, and Houston County, Minnesota. The nearest communities are Brownsville, Minnesota, which lies immediately upstream, and Stoddard, Wisconsin, which is east of the project area (USACE 1989).

3.2 PROJECT AREA

Pool 8 is part of the Upper Mississippi River System (UMRS) and was created in 1939 by the construction of Lock and Dam 8. The entire pool is 23.3 miles long, extending from R.M. 679.2 (Lock and Dam 8) to R.M. 702.5 (Lock and Dam 7). The project area for Phases I through V is located between R.M. 681 and R.M. 688. The river valley in Pool 8 is 2 to 3 miles wide and is bordered on either side by weathered bluffs. The Brown surveys of the 1930's showed that groups of islands, intertwined with sloughs, ponds, and marshes, existed within the lower Pool 8 project area prior to inundation. Several major sloughs existed in the area and may still be evident today. The Raft Channel, formerly the main channel of the river, runs along the western side of the project area. Coon Slough, currently the 9-foot navigation channel, runs diagonally across the project area from northwest to southeast. Crosby Slough, which flows into Coon Slough, and Middle Slough, which flows from Coon Slough approximately 1 mile downstream, essentially run diagonally in the opposite direction. Older survey maps of this stretch of the river do not show any pre-inundation farming on or access roads to the islands.

Phase I reflects all of the slough, marsh, and island characteristics discussed above. Presently, the 9-foot main channel forms the eastern border of the Phase I section of the project area, with the Minnesota shoreline and the Raft Channel on the west. Moving downstream to upstream, the Phase I area extends from about R.M. 685.3 to R.M. 687.8. A number of minor sloughs exist in this area, including Benover Slough. A horseshoe-shaped intermittent island system was the only landmass remaining in Phase I. This two-branched chain of islands extended from the head of the Raft Channel downstream approximately 5,000 feet, with several openings into the inner backwater area (USACE 1989).

3.3 PRE-PROJECT HABITAT CONDITIONS AND CHANGES

Navigation Pool 8 occupies an area that was once low-lying marsh, meadow, and floodplain forest. The channel of the Mississippi River meandered through the wide floodplain, forming a large number of oxbow channels and sloughs. After inundation (1939), a narrow rim of islands existed along the southern channel border and in the Stoddard Bay area.

A dramatic decrease in the lower Pool 8 Islands landmass had occurred since inundation (approximately an 80 percent loss since 1940). The loss in the Phase I area was less because of the placement of dredged material on portions of the islands. However, the islands were also eroding at a rapid rate. Island erosion in Phase I led to a loss of both terrestrial habitat (50 acres) and protected littoral zones (400 acres) associated with the islands. The islands historically acted as barriers, which reduced flow into backwater areas and broke up wind and wave action (USACE 1993). The erosion of the islands also contributed to the magnified negative impacts of currents and waves on backwater sediments and aquatic vegetation.

Although the project area is important for many species of fish and wildlife, declines in habitat values had been noted in recent years. Comparison of aerial photographs over several years showed an increase in breaches in existing islands that subjected protected shallow and deep habitats to increased current velocities and greater sediment loads. A decline in vegetation associated with island loss was measured in lower Pool 8 between 1978 and 1980. The results showed that there was an 83 percent decline in wild celery. That decline was considered to be an index to overall decreased habitat quality (USACE 1989).

3.4 PROJECT FEATURES

Under Phase I construction, the existing horseshoe-shaped island on the right descending bank of the main channel at R.M. 637.5 was raised and extended (Horseshoe Island) (USACE 1993). The project features involved a plan to rehabilitate the current horseshoe-shaped island system to form one interconnected island, and the construction of a second major island (Figure 2). The existing islands upstream of Benover Slough were raised so that the top elevations of these islands were approximately equivalent to a 10-year flood event. All openings between these islands were closed through the placement of fill. No change was made in the current alignment of the existing island system or the opening at Benover Slough. Downstream of Benover Slough, a new island (Boomerang Island) about 5,000 feet in length was constructed. This extends from the existing island bordering the downstream side of Benover Slough to a point immediately upstream of the next major slough. Upon completion, the entire island system forms a 9,500-foot-long barrier along the east side of the Phase I project area (USACE 1989). Construction extended downstream on the main channel side and approximately 2,400 feet along a secondary channel side. A third island (Grassy Island) was rehabilitated by raising it to a 5-year flood event and enlarging and stabilizing the existing island.

The proposed island height was based on several factors. During the decision-making process, the following information was used:

- Islands in lower Pools 7, 8, and 9 that are relatively stable typically have a top elevation 4 feet or more above the average water surface elevation.

- Islands that have been severely eroded initially had top elevations less than 3 feet above the average water surface elevation.

- Use of the island by wildlife requires that inundation by floods be minimized.

- Construction cost discourages consideration of higher top elevations.

Using the above information, an elevation approximately equivalent to the 10-year flood event was selected. The Phase I island elevations would vary from 634.8 feet National Geodetic Vertical Datum (NGVD) for the downstream 5,000-foot-long newly created island to 635.1 feet NGVD for the rehabilitation of the existing horseshoe-shaped island. The top elevation of the island averages 4.7 feet above the average water surface elevation in the project area.

The key island design consideration from the standpoint of erosion control was selection of the island cross-section and identification of areas that would require the additional protection afforded by riprap (rock fill). The top width of the islands was selected on the basis of the topography of the existing island, coupled with island stability and economic considerations. The minimum width was 50 feet, with expansions up to 100 feet in a few areas. From the top of the islands, side slopes were 1 foot vertical (V) for each 3 feet horizontal (H). At an elevation approximately 2 feet above the average water surface elevation, the side slopes decreased dramatically to form a 20-foot-wide berm, with a slope of about 1 V for every 20 H. Then, from a point 1 foot above the average water surface elevation, the side slopes change to approximately 1 V for every 6 H. The berm slopes were designed to combine ease of construction with what nature would most likely create over time. In this and other pools, field investigations indicated that side slopes underwater are usually about 1 V for every 12 H. Construction of this type of slope was very difficult and costly because of underwater construction. Therefore, the 20-foot berm was intended to be sacrificed in order to provide a stable slope for the waterline as erosion takes place long term.

Riprap was placed only at selected reaches of the island system. Placement was based on flow considerations, expected wave energy, and field investigations. The head of the horseshoe-shaped island was riprapped, as was each slough entrance. The elbow of Boomerang Island was also riprapped. Rockfill groins were placed perpendicular to the island at 180-foot intervals to trap material as it erodes from the island, producing a scallop-shaped shoreline.

Topsoil was placed on the upper portions of all constructed islands. No new topsoil or seeding was put on the berm since its height is within the range of normal wave action and it is expected to erode. The only exception to this was the lower half of the new 5,000-foot-long downstream island. Here, the berm facing the main channel was planted to stimulate plant growth for added erosion protection. The upper, horseshoe-shaped, portion of the island was drill-seeded in June 1991 and the long portion of the island was drill-seeded in June 1993 with the seed mixture shown in Table 1 and mulched.

TABLE 1

Seed Mixture, Pool 8 Islands-Phase I

Canada wild rye (*Elymus canadensis*)	5 lbs./acre
Thickspike wheatgrass (*Agropyron dasystachyum*)	6 lbs./acre
Side-oats grama (*Bouteloua gracilis*)	3 lbs./acre
Switchgrass (*Panicum virgatum*)	5 lbs./acre
Perennial ryegrass (*Lolium perene*)	10 lbs./acre

With the design top width, a total of about 15 acres of land above the 10-year flood event was constructed. As stated above, the additional fill was placed on the existing islands in a position to take full advantage of the available land features in order to create the most stable and erosion-free island conditions. This placement, coupled with the cross-section design, extended the inner side of the new island into the backwaters in some areas. This extension covered approximately 10 acres of sheltered shallow backwater habitat. The new 5,000-foot-long island downstream of Benover Slough occupied approximately 14 acres of unsheltered shallow habitat (USACE 1989 and 1993).

3.5 PROJECT HISTORY

Construction of the islands for the Phase I project was initiated in 1989 and completed in June 1993 (USACE 1993). Final seeding of the islands was completed in May 1994. The project was transferred to the USFWS in January 1994.

Upon project completion, an outbreak of avian botulism "Type C" claimed approximately 1,000 birds. It was theorized that the spores came from the fine sediment that was taken from the Willow Creek Bay borrow site. No other outbreaks have been recorded since that incident.

4.0 PROJECT MONITORING

4.1 MONITORING PLAN

A monitoring plan for project evaluation purposes was developed to directly measure the degree of attainment of the project objectives. The general parameters to be monitored for each project objective follow:

1. Project Objective: Reestablish 15 acres of stabilized islands from the head of the Raft Channel (R.M. 687.7) to R.M. 685.3.

   Conditions Monitored: Erosion was monitored primarily by visual inspection of the islands through on-site visits and aerial photographs. Surveys were also conducted at identified potential erosion points along the islands. Field inspections were done annually, with surveys conducted every 10 years and at the discretion of the evaluating team.

2. Project Objective: Reestablish a grass/shrub/herbaceous vegetative cover on the islands in order to provide secondary wildlife benefits (especially waterfowl nesting). The vegetation cover should average 100 percent and have an obscurity rating of 1.5 decimeters (dm) or greater within 2 years after construction.

   Conditions Monitored: Island vegetation was mapped from ground inspections, and the density of potential waterfowl nesting vegetation was determined using the Robel Method (height density pole). Sampling was conducted annually for at least 4 years after construction. In conjunction with these measurements, the effect of island vegetation on providing erosion protection was also monitored by assessing canopy coverage.

3. Project Objective: Increase sheltered shallow habitat by at least 100 acres, and sheltered deep habitat by a minimum of 30 acres. These habitats were interspersed with flowing sloughs, in a pattern similar to that present in 1987.

   Conditions Monitored: Aerial photographs of the project area will be interpreted and entered into the geographic information system (GIS) annually for at least 10 years.

4. Project Objective: Reduce 75 percent of the main channel flow into the project area (measured during periods of less than 10-year flood flows) to decrease sediment loading and thereby reduce backwater aquatic habitat loss from sedimentation.

   Conditions Monitored: Flow measurements were taken at selected sites for a minimum of three selected discharges. Surveys were conducted in the backwaters along established transects to determine average sedimentation in these areas. The transects are scheduled to be resurveyed every 15 years.

Monitoring activities were coordinated with similar efforts by the Long Term Resource Monitoring Program (LTRMP), a component of the EMP. The LTRMP collected data on a number of parameters within the Pool 8 project area.

4.2 MONITORING HISTORY

4.2.1 Pre-Construction Monitoring

Pre-construction habitat monitoring at the Pool 8 Island Construction-Phase I project was performed by the WDNR and the USFWS from July 1989 to August 1990. During this period, the WDNR monitored several water quality conditions such as water temperature, current velocity, DO, turbidity, Secchi disk transparency, and specific conductance (conductivity). Table 2 summarizes pre-construction monitoring data collection efforts.

TABLE 2

Pre-Construction Monitoring Data, Pool 8 Islands Construction-Phase I

Date	Agency	Components Monitored
August 1990	USFWS	DO and water temperature.
February 1991	WDNR	Ice and snow depth, percent snow cover, DO, temperature, velocity, and water depth.

Belanger et al. (1990) took DO and temperature readings within the Pool 8 Islands project area from August 13 through September 5, 1990. The results showed daily fluctuations in DO and water temperature. The frequency of these fluctuations was directly related to the daily weather conditions. Overcast days demonstrated less fluctuation than bright, sunny days. These fluctuations were primarily due to the increase in photosynthetic activity and water temperature that occurs during clear days when solar influences are the greatest. The density of aquatic vegetation also had a direct effect on these fluctuations. Areas with dense macrophyte growth showed higher DO and temperature variability than areas with a less dense aquatic plant bed. This was presumably due to the increase of photosynthetic activity in dense macrophyte areas.

Richardson (1991) examined water quality characteristics at the Pool 8 Islands HREP from December 3, 1990, to March 31, 1991. Measured parameters included DO levels, water temperature, turbidity, specific conductance, current velocity, and Secchi disk transparency. During this period, no detectable water velocity was found within the study area, although Richardson stated that prior to construction (December 1, 1988, to March 31, 1989), the average water velocity was 0.05 m/sec (range 0.01 to 0.11 m/sec). The average water temperature during the study period was 1.7 °C, while DO remained above 5.0 mg/L throughout most of the sampling period, except in areas that were completely frozen.

4.2.2 Post-Construction Monitoring

Post-construction habitat monitoring at the Pool 8 Island Construction-Phase I project has been performed by the WDNR, USFWS, and USACE. Table 3 summarizes post-construction monitoring data collection efforts.

TABLE 3

Post-Construction Monitoring Data, Pool 8 Islands Construction-Phase I

Date	Agency	Components Monitored
August 1991	USACE	Terrestrial vegetation.
August 1992	USFWS	Aquatic vegetation.
August 1992	USACE	Terrestrial vegetation.
February and March 1993	WDNR	Secchi depth, turbidity, DO, temperature, pH, and specific conductivity.
August 1993	USACE	Terrestrial vegetation.
August 1994	USACE	Terrestrial vegetation.
January through March 1995	WDNR	Secchi depth, turbidity, DO, temperature, pH, and specific conductivity.
August 1995	USACE	Terrestrial vegetation.
April through September 1995	WDNR	Secchi depth, turbidity, DO, temperature, pH, and specific conductivity.
August 1999	USACE	Terrestrial vegetation.
August 2000	WDNR	Aquatic vegetation.

August 1991 Terrestrial Vegetation Monitoring

Anfang (1991) monitored the Pool 8 Islands vegetation during the period August 19-22, 1991. During that time, he monitored newly seeded areas within the Pool 8 Islands HREP to determine the success of the plantings and to evaluate the suitability of species to be planted at future sites. In general, the newly seeded areas appeared to be growing very well, considering that the seeds had only 2 months to germinate and grow. The average percent cover for the entire site was 40 percent. Anfang stated that this percent cover value was quite good for the first year. Percent cover was also measured for each species within the site. From this measurement, the frequency, relative frequency, dominance, relative dominance and importance values were calculated for each species. On the basis of those calculations, Anfang concluded that some "weedy" species such as smartweed and barnyard grass were dominant at the time. He anticipated that weedy species would tend to disappear and the more desirable grass species would take over. Anfang stated that it was too early to draw many conclusions from the monitoring.

August 1992 Aquatic Vegetation Monitoring

Rogers (1992) conducted floating, emergent, and terrestrial vegetation surveys using aerial photographs of the Pool 8 Islands and submersed aquatic vegetation surveys by taking a grab sample within a vegetation bed using a long-handled rake. On the basis of the dominant species present, each aquatic bed was classified using the LTRMP vegetation classification system. Most of the vegetation in the interior of the Pool 8 Islands was dominated by two floating-leaved species, water lily and lotus lily (*Nelumbo*). Submersed aquatic vegetation included intermittent areas of European watermilfoil (*Myriophyllum spicatum*), horned pondweed (*Zanichellia palustris*), and sago pondweed

(*Potamogeton pectinatus*). The water lily had the highest frequency and relative abundance, while curly pondweed (*Potamogeton crispis*) had the lowest frequency, and water stargrass had the lowest relative abundance.

August 1992 Terrestrial Vegetation Monitoring

In August 1992, Anfang (1992) monitored the success of plantings within the Pool 8 Islands from 30 randomly selected sites, 15 to the east of the center of the islands and 15 to the west. Robel readings of 2.0 and 2.1 were recorded for the west and east sides of the islands, respectively. Those values represented a slight increase from the previous monitoring year. Total percent cover was estimated for each side of the island. The east side was estimated to have 78 percent total coverage, while the west side was estimated to be 70 percent covered. An "Analysis of Variance" (ANOVA) showed no difference between the east and west sides in either 1991 or 1992, while an ANOVA test showed there was a significant difference in the percent cover between 1991 and 1992. Weedy species that were a problem in 1991 were now almost nonexistent. The planted species (wheatgrass, side-oats grama, and Canada wild rye) were now the dominant species. The Jaccard Index of Species Similarity was calculated for both the east and west sides of the islands. This index showed that the east and west sides of the islands are fairly similar in species composition. Anfang (1992) concluded that the vegetation was dominated by the seeded species, weedy species were on the decline, there was good overall percent cover, and Robel readings were above the project goals.

February and March 1993 Current Velocity, DO, Temperature, and Winter Habitat Monitoring

Dukerschein (1993) collected water quality data (current velocity, temperature, and DO) from 16 locations along an east-west transect across the inside of Horseshoe Island. All sampling locations were marked and surveyed on February 13, 1993, and March 4, 1993. Generally, measurements taken on both dates were very similar. Ice depth, snow depth, DO, water temperature, and current velocity ranges were slightly wider and means and standard deviations slightly higher for the March 4 sampling. Water temperatures at all sites on both sampling dates were less than 1.0 °C; DO readings were above 5.0 mg/L at all sites except one on February 13, 1993, and one on March 4, 1993. All sites north of the northern inlet from the main channel had no current velocity, while the deepest site, located on the southeastern corner of the island, had the highest current velocity (0.07 to 0.10 ft/sec). Dukerschein (1993) concluded that the Pool 8 Phase I HREP partially accomplished the project goals for habitat improvement during the 1993 sampling. However, although the primary objective was to reduce the current velocities and to encourage macrophyte growth, improving winter fish habitat should be emphasized. In particular, measures to deepen portions of the study area needed to be incorporated into future plans in order to provide suitable habitat for wintering fish.

August 1993 Terrestrial Vegetation Monitoring

Anfang (1993) monitored the Pool 8 Islands vegetation to determine the success of seeded and planted areas and to evaluate the suitability of species for future sites. During this monitoring, 30 plots were randomly selected, 15 to the east of the center of the islands and 15 to the west, to determine if there was any difference between the two sides. During the summer of 1993, the islands were flooded with as much as 6 inches of water. Even though flooding occurred, the seeded areas looked to be growing very well. A Robel reading of 2.6 was recorded during 1993, which represents an increase of 0.6 from the previous year. An ANOVA calculation was made to examine the difference in percent cover for both sides of Horseshoe Island. The calculation showed that there was not a significant difference between the east and west sides from 1992 to 1993. There was, however, a significant difference between Horseshoe Island and Boomerang Island. There was a significant decrease in the importance of weedy species in 1993.

Species such as barnyard grass, smartweed, velvetleaf, and clammyweed had disappeared. These weedy species had been replaced by reed canary grass, switchgrass, side-oats grama, and Canada wild rye. On the basis of importance values, the most important species on Horseshoe Island was switchgrass, while the most important species on Boomerang Island was Canada wild rye. A total of 17 different species were documented on Horseshoe Island, while 25 were cataloged on Boomerang Island. The Jaccard Index of Species Similarity was calculated using the 1993 data. This index showed that the plant species on the two islands were fairly similar (index of 33). Anfang (1993) concluded that the seeded areas seemed to be growing well, with a dominance of seeded species and a sparse community of weedy species. There was also good percent cover, and Robel readings for Horseshoe Island exceeded project goals.

August 1994 Terrestrial Vegetation Monitoring

Anfang (1994) monitored the Pool 8 Islands vegetation. It was noted that the summer flood of 1993 inundated the entire group of islands with roughly 6 inches of water. Even though the islands had been flooded for a considerable time, the seeded areas seemed to be growing very well. A Robel reading of 2.9 was recorded in 1994, an increase of 0.3 from the previous year's monitoring. There was no significant difference in percent cover between Horseshoe Island and Boomerang Island in 1994. However, a significant difference in percent cover was observed when the 1994 data was compared to the 1993 data. As in 1993, weedy species showed a decline in abundance in 1994, but new invasive species such as reed canary grass and purple loosestrife became more common. The Jaccard Index of Species Similarity was 20, which means that Horseshoe Island and Boomerang Island had about 20 percent of the same species. Willow cuttings, which were placed at various locations throughout the two islands during 1993, appeared to be doing very well, and natural proliferation was observed at multiple locations. Anfang (1994) concluded that the seeded areas seemed to be growing well, the dominance of seeded species continued to increase, weed species were becoming more and more sparse, there was good overall cover, and Robel readings for the islands were above project goals.

January through March 1995 Current Velocity, DO, Temperature and Winter Habitat Monitoring

Richardson (1995) monitored water quality parameters as well as winter habitat conditions on three occasions during 1995 (January 12, February 14, and March 6). This monitoring effort was a replication of the monitoring activities performed on February 13 and March 4, 1993 (Dukerschein 1993). Sampling locations were established along the same east-west transects as the 1993 sampling. The winter of 1994-95 was very mild, with little snowfall and unseasonably warm temperatures. Even though temperatures were above normal, four of the 15 sampling locations were frozen to the bottom, so data presented represents 11 sampling locations instead of 15. The mean water depth ranged from 3 to 68 cm; mean water temperatures were <1.0 °C and ranged from 0.0 to 0.7 °C. Mean DO readings were ≥13.0 mg/L and ranged from 13.0 to 27.5 mg/L. As in the previous monitoring, current velocities were nearly undetectable in sampling points located in the northern interior of Horseshoe Island, and variable in the southern portion of the island (range of 0.03 to 0.20 ft/sec). Richardson (1995) concluded that the habitat improvements had accomplished, in part, the stated goals. However, the limiting factor affecting wintering habitat for fish, particularly centrarchids, was water depth. Measures still needed to be taken to increase winter water depth.

August 1995 Terrestrial Vegetation Monitoring

Anfang (1995) monitored the seeded portions of Horseshoe Island on August 11, 1995. Monitoring on that date included examining the progress of willow cuttings placed along the shoreline on both sides of Boomerang Island in all areas that were not riprapped at the time of initial seeding. During this monitoring period, a Robel reading of 5.2 dm was recorded for Horseshoe Island, which represents a 2.3 dm increase from the previous monitoring period. The Robel reading for Boomerang Island was 4.8 dm, which was an increase of 2.6 dm from the previous year. An ANOVA test performed on the percent cover data showed no difference between Horseshoe Island and Boomerang Island in 1995. The decrease in weedy species from year to year was less pronounced in 1995. Species such as reed canary grass, switchgrass, side-oats grama, and Canada wild rye are the dominant plants on Horseshoe Island, while purple loosestrife is becoming more common on Boomerang Island. The Jaccard Index of Species Similarity was calculated for species on Horseshoe Island and Boomerang Island. A value of 25 was obtained, which means that 25 percent of the plants surveyed were common to both islands. Willow cuttings were again extremely prolific on the islands. Aquatic vegetation around the island was becoming more established, and water lily and lotus were the most common. Anfang (1995) concluded that the seeded areas seemed to be growing well and the dominance of seeded species continued to increase, while weed species were becoming more and more sparse. There was good overall cover, and Robel readings for the islands were above project goals.

April through September 1995 Secchi Depth, Turbidity, DO, Temperature, pH, and Specific Conductance Monitoring

Fischer (1995) surveyed four areas around Horseshoe Island to evaluate water clarity within the protected area and to compare it to water clarity in the adjacent channel areas. Fischer also deployed a continuous monitoring instrument for 5 days to compare diel patterns. The resulting data showed that overall water clarity was lower inside Horseshoe Island than in the channel areas. Average turbidity for the protected areas for the entire summer was 24 Nephelometric Turbidity Units (NTU), compared to 15 NTU for the Raft Channel and the main channel. Results showed that turbidity in the northern bay of Horseshoe Island was nearly twice as high as that in the lower bay and the channel areas. Median Secchi Disk readings followed the same path. Fischer proposed that factors influencing the turbidity and Secchi Disk readings could be fish movement, southerly winds, local small-boat traffic, algal blooms, and the very fine surficial particles in the northern bay (≤ 63 microns). The fine sediments are easily resuspended by fish movement or even a slight southerly wind. Data also shows that the average 1-percent photic zone depth in 1995 was 25 percent higher than readings taken before construction. The 5-day continuous monitoring showed that DO never dropped below 5.7 mg/L and exhibited a typical diurnal pattern of minimum concentration at or before noon. Temperature and pH also exhibited similar variations. Specific conductance dropped over the last 48 hours due to an increase in river stage. Fischer (1995) concluded that the upper portion of Horseshoe Island was more turbid than the lower areas, and the lower areas were not substantially different from the channel areas in terms of water clarity. Fischer also recommended the removal or consolidation of fine bed sediments to reduce resuspension and increase deepwater habitat.

August 1999 Terrestrial Vegetation Monitoring

Anfang (1999) monitored vegetation within the Pool 8 Islands on August 18, 1999, to determine the success of the plantings and to evaluate the suitability of species for future sites. This was part of Phase II of the HREP, which included seeding of the seven islands with four different seed mixtures from May until June 1999. In August 1999, 30 plots were randomly selected on Horseshoe Island, 15 to the west and 15 to the east of the center of the island. Since the Robel reading was designed to be used with grass vegetation, readings were not taken in 1999 on Horseshoe and Boomerang Islands because they had become dense stands of 10- to 12-foot-tall willows, cottonwood, and false indigo and 4- to 5-foot-tall herbs. Islands C and D2 also were not monitored because the vegetation was sparse and the Robel reading would have been zero. The Robel reading on Island B was 6.8 dm, while readings on Island E were less than 1.5. An ANOVA test was performed on percent cover data obtained from Horseshoe Island. There was a significant difference in cover between Islands E1 and E2 and Island B, but not between E1 and E2. In 1999, Horseshoe Island had become dominated by tall woody and herbaceous vegetation. The Jaccard Index of Species Similarity showed that Islands E1 and E2 had over half of their species in common, while Island B had about 30 percent of the same species as Island E. Anfang (1999) concluded that the Phase I Islands started out well but had been taken over by dense woody and herbaceous vegetation. The Phase II Islands were just planted at the time of the monitoring and it was too early to draw any conclusions, but it did seem that the seeding had been successful.

August 2000 Aquatic Vegetation Monitoring

Horseshoe Island (88 sites)

Submersed aquatic vegetation decreased in frequency from 1999 (58 percent) to 2000 (34 percent). In 1999, coontail was the dominant species, while water stargrass was dominant in 2000. Coontail decreased from 31 percent (1999) to 10 percent (2000). Water stargrass was the same each year (approximately 15 percent). Nine species were recorded each year (WDNR 2000).

Rooted floating-leaf vegetation remained the same in frequency in both years (approximately 15 percent). American lotus (*Nelumbo lutea*) and white water lily (*Nymphaea odorata*) were the only two species recorded. White water lily increased from 1999 (8 percent) to 2000 (11 percent), while American lotus remained the same (approximately 7 percent) (WDNR 2000).

Boomerang Island (104 sites)

Submersed aquatic vegetation decreased in frequency from 1999 (72 percent) to 2000 (53 percent). Water stargrass dominated both years, decreasing from 66 percent (1999) to 49 percent (2000). Seven species were recorded each year (WDNR 2000).

Rooted floating-leaf vegetation remained the same in frequency in both years (approximately 45 percent). American lotus dominated in both years (approximately 43 percent). American lotus and white water lily were the only two species recorded (WDNR 2000).

4.3 PRESENT HABITAT CONDITIONS

On the basis of past data and observations made on the progress of the Pool 8 Island Construction-Phase I project, it seems that the overall effect on the area has met project goals. Construction of the islands has maintained existing valuable aquatic plant bed habitat and provided physical conditions necessary for the reestablishment of aquatic plant beds in about 1,000 acres of backwater habitat. This has benefited a wide spectrum of fish and wildlife, including migratory waterfowl.

4.3.1 Vegetation

Vegetation has become well established on the island, with weedy species becoming less prominent with every passing year, and seeded species becoming more prominent. One issue with the revegetation portion of the project seems to be the recent invasion of exotic nuisance species such as reed canary grass and purple loosestrife. If not monitored closely, these two species could take over, resulting in a monotypic stand of one of these species or a combination of both in some areas. Aquatic vegetation seems to have become established in the bay of Horseshoe Island. Various monitoring reports stated that dense beds of macrophytes were well established. These mats of aquatic vegetation provide excellent cover for numerous fish species.

4.3.2 Water Quality

The macrophyte beds also slow water velocities entering the bay. The slowed water velocities allow for sediment dropout; thus, increases in Secchi depth readings and decreases in turbidity may occur. However, as Fischer (1995) stated, when small particles of sediment are present (≤63 microns), even the slightest breeze or fish movement will resuspend these particles and lower water clarity.

4.3.3 Island Stability

The overall engineering design of the island seems to be adequate, based on the floods of 1993 and 1997. The riprapped banks, the slope of the banks, and the maintenance of a vegetative buffer zone (willow and cottonwood plantings) appear to have handled flooding well. At least 6 inches of water was present at the highest elevation on the island, with no visible signs of erosion or vegetation loss.

5.0 OPERATION AND MAINTENANCE

5.1 PROJECT FEATURES REQUIRING OPERATION AND MAINTENANCE

The project was designed to require little maintenance. The islands were expected to be overtopped during the 10-year flood event, and erosion could occur during these times. The critical areas along the islands would be protected from erosive action. Generally, it is anticipated that operation and maintenance (O&M) should, therefore, be limited to maintaining vegetation after floods greater than the 10-year event and repairing minor erosion or riprap displacement. The average annual estimated O&M cost of the project, over the 50-year project life, is shown in Table 4 (USACE 1989).

TABLE 4

Estimated Annual Operation and Maintenance Costs, Pool 8 Islands Construction-Phase I

Riprap replacement (30 cubic yards (CY)/year @ $50/CY)	$1,500
Island erosion repair (100 CY/year @ $10/CY)	$1,000
Vegetation management (seeding and planting)	$200
Inspection/report write-up	$500
Total estimated annual cost	**$3,200**

Rehabilitation costs were not included in this estimate. The rehabilitation costs were considered reconstructive work that would significantly exceed the annual O&M requirements identified above and would be needed as a result of a major storm or flood event (USACE 1989).

5.2 OPERATION AND MAINTENANCE RESPONSIBILITIES

Currently, no specific actions are required for operation of the Pool 8 Island Construction-Phase I project. Inspections are to be made after the project has been in place for 5 years. The USACE and USFWS will review these inspection activities for adequacy in meeting project goals. If design goals have not been met in spite of proper maintenance, continued O&M could be discontinued by mutual written agreement of these two government agencies. The project is to be inspected by the USFWS District Manager of the National Wildlife Refuge (USACE 1993).

The islands are visually inspected to insure they are functionally intact. The general condition of the islands is noted. If photographs are taken at the site, they are to be included in the submitted inspection report. Any significant loss of riprap should be replaced to prevent erosion problems. Some erosion of the berm on the back (southern) side of the islands was anticipated. The inspection is to be completed at least once a year (USACE 1993).

5.3 OPERATION AND MAINTENANCE TASKS AND SCHEDULE

In accordance with Section 906(e) of the Water Resources Development Act of 1986, the USFWS has the responsibility for project O&M. The USACE prepared an O&M manual in cooperation with other agencies to assist in fulfilling this obligation (USACE 1993). The O&M of the project is to be conducted annually by the USFWS. Specific operation and maintenance features were defined in the project O&M manual. The non-Federal sponsor for the project was the WDNR.

5.4 OPERATION AND MAINTENANCE HISTORY

An inspection checklist report and project drawing are to be submitted annually to the USACE St. Paul District Engineer for review. The report will also contain a brief summary of the condition of the entire system, including any maintenance work done during the past 1-year period (USACE 1993). Annual costs for operation, maintenance, and repair are the responsibility of the USFWS.

Annual O&M was originally estimated at $3,200. Since completion of the project in 1993, the USFWS has spent approximately $28,200 in total, or an average of about $2,800 per year.

6.0 PROJECT EVALUATION

6.1 PROJECT TEAM

A project team workshop was held with the resource managers from 9:00 a.m. to 10:00 a.m. on February 13, 2001, at the USFWS District Headquarters office in Onalaska, Wisconsin. The purpose of the workshop was to receive input from the resource managers relative to the project. Mr. Don Powell, USACE Project Manager, and Mr. Jon Gumtow, Earth Tech, Inc., facilitated the workshop. The format included a brief summary of the project history followed by solicitation and recording of responses to 10 questions related to the effectiveness, appearance, and implementation of the project. Responses were recorded on a flip chart. Appendix A presents the questions and the recorded responses from this meeting.

Ten people attended the workshop. Two people were unable to attend and provided written responses. In general, the resource managers considered the project successful. A majority of the attendees rated the overall project as excellent. Three good responses were also received. The resource managers agreed that the project effectively stabilized and reestablished vegetated islands, provided sheltered shallow and deepwater habitat, reduced main channel flow and sediment loading, and improved wildlife habitat.

Suggested considerations for similar future projects include the following:

1. Construct islands to a 2-year flood elevation.

2. Vary the top elevations of islands.

3. Create more rock sill openings into the islands to convey high flows.

4. Inspect construction materials imported to the islands to control introduction of invasive species.

5. Continue invasive species control measures.

6. Complete less frequent aerial photography; every 3 to 4 years is recommended.

6.2 INTERESTED PUBLIC

A public participation workshop was held from 7:00 p.m. to 8:00 p.m. on December 7, 2000, at the USFWS District Headquarters office located in Onalaska, Wisconsin. The purpose of the workshop was to receive input from the public relative to the project. Mr. Don Powell, USACE Project Manager, and Mr. Jon Gumtow, Earth Tech, Inc., facilitated the workshop. The workshop format included a brief summary of the project history followed by solicitation and recording of public responses to 11 questions related to the effectiveness, appearance, and implementation of the project. Responses were recorded on a flip chart. Appendix B presents the questions and the recorded responses from this meeting.

Eight people attended the workshop. A majority of the attendees rated the overall project as poor. In general, the public perception was that the project did not significantly change the use of the area by wildlife, specifically migratory waterfowl. This perception could be expected because pre-project habitat conditions in the area were good. The project was constructed to maintain these conditions in the future, not necessarily to improve conditions. The project was not perceived to have affected recreational use in the area. One commentator stated that the islands are impressive landforms and an effective attempt to restore habitat. Another commentator stated that the rock banks on the periphery of the islands prohibit use by recreational boaters due to perceived damage to boats.

Project improvements suggested by the public include the following:

1. Control invasive plants (purple loosestrife) on the islands.

2. Establish additional mud flat/sandbar areas and attempt to reestablish habitat similar to pre-dam conditions.

6.3 SUMMARY EVALUATION OF ECOLOGICAL EFFECTIVENESS

The post-construction monitoring data gathered for this project indicates the project goals and objectives were achieved. Construction of the islands has effectively reestablished and stabilized the islands and provided ecological diversity within Pool 8. Since completion of the project, the public and resource managers have observed revegetation of the islands and increased use by migratory birds, waterfowl, shorebirds, and turtles. Deer and fox have also been observed. The presence of loafing and nesting areas associated with the islands provides valuable habitat for migratory waterfowl. Non-vegetated shorelines and sand areas on the islands immediately following construction provide wading habitat for shorebirds and nesting habitat for turtles. As the island vegetation has matured, the amount of non-vegetated shorelines and barren sand areas has decreased.

Revegetation techniques have effectively stabilized the islands and provided valuable nesting and aquatic habitat. Invasive species including reed canary grass, purple loosestrife, and crown vetch are present. The USFWS has implemented biological control measures for purple loosestrife.

During construction, dredged material was sidecast into the adjacent floodplain forest habitat. This practice resulted in tree mortality and may have modified the hydraulic conditions in a localized area within the floodplain forest. Alternatives to dredged material placement in floodplain forest areas should be considered unless the intention is to modify habitat.

6.4 SUMMARY EVALUATION OF ENGINEERING EFFECTIVENESS

The engineering for this project was completed by the USACE. Comments received by the resource managers indicate that the project goals and objectives were achieved. The rock groins constructed on the perimeter of the islands have become vegetated and effectively stabilize the shoreline. Geotextile fabric used on the shoreline becomes exposed periodically, which requires maintenance and adversely affects the island appearance.

Island location in the backwater areas where historic and remnant islands exist is important because it decreases sedimentation in the backwater areas and restricts human use and the associated disturbance to the plant communities and wildlife. Less disturbance following construction reduces operation and maintenance costs.

The islands were effectively designed and constructed. Hydraulically, the islands were designed to the 10-year flood elevation before becoming overtopped. The top elevations of the islands were also generally flat. Future island designs could include lowering the overall top elevations to a 2- to 5-year flood elevation and varying the top elevations to add topographic diversity. Design to a 2-year flood elevation would allow removal of sediment buildup behind the islands by periodic flood flows.

6.5 SUMMARY EVALUATION OF COST

6.5.1 Estimated Cost

The total estimated cost of the project in June 1989 was $1,213,400 (USACE 1989).

6.5.2 Actual Cost

General design costs were $416,000, and construction costs were about $1,637,000 (Tables 5 and 6).

TABLE 5

Costs for Pool 8 Islands Construction-Phase I

EMP	POOL 8 ISLANDS PHASE 1, STAGE 1			
DACW37-90-C-0042	JF BRENNAN CO., INC. LA CROSSE, WI			
COMPLETION DATE: JUNE 27, 1991				
FINAL CONTRACT COSTS				
DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EARNINGS
EARTHWORK	1	JB	$40,000.00	$40,000.00
SITE PREPARATION	1	JB	$70,000.00	$70,000.00
SEEDING	7.8	ACRE	$2,450.00	$19,110.00
GEOTEXTILE	2,612	SY	$2.00	$5,224.00
RIPRAP	1,361	CY	$26.00	$35,386.00
BASE CONTRACT				$169,720.00
APPROVED MODIFICATION				
HAUL DISTANCE	1	LS	$11,986.00	$11,986.00
TOTAL MODIFICATION				$11,986.00
TOTAL CONTRACT EARNINGS				$181,706.00

TABLE 6

Costs for Pool 8 Islands Construction-Phase I

EMP	POOL 8 ISLANDS PHASE 1, STAGE 2			
DACW37-91-C-0032	LAMETTI & SONS, INC. HUGO, MN			
COMPLETION DATE: JUNE 8, 1993				
FINAL CONTRACT COSTS				
DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EARNINGS
EMBANKMENT FILL, SAND	156,515	CY	$5.46	$854,571.90
EMBANKMENT FILL, FINES	55,997	CY	$6.95	$389,179.15
SEEDING	17.28	AC	$1,250.00	$21,600.00
PLANTINGS	1	JB	$20,000.00	$20,000.00
GEOTEXTILE	7,013	SY	$2.50	$17,532.50
RIPRAP	6,663	CY	$21.00	$139,923.00
SUBTOTAL OF CONTRACT EARNINGS				$1,442,806.55
APPROVED MODIFICATIONS				
ADDITIONAL EXCAVATION	1	LS	$10,770.00	$10,770.00
PERM. CENTERLINE STAKES	1	LS	$1,171.93	$1,171.93
VARIATION IN EST. QTY.	1	LS	$979.72	$979.72
TOTAL MODIFICATIONS				$12,921.65
TOTAL CONTRACT EARNINGS				$1,455,728.20

7.0 LESSONS LEARNED

The following lessons have been learned from evaluating the effectiveness of the Pool 8 Islands Phase I project.

- Island projects create valuable wildlife habitat.
- Islands should be designed with openings or low areas to convey higher flows (e.g., 2- to 5-year flood event).
- Extending the littoral zone on the periphery of the islands creates more loafing area and habitat for shorebirds.
- Island and aquatic revegetation requires several growing seasons to effectively establish the desired plant community.
- Bioengineering stabilization measures (e.g., willow sprigs) work well.
- Consider implementing measures to control invasive species.
- Consider testing fine sediments from the borrow site to determine if avian botulism spores are present.

8.0 RECOMMENDATIONS FOR FUTURE SIMILAR PROJECTS

On the basis of the information summarized in this project completion report, the following recommendations have been developed for consideration in future similar projects.

- Improve public relations and education regarding project benefits.
- Limit the use of geotextile fabric and rock on the periphery of islands and replace them with bioengineering stabilization techniques.
- Lower the top elevation of some island designs to a 2- to 5-year flood event.
- Vary the top elevation of the islands to create greater diversity.
- Create barren sand areas on the islands to provide turtle nesting habitat.
- Create a shallow water shelf area 40 feet from the island shore to create shorebird and waterfowl loafing habitat.
- Control invasive plants (purple loosestrife) on the islands and inspect construction material to avoid importing invasive plants to the islands (i.e., crown vetch).
- Include a mix of soil textures in the topsoil to provide a good medium for plant growth.
- Limit compaction of the topsoil during construction.
- Consider dredging behind protected island areas to improve winter fish habitat.

9.0 REFERENCES

Anfang, Robert. August 1991. Revegetation Monitoring, Upper Mississippi River, Pool 5 through Pool 8. Report prepared by the United States Army Corps of Engineers.

Anfang, Robert. August 1992. Revegetation Monitoring for Pool 8 Islands EMP. Report prepared by the United States Army Corps of Engineers.

Anfang, Robert. August 1993. Revegetation Monitoring for Pool 8 Islands EMP. Report prepared by the United States Army Corps of Engineers.

Anfang, Robert. August 1994. Revegetation Monitoring for Pool 8 Islands EMP. Report prepared by the United States Army Corps of Engineers.

Anfang, Robert. August 1995. Revegetation Monitoring for Pool 8 Islands EMP. Report prepared by the United States Army Corps of Engineers.

Anfang, Robert. 1999. Revegetation Monitoring for Pool 8 Islands EMP. Report prepared by the United States Army Corps of Engineers.

Belanger, Kenneth D., D.J. Dieterman, and T.W. Deyo. 1990. Pre- and Post-Construction Water Quality Monitoring Projects at Big Lake Bay, Finger Lakes, Lake Onalaska, and Pool 8 Islands Area of the Upper Mississippi River. Report prepared by the United States Fish and Wildlife Service.

Dukerschein, Jeanne T. 1993. Winter Water Quality Monitoring in Pool 8 Islands Habitat Rehabilitation and Enhancement Project, Phase I, Stage 2, following completion of construction. Report prepared by the Wisconsin Department of Natural Resources.

Fischer, James R. 1995. Winter Water Quality and Clarity at the Horseshoe Island Rehabilitation and Enhancement of Pool 8, Upper Mississippi River. Report prepared by the Wisconsin Department of Natural Resources.

Richardson, L.A.H. 1991. A Summary of Water Quality Characteristics at the Pool 8 Islands Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System. Report prepared by the Wisconsin Department of Natural Resources.

Richardson, L.A.H. 1995. Winter 1995 Water Quality Monitoring in Pool 8 Island Habitat Rehabilitation and Enhancement Project, Phase I, Stage II. Report prepared by the Wisconsin Department of Natural Resources.

Rogers, Sara. 1992. Status of Aquatic Vegetation at Selected Habitat Rehabilitation and Enhancement Project Sites. Report prepared by the United States Fish and Wildlife Service.

United States Army Corps of Engineers. 1989. Definite Project Report/Environmental Assessment (SP-4), Pool 8 Island Construction - Phase I, Habitat Rehabilitation and Enhancement Project. Department of the Army, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605-1592.

United States Army Corps of Engineers. December 1993. Upper Mississippi River System Environmental Management Program, Operation and Maintenance Manual for Pool 8 Islands Phase I HREP. U.S. Army Corps of Engineers, St. Paul District, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Whiting, Robert J. 1992. Habitat Rehabilitation and Enhancement Project Vegetation Monitoring. Report prepared by the United States Army Corps of Engineers.

http://www.mvp.usace.army.mil

FIGURES

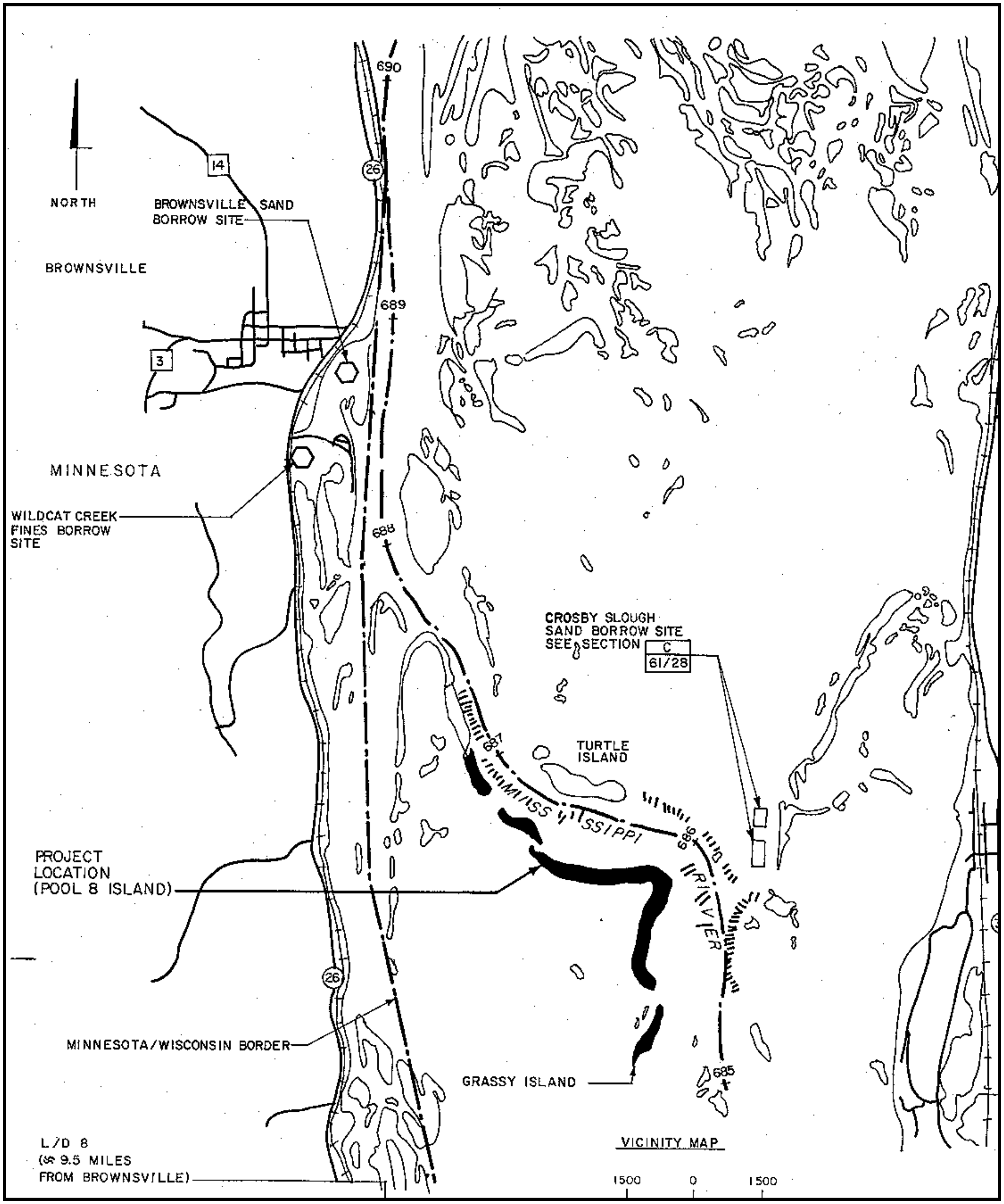


Figure 1. Pool 8 Islands HREP – Phase I, Project Location

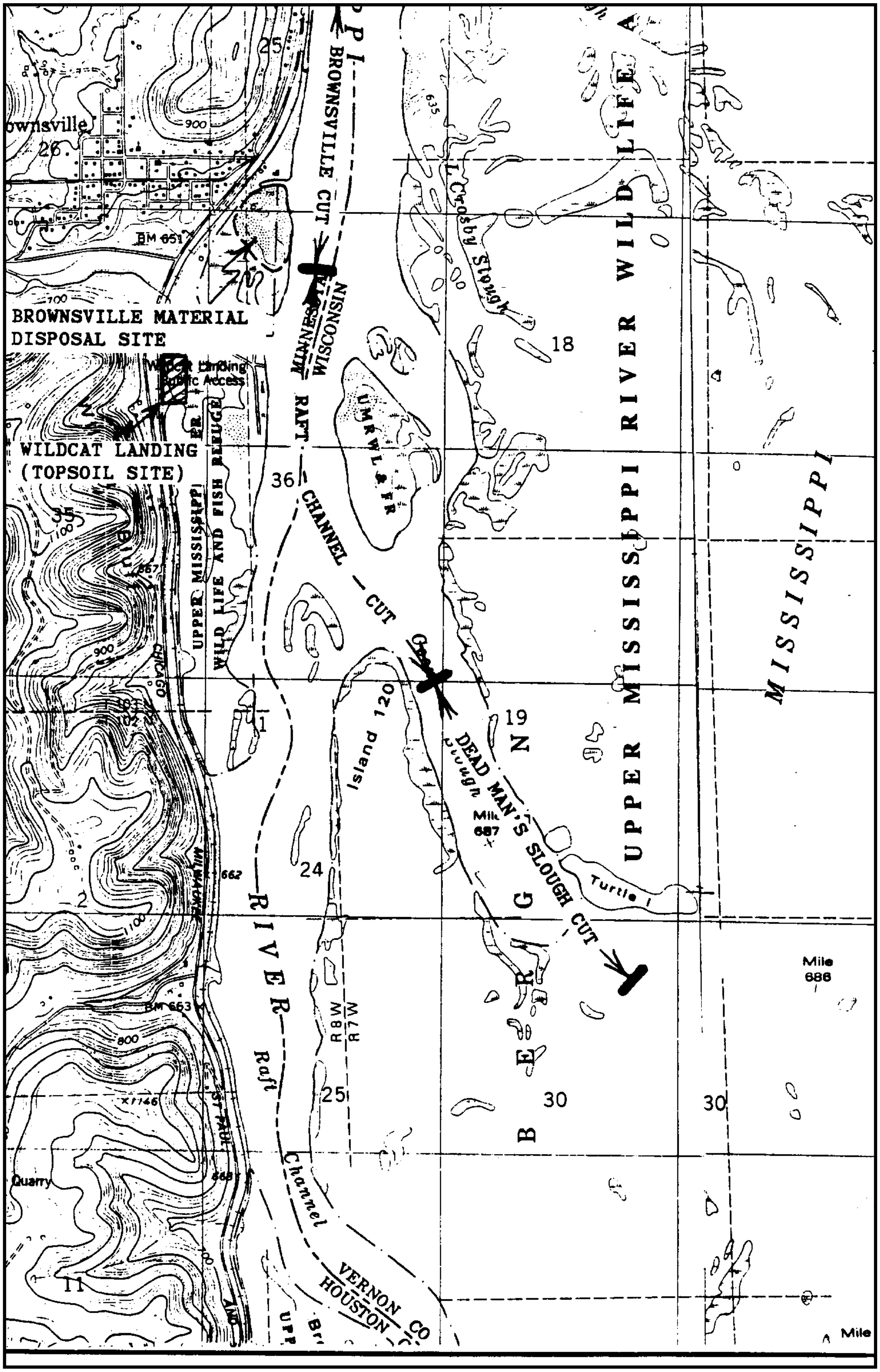


Figure 2. Pool 8 Islands HREP – Phase I, Island Construction Site Plan

APPENDIX A

COMPILED RESULTS OF INTERVIEWS WITH PROJECT TEAM

PROJECT OBJECTIVES

1. Reestablish 15 acres of stabilized island from the head of the Raft Channel at river mile (R.M.) 687.7 to R.M. 685.3.

2. Reestablish a grass/shrub/herbaceous vegetative cover on the island in order to provide secondary wildlife benefits (especially waterfowl nesting).

3. Increase sheltered shallow habitat (typically 2.5 feet deep or less) by at least 100 acres, and increase sheltered deep habitat (typically 2.5 to 6.5 feet deep) by a minimum of 30 acres. These habitats should be interspersed with flowing sloughs.

4. Reduce the main channel flow into the project area by 75 percent (measured during periods of less than 10-year flood flow) to decrease sediment loading and thereby reduce backwater aquatic habitat loss from sedimentation.

PROJECT TEAM RESPONSES
POOL 8 ISLAND CONSTRUCTION-PHASE I
FEBRUARY 13, 2001

	Question	Response
Q1	*Which of the project objectives were effectively addressed by the project?*	Objective # 1 was achieved. Objective # 2 was achieved – some crown vetch (invasive species). Objective # 3 was achieved. - deepwater habitat could be improved. Objective # 4 was achieved.

Q2	*What project features could have been changed to make a more effective project?*	- Place islands on the shelves (away from the main channel).
		- Create more islands to the south.
		- Diversify top elevation of islands.
		- Lower overall elevation of islands.
		    - construct to 2- to 5-year flood (not 10-year, as designed).
		    - 2-year flood can remove sediment buildup.
		    - have some islands at lower and some islands at higher elevation.
		Lessons Learned
		- More openings into the islands.
		    - more rock sills for conveying high flows (>2 years).
		- Islands are stable; create more beach zones (shelves) associated with islands for loafing.
		- Check the source of construction materials to control introduction of invasive species (particularly rock sources).

Question	Response
Q3 *How could the appearance of the project be improved?*	- Create different elevations on islands to increase diversity. - Over time, vegetation has grown on rocks and improved aesthetics. - Groins have made a positive visual appearance. - have now become vegetated. - Island works very well and appearance is good (per design). - Limit use of geotextile fabric – it becomes exposed after completion. - New islands should be incorporated with old islands and should not cover old islands.
Q4 *How did this project affect use of the area?*	- Fox and deer present on island. - Island placement on shelf area created habitat for *Sago*, wild celery and wildlife has responded positively. - Island placement off the main channel limited human use, which benefited wildlife. - Fish use increased on up-gradient side of the island. - Wildlife nesting is occurring on grassy island (particularly waterfowl). - Shorebird and turtle nesting decreased as vegetation cover increased. - Island functions as thermal protection.

Q5 *Is the amount of O&M appropriate, and how could it be reduced?*	- Crown vetch, purple loosestrife (invasive plants) present on island.
	    - biological controls being used.
	- Most O&M was completed shortly after construction.
	    - caused by design problems.
	- Long term, O&M will be minimal.
	- Increase width of island shelf from 30 feet to 40 feet.

Q5 (Continued)	- There are high cumulative costs associated with controlling invasive

Question	Response
	species in the river.
Q6 *What monitoring is appropriate to assess project effectiveness?*	- Complete standardized monitoring for all projects. - Aquatic and terrestrial vegetation monitoring results on islands relate to differences in elevation/source material/topsoil thickness. - Fishery use is unknown. - Water quality discharge is unknown. - Additional monitoring is needed on the exterior of the island. - No need to do annual air photography – 3 to 4 years is a good frequency. - Islands are used by shorebirds – complete surveys to document. - Complete waterfowl surveys – to document nesting and overall use (time of year).
Q7 *What is your assessment of the project overall?*	
A = Excellent - ecologically effective, appropriate design/cost, appearance acceptable.	(A - 7 responses)
B = Good - mostly ecologically effective, good design, reasonable cost, etc.	(B - 3 responses)
C = Fair - marginally effective, fair design, somewhat costly, etc.	
D = Poor - not ecologically effective, inappropriate design, too costly, etc.	
F = Failure - no positive attributes.	

Question		Response
Q8	*What needs to be done to further improve habitat conditions in the project area?*	- Create more islands (Phase 3 of the project). - Create more islands north of Turtle Island. - Maintain sand areas on islands for turtles and keep sand areas away from public use areas. - Control/management of invasive species.
Q9	*What was the public reaction to the project?*	- Public not aware of objectives or project. - More public outreach to educate the public on benefits. - The public who are aware of the island are impressed with the project. - Public wants more recreational use (islands for boating/picnics).
Q10	*What were the "lessons learned" from this project?*	- Locate islands on shelf areas; could use less rock. - Lower island elevations (2-year flood vs. 10-year flood design). - Bioengineering stabilization measures (willow) worked well. - Island construction with high fines creates stable conditions. - Design works and is used on other projects. - Do not allow 100% fines as topsoil; poor soil medium for plant growth. - Delta formation near the pond. - Dredge size should be appropriate for the size of the project. - Stabilize top of island over winter during construction.

APPENDIX B

COMPILED RESULTS OF INTERVIEWS WITH INTERESTED PUBLIC

PUBLIC RESPONSES
POOL 8 ISLAND CONSTRUCTION-PHASE I
DECEMBER 7, 2000

	Question	Response
Q1	*Were all the habitat project objectives met?*	(Yes - 1) (No - 1) (UNKNOWN - 1)
Q2	*If not, which of the project objectives were not attained and why?*	- No noticeable increase in duck populations. - Unable to answer Questions 1, 2, or 3 because the public does not have access to the information needed to address the question.
Q3	*How could the project features be changed to better meet the objectives?*	- No response.
Q4	*Are the present habitat conditions in the project area satisfactory?*	(Yes - 0) (No - 1) (UNKNOWN - 0)
Q5	*If not, what needs to be done to restore habitat conditions?*	- Establish additional mud flat/sandbar areas. Strive toward establishing habitats to replicate pre-dam conditions.
Q6	*How did this project affect use of the area?*	- Project has not affected use. During high water, the island may act as an obstruction. - Islands with rock banks hinder access by recreational boaters. - Project has not affected plant life. - Need to control purple loosestrife on the islands.

Q7	*How does the project look?*	- Project is impressive from the air and is an effective attempt to reestablish habitat.
		- Waterfowl populations have decreased since the 1986/1987 drought. Pool needs more vegetation cover/food.
		  - Predators have reduced nesting waterfowl production.
		  - Islands look artificial but provide good habitat.

Q8	*How could the appearance of the project be improved?*	- More trees (i.e., swamp maple) would improve project appearance.

	Question	Response
Q9	*What is your assessment of the project overall?*	
	A = Excellent - ecologically effective, appropriate design/cost, appearance acceptable.	- (A - 0)
	B = Good - mostly ecologically effective, good design, reasonable cost, etc.	- (B - 0)
	C = Fair - marginally effective, fair design, somewhat costly, etc.	- (C - 0)
	D = Poor - not ecologically effective, inappropriate design, too costly, etc.	- (D - 1) (Based on project cost.)
	F = Failure - no positive attributes.	- (F - 0)

Q10	*How could public participation in project planning be improved?*	- Better advertisement to the public (i.e., in local newspapers/TV).
		- Provide more information (i.e., photos, video) to the media.
		- Do a better job of getting the word out.
		- Internet may not be useful to all the interested public.
		- Contact local conservation organizations to get scheduled meetings into newsletters.
		- The public would use web site surveys; the Internet would be useful to the public.
		- Mail surveys to the public.
		- USACE Internet site should provide links to other web sites.
		- More media exposure during the completion report process.
		- Include schools in the projects.
		- Public presentations of monitoring data.
		- List of interested groups (Internet).
		  - USFWS (waterfowl counts).
		  - Audubon Society.
		  - Rod and gun clubs.
		  - Boat landing interviews.
		  - Flyers left on cars at interest points.
		  - Scientifically defensible surveys.

Question	Response

Q11 *What are your recommendations for habitat protection and restoration on the Upper Mississippi River?*	- Complete projects closer to higher use areas to increase public support.
	- The greater number of projects provides benefits to more species and users.
	- Integrate water level management into projects.
	- Know the outcomes related to water levels from a project.
	- Work with landowners adjacent to the river.
	    - Incorporate buffer strips along the river.
	- Interagency exchange of ideas.
	    - Increased interaction among State, Federal, and county resource agencies.
	- Ban the use of jet skis to reduce wave action in shallow water areas and aid in restoration.
	- Increase the frequency of gate changes to minimize fluctuations of water within pools.
	- Look at policies or projects on smaller tributary streams.
	    - In conjunction with other resource agencies.
	    - Build trust with other resource agencies.
	    - Establish one time line for the project.
	- Root River watershed use has degraded Pool 8.
	- Root River watershed improvements.
	    - Education (buffer strips, grass waterways).
	    - Control runoff into Pool 8.
	    - Remove livestock in rivers.
	    - Restore wetlands in the watershed.
	- Increase public participation within the watershed.
	- Improve interagency cooperation.
	    - Local.
	    - County.
	    - State.
	    - Federal.