UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-13F)

POOL 11 ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT

SEPTEMBER 2001

US Army Corps
of Engineers ®
Rock Island District

POOL 11, MISSISSIPPI RIVER
MILES 583.3 THROUGH 593.0
DUBUQUE COUNTY, IOWA AND
GRANT COUNTY, WISCONSIN

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

CEMVR-PM-M

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM DEFINITE PROJECT REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-13F)

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SEPTEMBER 2001

ACKNOWLEDGEMENT

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EXECUTIVE SUMMARY

The Pool 11 Islands Habitat Rehabilitation and Enhancement Project (HREP) is located near Dubuque, Iowa, in the lower end of Pool 11 between Upper Mississippi River Miles (RM) 583.3 and 593.0. The project stretches from Lock and Dam 11 upstream to Potosi Creek in Dubuque County, Iowa, and Grant County, Wisconsin. The project area roughly encompasses the aquatic and terrestrial lands between the rail lines that parallel either side of the Mississippi River. All project lands are in Federal ownership and are managed by the U.S. Fish and Wildlife Service as part of the Upper Mississippi River Wildlife and Fish Refuge.

The Pool 11 Islands area is losing valuable backwater areas to siltation, and aquatic vegetation is declining due to turbidity associated with wind-induced resuspension of bottom sediments across the large, open-water reaches. These decreases have led to the loss of both terrestrial and aquatic habitats, protected littoral zones associated with islands, and protected deep-water habitats. Significant opportunities are available for preserving, enhancing, and improving habitat for migratory birds, fisheries, aquatic mammals, and endangered species by reducing backwater sedimentation, increasing off-channel depths, and reducing sediment resuspension.

The goals of the proposed project are to restore and protect aquatic and backwater habitats. The objectives identified to meet these goals were: (1) reduce resuspension of sediments; (2) create areas with flow and depth diversity; (3) increase abundance and diversity of aquatic plants; (4) enhance nesting and brooding habitat for migratory birds; (5) reduce sedimentation in backwaters; (6) provide reliable food resources for migratory birds and resident wildlife; (7) reduce island erosion; and (8) create off-channel deep-water areas to provide year-round habitat for centrarchids and associated species. The following four enhancement areas and their associated plans were considered to achieve the project goals and objectives:

1. Sunfish Lake

    - No action.
    - Construct an 1800-m sediment deflection embankment and mechanically dredge a 6.5-ha system of channels.
    - Construct a 1500-m sediment deflection embankment and mechanically/hydraulically dredge an 11.5-ha system of channels.

2. Sinnippee Creek

    - No action.
    - Construct 1265 m of sediment deflection embankment and island using adjacent mechanically dredged material.

3. Mud Lake/Zollicoffer Slough

- No action.
- Construct a 1590-m sediment deflection embankment, 1000 m of deflection islands, and mechanically dredge 6.2 ha of channels adjacent to the embankment/islands and into Mud Lake and Zollicoffer Slough.
- Construct a 3038-m sediment deflection embankment and mechanically dredge 8.8 ha of channels adjacent to the embankment and into Mud Lake and Zollicoffer Slough.
- Construct a 4200-m sediment deflection embankment and mechanically/ hydraulically dredge 12.5 ha of channels adjacent to the embankment and into Mud Lake and Zollicoffer Slough.

4. Island Construction

- No action.
- Build 4 small islands totaling 315 m in length and a 2-ha boulder field.
- Build 6 small islands totaling 470 m in length and a 2-ha boulder field.
- Build 4 medium islands totaling 1000 m in length and a 2-ha boulder field.
- Build 5 medium islands totaling 1930 m in length and a 2-ha boulder field.
- Build 6 medium islands totaling 1500 m in length and a 2-ha boulder field.
- Build 4 large islands totaling 2000 m in length and a 2-ha boulder field.
- Build 6 large islands totaling 3000 m in length and a 2-ha boulder field.

Evaluation of the enhancement area's construction options was accomplished through application of Habitat Evaluation Procedures (HEP). HEP was developed by the U.S. Fish and Wildlife Service as a method to rate the quality and quantity of habitat impacted by land and water development projects. HEP uses a Habitat Suitability Index (HSI) to measure how suitable a habitat is for a particular species when compared to the optimum habitat. HEP quantifies habitat output in the form of habitat units (HUs) that are combined with project cost data and functional life expectancy to compare the construction options of the proposed enhancement areas. This incremental analysis identifies which combinations of construction options would be cost efficient and cost effective.

The recommended plan (shown on Figure ES-1) includes constructing a 1500-m sediment deflection embankment and mechanically/hydraulically dredging an 11.5-ha system of channels at Sunfish Lake; no action at Sinnippee Creek; constructing a 3038-m sediment deflection embankment and mechanically dredging 8.8 ha of channels adjacent to the embankment at Mud Lake/Zollicoffer Slough; and no action for the Island Construction enhancement area.

Constructing sediment deflection embankments would restore and enhance backwater habitat by reducing sedimentation and protecting against wind-induced wave forces that cause resuspension of sediments. Dredging channels behind the deflection embankments

would create overwintering habitat and increase aquatic diversity, while also providing material to construct the embankments.

Implementation of the recommended plan would increase the quality and quantity of preferred habitat at this location. The project outputs meet site management goals and objectives and support the overall goals and objectives of the Upper Mississippi River System-Environmental Management Program (UMRS-EMP), the North American Waterfowl Management Plan, and the Partners in Flight program.

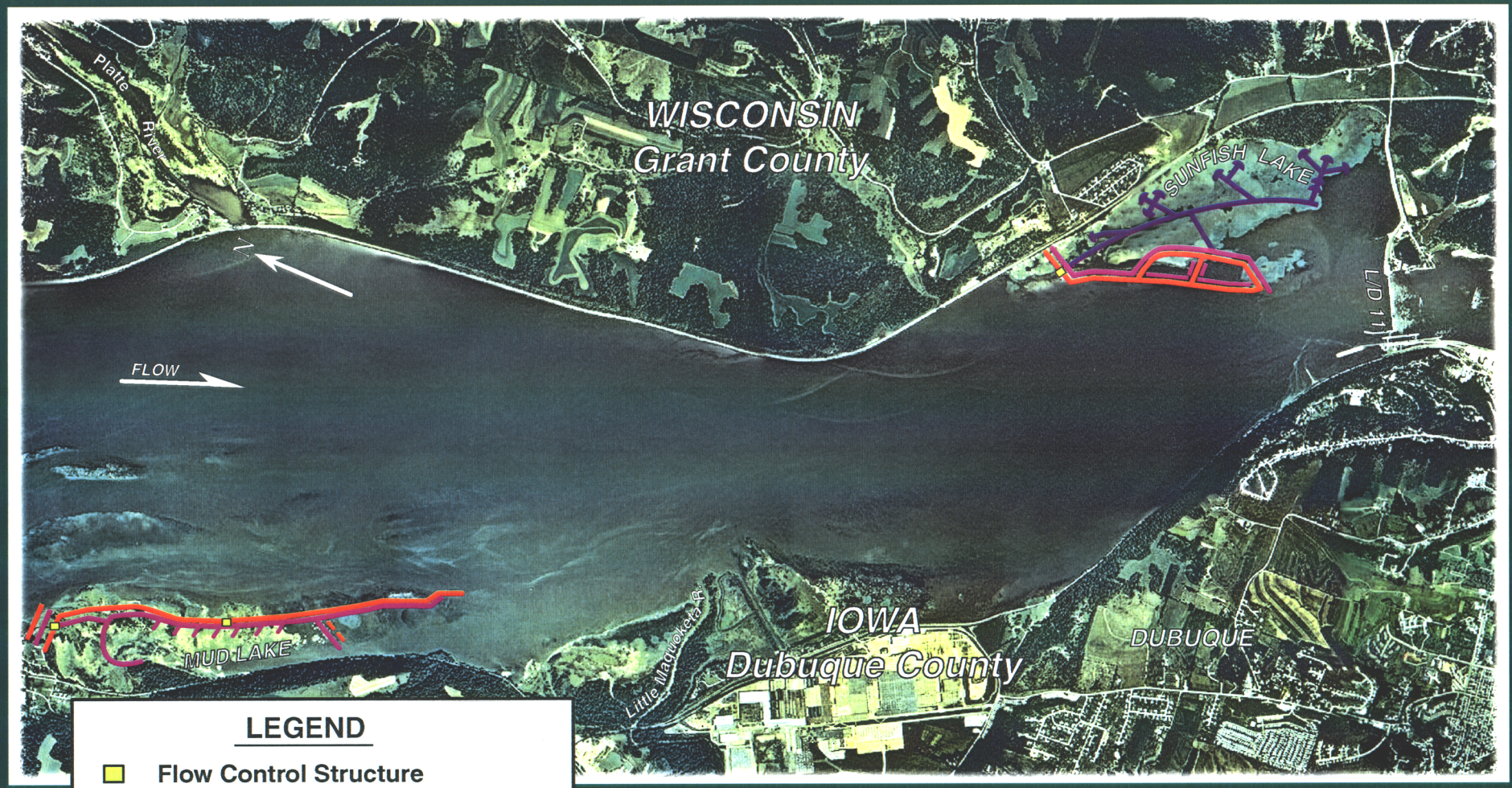
The U.S. Army Corps of Engineers will be responsible for the Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the final Definite Project Report (DPR) and that is needed as a result of specific storm or flood events. Rehabilitation of the project is considered to be reconstructive work that cannot be accurately estimated at this time.

Section 906(e) of the 1986 Water Resources Development Act (WRDA) specifies that first cost funding for enhancement features "located on lands managed as a national wildlife refuge" will be 100 percent Federal. All Pool 11 Islands project features will be located on federally owned lands managed through a cooperative agreement with the U.S. Fish and Wildlife Service, the Federal project sponsor. Per Section 107(b) of the 1992 WRDA, project operation and maintenance at an estimated average annual cost of $9,960 will be accomplished by the U.S. Fish and Wildlife Service. The Iowa Department of Natural Resources and the Wisconsin Department of Natural Resources are the non-Federal project sponsors.

The District Engineer has reviewed the project outputs and determined that the implementation of the selected plan is justified and in the Federal interest. Therefore, the Rock Island District Engineer recommends construction approval for the Pool 11 Islands Habitat Rehabilitation and Enhancement project at an estimated Federal expense of $6,328,409. The total Federal cost estimate, including general design and construction management, is $8,558,617.

UMRS EMP

Figure ES-1
POOL 11 ISLANDS
Project Location Map



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1. INTRODUCTION

a. Purpose. The purpose of this report is to present a detailed proposal for the rehabilitation and enhancement of the Mississippi River's lower Pool 11. This report provides planning, engineering, and sufficient construction details of the selected plan to allow final design and construction to proceed subsequent to approval of this document.

b. Resource Problems and Opportunities. The Pool 11 Islands project area is part of the U.S. Fish and Wildlife Service's (USFWS) Upper Mississippi River Wildlife and Fish Refuge. The project area is comprised primarily of vast areas of open water created following construction of Lock and Dam 11 in 1937. A few low-level islands are present in the Mud Lake and Sunfish Lake vicinity.

The Pool 11 Islands area is losing valuable backwater areas to siltation and aquatic vegetation is declining due to turbidity associated with wind-induced resuspension of bottom sediments across the large, open-water reaches. These decreases have led to the loss of both terrestrial and aquatic habitats, protected littoral zones associated with islands, and protected deep-water habitats.

Significant opportunities are available for preserving, enhancing, and improving habitat for migratory birds, fisheries, aquatic mammals, and endangered species by reducing backwater sedimentation, increasing off-channel depths, and reducing sediment resuspension.

c. Project Selection. The Iowa and Wisconsin Departments of Natural Resources (DNRs) (with support from the USFWS) nominated the Pool 11 Islands Habitat Rehabilitation and Enhancement Project (HREP) for inclusion in the Rock Island District's habitat program. The Fish and Wildlife Interagency Committee (FWIC) then ranked the project habitat benefits based on critical habitat needs along the Mississippi and Illinois Rivers. After considering resource needs and deficiencies pool by pool, the Pool 11 Islands HREP was recommended and supported by the FWIC and the River Resources Coordinating Team (RRCT) as providing significant aquatic, wetland, and terrestrial benefits with opportunities for habitat enhancement. Enhanced capability to manage the

project area for migratory birds, fish, and wildlife use only will be achieved by implementing the proposed project enhancement features.

d. Scope of Study. The Pool 11 Islands project area is located in the lower 16 km of Pool 11, immediately upstream of Dubuque, Iowa. The project is located in Dubuque County, Iowa, and Grant County, Wisconsin, between River Miles (RM) 583.3 and 593.0. Plate 1 provides vicinity and general location maps for the Pool 11 Islands Habitat Rehabilitation and Enhancement Project (HREP). Plates 11 and 12 show site-specific plans.

The scope of this study focuses on proposed project features that would improve aquatic and wetland habitat and enhance overall resource values. The project is consistent with agency management goals and was planned for the benefit of resident and migratory birds and fish and other wildlife.

Field surveys and habitat quantification procedures were completed to support the planning and assessment of proposed project alternatives. Soil borings were taken to determine sediment types and properties. Baseline water quality monitoring was performed to define present water quality conditions/problems.

The Iowa and Wisconsin DNRs have made wildlife and resident fish observations within the study area. The WDNR also has collected invertebrate and water quality samples in the project area. These observations, along with future studies and monitoring, will assist in evaluating project performance.

e. Format of Report. The report is organized to follow a general problem-solving format. The purpose, problems, and project selection process are presented in Section 1. Section 2 establishes the baseline for existing resources. Section 3 provides the goals and objectives of the project. Sections 4 and 5 propose and evaluate project alternatives. Section 6 describes the recommended plan and lists general design, construction, operation, and maintenance considerations. Section 7 describes the schedule for design and construction. Section 8 contains cost estimates for initial construction and annual operation and maintenance. Section 9 assesses the environmental effects of the recommended plan. Section 10 details performance evaluation and monitoring plans. Section 11 describes real estate requirements. Sections 12 and 13 summarize implementation requirements and coordination. Sections 14 and 15 present the conclusions and recommendations. Section 16 contains a finding of No Significant Impact statement. Drawings (plates) have been furnished to provide sufficient detail to allow review of the existing features and the recommended plan.

f. Authority. The authority for this report is provided by the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662), Section 405 of WRDA 1990 (Public Law 101-640), Section 107 of WRDA 1992 (Public Law 102-580), and Section 509 of WRDA 1999 (Public Law 106-53). The proposed project would be funded and constructed under these authorizations.

2. ASSESSMENT OF EXISTING RESOURCES

Pool 11 is part of the Upper Mississippi River and extends from Dubuque, Iowa, northwesterly 32.1 river miles to Guttenberg, Iowa (see plate 1). It was created in 1937 with the completion of Lock and Dam 11 at Upper Mississippi RM 583.3. The river flows from west to east in the upper part of the pool, turning to flow south at approximate RM 591. The lower 16 km of Pool 11 is open and lake-like with few or no islands. Moving upstream of the open water, islands and side channels become more numerous. Four sediment-laden tributaries enter in this reach. The Little Maquoketa River, Platte River, and Grant River enter in the lower part of the pool, while the Turkey River enters 40 km upstream of the lock and dam. Sinnippee Creek, a smaller tributary, enters the lower part of the pool on the Wisconsin side. Leisure Creek enters into Mud Lake on the Iowa side.

The navigation channel in lower Pool 11 begins on the Iowa side at the lock and dam. Just 1.5 km above the lock and dam it begins a crossing to the Wisconsin shoreline (RM 585.5) and crosses back immediately. At RM 586.6, it completes its cross back to the Iowa side and remains there for 24 km.

This study focused on lower Pool 11, immediately upstream of Lock and Dam 11 (RM 583.3) to immediately upstream of Potosi Pier (RM 593.0).

a. Resource History. Prior to constructing the lock and dam, lower Pool 11 was characterized by multiple channels, sloughs, islands, and shallow lakes. Figure 2-1 shows the area prior to impoundment. Notable features include two large backwater lakes on the Iowa side—Zollicoffer Lake and Mud Lake. Grant River was a yazoo tributary that ran parallel to the Mississippi River from RM 593 to RM 587. Maquoketa Island was a large mid-channel island located at approximate RM 586 to RM 588. Numerous wing dams, closing dams, and bank revetment in the channel borders and side channels were constructed as part of the 4- and 6-Foot Channel Navigation Projects.

When the pool was created, the majority of the islands in the lower pool were covered with 1 m to 2 m of water. Portions of Island 212 remained above water, as did what is now known as O'Leary Island in Sunfish Lake. Immediately after impoundment, the inundated channels and stump fields provided a diversity of habitats. These areas have become more uniform as the former islands have eroded and the deeper areas have filled in. The lower portion of the navigation pool is now a wide, exposed body of water. The wing dams, closing dams, and revetment in the lower pool were inundated. Since impoundment, many of these structures have been wholly or partially covered with sediment (Boland 1980).

b. Land Use and Management. The Corps of Engineers has primary administrative responsibility for land in lower Pool 11. Management of the majority of this area was subsequently transferred to the Department of Interior, U.S. Fish and Wildlife Service (USFWS) for fish and wildlife purposes under a Cooperative Agreement between

the Department of the Interior, the USFWS, and the U.S. Army Corps of Engineers, dated February 14, 1963.

Lower Pool 11 is part of the USFWS's Upper Mississippi River National Wildlife and Fish Refuge.

A number of recreational facilities are in lower Pool 11. At the Lock and Dam 11 overflow structure, the Corps of Engineers has a boat ramp with access to Pool 11 from the Wisconsin side. The Dubuque County Conservation Board, under lease with the Corps, operates a picnic area at the upstream end of Mud Lake. The area has a boat ramp with access to the river, but does not provide boat access to Mud Lake. A marina is located upstream of the picnic area. The marina also provides access to the river, but does not provide boat access to Mud Lake. The Corps of Engineers manages the Grant River Recreation Area located downstream of Potosi Pier in Wisconsin. The recreation area has campgrounds, a day-use area, and boat ramps. Through a lease with the Corps of Engineers, the Village of Potosi, Wisconsin, manages a small recreation site with a boat ramp at Potosi Pier.

John Deere Dubuque Works, located on the Iowa side of the river at approximate RM 586, is the only large industry in lower Pool 11.

c. Water Resources. The existing project for navigation on the Mississippi River between the Missouri River and Minneapolis, Minnesota, was authorized by the Rivers and Harbors Act of July 3, 1930. The project provides for a 9-foot channel of adequate width between the mouth of the Missouri River and Minneapolis by constructing a system of locks and dams, supplemented by dredging. The proposed project features are adjacent and contiguous to the Mississippi River 9-foot channel. The proposed project and features thereof as described in this report will not affect navigation. Table 2-1 details flood flows and elevations at Lock and Dam 11 for the Pool 11 Islands project location.

TABLE 2-1. Flood Flows and Elevations.

Event	Elevation (m)*	Flow
flat pool	183.79	0 liters/sec
5-year	184.89	4 785 500 liters/sec
10-year	185.47	5 550 100 liters/sec
50-year	186.68	7 249 100 liters/sec
100-year	186.99	7 957 000 liters/sec

* Elevations are listed in metric and based on NGVD 1912.

d. Water Quality. The wide-water expanse above Lock and Dam 11 is negatively impacted by high turbidity and suspended solids values, due in part to resuspension of bed sediments caused by wind-generated waves. Unstable bottom sediments, coupled with a

decrease in the photic zone, are conditions that are not favorable for the successful establishment of aquatic submergent vegetation. The Grant and Platte Rivers, tributaries to the Mississippi River in lower Pool 11, have some of the highest sediment yields of rivers in Wisconsin. Sedimentation in the Sunfish and Mud Lakes backwater areas has limited their usefulness as deep-water, off-channel habitat for fish.

The results from baseline water quality monitoring studies performed in lower Pool 11 have shown that on occasion pH values exceed 9.0 and dissolved oxygen (D.O.) concentrations fall below 5 mg/l. The high pH values appeared to be a result of plant photosynthetic activity. The low D.O. concentrations were measured during the summer at a shallow Mud Lake site that is relatively isolated from the main channel. Monitoring during the winter indicated sufficient D.O. concentrations; however, only a limited number of samples have been collected from backwater areas of lower Pool 11 that have minimal water exchange with the main channel. It is likely that these areas would experience low D.O. concentrations during winters with heavy snowfall.

Bed sediment samples collected from Sunfish Lake and the Mud Lake/Zollicoffer Slough complex consisted primarily of fine-grained material. These samples were analyzed for various chemical constituents, and generally the levels measured were consistent with levels commonly seen in fine-grained Mississippi River sediments.

The results from wind monitoring at the Grant River Recreation Area during the 1997 through 1999 growing seasons are given in Appendix F, Figures F-35 through F-38. Comparison of the pie charts indicates that the wind direction distribution for the 3 years was similar (see Figure F-35). The prevailing wind direction was from the east during all 3 years: 1997 (44 percent), 1998 (35 percent) and 1999 (31 percent). Figures F-36 through F-38 show the wind direction distribution for the 3 years at the following wind speed ranges: 0-5 mph, 5-10 mph, 10-15 mph, and >15 mph. A dramatic shift in prevailing wind direction is seen each year as the wind speed increases from 0-5 mph to >15 mph (see Figures F-36 through F-33). Lighter winds are predominantly from the east, whereas the stronger, more damaging winds are from the west. In fact, when considering speeds greater than or equal to 10 mph, the prevailing wind direction was from the combined northwest/west/southwest direction no less than 79 percent of the time during the three growing seasons. Therefore, to maximize water quality benefits gained by reducing wind fetch, it is imperative that potential project features take into consideration that the most damaging winds are from the west, northwest, and southwest directions.

e. Vegetation. Aquatic vegetation in lower Pool 11 is varied. Plants commonly found in shallow areas include sago pondweed (*Potamogeton pectinatus*), coontail (*Certophyllum demersum*), elodea (*Elodea canadensis*), curly pondweed (*Potamogeton crispus*), floating-leaf pondweed (*Potamogeton natans*), lotus (*Nelumbo lutea*), water-lily (*Nymphaea* sp.), water milfoil (*Myriophyllum verticillatum*), duckweed (*Lemna* sp.), arrowhead (*Sagittaria latifolia*), and bulrush (*Scirpus* sp.). Deeper areas contain water milfoil, coontail, with some small beds of wild celery (*Vallisneria americana*) in secondary channels (Langrehr and Dukerschein 1997).

Terrestrial vegetation in lower Pool 11 is limited to the few small islands and adjacent shorelines. Dominant tree species include silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), cottonwood (*Populus deltoides*), box elder (*Acer negundo*), elm (*Ulmus americana*), and willow (*Salix* sp.). Understory tree species include willow, silver maple, green ash, box elder, mulberry (*Morus* sp.), hackberry (*Celtis occidentalis*), and false indigo (*Amorpha fruticosa*). Herbaceous species include *Leersia* sp., *Scirpus* sp., reed canary grass (*Phalaris arundinacea*), and sedges (*Carex* sp.).

The Northern monkshood (*Aconitum novaboracense)* is a federally listed threatened plant species known to occur in Dubuque County, Iowa, and Grant County, Wisconsin. However, no suitable habitat for this species exists in the study area.

f. Fish and Wildlife. Lower Pool 11 provides suitable habitat for a variety of wildlife including waterfowl, wading birds, muskrats (*Ondatra zibethicus*), bald eagles (*Haliaeetus leucocephalus*), and turtles. Mallards and Canada geese have successfully nested on the remaining islands. Lower Pool 11 is an integral part of the Mississippi Flyway, a major migratory corridor for birds in the central United States. The area provides migration requirements in the fall and spring for species that spend the summer and winter in other parts of the continent. It has been estimated that 20 percent of all ducks in North America utilize the Upper Mississippi River. Figure 2-2 shows areas of lower Pool 11 that have historically been used by diving ducks during migration. It should be noted that aquatic vegetation in this portion of the pool has substantially declined in the past decade, and waterfowl use of the area is currently less extensive than that shown in historic use patterns.

Fish sampling in lower Pool 11 from 1990 to 1993 with hoop, fyke, and gill nets and electrofishing gear yielded 39 species of fish, representing 12 families. Samples were dominated by carp (*Cyprinus carpio*), longnose gar (*Lepisosteus osseus*), gizzard shad (*Dorosoma cepedianum*) and mooneye (*Hiodon tergisus*). Black crappie (*Pomoxis nigromaculatus*), northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), sauger (*Stizostedion canadense*), channel catfish (*Ictalurus punctatus*) and white bass (*Morone chrysops*) were found in the lower Pool 11 area at selected sites and in limited numbers. Other game and forage species were present but categorized as uncommon. The Catch Per Unit Effort (CPUE) and diversity values for the gear and sites were relatively low.

Mussel surveys have been conducted in the main channel border of lower Pool 11. Common species include three-ridge (*Amblema plicata*), mapleleaf (*Quadrula quadrula*), hickorynut (*Obovaria olivaria*), washboard (*Megalonaias nervosa*), and pimpleback (*Quadrula pustulosa*) (Theil 1981). Other species found include the following: giant floater (*Pyganodon grandis*), wartyback (*Quadrula nodulata*), Wabash pigtoe (*Fusconaia flava*), deertoe (*Truncilla truncata*), three-horned wartyback (*Obliquaria reflexa*), fragile papershell (*Leptodea fragilis*), pink heelsplitter (*Potamilus alatus*), white heelsplitter (*Lasmigona complanata*), fawnsfoot (*Truncilla donaciformis*), yellow sandshell (*Lampsilis*

teres), squawfoot (*Strophitus undulatus*), plain pocketbook (*Lampsilis cardium*), and rock-pocketbook (*Arcidens confragosus*).

Benthic invertebrates including fingernail clams, burrowing mayflies, and presumably chironomids were reduced following the drought years of 1988 and 1989. Fingernail clams are found in low densities on the Wisconsin side of the channel across from Mud Lake (Wisconsin DNR, unpublished data).

Three federally listed threatened or endangered species may occur in the project area. Migrating bald eagles perch in trees in the Potosi Pier area. Two bald eagle nest sites are known to occur in lower Pool 11. One of the nest sites occurs within the project area. Prior to 1999, one record of the federally endangered Higgins' eye pearly mussel (*Lampsilis higginsi*) was known in the project area (Kurt Welke, personal communication). The endangered Indiana bat (*Myotis sodalis*) is listed as potentially occurring in Dubuque County, Iowa. No habitat for the Indiana bat is present in the potential construction areas.

Numerous State of Wisconsin threatened and endangered species may occur in the project area. State threatened and endangered mussels found in the project area include the rock pocketbook, Higgins' eye, and wartyback. The salamander mussel, ebony shell, and winged mapleleaf are also listed. The State endangered ornate box turtle (*Terrapene ornata*) and the State threatened Blanding's turtle (*Emydoidea blandingii*) may utilize the area. Bald eagles, Cooper's hawks, and red-shouldered hawks are also listed for the county.

State of Iowa threatened and endangered species that may occur in the project area include the following: river otter (*Lutra canadensis*), Indiana bat (*Myotis sodalis*), ornate box turtle, and Higgins' eye pearly mussel.

g. Habitat Types and Distribution. Sunfish Lake, upstream to Sinnippee Creek, is a shallow, off-channel aquatic area with stumps remaining from the timber that was cleared prior to impoundment. The area has some rooted floating aquatic and submergent vegetation. There are a few island remnants upstream of Sunfish Lake at approximate RM 584. There may be remnants of wing dams from the 6-foot navigation channel in the main channel border.

On the Iowa side of the channel from approximate RM 584-587.5, there is additional shallow off-channel aquatic habitat in association with the Little Maquoketa River delta. This area has submergent, rooted floating aquatic and emergent vegetation as well as the remnant stumps. Migrating waterfowl have historically used this area. The Little Maquoketa River enters at approximate RM 586.5R. Bottomland forest and some grassy areas are found in the Little Maquoketa River delta. There is an excavated channel to the John Deere Dubuque Works at approximate RM 586.3R.

Upstream of the Little Maquoketa River is Zollicoffer Slough, a deep off-channel area. Mud Lake lies immediately upstream of Zollicoffer Slough. Mud Lake is a shallow off-

channel area with emergent vegetation on the perimeter and submergent and rooted floating aquatic vegetation more interior.

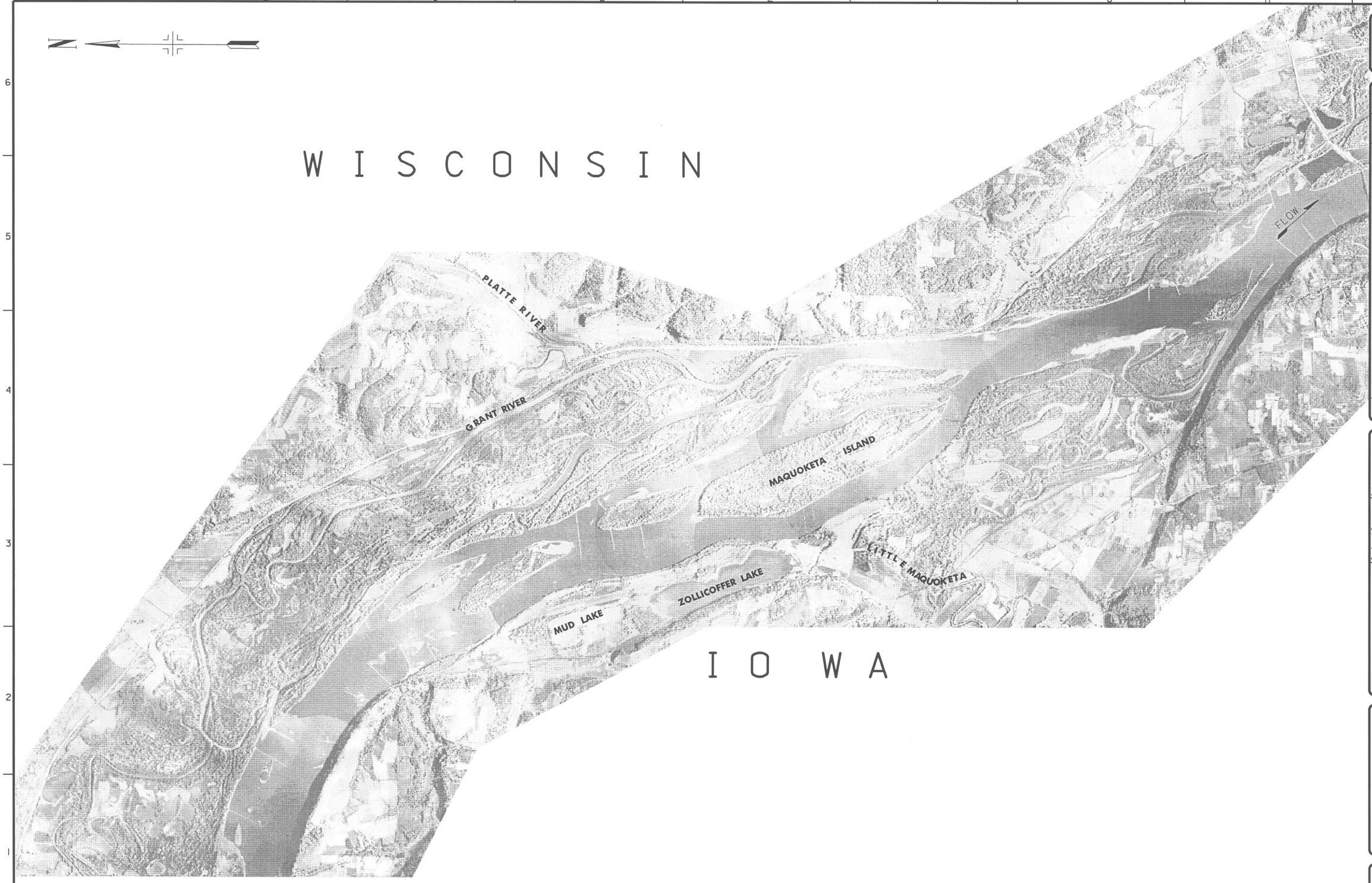
Along the main channel border from approximate RM 585 up to and beyond RM 592 are areas that have historically supported submergent aquatic vegetation. Migrating waterfowl have historically used these areas. The amount and location of aquatic vegetation varies from year to year. Observations by resource agency staffs indicate a decline in aquatic vegetation distribution in the decade following the 1989 baseline. The aquatic areas, landward and towards the Wisconsin shore, are of uniform depth and have little habitat value. The tree stumps in this area and others have deteriorated or been covered with sediment.

Potosi Creek enters on the Wisconsin side at approximate RM 592.5. There is a variety of emergent to submergent/rooted floating aquatic vegetation along the shore upstream and downstream of Potosi Pier. Migrating and resident waterfowl use this area. Riverward of this area there is little aquatic vegetation.

h. Hazardous, Toxic, and Radioactive Waste. A hazardous, toxic, and radioactive waste (HTRW) compliance assessment was conducted. The results of this assessment indicate that there is a very slight potential for HTRW contamination with project areas. Although upstream industrial activity has likely contributed sediment contamination, past testing of the sediments and water indicate that the contaminant concentration is relatively low and well below action levels. See Appendix K for the full HTRW Documentation Report.

i. Historic Properties. The Pool 11 project has no historic properties listed on or eligible for inclusion in the National Register of Historic Places. Appendix A includes Corps letters dated July 10, 1998, to the Iowa and Wisconsin State Historic Preservation Offices (SHPOs). The Iowa SHPO's reply of July 22, 1998 (R&C#: 980731044) indicates that there are "no historic properties that might be affected by proposed undertaking." The Wisconsin SHPO's reply of July 28, 1998 (Case #98-0778/GT) found that "the archeological survey procedures were both appropriate and thorough, and support the conclusion that there are no archeological sites eligible for listing on the National Register of Historic Places, within the areas surveyed." If the scope of the project should change, the Corps will coordinate any changes with the appropriate SHPO. In addition, if the execution of the project should uncover any item of archaeological, historical, or architectural interest, the Corps will ensure that reasonable efforts are taken to avoid or minimize harm to the property until its significance can be determined (36 CFR 800.11) and with appropriate Federal and State laws should human remains be discovered.

WISCONSIN



IOWA

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SCALE IN METERS

US Army Corps of Engineers
Rock Island District

Symbol	Description Revisions	Date	Approved

Designed By: RTN	Date: 16 SEP. 2001	
Drawn By: TPD/SDB	Scale: AS SHOWN	
Checked By: KNM	Drawing Code:	
Reviewed By: DJH	Solicitation Number:	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT
PROGRAM POOL 11,
RIVER MILES 583-594

PREIMPOUNDMENT

FIGURE 2-1

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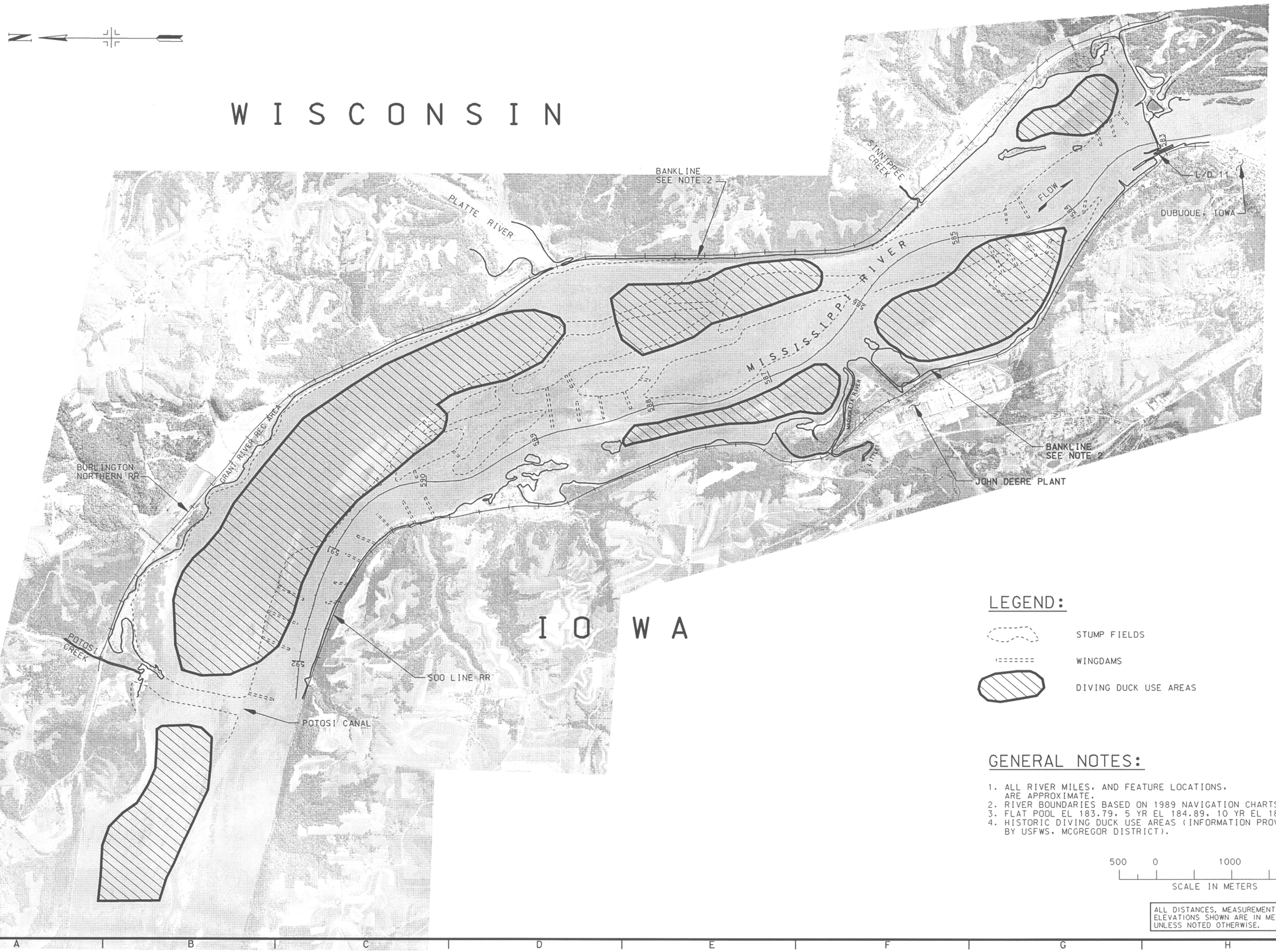

LEGEND:

- STUMP FIELDS
- WINGDAMS
- DIVING DUCK USE AREAS

GENERAL NOTES:

1. ALL RIVER MILES, AND FEATURE LOCATIONS, ARE APPROXIMATE.
2. RIVER BOUNDARIES BASED ON 1989 NAVIGATION CHARTS.
3. FLAT POOL EL 183.79, 5 YR EL 184.89, 10 YR EL 185.47.
4. HISTORIC DIVING DUCK USE AREAS (INFORMATION PROVIDED BY USFWS, MCGREGOR DISTRICT).

500 0 1000 2000

SCALE IN METERS

ALL DISTANCES, MEASUREMENTS AND ELEVATIONS SHOWN ARE IN METERS UNLESS NOTED OTHERWISE.

US Army Corps of Engineers
Rock Island District

Symbol	Description Revisions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed By: RTN
Drawn By: SDB/TPD
Checked By: KGB
Reviewed By: DJH

Date: 16 SEP. 2001
Scale: AS SHOWN
Drawing Code:
Solicitation Number:

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT
PROGRAM POOL 11,
RIVER MILES 583-594

DIVING DUCK USE AREAS

FIGURE 2-2

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3. PROJECT GOALS AND OBJECTIVES

a. Problem Identification. Prior to inundation, the area now known as lower Pool 11 provided a diversity of habitats with numerous islands, side channels, and backwater lakes. Construction of Lock and Dam 11 inundated low-lying areas, creating a wide variety of aquatic habitats and inundating most of the islands. Since inundation, natural processes such as sedimentation and erosion have changed the habitats in lower Pool 11. High turbidity levels in the lower pool are caused by sediment loading from the Grant, Platte, Little Maquoketa, and Turkey Rivers, and by resuspension of these sediments from current, wind, and wave action. Few island remnants of the preimpoundment period exist in the lower pool today. Former small channels and ponds appear to be filling in, making the bed more uniform. Most of the remaining deep water is located in the navigation channel, but some deep channels still persist east of the main channel. These flowing channels provide oxygenated water but are devoid of vegetation. Typically, aquatic vegetation in lower Pool 11 is restricted to shallow areas adjacent to the main channel and near-shore areas. However, under existing conditions there is very little vegetated shallow water (littoral) habitat in near-shore areas. Expansion of vegetated littoral zones is limited due to the detrimental effects of wind and wave action.

(1) Lack of Protected Off-Channel Fisheries Habitat. Little protected off-channel lacustrine fisheries habitat exists in lower Pool 11. Existing habitat of this type is located along the periphery of lower Pool 11. The value of these areas as protected off-channel lacustrine fisheries habitat is limited due to a lack of depth and vegetation diversity. In addition to the loss of vegetation in recent years, macroinvertebrates such as burrowing mayflies, midges, and fingernail clams have also declined in lower Pool 11.

Protected shallow water with vegetation adjacent to deeper sloughs or flowing channels provides essential fishery habitat for feeding, spawning and nursery areas. Areas of this nature are often referred to as "centrarchid habitat" due to the research emphasis on species in the centrarchid, or sunfish, family. Species in this family include bluegill, largemouth bass, smallmouth bass, and white and black crappie. Many other species of fish also utilize protected off-channel lacustrine habitat either exclusively or for part of their life cycle. Therefore, the project objectives were developed based on existing knowledge of protected off-channel lacustrine fisheries habitat as it pertains to centrarchids with the assumption that other species would also benefit.

Recent studies by the Iowa DNR have illustrated the importance of backwater habitats as overwintering areas for centrarchids (Iowa DNR 1992 and Gent *et al.* 1995). General characteristics of suitable overwintering sites include off-channel areas that do not freeze to the bottom, have suitable D.O. levels, slightly warmer waters (stratification), and protection from the current. Areas providing this type of habitat are nearly nonexistent in lower Pool 11. Zollicoffer Slough currently provides unreliable overwintering habitat, as low D.O. concentrations may occur during winters with heavy snowfall and access in and out of Zollicoffer Slough may be frozen solid. The nearest suitable overwintering site is in McCartney Lake (RM 600-601), 27.5 km upstream of Lock and Dam 11. While there is

suitable summer habitat in lower Pool 11, the fish must travel quite a distance to reach suitable wintering habitat. Overwintering habitat does not currently exist at Sunfish Lake due to the unavailability of deep-water areas and lack of protection from high current velocities. Adequate wintering habitat is critical to sustaining centrarchid populations. Providing sufficient protected off-channel areas is required to maintain and enhance aquatic habitat for fish populations in lower Pool 11.

(2) Decreased Diversity of Habitats in Off-Channel Areas. The physical actions of wind and waves and a general increase in turbidity are believed to have caused a decline in the aquatic vegetation in lower Pool 11. The off-channel areas have relatively high turbidity and suspended solids due to resuspension of bed sediments caused by wind-generated waves.

Historically, large numbers of diving ducks used the "elbow area" between the Grant and Platte Rivers. Over the past two decades, this use is much reduced, possibly due to losses of vegetative food sources such as *Vallisneria* and other aquatic plants, and the loss of important invertebrate food sources such as fingernail clams. Aquatic vegetation and invertebrates provide food resources and cover for migratory and resident water birds and fish. These resources can best be provided in habitat described as a complex of emergent and submergent vegetation protected from prevailing winds and wave action, and direct inflow of main channel water. The reductions in bathymetric and flow diversity described above are limiting the production of food resources and the availability of cover for migratory waterfowl, particularly diving ducks, and fish. Losses in habitat diversity have also been detrimental for other neotropical migrant birds, turtles, eagles, and other wildlife.

With respect to migratory waterfowl, particularly diving ducks, the focus is on meeting food and cover requirements during migration for populations that are dependent on this portion of the flyway as a stopover on the way to and from wintering and breeding areas on more extensive parts of the continent. Undisturbed feeding and loafing sites, particularly in the fall, but also in the spring, are essential at appropriate intervals. Dependability and sufficiency of food resources, and location of feeding and loafing areas within the flyway corridor, are essential features of the required habitat. It is estimated that about 1000 ha of the lower pool area were extensively used by diving ducks in the approximate period 1977-1985.

b. General Fish and Wildlife Management Goals. Lower Pool 11 is part of the Upper Mississippi River National Wildlife and Fish Refuge. The *Upper Mississippi River National Wildlife and Fish Refuge Master Plan* (USFWS 1987) identifies goals and objectives for the refuge as a whole. Of the many goals and objectives, the following are those that relate to the problems described above:

Goal - Environmental Quality

Objectives

-Reduce adverse impacts of sedimentation and turbidity entering the river system
-Eliminate or reduce adverse impacts of water quality degradation
-Preserve unique and/or representative ecotypes

Goal - Migratory Birds

Objectives

-Maintain or improve habitat of migrating waterfowl using the Upper Mississippi River
-Increase the production of historically nesting waterfowl

Goal - Fisheries and Aquatic Resources - Conserve and enhance the habitats of fish and other aquatic plant and animal life

Objectives

-Maintain and enhance, in cooperation with the states, the habitat of fish and other aquatic life on the Upper Mississippi River

Goal - Endangered Species - Conserve, restore, and enhance federally listed endangered and threatened species and the habitats upon which they depend

Objectives

-Protect and enhance Upper Mississippi River habitat and maintain or increase its use by native species historically found in this area
-Carry out the recommendations of the Endangered Species Recovery Plans applicable to the refuge

The interagency team also has developed goals and objectives for fish and wildlife resources in lower Pool 11 that relate to existing resource problems in the project area. These goals and objectives are detailed in a letter from the WDNR dated June 24, 1999, and reproduced in Appendix A of this report (pages A-33 - A-39).

c. Project Goals, Objectives, and Potential Project Features. Based on the identified problems and the fish and wildlife management goals of the cooperating agencies, the following goals, objectives, and potential project features have been developed for the project (Table 3-1).

TABLE 3-1. Project Goals, Objectives, and Potential Project Features.

Goal	Objectives	Potential Enhancement Features
Restore and Protect Aquatic Habitat Restore and Protect Backwater Habitat	Reduce resuspension of sediments Create areas with flow and depth diversity Increase abundance and diversity of aquatic plants Enhance nesting and brooding habitat for migratory birds Reduce sedimentation in backwaters Provide reliable food resources for migratory birds and resident wildlife Reduce island erosion Create off-channel deep-water areas to provide year-round habitat for centrarchids and associated species	Create mid-river islands Construct deflection embankments Place island and embankment revetment/protection Develop mid-river boulder field Construct flow control structure Construct oxygen injection system Manipulate pool elevation Install semi-permanent snow fence Excavate channels in backwater areas

d. Criteria for Potential Enhancement Features. Table 3-2 presents general and specific criteria developed to assess potential enhancement features.

TABLE 3-2. Potential Enhancement Features Development Criteria.

Item	Purpose of Criteria
A. General Criteria	
Locate and construct features consistent with EMP directives	Comply with program authorities
Construct features consistent with Federal, State, and local laws	Comply with environmental laws
Develop features that can be monitored (e.g., sedimentation, stability, water quality)	Provide baseline for project effects
Design features to facilitate operation and maintenance	Minimize operation and maintenance costs. Realize USFWS logistical difficulties in accessing the site
Locate and construct features consistent with best planning and engineering practice	Provide basis for project evaluation and alternative selection
Construct features which meet one or more project objectives	Meet project goals and objectives
B. Restore and Protect Aquatic Habitat	
Excavate channels in backwater areas	Increase depths in off-channel habitats and provide access between shallow and deep aquatic areas, increase wintering fish habitat for centrarchids and associated species
Create mid-river islands Construct deflection embankments	Create areas with increased diversity of depths and flows, reduce resuspension of sediment, promote growth of a diverse assemblage of aquatic vegetation to benefit fish and aquatic invertebrates, enhance nesting and brooding habitat, and provide reliable food resources for migratory birds and resident wildlife
Develop mid-river boulder field	Create areas with increased diversity of depths and flows
Manipulate pool elevation	Reduce resuspension of sediments, increase abundance and diversity of aquatic plants
Install semi-permanent snow fence	Reduce sediment resuspension
C. Restore and Protect Backwater Habitat	
Construct deflection embankments	Increase wintering fish habitat by reducing current velocity, reduce sedimentation in backwaters
Construct flow control structure Construct oxygen injection system	Introduce higher levels of dissolved oxygen into protected backwater areas to enhance fish habitat
Place island and embankment revetment/protection	Prevent erosion and future loss of island habitat

4. POTENTIAL PROJECT FEATURES

a. General. The purposes of this section are to describe and assess potential enhancement features that will meet the goals of restoring and enhancing off-channel habitat and diversity. Potential enhancement features were determined based on their ultimate contribution to the project goals and objectives, engineering considerations, and local restrictions or constraints. Features that were not feasible were not subject to further evaluation. The potential enhancement features are combined into alternatives in paragraph c. of this section. These alternatives are then evaluated in Section 5.

b. Potential Features to Restore and Protect Aquatic and Backwater Habitat. The following features were considered for inclusion in this project: construction of deflection embankments, deflection islands, constructed islands, a boulder field, mechanical dredging, hydraulic dredging, a flow control structure, an oxygen injection system, a semi-permanent deflection barrier (snow fence), and pool level manipulation. How these potential features might meet the project goals and objectives as listed in Table 3-1 is discussed below:

(1) Deflection Embankments and Islands. Deflection embankments and islands address the project goal of restoring and enhancing backwater habitat. Lower Pool 11 is devoid of land masses that would break up long areas of wind fetch. The area is subjected to wind and wave forces that resuspend sediments, resulting in high turbidity and degraded water quality. While protecting the area from wind, waves and current, deflection structures would reduce sediment transport and resuspension on its leeward side. The decrease in turbidity and suspended sediments should allow increased light penetration through the water column. The increase in the photic zone should promote growth of submergent vegetation. This vegetation will provide habitat for fish and a food source for waterfowl. Additional features constructed in the area behind the embankment also would benefit from the protection this feature would provide.

(2) Island Construction. The construction of off-channel islands in the open river addresses the objective of reducing wind fetch and wave resuspension of sediments. A shadow zone with reduced turbidity and suspended sediments should be found behind the island. The decrease in turbidity and suspended sediments should allow increased light penetration through the water column. The increase in the photic zone should, in turn, promote growth of submergent vegetation. This vegetation will provide habitat for fish and a food source for waterfowl. The islands may also provide nesting habitat for resident waterfowl. Islands create additional shoreline and shallow, near shore habitat that would enhance production of aquatic vegetation, fish, and water birds. Islands would be constructed in locations where they existed prior to impoundment, taking advantage of shallower depths. The islands would create diverse current velocities and water depths. This increased flow diversity would be expected to improve existing conditions for mussels and fish. They may be constructed as seed islands that would accumulate sediments from the water column and grow in size over time, or they may be constructed to a predetermined set of dimensions from immediately available materials.

Seed islands may be made of tree stumps, riprap, or other similar materials that would cause the water velocities around them to slow enough to cause sediments transported in the water column to drop out. Material for constructing islands would be obtained from dredging in the immediate project area or possibly from maintenance dredging activities in other reaches of the pool.

(3) Dredging. Shallow water depths are found throughout the project area. Dredging a system of channels can restore deep-water habitat. This feature would provide deep overwintering habitat for fish and increase aquatic diversity, while also providing material for construction of another potential feature—a deflection embankment. It could be accomplished using mechanical or hydraulic techniques. If hydraulic dredging is used, the dredged material would be placed within containment cells, creating additional island and land mass diversity.

(4) Flow Control. Used in combination with deflection embankments, a flow control structure, such as a culvert or concrete pipe or notched rock weir, would provide fresh inflow to a backwater area in times when areas typically experience low dissolved oxygen levels. This feature enhances fish habitat by allowing a constant low flow of oxygenated water into a protected backwater.

(5) Oxygen Injection. An oxygen injection or aeration-type system was discussed as a possible way to introduce higher levels of dissolved oxygen. This feature would require a structure to house the aeration system and may require significant operation and maintenance. This feature would enhance fish habitat by injecting a constant low flow of mechanically oxygenated water into a protected backwater. This feature will not be considered for further analysis at this time due to its associated operation and maintenance costs.

(6) Boulder Field. Placing a field of large boulders in association with the island construction feature was considered to further increase the bathymetric and flow diversity in off-channel areas. This feature would create a variety of current velocities in the aquatic habitat, with pockets of "slow water" and eddies. The boulders would provide habitat for aquatic invertebrates that prefer attachment to hard surfaces. Riverine fish species such as catfish could find food and cover in eddies created by the boulders.

(7) Semi-Permanent Snow Fence. Placing a semi-permanent snow fence was considered as an innovative way to reduce wind fetch and slow current velocities to settle out sediments transported in the water column. Construction of this feature would involve installing a snow fence at select locations in the Grant River area, just off the Wisconsin (left) bank, where cool waters hug the bank. This feature would encourage growth of aquatic vegetation that would provide habitat for cool water species such as northern pike. It would also further mitigate wave action. However, due to the unknown reliability and longevity of this feature, it was eliminated from further evaluation.

(8) Pool Level Manipulation. Pool level manipulation was considered as a potential project feature. This feature would consist of lowering pool elevations during the growing season to expose mudflats and to consolidate flocculent sediments. This would stimulate the growth of emergent aquatic plants—particularly those species referred to as "moist soil" plants—which provide an important food source for waterfowl. Reduced water depths in areas not dewatered may allow increased light penetration, in turn promoting increased growth of submergent vegetation. Increased growth of aquatic vegetation would provide habitat for fish and invertebrates as well as providing food for migrating waterfowl. Pool lowering may result in negative impacts to fish and mussels that inhabit the drawdown area. At this time, studies and analyses are being performed on pool level manipulation at select pools in the Upper Mississippi River. This potential feature was eliminated from further consideration at this time.

c. Combination of Potential Features into Potential Alternatives. Restoration features were combined into alternatives that would best fit the goals and objectives for this project (see Table 3-1). Restoration activities were considered at the following locations: Sunfish Lake, Sinnippee Creek, John Deere, Mud Lake/Zollicoffer Slough, Mid River, and Potosi Pier. The combinations and their proposed locations are described in the following paragraphs (see plate 2):

(1) Sunfish Lake. Backwater restoration at Sunfish Lake involves constructing a deflection embankment that will deflect sediments transported from sources upstream as well as break up wind fetch to reduce the resuspension of sediments in this lower reach of the pool. The deflection embankment would connect two existing islands with one end tying in to the Wisconsin shore. Dredging would provide the material needed to construct the embankment and create deep-water aquatic habitat. With the addition of a notched rock weir, the excavated channels would have conditions suitable for overwintering centrarchid fish—low flows, slightly warmer water, and sufficient dissolved oxygen levels. It would provide protected areas in which aquatic vegetation will be able to take root and grow.

(2) Sinnippee Creek. A potential alternative at the Sinnippee Creek location would involve construction of a deflection embankment and island. The features of this alternative would maximize the protected area and take advantage of existing shallow water, creating an area with slower current velocities and reduced turbidity. Increased growth of submergent vegetation behind the embankment and island would be anticipated.

(3) John Deere. Constructing a deflection embankment on the Iowa side of the channel downstream from the John Deere Plant was considered. The embankment would reduce wind fetch and minimize sedimentation of the protected area. Expansion of existing beds of aquatic vegetation would be expected, providing additional food for migratory birds. The value of this area as a resting area for migratory waterfowl would be improved by providing additional food sources and protection from winds. Use of adjacent borrow to construct the embankment also would provide protected deepwater habitat for

fish. Construction at this site initially was removed from further consideration following sediment sampling that showed high levels of cyanide. Later in the planning process, it was discovered that the high cyanide concentrations were likely the result of sampling procedures. However, at that time, features at the other sites were farther along in the planning process. The interagency planning team deferred further consideration of this site in an effort to reduce the scope of the project; however, this feature may be addressed as a separate EMP project in the future.

(4) Mud Lake/Zollicoffer Slough. Restoration of the Mud Lake backwater would involve constructing a deflection embankment to deflect sediments as well as reduce resuspension of sediments caused by wind- and boat-induced waves. The deflection embankment would extend from the upper land mass of Mud Lake and run parallel to the Iowa side of the main channel. Adjacent dredging would provide material for the construction of the embankment and provide suitable overwintering habitat. A deep channel would connect the deep water of Zollicoffer Slough to the main channel. In the upper portion of Mud Lake, an additional deep channel "hook" would be dredged to create deep-water habitat in the area.

(5) Island Construction. To restore habitat for migrating water birds and reduce wave resuspension of sediments, islands would be constructed in the mid-lower Pool 11 reach of the river. These islands act in much the same manner as the deflection embankment/island feature described in paragraphs b.(1) and b.(2) above. They would provide a break in the wind fetch and therefore reduce wave action that resuspends sediments in the project area. The shadow zone created behind the islands should allow increased growth of submergent aquatic vegetation, thus providing additional food sources for waterfowl and habitat for fish. The islands would create increased flow diversity that would be expected to improve existing conditions for mussels and fish. Different combinations of alignments, lengths, and number of islands will be evaluated in Section 6 in order to determine area of impact and resulting habitat restoration. For benefits to be realized early in the project life, these islands would be constructed of immediately available construction materials, as opposed to seed islands that would slowly grow over time. In addition to the variations on the islands, a boulder field would be placed randomly in conjunction with the islands over a 2-ha area near the constructed islands.

(6) Potosi Pier. This alternative involves two different combinations of barrier islands to protect this area's existing resources and encourage their expansion. The barrier islands would be completely constructed of riprap. The constructed islands would reduce wind fetch and wave resuspension of sediments, thereby encouraging the expansion of existing aquatic vegetation beds. Project features in this area were deferred due to the interagency planning team's priorities for the Pool 11 study area and to reduce the scope of the project to meet financial constraints which existed during the time this project was in the planning process. Enhancement activities may be pursued in the future when concerns regarding impacts to existing resources are fully understood.

5. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES

This section describes the project alternatives that meet the goals and objectives of the project (see Table 3-1). Each increment was analyzed using Habitat Evaluation Procedures (HEP) to determine its restoration or enhancement potential. Estimated costs associated with each alternative also were derived for all the feasible project alternatives and increments.

Note: For features above water surface, total areas are based on a feature's cross-sectional area above flat pool elevation of 183.79 m. For areas of deep-water creation, the area of the bottom of the cut plus side slopes were estimated.

a. Feasible Project Alternatives and Increments.

(A) Sunfish Lake: The alternatives presented at this location vary in combinations of lengths of embankment and extent of hydraulic and/or mechanical dredging and the total area impacted by these alternatives. These alternatives would provide overwintering habitat for fish in the lower portion of Pool 11. The deflection embankments would reduce resuspension of sediments, thus increasing the photic zone and diversity of vegetation in Sunfish Lake. An increase in diversity of vegetation would benefit waterfowl and other wildlife that utilize this area.

This management measure consists of the following increments:

(1) No Action (S0). No action would result in no additional management efforts above the existing practices. No habitat gain or loss would be realized other than what might occur naturally. The area would continue to lack plant and depth diversity and have low potential for overwintering use.

(2) Deflection Embankment with 6.5 Hectares of Mechanical Off-Channel Excavation (S1). This alternative would consist of constructing 1800 m of deflection embankment and mechanically dredging a total of 6.5 ha to construct the embankment, as well as offshoots for deep-water habitat shown on plate 3. Material dredged for the deep-water channel offshoots would be sidecast, creating low-lying islands. The excavation would be to depths averaging 2.5 m with a bottom width of 10 m. Two 900-mm-diameter reinforced concrete pipes would be placed in the deflection embankment near the Wisconsin shore to provide an inflow of oxygenated water.

(3) Deflection Embankment with 11.5 Hectares of Mechanical and Hydraulic Off-Channel Excavation (S2). This alternative would consist of constructing 1500 m of deflection embankment and a 2-cell containment area for the hydraulically dredged material. To construct the embankment and also create deep-water habitat, a total of 11.5 ha of dredging would be accomplished through a combination of mechanical and hydraulic methods, as shown on plate 11. The excavation would be to depths averaging

2.5 m with a bottom width of 10 m. A notched rock weir would be placed in the deflection embankment near the Wisconsin shore to provide an inflow of oxygenated water. Directly downstream of the rock weir, a sediment trap would be constructed to reduce sedimentation in the newly dredged channels.

(B) Sinnippee Creek. Deflection island construction reduces resuspension of sediments in protected areas, thus increasing the photic zone and diversity of vegetation in this location. An increase in diversity of vegetation would benefit waterfowl and other wildlife that utilize this area. In addition, the area influenced by inflows from the creek will be increased, creating microhabitat conditions utilized by fish species such as northern pike and crappie in the summer and by centrarchids and gizzard shad in the winter.

This management measure would consist of the following increments:

(1) No Action (N0). No action would result in no additional management efforts above the existing practices. No habitat gain or loss would be realized other than what might occur naturally. The area would continue to be subjected to wind and wave forces that would resuspend sediments in this area with no improvement in water quality, and there would continue to be a lack of protected backwater areas in this reach of river.

(2) Deflection Embankment and Island (N1). This alternative would consist of constructing 1265 m of deflection embankment and island using adjacent mechanical dredging, as shown on plate 3. The excavation would be to depths averaging 3.2 m with a bottom width of 10 m.

(C) Mud Lake/Zollicoffer Slough. The alternatives presented at this location vary in combinations of embankment lengths, extent of mechanical dredging, and the total area impacted by these alternatives. These alternatives would include establishing and maintaining year-round fish access to suitable overwintering habitat in Zollicoffer Slough. Construction of a deflection embankment and dredging would slow the gradual conversion of shallow aquatic habitat to terrestrial habitats by deflecting sediments. The aquatic vegetation in this area provides brood habitat for waterfowl.

This management measure would consist of the following increments:

(1) No Action (M0). No action would result in no additional management efforts above the existing practices. No habitat gain or loss would be realized other than what might occur naturally. Sedimentation in Mud Lake would continue, converting wetland to terrestrial. As the surrounding area fills in, the deep water in Zollicoffer Slough may become completely inaccessible.

(2) Upper Deflection Embankment with Deflection Islands and 6.2 Hectares of Off-Channel and Upper Mud Lake Excavation (M1). This alternative consists of constructing 1590 m of deflection embankment and 1000 m of deflection islands using adjacent mechanically dredged material, as shown on plate 8. The dredged

channels would average 2.3 m in depth with a bottom width of 10 m, totaling approximately 6.2 ha of deep water. A connecting channel to Zollicoffer Slough and a channel into Mud Lake also would be dredged.

(3) Upper Deflection Embankment with 8.8 Hectares of Mechanical Off-Channel and Upper Mud Lake Excavation (M2). This alternative would consist of constructing 3038 m of deflection embankment using adjacent dredged material, as shown on plate 12. Dredging would be to depths averaging 2.3 m with a minimum bottom width of 10 m, totaling approximately 8.8 ha of deep water. Several high points would be strategically placed in the dredged channel to inhibit the flow of warmer water out of the channel during overwintering periods. To provide an inflow of oxygenated water, two notched rock weirs would be constructed in the deflection embankment, one near the upper end of Mud Lake, and another near the midpoint. A second 250 m embankment would be constructed upstream of the primary embankment to prevent sediment and debris from accumulating in the notched rock weir and to further reduce sediment loads entering Mud Lake. A connecting channel to Zollicoffer Slough and a channel into Mud Lake also would be dredged.

(4) Upper and Lower Deflection Embankments with 12.5 Hectares of Mechanical and Hydraulic Off-Channel and Upper Mud Lake Excavation (M3). This alternative would consist of constructing 4200 m of deflection embankment using a combination of mechanical and hydraulic dredging adjacent to the embankment and into the upper portion of Mud Lake, as shown on plate 9. A connecting channel to Zollicoffer Slough also would be dredged. Dredging would be to depths averaging 2.3 m with a bottom width of 10 m, totaling approximately 12.5 ha of deep water. Two 900-mm-diameter reinforced concrete pipes would be placed near the deflection embankment's midpoint to provide an inflow of oxygenated water. A second 250 m embankment would be constructed upstream of the primary embankment to prevent sediment and debris from accumulating in the concrete pipes and to further reduce sediment loads entering Mud Lake.

(D) Island Construction. Constructing islands across from Mud Lake would restore habitat for migrating water birds and reduce wave resuspension of sediments. The features of this alternative would protect mid-river areas between RM 589.5 and RM 590.5 from high water velocities and wind-induced waves. Islands would be constructed in locations where they existed prior to impoundment, taking advantage of shallower depths. The islands would create diverse current velocities, water depths, and near-shore habitat. This diversity would enhance production of aquatic vegetation, fish, and water birds. The differences in the alternatives listed below are in the number of islands, the length of islands, and the area of impact.

Each alternative considered here includes the boulder field feature described in Section 5. This part of the alternative would consist of randomly placing 150 large derrick stones or boulders within a 2-ha area immediately upstream of the proposed constructed islands. The boulders would vary in size with maximum dimensions of 2 m in length, 2 m in width,

and 1 m in height with a maximum weight of 7.8 MG. While the boulder field would be located in historic channels adjacent to the islands, the boulders are not required for construction or stabilization of the island structures. However, both structures are intended to address the project goal of restoring off-channel habitat diversity by creating areas with flow and depth diversity. The localized alterations in current patterns and velocities that would result from the boulder field cannot readily be modeled at such a small scale, and the fisheries benefits that could result cannot readily be quantified using existing habitat methodologies. For this reason, the boulder field was not evaluated as a separable feature of this HREP and was included in all island feature alternatives for cost effectiveness and incremental cost analysis.

This management measure would consist of the following increments:

(1) No Action (I0). No action would result in no additional management efforts above the existing practices. No habitat gain or loss would be realized other than what might occur naturally. The main channel border would continue to lack depth diversity. Without any protection from wind, high water velocities, and waves, sediments would continue to be resuspended and growth of aquatic vegetation would remain limited.

(2) Construct Islands - 4 Small, 315 m (I1). This option consists of constructing four islands, as shown on plate 4, totaling 315 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 0.9 ha of new island land mass and create a 13.2-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(3) Construct Islands - 6 Small, 470 m (I2). This option would consist of constructing six islands, as shown on plate 4, totaling 470 m in length and built to a height of 1.6 m above the flat pool. This alternative would create approximately 1.3 ha of new island land mass and create a 22.6-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(4) Construct Islands - 4 Medium, 1000 m (I3). This option consists of constructing four islands, as shown on plate 5, totaling 1000 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 2.8 ha of new island land mass and create a 29.2-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(5) Construct Islands - 5 Medium, 1930 m (I4). This option would consist of constructing five island groupings, as shown on plate 7, totaling 1930 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 7.58 ha of new island land mass and create a 46.1-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(6) Construct Islands - 6 Medium, 1500 m (I5). This option would consist of constructing 6 islands, as shown on plate 5, totaling 1500 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 4.2 ha of new island land mass and create a 70.1-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(7) Construct Islands - 4 Large, 2000 m (I6). This option would consist of constructing four islands, as shown on plate 6, totaling 2000 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 5.7 ha of new island land mass and create a 36.5-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

(8) Construct Islands - 6 Large, 3000 m (I7). This option would consist of constructing six islands, as shown on plate 6, totaling 3000 m in length and built to a height of 1.6 m above flat pool. This alternative would create approximately 8.5 ha of new island land mass and create a 78.6-ha shadow zone with reduced velocities. This alternative would include boulders randomly placed within a 2-ha area upstream of the islands.

b. Environmental Output Evaluation. A habitat analysis of existing study area conditions, future conditions without the project, and impacts of the several proposed alternatives and increments was conducted using Habitat Evaluation Procedures (HEP). The HEP evaluation is described in detail in Appendix D. The evaluation study team consisted of staff from the Iowa DNR, the Wisconsin DNR, the USFWS, and the Corps of Engineers.

The HEP is a procedure for evaluating the quality and quantity of particular habitats for species selected by the HEP team. The HEP assumes that, for a given species, the value of a habitat can be described by a set of measurable habitat variables important to the species. It is also assumed that the value of an area may be influenced by changes in either habitat quantity or quality. The qualitative component is known as the Habitat Suitability Index (HSI) and is usually rated on a 0.1 to 1.0 scale. The suitability of a given habitat type for a given species is determined by the qualitative characteristics of the habitat type. The quantitative component of the HEP is the quantity of habitat available for a given species. For this application, quantity was measured in hectares. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the following formula: HSI x area = HUs.

The team evaluated existing habitat conditions by using existing survey data, whereas future conditions with and without the project were estimated using the expertise of team members. Projections of future with- and without-project conditions were based on predicted changes in the physical conditions (e.g., flow, wind fetch, temperature, water

depth) and professional judgment as to how these changed physical conditions would affect other habitat components such as dissolved oxygen levels, vegetation distribution, and species composition.

Target species were selected to represent groups of species to evaluate the goals and objectives of the project. Target species selected were the bluegill and diving ducks. The following two models were used in the analysis: *Modification of the Habitat Suitability Index model for the bluegill (Lepomis macrochirus) for winter conditions for the Upper Mississippi River backwater habitats* (Palesh and Anderson 1990) and the *Migratory habitat model for diving ducks using the Upper Mississippi River* (Devendorf 1995). For the final analysis, diving duck habitat outputs were used for evaluating the Sinnippee Deflection Embankment (N) and Island Construction (I). Bluegill overwintering habitat benefits were used for evaluating the Sunfish Lake (S) and Mud Lake/Zollicoffer Slough Restoration (M).

Models to evaluate habitat outputs for the Boulder Field feature of Island Construction were not readily available. However, Farabee (1986) and others have documented the benefits of large boulders.

Changes in HUs occur as a habitat matures naturally or is influenced by development. To capture these changes, HUs are estimated at selected target years. The target years selected for this project were Year 0, 1, 10, 25, and 50, with an estimated project life of 50 years. Habitat gains or losses are annualized by summing the cumulative HUs across all the target year intervals and dividing the total HUs by the number of years in the life of the project. This calculation determines what is known as Average Annual Habitat Units (AAHUs).

AAHUs are used as the output measurement to compare features and alternatives. Table 5-1 shows each potential enhancement feature and its respective output measured in AAHUs.

Because the project would be a habitat restoration effort and not mitigation for habitat losses occurring elsewhere, there were no numerical habitat goals per se as part of the project objectives. Although optimal conditions would be welcomed in lower Pool 11, these conditions are neither physically attainable nor affordable.

c. Cost Estimates for Habitat Improvement Measures. Table 5-1 shows the cost per feature. A more detailed breakdown of costs is outlined in Section 8 - Cost Estimates. Costs were annualized and are based on construction estimates.

TABLE 5-1. Potential Project Features - Outputs and Costs.

Feature	Symbol	Output*	Annualized Cost**
Sunfish Lake			
no action	S0	0	0
Mechanical Dredging	S1	159	$153
Mechanical and Hydraulic Dredging	S2	196	$192
Sinnippee			
no action	N0	0	0
Deflection Island	N1	73	$104
Mud Lake/Zollicoffer Slough			
no action	M0	0	0
Deflection with Islands	M1	271	$301
Full Deflection	M2	272	$280
Full Deflection with Hydraulic Dredging	M3	279	$407
Island Construction			
no action	I0	0	0
4 Small Islands	I1	18	$ 64
6 Small Islands	I2	32	$98
4 Medium Islands	I3	41	$144
5 Medium Islands	I4	64	$176
6 Medium Islands	I5	98	$243
4 Large Islands	I6	51	$285
6 Large Islands	I7	110	$499

* Outputs are calculated as net Average Annual Habitat Units.
** Annualized cost is initial construction cost in $1000s based on a 50-year project life, 6.625% interest rate.

d. Formulation and Evaluation of Alternative Plans. For environmental planning, traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units. However, cost effectiveness and incremental cost analyses can provide decision-makers with relative benefit-cost relationships of the various enhancement, restoration, or mitigation solutions. While these analyses are not intended to lead to a single best solution, they do improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs.

(1) Methodology. Corps of Engineers guidance requires incremental cost analysis for recommended environmental restoration and mitigation plans. Two analytical processes are conducted to meet these requirements. First, a cost-effectiveness analysis is conducted to ensure that the least-cost solution is identified for each possible level of environmental output. Then, incremental cost analysis of the least-cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the non-monetary benefits with the

monetary costs of environmental plans, cost effectiveness and incremental cost analyses are valuable tools to assist in decision making.

Appendix E presents the cost-effectiveness and incremental cost analyses for the Pool 11 Habitat Rehabilitation and Enhancement Project, Dubuque County, Iowa and Grant County, Wisconsin. Results of the analyses are summarized below.

(2) Results. Management measures were combined on the basis of the type of benefits evaluated in the habitat analysis. Sunfish Lake and Mud Lake/Zollicoffer Slough (bluegill benefits) were combinable with each other, while the Sinnippee Deflection Embankment and Island Construction measures (diving duck benefits) were combined with each other, but evaluated separately from the Sunfish Lake and Mud Lake measures. All combinations were ranked by combined AAHU output. The economically inefficient and ineffective solutions were eliminated. For example, if two plans produce 2 AAHUs and one costs $3,000 while the other $4,000, the more expensive plan is eliminated because it is economically inefficient. An example of an economically ineffective solution is a solution that would cost $8,000 and produce only 2 AAHUs while another solution would produce 4 AAHUs for $6,000. Table 5-2 and Figure 5-1 show the cost-effective and least-cost combinations of Sunfish Lake and Mud Lake management measures. Table 5-3 and Figure 5-2 show the cost-effective and least-cost combinations of Sinnippee Deflection Dike and Island Construction management measures.

An incremental cost analysis was conducted on the cost-effective and least-cost plans to identify the "best buy" plans—those plans that resulted in the most "bang for the buck" in terms of producing AAHUs. Table 5-4 and Figure 5-3 show the best buy plans for Sunfish Lake and Mud Lake combinations and their incremental costs.

Table 5-2 and Figure 5-3 were used as decision-making tools by progressively proceeding through the available levels of outputs and asking if the next level was "worth it"—that is, was the habitat value of the additional AAHU output in next level of output worth its additional monetary costs?

Federal planning for water resources development is conducted in accordance with the requirements of the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G). The P&G provides a decision rule for selecting a recommended plan where both outputs and costs are measured in dollars. This rule states that "the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (National Economic Development Plan, NED Plan) is to be selected ..." (paragraph 1.10.2). There is no similar rule for plan selection where the outputs are measured in dollars, as is the case in planning for restoration and mitigation (Robinson *et al.* 1995).

TABLE 5-2. Cost-Effective and Least-Cost Combinations – Sunfish Lake and Mud Lake.

Alternative Combination	Annualized Cost ($1000s)	Output (AAHUs)	Average Cost ($1000/AAHU)
S0+M0	0	0	0
S1+M0	153	159	0.962
S2+M0	192	196	0.980
S0+M2	280	272	1.029
S0+M3	407	279	1.459
S1+M2	433	431	1.005
S2+M2	472	468	1.009
S2+M3	599	475	1.261

FIGURE 5-1. Cost-Effective and Least-Cost Plans – Sunfish Lake and Mud Lake.

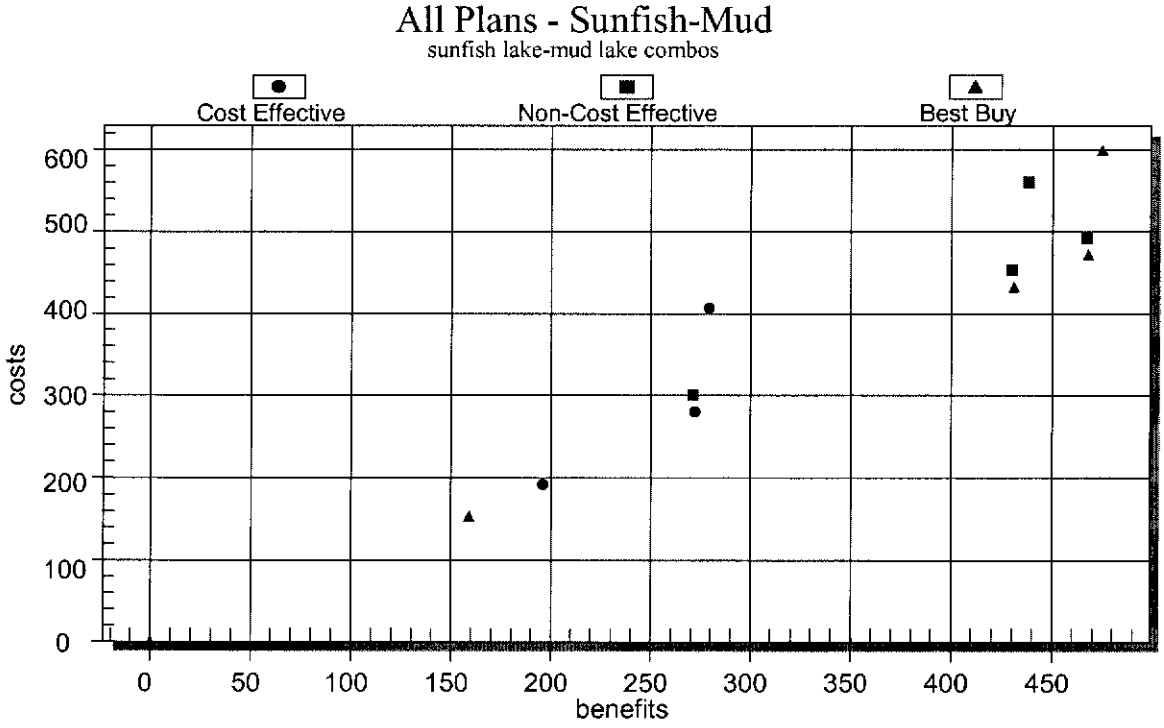

TABLE 5-3. Cost-Effective and Least-Cost Combinations - Sinnippee and Islands.

Alternative Combination	Annualized Cost ($1000s)	Output (AAHUs)	Average Cost ($1000/AAHU)
N0+I0	0	0	0
N0+I1	64	18	3.556
N0+I2	98	32	3.063
N1+I0	99	73	1.356
N1+I1	163	91	1.791
N1+I2	197	105	1.876
N1+I3	243	114	2.132
N1+I4	275	137	2.007
N1+I5	342	171	2.000
N1+I7	598	183	3.268

FIGURE 5-2. Cost-Effective and Least-Cost Plans - Sinnippee and Islands.

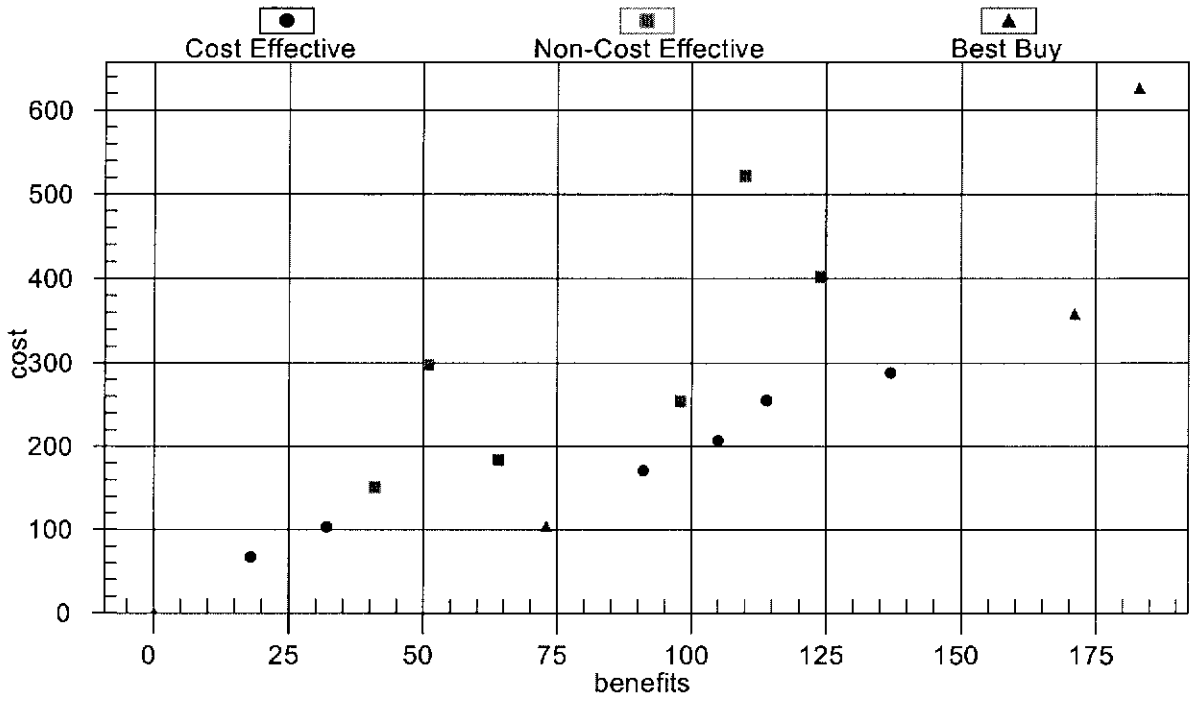

FIGURE 5-3. Best Buy Plans - Sunfish Lake and Mud Lake.

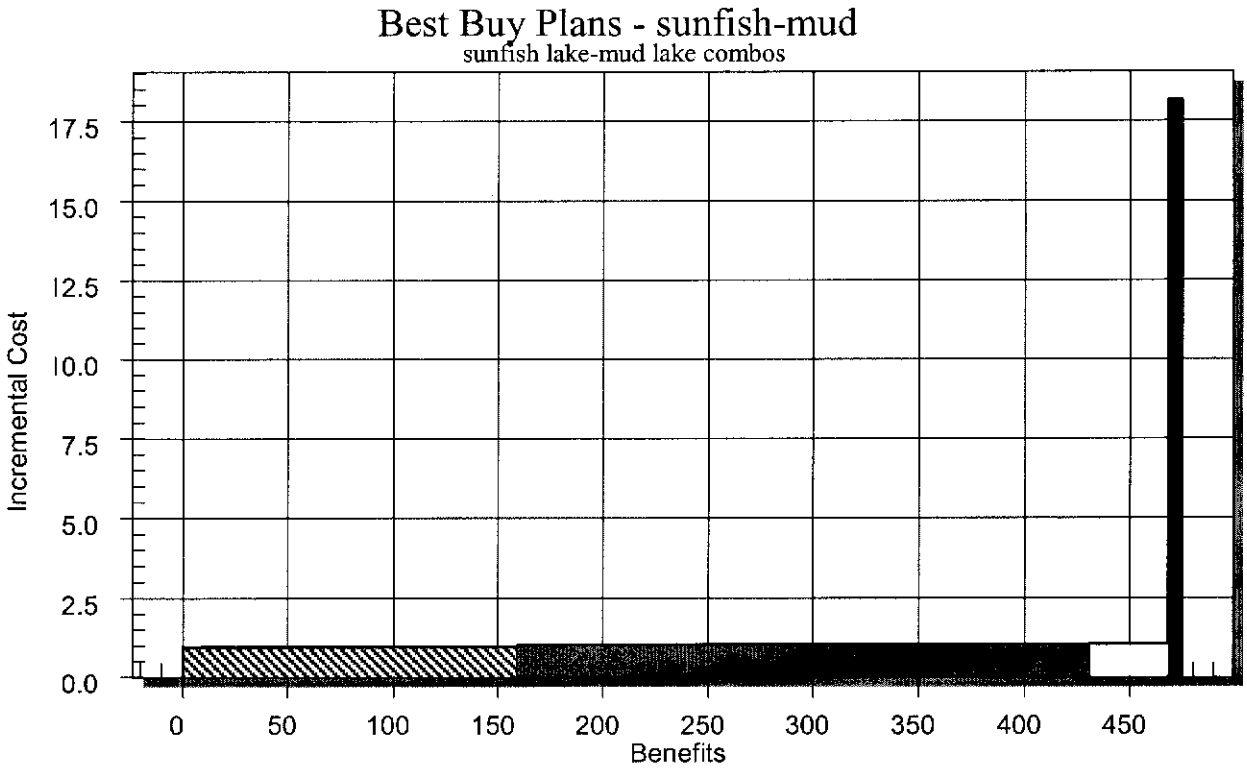

TABLE 5-4. Incremental Costs (Best Buy Plans) – Sunfish Lake and Mud Lake.

Alternative Combination	Annualized Cost ($1000s)	Output (AAHUs)	Average Cost ($1000/AAHU)	Incremental Cost per Output ($1000)
S0+M0	0	0	0	0
S1+M0	153	159	0.962	0.962
S1+M2	433	431	1.005	1.029
S2+M2	472	468	1.009	1.054
S2+M3	599	475	1.261	18.143

Neither cost effectiveness nor incremental cost analysis includes a plan selection rule similar to the NED rule. In the absence of such a decision making rule, neither analysis indicates what choice to make. However, the information developed by both analyses will help to make better informed decisions, and, once a decision is made, they will help to better understand its consequences in relation to other choices.

While incremental cost analysis identifies those alternatives that are the most cost-effective and, as stated above, provides information to the decision maker, this procedure should not be the sole source on which to base a decision. Other factors considered in the analysis were site topography, management objectives of the resource agencies, critical needs of the region, and ecosystem needs of the Upper Mississippi River System.

The interagency planning team initially decided that the plan S2 N1 M2 I5 best met the planning objectives. This plan included mechanical and hydraulic dredging at Sunfish Lake, constructing a deflection embankment at Sinnippee Creek, constructing a full deflection at Mud Lake, and constructing six medium islands across the channel from Mud Lake.

Following a closer review of this plan and alternatives, the planning team instead supported the 5-island alternative (I4) and no action at Sinnippee Creek (N0).

The Corps and cooperating agencies preferred the 5-island configuration for a number of reasons. The 5-island configuration would provide better protection from wind fetch and greater reduction in resuspension of sediments than the 6-island configuration. These effects could not be sufficiently measured by the habitat evaluation. Also the 6-island alternative would have involved constructing two islands in slightly deeper water. While the construction cost accounted for the increased cost of island construction in deeper water, the increased potential for island erosion could not be sufficiently quantified.

Constructing the Sinnippee deflection embankment was dropped from the preferred alternative after real estate investigations determined that lands needed for construction of this feature are not currently in Federal ownership. The incremental analysis did show that this was a cost-effective feature to construct. However, because the logistical aspects of acquiring the necessary lands and easements would substantially extend the current study schedule, the Corps and cooperating agencies decided not to include this feature in the selected plan for this HREP. Constructing the Sinnippee deflection embankment could be pursued at a later date under the Environmental Management Program, or another environmental restoration enhancement program.

The preferred alternative of the Corps and cooperating agencies as of June 1999 was S2 N0 M2 I4. This plan includes mechanical and hydraulic dredging at Sunfish Lake, constructing a full deflection levee at Mud Lake, and constructing five medium islands across the channel from Mud Lake. It differed from the plan discussed above in that it did not include constructing a deflection embankment at Sinnippee Creek and included constructing five medium islands, not six medium islands.

Mussel surveys conducted in August and October 1999 encountered specimens of the federally endangered *Lampsilis higginsi* (Higgins' eye pearly mussel) at the location of the proposed islands feature. A detailed Biological Assessment (BA) was prepared and is included as Appendix L of this DPR. The determination of the BA is that the proposed islands feature may adversely affect individual specimens of the federally endangered Higgins' eye pearly mussel (*Lampsilis higginsi*) within the construction footprint or the "shadow zones" of reduced flow, but would not directly or cumulatively threaten the continued survival of the species. However, even in the absence of the above project-related direct or cumulative effects, the ultimate fate of the Higgins' eye pearly mussel remains uncertain.

One of the general goals of the HREP is to conserve, restore, and enhance federally listed endangered and threatened species and the habitats upon which they depend. Construction of a feature that has the potential to adversely affect any endangered species is in direct conflict with this stated goal. For this reason, the Corps and the interagency team determined that the islands feature would not be included as part of the selected plan for this HREP. Construction of mid-river islands in lower Pool 11 could be pursued at a later date under the EMP or other environmental restoration authorities, provided that the feature could be located and constructed without adversely affecting the Higgins' eye or any other federally listed species.

The selected plan for this HREP is S2 N0 M2 I0. This plan includes constructing a deflection embankment with mechanical and hydraulic dredging at Sunfish Lake, and constructing a full deflection embankment with mechanical dredging at Mud Lake.

6. RECOMMENDED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE CONSIDERATIONS

a. General Description. The selected plan for the project would include the following alternatives: construct a deflection embankment and hydraulically/mechanically dredge deep-water channels at Sunfish Lake (S2); no action at Sinnippee Creek (N0); construct a deflection embankment in conjunction with mechanically dredging deep-water channels at Mud Lake (M2); and no action for island construction (I0). Details of the alternatives in the selected plan are shown on plates 10 through 15 and listed in Table 6-4.

b. Recommended Plan.

(1) Sunfish Lake Deflection Embankment and Off-Channel Dredging (S2). This alternative would create a protected backwater off the main channel (see plate 11). The 1500-m deflection embankment would tie in to the Wisconsin shore at the upstream end (RM 584.1) and extend out toward the main channel, terminating near RM 583.5. The embankment's top elevation would be constructed to 185.27 m, sloping gradually downstream to elevation 185.24 m. This elevation coincides with the 5-year flood elevation plus 0.3 m. The top width would be 3 m with side slopes no steeper than 6H:1V. A 3-m bench on the river side of the embankment would be planted with willow stakes to protect against wind, wave, and current erosion. The borrow for this embankment would be mechanically dredged from the river bottom, downstream and adjacent to the embankment alignment.

To further enhance erosion protection, riprap would be utilized at the upstream end of the embankment and at other critical areas. A riprap berm would be placed near the toe of the embankment to an elevation approximately 0.8 m above flat pool. This arrangement is preferred over the more conventional method of armoring the slope face, as it uses less riprap and allows for vegetation of the embankment slope, giving a more natural appearance.

To maintain a fresh inflow of dissolved oxygen, a notched rock weir would be constructed at the upstream end of the deflection embankment. The weir crest elevation would be 0.76 m below flat pool elevation. Downstream of the weir, a sediment trap would be constructed to reduce sedimentation in the newly dredged channels. The trap would be sized to retain the majority of the expected sediment load through the weir for a 50-year period.

Downstream of the deflection embankment, a series of deep-water channels totaling 11.5 ha would be dredged. A 2-cell containment area would be constructed as part of the deflection embankment to hold the hydraulically dredged material. Both the hydraulically and mechanically dredged channels would be excavated to a bottom elevation of 181.31 m, a bottom width of 10 m, and side slopes of approximately 3H:1V. Additionally, the side slopes of the hydraulically dredged channels would be constructed in a stepped fashion. Dredging depths were based on estimated post-project sedimentation rates and are discussed further in paragraph c.2.

(2) Mud Lake Deflection Embankment and Off-Channel Dredging (M2). This alternative would create a protected backwater off the main channel (see plate 12). The 3038-m deflection embankment would tie in to the Iowa shore at the upstream end near RM 589.4 and extend out toward the main channel and then angle downstream paralleling the main channel, ending near RM 587.7. The embankment was extended approximately 200 m from the previously suggested 2822-m length. This was due to concerns that an eddy would form at the end of the embankment and carry sediment-laden water into the lower end of the excavated channel. The embankment's top elevation would be constructed to 185.39 m and slope gradually downstream to elevation 185.35 m. This elevation coincides with the 5-year flood elevation plus 0.3 m. A second 250-m embankment would be constructed upstream of the primary embankment. This secondary embankment would deflect sediment and debris that naturally accumulates at the head of Mud Lake, thereby decreasing maintenance of the upstream notched rock weir and decreasing sediment loads into Mud Lake. This arrangement would also allow pleasure craft to access the adjacent marina. The embankment top width would be 10 m (except for the secondary embankment length at 3 m) with side slopes no steeper than 6H:1V. The embankment would be protected against wind, wave, and current erosion with a 250-mm-thick layer of bedding stone and a 500-mm-thick layer of Iowa Class E riprap.

The borrow for this embankment would be mechanically dredged from the river bottom, landward and adjacent to the embankment alignment. The resulting 8.8-ha deep-water channel would be excavated to a bottom elevation of 181.45 m, a minimum bottom width of 10 m, and side slopes of approximately 3H:1V. Several high spots would intentionally be left in the dredged channel to retain the warmer bottom water during overwintering periods.

To maintain a fresh inflow of dissolved oxygen, two notched rock weir structures would be constructed, one near the deflection embankment's midpoint at station 14+30 and one near the upstream end at station 2+10. The weir crest elevation would be 0.89 m below flat pool elevation.

In addition to the dredging needed to construct the deflection embankment, a connecting channel to Zollicoffer Slough and a channel into Mud Lake also will be dredged. The dredged channel into Zollicoffer Slough would provide a reliable connection to the main channel for the slough's existing deep water.

The dredged channel into Mud Lake would be placed away from the shore to minimize the potential for shoreline development such as boat docks that would create additional disturbance to the backwater lake. In addition to increasing fish access and fish habitat in upper Mud Lake and Zollicoffer Slough, the dredged channels would allow for boat access and would likely result in increased hunting and fishing in this area. Material from these channels would be side cast to create small islands or used in the construction of the deflection embankment or constructed islands. These channels would have the same dimensions as the channel created for embankment construction.

c. Construction Considerations.

(1) Existing Site Elevations. The Pool 11 Islands project area is located within the Mississippi River floodway. Flat pool elevation is 183.79 m. The river bottom elevation throughout the project area—not including the navigation channel—ranges from 180.0 m to 183.0 m. Embankment construction can be accomplished during flat pool conditions using barge-mounted earth-moving equipment.

(2) Dredging Depths and Equipment. Mechanical dredging is the preferred method for constructing the embankment and the majority of deep-water features of the project. Hydraulic dredging is preferred to complete the remaining channel network in the Sunfish Lake area that is not needed as a borrow source for embankment construction. Based on information from sedimentation transects (see Table 6-1), dredged channels are intended to have average water depths of 1.85 m or deeper at the end of the project life.

TABLE 6-1. Basis of Dredging/Excavation.

Mud Lake

Elevation (meters NGVD 1912)	Description
183.79	Pool 11 flat pool
-0.30	Present low-flow winter regulation
-1.83	Maintained water depth
-0.21	50 years of sediment (0.0258 meter per year)
181.45	Minimum dredging depth

Sunfish Lake

Elevation (meters NGVD 1912)	Description
183.79	Pool 11 flat pool
-0.30	Present low-flow winter regulation
-1.88	Maintained water depth
-0.30	50 years of sediment (0.0364 meter per year)
181.31	Minimum dredging depth

(3) Borrow and Construction Materials. Borrow locations will be precisely delineated prior to construction. In the Mud Lake vicinity, shallow water near the deflection embankment alignment may dictate that construction by floating plant begin at the downstream end and work upstream. It would require approximately 143 065 cubic meters of material to construct the embankment. As the embankment is constructed, the borrow material would come from the river bottom, thus creating a protected deep backwater channel. To excavate the channel to the required dimensions, approximately 138 497 cubic meters would have to be excavated. Therefore, the excavation and fill

quantities would nearly balance. The excavation dimensions, as shown on plate 14, are the minimum required to realize habitat benefits.

Access to Sunfish Lake would likely be by way of floating plant from the navigation channel. Here, too, the access would have to be mechanically excavated and the suitable material used in the concurrent construction of the deflection embankment and containment cells. An estimated 77 427 cubic meters would be needed for construction of the deflection embankment and containment cells. To construct the channel to the required dimensions, approximately 51 935 cubic meters would have to be excavated. The additional 25 492 cubic meters required for the embankment could be borrowed from within the containment cells to increase their capacity.

A network of hydraulically excavated channels, totaling approximately 81 281 cubic meters, would add to the deep-water habitat in the project area. Excavated material would be placed alternately into one of two containment cells built in conjunction with the deflection embankment.

(4) Excavation Quantities. The quantities required to construct the embankments are based on estimates from models created through InExpress, a MicroStation 95 software application that uses raw survey data as input and interprets the information to create a topographical surface map. For example, cut and fill amounts for embankment construction were matched as closely as possible so that a minimum of mechanical excavation would be required. The minimum dimensions of the channels created by this excavation result in a bottom width of 10 m, side slopes of 3H:1V, and a bottom elevation of 181.31 m at Sunfish Lake and 181.45 m at Mud Lake.

(5) Construction Sequence. It is likely that the features in Sunfish Lake would be constructed completely by a floating plant because land access is limited and remote. The Mud Lake features can be constructed beginning with the land tie-in and continuing with a more conventional haul road with adjacent borrow method.

Table 6-2 summarizes the probable construction sequence for both the Mud Lake and Sunfish Lake project features. This is a suggested sequence, and would not be contractually required.

TABLE 6-2. Probable Construction Sequence.

Sequence	Construction Work Item	Instructions	Purpose
1.	Construct deflection embankment and deep-water channel dredging	Excavate channel to gain access, use suitable material excavated from channel to construct embankment, stockpile unsuitable embankment material for either disposal or use in vegetation of slopes.	Provides protection of excavated channels and protect area from resuspension of sediments by wind and wave action.
2.	Riprap channel side of embankment as necessary	-----	Provides slope protection and minimize erosion by wind and wave action.
3.	Implement soil stabilization on deflection embankment	Seed with flood-resistant grasses and willow stakes.	Provides slope protection and minimize erosion by wind and wave action.
4.	Construct hydraulically dredged channels (Sunfish Lake only)	-----	Provides deep water fish habitat to meet project objectives.

(6) Construction Schedule Constraints. Scheduling of construction contracts will depend on availability of EMP funds. Current funding forecasts indicate that the Pool 11 Islands project will need to be separated into stages. Table 6-3 presents a proposed schedule for staging of construction activities.

TABLE 6-3. Proposed Contract Award Schedule.

Stage I	Sunfish Lake	FY 02
Stage II	Mud Lake	FY 04

Construction activities should not occur at Sunfish Lake or Mud Lake from October 15 to December 15 to avoid recreational impacts to waterfowl hunters using the area and to ensure safety of contractors. According to agency staff, this area is not intensely hunted and may be closed to hunters if construction activities need to take place during this period. While this would negatively impact hunters for one or two seasons, future hunting opportunities would be improved with the improvement of waterfowl habitat.

As a part of pre-construction monitoring, refuge staff will monitor the various project areas for bald eagle nesting activity during the latter part of January and February. The Contracting Officer's Representative (COR) would contact refuge staff at the end of February to determine if there is any nesting activity within the project area. If there is no nesting activity, construction could begin immediately. If there is nesting activity, construction in this area would be delayed until the nesting activities are abandoned or until

the chicks are at least 1 month of age and thus beyond the moderately critical period discussed in the Bald Eagle Recovery Plan. Based on normal timing of breeding activities in this area, if the nest is active, construction may be delayed until June. The plan described above would avoid impacts to nesting bald eagles. The COR would need to stay in close contact with the refuge staff regarding initiation of construction in the project areas.

(7) Storm Water Pollution/Erosion Control. The potential for storm water pollution during construction is minimal for this project. Temporary stabilization measures would be employed on newly constructed areas of the embankments and island until stabilization occurs. Stabilization practices may include mulching, temporary seeding, and/or the erection of silt fencing. Overall, the long-term storm water runoff characteristics of the site are not expected to be significant. The newly constructed features would be protected from erosion by placing riprap along the embankments' upstream side and seeding the remaining exposed surfaces (see plates 13 and 14).

(8) Permits. A public notice, as required by Section 404 of the Clean Water Act, will be made prior to submission of this report for final approval. A Section 404(b)(1) Evaluation is found in Appendix B. A Section 401 water quality certificate from the State of Iowa and a Finding of Compliance for the Section 404(b)(1) Evaluation will be included in the final submission of this report. A Section 401 water quality certificate from the State of Wisconsin will be received during the plans and specifications stage. Because all land disturbances associated with this project are addressed in the 404(b)(1) Evaluation, a National Pollutant Discharge Elimination System (NPDES or Section 402) permit for storm water discharges will not be required.

d. Project Data Summary. Table 6-4 summarizes project data. Measurements are based on best available data at the time.

TABLE 6-4. Pool 11 Islands Project Data Summary.

Feature	Measurement	Unit of Measure
Sunfish Lake Deflection Embankment		
Length	1500	meters
Crown Width	3	meters
Side Slopes	6:1	H:V
Bench width	3	meters
Level of Protection	5-year plus 0.3m	flood frequency
Elevation	185.27 - 185.24	meters (NGVD 1912)
Avg. River Bottom Elev.	183.0	meters
Embankment Volume	56 185	meters ^{3}
Riprap (Iowa Class E)	1677	megagrams
Notched Weir Width (bottom)	3.5	meters
Bottom Elevation	183.03	meters (NGVD 1912)
Seeding	3.25	hectares

TABLE 6-4 (Continued)

Feature	Measurement	Unit of Measure
Sunfish Lake Containment Cells		
Length	1060	meters
Crown Width	3	meters
Side Slopes	6:1	H:V
Level of Protection	5-year plus 0.3m	flood frequency
Elevation	185.25 - 185.24	meters (NGVD 1912)
Embankment Volume	21 242	meters ^{3}
Seeding	1.1	hectares
Sunfish Lake Channels		
Length (hydraulic)	3307	Meters
Length (mechanical)	1082	meters
Bottom Width	10 (minimum)	meters
Side Slopes	3:1	H:V
Bottom Elevation	181.31	meters (NGVD 1912)
Excavation Volume (hydraulic)	81 281	meters ^{3}
Excavation Volume (mechanical)	51 935	meters ^{3}
Mud Lake Deflection Embankments		
Length		meters
Primary	3038	
Secondary	250	
Crown Width	10	meters
Side Slopes	6:1	H:V
Level of Protection	5-year plus 0.3m	flood frequency
Elevation	185.39 - 185.35	meters (NGVD 1912)
Avg. River Bottom Elev.	183.0	meters
Embankment Volume		meter ^{3}
Primary	131 815	
Secondary	11 250	
Riprap (Iowa Class E)	17 726	megagrams
Thickness	500	millimeters
Top Elevation	184.09	meters (NGVD 1912)
Bedding Stone	8863	megagrams
Thickness	250	millimeters
Notched Rock Weir	(2)	each
Width	3.66	meters
Sill Elevation	182.9	meters
Seeding	7.2	hectares
Mud Lake Channels		
Length (along embankment)	2730	meters
Length (along hook)	315	meters
Length (of offshoots)	350	meters
Bottom Width	10 (minimum)	meters
Side Slopes	3:1	H:V
Bottom Elevation	181.45	meters (NGVD 1912)
Excavation Volume	138 497	meter ^{3}

e. Operation. This project has no general operating requirements.

f. Maintenance. The project features have been designed to require only minimal annual maintenance. Estimated annual maintenance costs are listed in Table 8-2, Section 8, Cost Estimates.

7. SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 7-1 presents the schedule of project completion steps.

TABLE 7-1. Project Implementation Schedule.

Requirement	Scheduled Date
Submit Draft DPR for review to Corps of Engineers' Mississippi Valley Division	Apr 99
Distribute DPR for public and agency review	Feb 01
Submit final and public reviewed DPR to Mississippi Valley Division	Sep 01
Receive plans and specifications funds	Sep 01
Submit Stage I plans and specifications for Internal Technical Review	Oct 01
Construction approval by HQUSACE	Nov 01
Obtain approval of Stage I plans and specifications	Nov 01
Advertise Stage I contract	Dec 01
Award Stage I contract	Jan 02
Submit Stage II plans and specifications for Internal Technical Review	Sep 02
Obtain approval of Stage II plans and specifications	Oct 02
Advertise Stage II contract	Aug 03
Complete construction of Stage I	Sep 03
Award Stage II contract	Oct 03
Complete construction of Stage II	Sep 05

8. COST ESTIMATES

Project element and contingency costs are presented in Appendix I. This appendix includes the fully funded estimate (FFE) and the current work estimate (CWE). Table 8-1 compares these costs.

TABLE 8-1. Pool 11 Islands Habitat Rehabilitation and Enhancement Project Cost Summary, August 2000 Price Levels.

Account	Feature	Fully Funded Estimate (FFE) [2]	Current Working Estimate (CWE)
01	Lands and Damages	0	0
02	Relocations	0	0
06	Fish and Wildlife Facilities	$ 6,832,982	$ 6,328,409
30	Planning, Engineering and Design	$ 1,700,000	$ 1,700,000
31	Construction Management	$ 579,942	$ 530,208
	Total Project Costs[1]	$ 9,112,924	$ 8,558,617

[1] Project features are on Federal land and therefore 100% federally funded.

[2] The FFE was calculated based on the proposed construction schedule, expected escalation costs, and a contingency factor, and represents the money expected to be spent at the end of project construction. The CWE, with a 20-percent contingency factor, was used for annualized costs in the incremental analysis and is shown in a detailed estimate of project design and construction costs as presented in Table 8-2.

TABLE 8-1 (Cont'd)

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
01	**LANDS AND DAMAGES**						
	Real Estate	-	-	-	-	-	0%
02	**Relocation**	-	-	-	-	-	0%
06	**FISH AND WILDLIFE FACILITIES**						
06	**SUNFISH LAKE**						
	Mob/Demob (Mechanical Dredge)	1	job	$ 252,958.00	$ 252,958	$ 50,592	20%
	Mob/Demob (Hydraulic Dredge)	1	job	$ 175,902.00	$ 175,902	$ 35,180	20%
	Embankment – Deflection	56185	m^3	$ 13.58	$ 763,252	$ 152,650	20%
	Embankment – Containment Cells	21242	m^3	$ 13.58	$ 288,562	$ 57,712	20%
	Excavated Channels (Hydraulic)	81281	m^3	$ 7.56	$ 614,518	$ 122,904	20%
	Riprap	1677	megagrams	$ 52.69	$ 88,362	$ 17,672	20%
	Seeding	4.35	hectares	$ 1,155.39	$ 5,026	$ 1,005	20%
	TOTAL – SUNFISH LAKE				$ 2,188,579	$ 437,716	
06	**MUD LAKE**						
	Mob/Demob (Mechanical Dredge)	1	Job	$ 255,977.00	$ 255,977	$ 51,195	20%
	Embankment – Deflection	127097	m^3	$ 13.08	$ 1,661,901	$ 332,380	20%
	Excavated Channel – Mud Lake Hook	11400	m^3	$ 18.53	$ 211,283	$ 42,257	20%
	Riprap w/Bedstone	17726	megagrams	$ 53.45	$ 947,429	$ 189,486	20%
	Seeding	7.2	hectares	$ 1,181.14	$ 8,504	$ 1,701	20%
	TOTAL – MUD LAKE				$ 3,085,095	$ 617,019	
06	**FISH AND WILDLIFE FACILITIES COST SUBTOTAL**				$ 5,273,674		
	Contingencies Subtotal					$ 1,054,735	
	FISH AND WILDLIFE FACILITIES COST TOTAL				$ 6,328,409		
30	**PLANNING ENGINEERING AND DESIGN**						
	Definite Project Report				$ 1,400,000		
	Plans and Specifications				$ 150,000		
	Engineering During Construction				$ 150,000		
	SUBTOTAL				$ 1,700,000		
31	**CONSTRUCTION MANAGEMENT**						
	Contract Administration				$ 66,276		
	Shop Drawing Review				$ 44,184		
	Inspection and Quality Assurance				$ 331,380		
	CONST MGMT SUBTOTAL				$ 441,840		
	Contingency Subtotal					$ 88,368	20%
	CONST MGMT COST TOTAL				$ 530,208		
	TOTAL PROJECT COST				$ 8,558,617		

TABLE 8-2. Estimated Annual Operation and Maintenance Costs, April 1999 Price Levels.

	Qty	Unit	Unit Price ($)	Total Cost ($)
Operation				0
Maintenance				
Embankment Inspection	40	Hr	25	1,000
Riprap	115	MG	30	3,450
Erosion Control	20	Hr	100	2,000
Debris Removal, Weirs	20	Hr	50	1,000
Planting Maintenance	16	Ha	50	800
Rehabilitation [1]				0
			Subtotal:	8,250
Contingencies (20%)				1,710
			TOTAL:	**9,960**

[1] Rehabilitation cannot be accurately estimated. Rehabilitation is reconstructive work that significantly exceeds the annual operation and maintenance requirements identified above and which is needed as a result of major storms or flood events.

TABLE 8-3. Estimated Post-Construction Annual Monitoring Costs, April 1999 Price Levels.

Item	Annual Cost ($)
Engineering Data [1]	3,000
Natural Resource Data [1]	2,000
Subtotal	5,000
Contingencies (20%)	1,000
Subtotal	6,000
Planning, Engineering, Design [2]	1,500
Total	**7,500**

[1] Reference Tables 8-1 and 8-2.

[2] Includes cost of annual evaluation report.

9. ENVIRONMENTAL EFFECTS

a. Summary of Effects. The proposed project would result in short-term decreases in water quality due to localized increases in turbidity resulting from dredging and construction activities. There would be a long-term reduction in turbidity resulting from a decrease in resuspension of sediments. There would be a slight increase in terrestrial habitat and a conversion of shallow-water habitat to deep-water habitat. The project would increase the diversity and amount of aquatic vegetation, providing food and cover for a variety of fish and wildlife, and would provide overwintering habitat for fish. No significant social or economic impacts would result. No federally protected species would be impacted. No impacts to historic properties are anticipated.

b. Economic and Social Impacts.

(1) Community and Regional Growth. No impacts to the growth of the community or region would be realized as a result of the proposed project.

(2) Community Cohesion. The proposed environmental enhancement project would not adversely impact community cohesion.

(3) Displacement of People. No residential relocations would be required as a result of the project.

(4) Property Values and Tax Revenues. The project would have no direct impact on property values or related tax revenues.

(5) Public Facilities and Services. The proposed project would maintain and enhance recreational opportunities within Pool 11. Protecting the existing fish and wildlife habitat from sedimentation and enhancing the areas through dredging activities would provide for the continued recreation needs of the general public. Access to the campground and boat ramp near the Mud Lake site should not be affected during project construction.

Dredging in Mud Lake would allow easier boat access into this area for hunting and fishing. This may change the nature of hunting and fishing in this area from a walk-in, solitary hunting or fishing experience to a more crowded experience with multiple boats carrying multiple hunters or anglers. The dredged channel would be placed away from the shore to minimize the potential for shoreline development such as boat docks that would create additional disturbance to the backwater lake.

(6) Life, Health, and Safety. The proposed project poses no threats to the life, health, or safety of recreationists or others in the area.

(7) Business and Industrial Growth. No long-term impacts to business or industrial activity would result from the proposed project. No business relocations would be required.

(8) Employment and Labor Force. There could be a slight increase in short-term employment opportunities resulting from project construction. No long-term impacts are evident.

(9) Farm Displacement. No farms would be displaced as a result of the project.

(10) Aesthetics. The proposed environmental enhancement project would not diminish the aesthetic resources of the area.

(11) Noise Levels. Project construction would generate a temporary increase in noise levels; no long-term impacts would result.

c. Natural Resources Impacts.

(1) Terrestrial Habitat. Little terrestrial habitat would be impacted by the proposed project. Approximately 2.3 ha of existing terrestrial vegetation at Mud Lake and 1.6 ha of terrestrial vegetation at Sunfish Lake would be disturbed by construction of the deflection embankments. The deflection embankments and adjacent disturbed areas would be replanted following construction.

There will be an overall increase in terrestrial habitat in lower Pool 11. At Sunfish Lake, approximately 23.8 ha of terrestrial habitat will be created through construction of the deflection embankment (18.8 ha) and the confined dredged material placement site embankment (5 ha). At Mud Lake, approximately 10.9 ha of terrestrial habitat will be created through construction of the deflection embankment. The embankments would be constructed to a 5-year flood frequency height plus 0.3 m. Newly created deflection embankments would be revegetated to encourage use by nesting water birds and to discourage use by recreational boaters. Signs may be erected asking for voluntary avoidance by recreationists to minimize disturbance to birds, turtles, and other wildlife that may utilize the embankments.

Portions of the confined disposal site in Sunfish Lake would be at a lower elevation and should support a variety of wetland plants. Improved access onto the deflection embankment at Mud Lake may increase the amount of trash and litter in these areas. Barriers may be erected to discourage or limit access.

(2) Wetland Habitat. Construction of the deflection embankments at Mud Lake and Sunfish Lake should reduce sedimentation in these areas and slow the gradual conversion of wetland habitat to terrestrial. As stated previously, the confined disposal site in Sunfish Lake should support a variety of wetland plants.

(3) Aquatic Habitat. The quality of aquatic habitat in the project areas currently is relatively low due to uniform depths and flow. Aquatic habitat losses associated with construction would be more than offset by the increase in habitat quality resulting from an increase in diversity of depths and flow.

Approximately 23.8 ha of shallow-water habitat in Sunfish Lake would be converted to terrestrial habitat by construction of the deflection embankment and confined disposal site; 11.5 ha of shallow-water habitat would be converted to deep-water habitat. The deflection embankment would incorporate existing islands to the extent possible to minimize aquatic impacts. The deflection embankments would reduce the input of sediments and resuspension of sediments resulting from wind-generated and boat-induced waves. This would result in an increase in the photic zone. The increased bathymetric and flow diversity and size of the photic zone should increase the diversity and amount of aquatic vegetation. The 11.5 ha of newly created deep water would provide suitable wintering habitat for centrarchids and other fishes.

In Mud Lake, 10.9 ha of shallow-water habitat would be converted to terrestrial habitat by constructing the deflection embankment. Utilizing existing land in the deflection embankment would minimize impacts to aquatic habitats. Roughly 8.8 ha of shallow water in Mud Lake would be deepened to provide habitat for overwintering fish and reliable access to existing deep areas in Zollicoffer Slough. As discussed above, the deflection embankments would reduce the input and resuspension of sediments.

Mechanical and hydraulic dredging activities would result in a temporary increase in turbidity at all project areas.

(4) Wildlife. The expansion of aquatic vegetation expected to result from deflection embankment construction would increase the value of this area for migrating waterfowl, especially diving ducks. The leeward side of the deflection embankments would provide a resting area for migrating waterfowl. Use of existing islands to construct the deflection embankment in Sunfish Lake may reduce waterfowl nest success by providing land access to predators.

(5) Fish. The restoration of Sunfish Lake and Mud Lake/Zollicoffer Slough would substantially improve the quality of the fish habitat in this area. Lower Pool 11 currently provides summer habitat for centrarchids, but overall the area is considered to be poor habitat. The primary limiting factors are lack of deep off-channel habitat and high flows. The construction of weir structures in the deflection embankments would ensure suitable flow, dissolved oxygen, and temperature conditions in the excavated channels. An access channel to Zollicoffer Slough would provide reliable access to existing deep-water habitat.

The riprap associated with embankment construction would provide habitat for invertebrates and structure and cover for fish.

(6) Threatened and Endangered Species. Construction activities would be timed to avoid impacts to nesting bald eagles. Therefore, no impacts to bald eagles are anticipated. As a part of pre-construction monitoring, refuge staff will monitor the various project areas for bald eagle nesting activity during the latter part of January and February. The Contracting Officer's Representative (COR) would contact refuge staff at the end of February to determine if there is any nesting activity within the project area. If there is no nesting activity, construction could begin immediately. If there is nesting activity, construction in this area would be delayed until the nesting activities are abandoned or until the chicks are at least 1 month of age and thus beyond the moderately critical period discussed in the Bald Eagle Recovery Plan. Based on normal timing of breeding activities in this area, if the nest is active, construction may be delayed until June. The plan described above would avoid impacts to nesting bald eagles. The COR would need to stay in close contact with the refuge staff regarding initiation of construction in the project areas.

Mussel surveys were conducted in August and October 1999 at proposed feature construction areas by Ecological Specialists, Inc. (ESI) under contract with the Corps. The federally endangered *Lampsilis higginsi* (Higgins' eye pearly mussel) was found at the location of the proposed islands feature. A detailed Biological Assessment (BA) was prepared and is included as Appendix L of this DPR. The determination of the BA is that, while two of the proposed project features (Sunfish Lake deflection/dredging and Mud Lake deflection/dredging) are not likely to affect federally listed species, the proposed islands feature may adversely affect individuals of the federally endangered Higgins' eye pearly mussel (*Lampsilis higginsi*).

One of the general goals of the HREP (and the Refuge Master Plan) is to conserve, restore and enhance federally listed endangered and threatened species and the habitats upon which they depend. Construction of a feature that has the potential to adversely affect any endangered species is in direct conflict with this stated goal. For this reason, the Corps and the interagency team determined that the islands feature would not be included as part of the selected plan for this HREP.

(7) Hazardous, Toxic, and Radioactive Waste. The specific and relevant purpose of a hazardous, toxic, and radioactive waste documentation report (HDR) is to adequately document an appropriate inquiry into hazardous, toxic, and radioactive waste (HTRW) activities on potential project lands. The HTRW Documentation Report contained in Appendix K documents the inquiry for the Pool 11 Islands Project in order to minimize and prevent Federal liability under the Comprehensive Environmental Response, Compensation and Liability Act and to reduce any threats to site workers and avoid costly delays associated with environmental abatement activities.

The Pool 11 Islands project involves work on land that is historically a riverine environment and is located in the past and present floodplains. The proposed project features are located in a waterway that has a limited amount of upstream industrial activity.

Since there is only a slight potential of encountering contaminants in the sediments, it is not recommended that any further HTRW Environmental Assessments be conducted. The existing sediments that are to be used for island creation pose little, if no, potential for HTRW contamination. Additionally, no borrow material is to be brought in to the project site, so there is no potential for contamination from off-site sources.

(8) Prime and Unique Farmland. No prime and unique farmland would be impacted by the proposed project.

d. Historic Properties. The Pool 11 project has no historic properties listed on or eligible for inclusion in the National Register of Historic Places. Appendix A includes Corps letters dated July 10, 1998, to the Iowa and Wisconsin State Historic Preservation Offices (SHPO). The Iowa SHPO reply of July 22, 1998 (R&C#: 980731044) indicates that there are "no historic properties that might be affected by proposed undertaking." The Wisconsin SHPO reply of July 28, 1998 (Case #98-0778/GT) found that "the archeological survey procedures were both appropriate and thorough, and support the conclusion that there are no archeological sites eligible for listing on the National Register of Historic Places, within the areas surveyed." If the scope of the project should change, the Corps will coordinate any changes with the appropriate SHPO. In addition, if the execution of the project should uncover any item of archaeological, historical, or architectural interest, the Corps will ensure that reasonable efforts are taken to avoid or minimize harm to the property until its significance can be determined (36 CFR 800.11) and with appropriate Federal and State laws should human remains be discovered.

e. Mineral Resources. No impacts are expected to occur to mineral resources as a result of this project.

f. Cumulative Impacts. Habitat modifications should have long-term benefits to the fish and wildlife utilizing this area. This project, in concert with other EMP projects in the Upper Mississippi River System, should counter other impacts to the river ecosystem such as sedimentation, pollution, and general decline in river habitats.

g. Adverse Impacts Which Cannot Be Avoided. During construction, temporary noise impacts and a temporary increase in turbidity cannot be avoided.

h. Short-Term Versus Long-Term Productivity. Short-term construction impacts would be offset by the long-term increase in quantity and diversity of wetland and aquatic vegetation and overall improvement of habitat quality.

i. Irreversible or Irretrievable Resource Commitments. Materials and human resources used in proposed construction are the sole irreversible commitments.

j. Relationship of the Proposed Project to Land-Use Plans. The lands are identified as Wildlife Management/Reserve Forest Lands in the Land Use Allocation Plan (Corps of Engineers 1989). The proposed project does not conflict with this zoning. The

proposed project does not conflict with any laws or regulations pertaining to establishment and management of the Upper Mississippi River Wildlife and Fish Refuge.

k. Compliance with Environmental Quality Statutes. Table 9-1 summarizes compliance with applicable statutes.

(1) Endangered Species Act of 1973, as amended. Construction activities would be timed to avoid impacts to nesting bald eagles. Therefore, no impacts to bald eagles would be anticipated.

Intensive mussel surveys were conducted during the summer and fall of 1999 to determine if any federally endangered Higgins' eye mussels or other federally protected mussels are found in the proposed island construction area, including the proposed boulder field. Results of the survey and determination of impacts to the Higgins' eye are described in the Biological Assessment (Appendix L).

(2) National Historic Preservation Act of 1966, as amended. The Pool 11 Islands project has no historic properties listed on or eligible for inclusion in the National Register of Historic Places. The project has been coordinated with the Iowa and Wisconsin State Historic Preservation Offices (SHPOs).

(3) Federal Water Project Recreation Act. Recreational opportunities were considered during the development of this project. Hunting and fishing in the immediate project area may be temporarily impacted during construction. However, following construction, dredging in Mud Lake and Sunfish Lake would provide improved access for fishing and hunting in these areas.

(4) Fish and Wildlife Coordination Act. Project plans have been coordinated with the U.S. Fish and Wildlife Service, the Iowa DNR, and the Wisconsin DNR. Coordination with these agencies, as well as others, is detailed in Section 13, Coordination, Public Views, and Comments; and Appendix A - Correspondence. The Fish and Wildlife Coordination Act Report can be found in Appendix A.

(5) Wild and Scenic Rivers Act of 1968, as amended. The Mississippi River is not listed as a component river in the National Wild and Scenic River System.

(6) Executive Order 11988 Flood Plain Management. The project would not directly or indirectly induce growth (construction of structures and/or facilities) in the floodplain. Therefore, the project is judged to be in full compliance with this executive order.

(7) Executive Order 11990 (Protection of Wetlands). While existing wetland habitat would be impacted by construction of the deflection embankments, the embankment would be replanted with native vegetation and would provide protection from sedimentation to wetlands behind the embankments.

(8) Clean Water Act (Sections 401 and 404). A Section 404(b)(1) evaluation for the selected plan is found in Appendix B of this report.

(9) Clean Air Act, as amended. No aspect of the proposed project has been identified that would result in violations to air quality standards.

(10) Farmland Protection. No farmland would be impacted by the proposed project.

(11) National Environmental Policy Act of 1970, as amended. The completion of the EA and signing of the FONSI will fulfill NEPA compliance.

(12) National Economic Development (NED) Plan. The NED Plan is that plan that best satisfies the Federal planning objectives of increasing the Nation's output of goods and services and produces the most improvement to the national economy (dollars) and non-monetary outputs (average annual habitat units) were used to quantify all possible plans and alternatives for this project.

TABLE 9-1. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements.

Federal Policies	Compliance
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Full compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full compliance
Clean Water Act, 33 U.S.C. 1857h-7, et seq.	Full compliance
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Full compliance
Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Full compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Not applicable
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Not Applicable
Flood Plain Management (Executive Order 11988)	Full compliance
Protection of Wetlands (Executive Order 11990)	Full compliance
Farmland Protection Policy Act, 7 U.S.C. 4201, et seq.	Not applicable
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)	Not applicable

NOTES:

a. Full compliance. Having met all requirements of the statute for the current stage of planning.
b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning.
c. Noncompliance. Violation of a requirement of the statute.
d. Not applicable. No requirements for the statute required.

10. PROJECT PERFORMANCE ASSESSMENT

This section summarizes the monitoring and data collection aspects of the project. The primary project objectives have been summarized elsewhere in this document. The performance assessment is intended to gauge progress toward meeting these objectives.

The tables in this section present an overall description of the project phases, the activities that are to take place during certain phases, agency responsibilities, and monitoring data collection summaries.

TABLE 10-1. Monitoring and Performance Evaluation Matrix.

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	Define system-wide problem. Evaluate planning assumptions.	USFWS	USGS (UMESC)	LTRM	--
	Pre-Project Monitoring	Identify and define problems at HREP site. Establish need of proposed project features.	Sponsor	Sponsor	Sponsor	--
	Baseline Monitoring	Establish baseline for performance evaluation.	Corps	Field station or Sponsor through Cooperative Agreements, or Corps	HREP/ Sponsor	See Table 10-2
Design	Data Collection for Design	Include quantification of project objectives, design of project and development of performance evaluation plan.	Corps	Corps	HREP	See Table 10-2
Construction	Construction Monitoring	Assess construction impacts; assure permit conditions are met.	Corps	Corps	HREP	See State Section 401 Stipulations
Post Construction	Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative) Sponsor (field observations)	Sponsor through O&M, or Corps	HREP/ Sponsor	See Table 10-3

TABLE 10-2. Resource Monitoring and Data Collection Summary. [1]

	WATER QUALITY DATA						ENGINEERING DATA			NATURAL RESOURCE DATA				
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase	Sampling Agency	Remarks
Type Measurement	APR-SEP	OCT-MAR	JUN-SEP	DEC-MAR	JUN-SEP	DEC-MAR								
POINT MEASURMENTS														
Water Quality Stations [2]													Corps	
Turbidity														
Secchi Disk	2W	M	2W	M	2W	M								
Transparency	2W	M	2W	M	2W	M								
Dissolved Oxygen	2W	M	2W	M	2W	M								
Specific Conductance	2W	M	2W	M	2W	M								
Water Temperature	2W	M	2W	M	2W	M								
Velocity	2W	M	2W	M	2W	M								
Water Depth	2W	M	2W	M	2W	M								
Water Elevation	2W	M	2W	M	2W	M								
% Cloud Cover	-	M	-	M	-	M								
Ice Depth	-	M	-	M	-	M								
Snow Depth	-	M	-	M	-	M								
pH	2W	M	2W	M	2W	M								
Chlorophyll	2W	M	2W	M	2W	M								
Total Alkalinity	2W	M	2W	M	2W	M								
Suspended Solids	2W	M	2W	M	2W	M								
Wind Direction	2W	M	2W	M	2W	M								
Wind Velocity	2W	M	2W	M	2W	M								
Wave Height	2W	M	2W	M	2W	M								

TABLE 10-2 (Continued)

	WATER QUALITY DATA						ENGINEERING DATA			NATURAL RESOURCE DATA				
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase	Sampling Agency	Remarks
Type Measurement	APR-SEP	OCT-MAR	APR-SEP	OCT-MAR	APR-SEP	OCT-MAR								
Water Quality Station [3] W-M592.1N														WDNR Grant River mouth grid sampling 1988-1989; identifies Grant plume/net sedimentation rate
Velocity	M													
Water Depth	M													
Secchi Disk	M													
Dissolved Oxygen	M													
Water Temperature	M													
Water Quality Station W-M590-8B. W-M590.8H														WDNR 1990; to monitor light changes with time
Wind Direction				7C										
Wind Velocity				7C										
Secchi Disk				7C										
Dissolved Oxygen				7C										
Water Temperature				7C										
Boring Stations [4]														
Geotechnical Borings							1	1					Corps	
Fish Station [5]														
Electrofishing											1		WDNR 1991	
Column Settling Stations [6]														
Column Settling Analysis											2		Corps 1991 and 1992	

TABLE 10-2 (Continued)

Type Measurement	WATER QUALITY DATA						ENGINEERING DATA			NATURAL RESOURCE DATA			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	APR-SEP	OCT-MAR	APR-SEP	OCT-MAR	APR-SEP	OCT-MAR								
Trap Cylinder Sediment Test Stations														
Settleable Solids				3									WDNR Potosi Area identifies Grant plume/net	
Velocity				3										
Dissolved Oxygen				3										
Conductivity				3										
Water Depth				3										
Secchi Disk				3										
Temperature				3										
Photosynthetic Active Radiation				3										
Wind Speed				3										
Elutriate [7] and Sediment Chemical Analysis [8]				1									Corps	
TRANSECT MEASUREMENTS Sedimentation Transects [9]														
Hydrographic Soundings							1	1					Corps	
Invertebrates														
Mussel Survey [10]											1		Corps	

TABLE 10-2 (Continued)

Type Measurement	WATER QUALITY DATA: Pre-Project Phase APR-SEP	WATER QUALITY DATA: Pre-Project Phase OCT-MAR	WATER QUALITY DATA: Design Phase APR-SEP	WATER QUALITY DATA: Design Phase OCT-MAR	WATER QUALITY DATA: Post-Const. Phase APR-SEP	WATER QUALITY DATA: Post-Const. Phase OCT-MAR	ENGINEERING DATA: Pre-Project Phase	ENGINEERING DATA: Design Phase	ENGINEERING DATA: Post-Const. Phase	NATURAL RESOURCE DATA: Pre-Project Phase	NATURAL RESOURCE DATA: Design Phase	NATURAL RESOURCE DATA: Post-Const. Phase	Sampling Agency	Remarks
AREA MEASUREMENTS														
Aerial Photography (1:15,000)										1		5Y	Corps	
Vegetation Mapping										1		5Y	Corps	Historical Aerial Maps available for comparison Island 212
Nesting										3			WDNR, USFWS	

Legend

C = Continuous
W = Weekly
M = Monthly
Y = Yearly
nC = n-Day Continuous
nW = n-Week Interval
nY = n-Year Interval
1,2,3 = Number of times data are collected within designated project phase
Corps = Corps of Engineers, Rock Island District
USFWS = U.S. Fish and Wildlife Service
WDNR = Wisconsin Department of Natural Resources

TABLE 10-2 (Continued)

[1] See plates 16 and 17 for monitoring sites.

[2] Corps Water Quality Stations

Station Code (Design Phase)	Station Code (Post-Construction Phase)
W-M583.5R	W-M583.5R
W-M590.7I	W-M583.7Q
W-M587.5Q	W-M588.0B
W-M593.2K	W-M589.0C
W-M589.0C (active site)	W-M589.1D
W-M588.0B (active site)	W-M589.3H
	W-M589.6G

[3] WDNR Trap Cylinder Sediment Tests --

[4] Corps Geotechnical Borings

Pre-Construction Phase

Station Code		Geotechnical Boring		Corps Transect
B-M584.5	U	P11-90-	1	1
	I	P11-90-	2	
	F	P11-90-	3	
	C	P11-90-	4	
B-M 587.5	W	P11-90-	5	
	T	P11-90-	6	
	P	P11-91-2-	2	2
	K	P11-90-7-	7	
B-M589.5	W		8	
	R		9	
	I		10	3
	G		11	
B-M590.7	X		12	
	P		13	4
	I		14	
B-M592.1	V		15	
	R		16	
	N		17	5
	F		18	
B-M593.2	S		19	
	P		20	
	K		21	6
	H		22	
B-M583.5	V	P11-91-	1	Sunfish Lake
	R			

Design Phase

P11-96-1 thru P11-96-7,
P11-96-7A, P11-97-1
thru P11-97-12

TABLE 10-2 (Continued)

[5] WDNR Fish Sampling

1. Mouth of Grant River and downstream along left descending bank to Potosi Landing
2. Adjacent to Grant River Recreation Area above Platte River and near Island 212 off shore of Grant River Recreation Area
3. Sunfish Lake

[6] Corps Column Settling Analysis Stations

C-M583.5V	P11-91-1
C-M590.8I	P11-90-14
C-M587.5P	P11-91-2
C-M593.1S	P11-90-21

[7] Corps Elutriate Tests

E-M583.5V
E-M587.5P
E-M590.8I
E-M593.1S

[8] Corps Bulk Sediment Analysis

E-M583.5V
E-M587.5P
E-M590.8I
E-M593.1S
E-M586.1K
E-M585.7L
E-M585.3I
E-M583.1P
E-M583.8R
E-M588.0C
E-M588.9C

[9] Transects

S	S-M 584.5B	Corps #1
S	S-M 587.5B	Corps #2
S	S-M 589.6B	Corps #3
S	S-M 590.8B	Corps #4
S	S-M 592.1B	Corps #5
S	S-M 593.1B	Corps #6

Additional hydrographic soundings done during design phase.

[10] Corps mussel surveys to be performed in summer 1999.

TABLE 10-3. Pool 11 Islands Post-Construction Evaluation Plan.

Enhancement Potential									
Goal	**Objective**	**Enhancement Feature**	**Unit**	**Year 0 Without Alternative**	**Year 1 With Alternative**	**Year 25 With Alternative**	**Year 50 Target With Alternative**	**Feature Measurement**	**Annual Field Observations by Site Manager**
Restore and Protect Backwater Habitat	Create off-channel deep-water areas to provide year-round habitat for centrarchids and associated species	Excavate channels in backwater areas	Winter water temperature (°C)	0.5	1.0	1.0	1.0	Perform water quality tests at W-M589.0C (outside dredged cut), W-M588.0B (Zollicoffer Slough), W-M589.1D (Mud Lake in dredged channel), W-583.5R (Sunfish protected area, dredge cut), 583.7Q (Sunfish outside protected area)	Describe presence or absence of fish stress or kills
Restore and Protect Aquatic Habitat			Water depth (ha > 1.2 m)	0	24.3	24.3	24.3		
	Reduce sedimentation in backwaters	Construct deflection embankments	Current velocity (cm/sec)	>3.0	0	0	0	Perform water quality tests at stations listed above	Describe presence or absence of debris snags, channel sedimentation, or vegetation. Describe water clarity.
		Construct flow control structure	Dissolved oxygen mg/L	3.0-5.0	≥ 5.0	≥ 5.0	≥5.0		

11. REAL ESTATE REQUIREMENTS

The Pool 11 Islands Habitat Rehabilitation and Enhancement Project is a part of the Upper Mississippi River System - Environmental Management Program authorized by Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended. The project is located on the Mississippi River in Pool 11 between RM 583.3 and 593.0.

The project is comprised of two different areas: Sunfish Lake and Mud Lake.

a. The Sunfish Lake area is presently owned by the United States of America (USA) and is under the control of the United States Army Corps of Engineers (USACE). The Department of the Interior, U.S. Fish and Wildlife Service (USFWS) manages these lands under a cooperative agreement between the USFWS and the USACE, dated February 14, 1963.

b. The Mud Lake area is presently owned by the USA and is under the control of the USACE. The USFWS manages part of these lands under a cooperative agreement between the USFWS and the USACE, dated February 14, 1963. The remainder of the land needed for this project, approximately 0.50 ha (1.23 ac), is leased to the Dubuque County Conservation Board (DCCB) for public park and recreation purposes. Upon project approval, one of the following three options will need to be negotiated and implemented to authorize the USFWS to operate and maintain that portion of the project to be located on the 0.50 ha (1.23 ac) leased to the DCCB:

(1) Grant a permit to the USFWS authorizing operation and maintenance of the project features on the 0.50 ha (1.23 ac), subject to the lease to the DCCB.

(2) Include the 0.50 ha (1.23 ac) in the cooperative agreement with the USFWS, subject to the lease to the DCCB.

(3) Amend the lease with the DCCB to delete the 0.50 ha (1.23 ac) and include the area in the cooperative agreement with the USFWS.

The project sponsor is the USFWS. The project will be 100% Federal cost.

There are no proposed Public Law 91-646 relocations as there are no acquisitions required.

Borrow material needed for the project would be dredged from within navigational servitude waters.

Access to the project would be on federally owned lands.

There are no known hazardous, toxic, or radioactive sites within the project area.

A map showing the project area is included as plate 10 of this report.

A draft Memorandum of Agreement (MOA) between the USFWS and the USACE is included as Appendix C. Estimated operation and maintenance costs can be found in Table 8-2.

12. IMPLEMENTATION RESPONSIBILITIES AND VIEWS

a. Corps of Engineers. The U.S. Army Corps of Engineers, Rock Island District, is responsible for project management and coordination with the USFWS, the States of Iowa and Wisconsin, and other affected agencies. The Rock Island District will submit the subject DPR; program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration.

b. U.S. Fish and Wildlife Service. The USFWS is the Federal project sponsor and will produce a Coordination Act Report (CAR) for this project. Operation and maintenance of the project, as described in Table 8-2, is the responsibility of the USFWS in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580. These functions will be further specified in the Project Operation and Maintenance Manual to be provided by the U.S. Army Corps of Engineers prior to final acceptance of the project by the sponsors.

c. Iowa and Wisconsin Departments of Natural Resources. The IADNR and WDNR, the non-Federal project sponsors, have provided technical and other advisory assistance during all phases of the project and will continue to provide assistance during project implementation.

13. COORDINATION, PUBLIC VIEWS, AND COMMENTS

Coordination has been made throughout the planning and design process with the following State and Federal agencies:

Iowa Department of Natural Resources
Wisconsin Department of Natural Resources
State Historical Society of Iowa
State Historical Society of Wisconsin
Dubuque County Conservation Board
Natural Resources Conservation Service
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency

a. Coordination Meetings. Numerous coordination meetings were held with project cooperators to discuss potential enhancement features. Progress on the HREP was slow due to frequent modifications to project features, the addition of new project features, a lack of consensus on project features, and flood recovery efforts following the Great Flood of 1993. The following meetings demonstrated ongoing coordination:

(1) February 14, 1990. General scoping meeting with the Corps, USFWS, Iowa DNR, Wisconsin DNR, and EMTC.

(2) July 18, 1990. General scoping meeting with the Corps, USFWS, Iowa DNR, Wisconsin DNR, and U.S. EPA (Environmental Protection Agency).

(3) January 7, 1991. General scoping meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(4) April 14, 1992. General scoping meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(5) June 8, 1992. General scoping meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(6) May 23, 1994. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(7) April 5, 1995. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(8) September 12, 1995. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(9) April 22, 1996. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(10) September 11, 1996. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(11) December 2, 1996. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(12) March 10, 1997. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(13) June 6, 1997. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR.

(14) July 23, 1997. Public meeting in Dickeyville, Wisconsin.

(15) November 4, 1997. General coordination meeting with the Corps, USFWS, Iowa DNR, Wisconsin DNR, and U.S. EPA.

(16) July 8, 1999. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR to discuss draft DPR.

(17) March 6, 2001. Public meeting at Best Western Inn, Dubuque, Iowa.

(18) April 17, 2001. General coordination meeting with the Corps, USFWS, Iowa DNR, and Wisconsin DNR to discuss comments on the public review draft DPR.

b. Coordination by Correspondence. The following letters are contained in Appendix A - Correspondence:

(1) Letter dated January 12, 1988, from Wisconsin Department of Natural Resources to U.S. Fish and Wildlife Service, enclosing final problem and objective statement for the Pool 11 project.

(2) Letter dated October 8, 1990, from Wisconsin Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, clarifying Wisconsin DNR's position regarding Pool 11 project.

(3) Record of conversation on November 27, 1990, between Rock Island District, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service in which the USFWS states that they will not support further general design action on the Pool 11 project.

(4) Record of conference call on December 3, 1990, between personnel from the Rock Island District, U.S. Army Corps of Engineers, and Wisconsin Department of Natural

Resources for the purpose of verifying status of Pool 11 project with respect to Fiscal Year 1991 data collection efforts and general project advancement plans.

(5) Record of conversation on September 4, 1991, between Rock Island District, U.S. Army Corps of Engineers, and Wisconsin Department of Natural Resources regarding establishment of water quality sampling stations.

(6) Letter dated September 18, 1992, from Wisconsin Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, outlining project features that the Wisconsin DNR proposes for further discussion.

(7) Letter dated April 21, 1993, from Complex Manager, Upper Mississippi River Refuge Complex, to Wisconsin Department of Natural Resources, commenting on Wisconsin DNR's suggested project features and clarifying USFWS' position.

(8) Letter dated June 9, 1994, from Wisconsin Department of Natural Resources to Complex Manager, Upper Mississippi River Refuge Complex, enclosing information on mallard nesting in lower Pool 11.

(9) Letter dated June 14, 1994, from Iowa Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, providing comments on Pool 11 project.

(10) Letter dated June 15, 1994, from Iowa Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, providing suggestions on preparation of Pool 11 report.

(11) Memorandum dated September 22, 1994, from Wisconsin Department of Natural Resources enclosing Pool 11 HREP goals and objectives.

(12) Letter dated March 8, 1995, from Iowa Department of Natural Resources to Wisconsin Department of Natural Resources concerning Pool 11 project potentials.

(13) Letter dated July 19, 1995, from Iowa Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, providing a copy of a conceptual project and their questions.

(14) Letter dated August 4, 1995, from Rock Island District, U.S. Army Corps of Engineers, to Iowa Department of Natural Resources, which responds to questions posed in their July 19, 1995, letter.

(15) Memo dated November 20, 1995, from Iowa Department of Natural Resources representatives to lower Pool 11 HREP partners, which outlines their potential project components to be evaluated with other proposals.

(16) Letter dated June 8, 1995, from Rock Island District, U.S. Army Corps of Engineers, to State Historical Society of Wisconsin, requesting cultural resources information for the project area.

(17) Letter dated July 21, 1995, from State Historical Society of Wisconsin to Rock Island District, U.S. Army Corps of Engineers, providing cultural resources information.

(18) Letter dated November 2, 1995, from Rock Island District, U.S. Army Corps of Engineers, to State Historical Society of Iowa, requesting cultural resources information for the project area.

(19) Letter dated January 2, 1996, from Wisconsin Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, regarding data for use in planning Pool 11 project.

(20) Letter dated April 22, 1997, from Wisconsin Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, forwarding HEP analysis for Pool 11 project.

(21) Letter dated April 24, 1997, from District Manager, Upper Mississippi River National Wildlife and Fish Refuge, to Rock Island District, U.S. Army Corps of Engineers, forwarding HEP analysis for Pool 11 project.

(22) Letter dated May 19, 1997, from Iowa Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, providing comments on HEP evaluation.

(23) Letter dated June 27, 1997, from Iowa Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, enclosing summarized fishery data collected in spring of 1995.

(24) Letter dated December 2,1997, from Wisconsin Department of Natural Resources to Rock Island District, U.S. Army Corps of Engineers, commenting on islands and dredge cuts.

(25) Letter dated July 10, 1998, from Rock Island District, U.S. Army Corps of Engineers, to State Historical Society of Wisconsin, forwarding June 1998 draft cultural resources survey report for Pool 11 Islands prepared by Bear Creek Archeology, Inc.

(26) Letter dated July 10, 1998, from Rock Island District, U.S. Army Corps of Engineers, to State Historical Society of Iowa, forwarding June 1998 draft cultural resources survey report for Pool 11 Islands prepared by Bear Creek Archeology, Inc.

(27) Letter dated July 14, 1998, from U.S. Fish and Wildlife Service, concurring that no historic properties would be affected by the proposed project.

(28) Letter dated July 22, 1998, from State Historical Society of Iowa, concurring that no historic properties would be affected by the proposed project.

(29) Letter dated July 28, 1998, from State Historical Society of Wisconsin, concurring that no historic properties would be affected by the proposed project.

(30) Letter dated August 5, 1998, from Rock Island District, U.S. Army Corps of Engineers, to Bear Creek Archeology, Inc., requesting preparation and submission of final cultural resources survey report for Pool 11 Islands project.

(31) Record of conversation on October 27, 1998, between Rock Island District, U.S. Army Corps of Engineers, and Wisconsin Department of Natural Resources, regarding the DNR's concerns about construction timing for the Pool 11 project.

(32) Letter dated September 2, 1998, from Rock Island District, U.S. Army Corps of Engineers, to various state agencies and archeological entities enclosing the final Pool 11 cultural resources survey report.

(33) Letter dated November 3, 1998, from State Historical Society of Wisconsin, to Rock Island District, U.S. Army Corps of Engineers, stating that the project will have no effect on cultural resources.

(34) Draft Fish and Wildlife Coordination Act Report, dated April 22, 1999, from the U.S. Fish and Wildlife Service, Rock Island Field Office.

(35) Letter dated June 4, 1999, from Mr. Mike Griffin, Mississippi River Wildlife Biologist, Iowa Department of Natural Resources, providing field biologists' comments on draft Pool 11 Islands DPR.

(36) Letter dated June 16, 1999, from Mr. James R. Fisher, Complex Manager, Upper Mississippi River National Wildlife and Fish Refuge, providing comments on draft Pool 11 Islands DPR.

(37) Letter dated June 16, 1999, from Mr. Jeffrey A. Janvrin, Mississippi River Habitat Specialist, Wisconsin Department of Natural Resources, providing comments on draft Pool 11 Islands DPR.

(38) Letter dated July 14, 1999, from St. Paul District, Corps of Engineers, forwarding comments on draft Pool 11 Islands DPR.

(39) Letter dated March 20, 2001, from Mr. Terence N. Martin, Team Leader, Natural Resources Management, U.S. Department of the Interior, Office of Environmental

Policy and Compliance, requesting time extension to provide comments on Pool 11 Islands DPR.

(40) Letter dated April 4, 2001, from Mr. James R. Fisher, Complex Manager, Upper Mississippi River National Wildlife and Fish Refuge, providing comments on draft DPR.

(41) Letter dated April 26, 2001, from Mr. Michael T. Chezik, Regional Environmental Officer, U.S. Department of the Interior, Office of Environmental Policy and Compliance, providing comments on the Pool 11 Islands DPR.

(42) Letter dated July 30, 2001, from Ms. Christine M. Schwake, Environmental Specialist, Iowa Department of Natural Resources, forwarding State 401 Water Quality Certification.

(43) Letter dated October 1, 2001, from Mr. Darrell Bazzell, Secretary, Wisconsin Department of Natural Resources, expressing support for construction of the features recommended in the Pool 11 Islands DPR.

(44) Final Fish and Wildlife Coordination Act Report, dated October 3, 2001, from the U.S. Fish and Wildlife Service, Rock Island Field Office.

14. CONCLUSIONS

Full realization of the potential habitat value in the Pool 11 Islands project area has been hindered by the dramatic decrease in island landmass, which has led to the loss of terrestrial and aquatic habitats, protected littoral zones, and deep-water habitats. Establishing off-channel areas containing reliable aquatic/wetland habitat would allow the project area to realize the highest benefit to migratory birds and wintering fish.

The recommended project enhancement features for Sunfish Lake and Mud Lake (sediment deflection embankments, mechanically and hydraulically dredged channels) are designed to meet the project's goals of restoring and protecting aquatic and backwater habitat. These goals will be met by reducing sediment resuspension, increasing the abundance of aquatic plants, reducing sedimentation in backwaters, and increasing wintering fish habitat.

Assessment of the future with-project scenario shows definite increases in total habitat units over the 50-year project life for the target species, as well as a majority of other wetland dwelling species considered. These increases represent quantification of the projected outputs: improved habitat quality and increased preferred habitat quantity.

This project is consistent with and fully supports the overall goals and objectives of the UMRS-EMP, the North American Waterfowl Management Plan, and the Partners in Flight Program.

15. RECOMMENDATIONS

I have weighed the outputs to be obtained from the full implementation of this habitat rehabilitation and enhancement project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. In my judgment, this project, as proposed, justifies expenditure of Federal funds. I recommend that the Chief of Engineers approve the proposed project to include constructing a 1500-m sediment deflection embankment and mechanically/hydraulically dredging an 11.5-ha system of channels at Sunfish Lake; no action at Sinnippee Creek; constructing a 3038-m sediment deflection embankment and mechanically dredging 8.8 ha of channels adjacent to the embankment at Mud Lake/Zollicoffer Slough; and no action for the island construction enhancement area.

The current estimated Federal construction cost of this project is $6,328,409. Total Federal estimated project cost, including general design and construction management, is $8,558,617.

At this time, I further recommend that funds in the amount of $150,000 be allocated for the preparation of the project plans and specifications.

William J. Bayles
Colonel, U.S. Army
District Engineer

16. FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the information provided by this Environmental Assessment, along with data obtained from Federal and State agencies having jurisdiction by law or special expertise, and from the interested public. I find that the proposed habitat enhancement project in lower Pool 11, Dubuque County, Iowa, and Grant County, Wisconsin, would not significantly affect the quality of the human environment. Therefore, it is my determination that an Environmental Impact Statement is not required. This determination may be reevaluated if warranted by further developments.

An array of management measures was considered in which alternatives were derived. The measures are:

a. No Federal Action

b. Construct Deflection Embankments at Sinnippee Creek

c. Construct Deflection Embankments and Off-Channel Dredging at Sunfish Lake

d. Construct Deflection Embankments and Off-Channel Dredging at Mud Lake/Zollicoffer Slough

e. Construct Mid-River Islands

f. Boulder Field

The primary objectives of the Pool 11 Islands HREP are to reduce resuspension of sediments, reduce sedimentation in backwaters, create areas with flow and depth diversity, increase abundance and diversity of aquatic plants, enhance nesting and brooding habitat for migratory birds, create off-channel deep-water areas to provide year-around habitat for centrarchids and associated species, reduce island erosion, and provide reliable food resources for migratory birds and resident wildlife. The recommended plan includes constructing a 1500-m sediment deflection embankment and mechanically/hydraulically dredging an 11.5-ha system of channels at Sunfish Lake; no action at Sinnippee Creek; constructing a 3038-m sediment deflection embankment and mechanically dredging 8.8 ha of channels adjacent to the embankment at Mud Lake/Zollicoffer Slough, and no action for the island construction feature.

Factors considered in making a determination that an Environmental Impact Statement was not required were as follows:

a. The project is anticipated to improve the habitat value of lower Pool 11 for fish, resident and migratory water birds, and wildlife.

b. Aside from temporary disturbances, no long-term significant impacts to natural or cultural resources are anticipated. No federally protected species would be affected by the proposed action.

c. Land use after the project should remain unaltered, and no significant economic impacts to the project area are envisioned.

d. The project will comply with Sections 401, 402, and 404 of the Clean Water Act.

2 OCT 2008
(Date)

William J. Bayles
Colonel, U.S. Army
District Engineer