US Army Corps
Of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/ ENVIRONMENTAL ASSESSMENT (SP-24)

POOL 8 ISLANDS PHASE III HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Pool 8
Upper Mississippi River
Vernon County, Wisconsin and
Houston County, Minnesota

April 2002

POOL 8 ISLANDS PHASE III
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

EXECUTIVE SUMMARY

The Pool 8 Islands Phase III Habitat Rehabilitation and Enhancement Project is located in the lower portion of pool 8 of the Upper Mississippi River. The study investigated habitat conditions and concerns over a 3,000-acre area of the open, lake-like portion of lower pool 8.

The habitat concerns within the study area center around the general degradation of habitat quality in lower pool 8. This degradation has been the result of the loss of islands, declining bathymetric diversity, and a decline in aquatic vegetation over the past few decades. Most of the study area lies within a closed portion of the Upper Mississippi River National Wildlife Refuge and is considered critical habitat for migrating waterfowl and other water birds. This decline in migration habitat quality is of great concern to the U.S. Fish and Wildlife Service and State resource management agencies.

Due to its size, differing site conditions, and differing habitat goals and objectives, the study area was subdivided into five smaller areas for ease of planning. This allowed the planning of habitat restoration to be more efficient and to better meet the habitat needs within each of these areas.

The planning process focused on the restoration of islands and river processes to restore habitat diversity within the study area. Because it is not possible to restore or create ideal habitat conditions for all forms of fish and wildlife, features were designed and evaluated primarily to improve conditions for migratory waterfowl. However, once the basic island layouts and designs were developed, they were modified to benefit other fish and wildlife wherever possible. For example, islands were positioned to maintain and/or encourage flowing channels for riverine fish or to provide protected deepwater habitat for overwintering Centrarchids. Features such as mudflats were incorporated into the island designs to provide habitat for shorebirds and wading birds.

The focus in the 550-acre Three West area was on the restoration of migration habitat for dabbling ducks and the maintenance of flowing channel habitat. Eight island restoration alternatives were developed and evaluated for this area. The recommended plan is to construct six islands, with two mudflats incorporated into the island designs. The estimated construction cost of the plan for the Three West area is $5,185,000.

Planning in the 470-acre Three North area also focused on the restoration of migration habitat for dabbling ducks. In additions, islands were designed to enhance flowing channels and to provide overwintering habitat for Centrarchids. Five island restoration alternatives were developed and evaluated for this area. The recommended plan is to construct four islands, with a mudflat incorporated into one island's design. In addition, four small seed islands are recommended in an area where river forces should

then cause sediment deposition to form larger islands. The estimated cost of the plan for the Three North area is $3,420,000.

The 1,600-acre Three Central has deeper water and is more open (no remnant islands) than the two previously discussed sub-areas. The focus in this area was on the restoration of migration habitat for diving ducks, along with enhancing flowing channels and providing overwintering habitat for Centrarchids. Eight island restoration alternatives were developed and evaluated for this area. The recommended plan is to construct seven islands, with a mudflat incorporated into one island's design. The estimated cost of the plan for the Three Central area is $6,100,000.

The Three East area is located along the Wisconsin side of the floodplain, near Stoddard, Wisconsin. Planning in this area addressed concerns with maintaining the delta of Coon Creek, a mosaic of wetland habitats. The recommended plan is to construct three rock breakwaters to protect the delta from river currents and wind-induced wave action. This will protect the delta habitat and encourage the growth of the delta. The estimated cost of the plan for the Three East area is $645,000.

The Three Northwest area is located along the Minnesota side of the floodplain, near Brownsville, Minnesota. Study in this area looked at the effects of sediment deposition from Wildcat Creek on wetland habitats. Two alternatives for rerouting the mouth of Wildcat Creek were evaluated. The conclusion is that sedimentation from Wildcat Creek in not having unacceptable adverse effects on the wetland habitats and therefore, no action is recommended at this time. Resource management agencies will continue to monitor the situation.

The overall recommended plan is to construct seventeen islands, four seed islands, and three breakwaters at an estimated cost of $15,714,000 (including sunk general design costs). The project will restore and/or create about 123 acres of islands, nearly doubling the amount of island acreage that was remaining in lower pool 8 in 1989. The addition of these islands would bring the total island acreage in lower pool 8 to over 300 acres, approximately the amount present in 1961.

The islands recommended for construction will protect about 1,000 acres of aquatic habitat from large wind fetches, improving conditions for the growth of aquatic vegetation. This constitutes about 10 percent of the lake-like portion of lower pool 8.

Substantial habitat benefits to shorebirds and wading birds are expected to accrue due to the creation of about 80,000 linear feet of sandy shoreline and four mudflats totaling about 22 acres. The sandy shorelines of the islands will also provide a substantial amount of area available for turtle nesting.

The 123 acres of islands created will provide habitat for terrestrial and semi-aquatic species of wildlife. This type of habitat is nearly non-existent in the areas where the islands would be constructed.

The islands will help maintain about 20,000 linear feet of submerged channel, which will contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. Two protected deepwater areas about 60 and 40 acres in size, respectively, will be created that will provide overwintering habitat for Centrarchids and other backwater fish species. This type of habitat is of critical importance in the project area where overwintering habitat is almost non-existent.

Project construction is scheduled to begin in 2005 and be completed in 2009. Construction of the Three West and Three North area islands would take place first, to be followed by construction of the Three Central area islands. Construction of the Three East area breakwaters would occur whenever it could be optimally fit into the construction schedule.

The entire project lies within the Upper Mississippi River National Wildlife and Fish Refuge. Once completed, the project would be turned over to the U.S. Fish and Wildlife Service for operation and maintenance.

DEFINITE PROJECT REPORT/
ENVIRONMENTAL ASSESSMENT

POOL 8 ISLANDS PHASE III
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
VERNON CO., WISCONSIN & HOUSTON CO., MINNESOTA

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INTRODUCTION

1.1 AUTHORITY

The authority for this report is provided by Section 1103 of the Water Resources Development Act of 1986, as amended (Public Law 99-662). The proposed project would be funded and constructed under this authorization. Section 1103 is summarized as follows:

Section 1103. UPPER MISSISSIPPI RIVER PLAN

(a) (1) This section may be cited as the Upper Mississippi River Management Act of 1986.

(2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of the Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system....The system shall be administered and regulated in recognition of its several purposes.

(e) PROGRAM AUTHORITY

(1) AUTHORITY

(A) IN GENERAL. The Secretary, in consultation with the Secretary of the Interior and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, may undertake, as identified in the master plan -

(i) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; and....

1.2 PARTICIPANTS AND COORDINATION

Participants in the planning for the Pool 8 Islands Phase III project included the Upper Mississippi River National Wildlife and Fish Refuge and the Region 3 Offices of the U.S. Fish and Wildlife Service (USFWS); the Upper Midwest Environmental Sciences Center (UMESC) of the U.S. Geological Survey; the Wisconsin and Minnesota Departments of Natural Resources (Wisconsin DNR and Minnesota DNR); and the St. Paul District, Corps of Engineers.

The USFWS, the Wisconsin DNR, and the Minnesota DNR were involved in project planning because the study area is located within the Upper Mississippi River National Wildlife and Fish Refuge and is located within the States of Wisconsin and Minnesota. The UMESC provided scientific and technical input in a variety of areas. The USFWS is considered a cooperating agency under Federal regulations governing the implementation of the National Environmental Policy Act of 1969.

The following individuals played an active role in the planning and design of the Pool 8 Islands Phase III project. For St. Paul District personnel, the discipline and contribution of the individual planning team members are listed. For resource agency personnel, the individual's position title is listed.

ST. PAUL DISTRICT, CORPS OF ENGINEERS

Gary Palesh	Fishery Biologist	Project Manager
Randy Devendorf	Wildlife Biologist	Environmental analysis, NEPA doc.
Brad Johnson	Archaeologist	Cultural resources analysis
Mike Walker	Cartographic Technician	GIS analysis
Jon Hendrickson	Hydraulic engineer	Hydraulic analysis
Kari Layman	Hydraulic engineer	Hydraulic modeling
Joel Face	Civil Engineer	Geotechnical analysis
Terry Williams	Civil Engineer	Design and layout
Gary Smith	Civil Engineer	Cost estimating

U.S. FISH AND WILDLIFE SERVICE

Keith Beseke	Habitat Projects Coordinator
Jim Nissen	Refuge District Manager
Pam Thiel	Refuge Fishery Resources
Gary Wege	Ecological Services

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Jeff Janvrin	Habitat Projects Coordinator
Mark Anderson	Area Wildlife Manager
Dave Heath	Area Fisheries Manager

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Tim Schlagenhaft	Habitat Projects Coordinator
Nick Gulden	Area Wildlife Manager

1.3 PROJECT PURPOSE

1.3.1 RESOURCE PROBLEMS/OPPORTUNITIES

The purpose of this Definite Project Report is to document existing and predicted future habitat conditions and deficiencies, define habitat goals and objectives, identify alternative measures that would address the goals and objectives, and recommend a plan for implementation.

1.3.2 PROJECT BOUNDARIES

The Pool 8 Islands Phase III project is located in the lower reaches of pool 8, about 15 miles below La Crosse, Wisconsin (plate 1). The Pool 8 Islands Phase III study area roughly encompasses a band about 2 miles deep across lower pool 8 (plates 2a and 2b). The study area was subdivided into five distinct study sub-areas (plate 2a).

1.3.2.1 Three West Area

The Three West area is located along the Minnesota mainland, bounded on the east by Raft Channel. This area is approximately 550 acres in size.

1.3.2.2 Three Central Area

The Three Central area is bounded on the west by Raft Channel and on the east by the main channel of the Mississippi River. The upstream or northern boundary is the lower boundary of the Pool 8 Islands Phase I project area and the Three North area. The boundary between the Three Central and the Three North area is based on bathymetry, i.e., the Three North area is shallower with water depths generally less than 3 feet, while water depths in the Three Central Area are generally 3 feet or greater. The downstream or southern boundary of the Three Central area is defined by a line extending from where Raft Channel abuts the Minnesota shoreline to a point where the main channel of the Mississippi River abuts the Wisconsin shoreline. This area is approximately 1,600 acres.

1.3.2.3 Three North Area

The Three North area is bounded on the west by Raft Channel, on the east by the Phase I project area, and on the south by the Three Central area. A portion of the Three North area overlaps the western portion of the Phase I project area. This area is approximately 470 acres.

1.3.2.4 Three East Area

The Three East area is bounded on the west by the main channel of the Mississippi River and on the east by the Wisconsin mainland. The northern limit is the southern boundary of the Pool 8 Islands Phase II project area. The southern or downstream limit is the point where the main channel of the Mississippi River abuts the Wisconsin shoreline. This area is approximately 700 acres.

1.3.2.5 Three Northwest Area

The Three Northwest area is located along the Minnesota mainland below Brownsville, Minnesota. The area is a backwater called "Schnick's Bay" that is bounded on the west by the Minnesota shoreline, on the east by higher ground occupied by Wildcat Park, and on the north by the entrance road to Wildcat Park.

GENERAL PROJECT SELECTION PROCESS

2.1 ELIGIBILITY CRITERIA

A design memorandum (or implementation document) did not exist at the time of the enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP) in January 1986. The U.S. Fish and Wildlife Service, Region 3, and the five affected States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addenda.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addenda led to an examination of the Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Master Plan, completed by the Upper Mississippi River Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below:

a. (First Annual Addendum). The Master Plan report... and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. For habitat projects, the main eligibility criterion should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan; i.e., the sedimentation of backwaters and side channels of the UMRS. Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance....

b. (Second Annual Addendum).

(1) The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:

- backwater dredging
- dike and levee construction
- island construction
- bank stabilization
- side channel openings/closures
- wing and closing dam modifications
- aeration and water control systems
- waterfowl nesting cover (as a complement to one of the other project types)
- acquisition of wildlife lands

(2) A number of innovative structural and nonstructural solutions that address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects including such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and the measures will be recommended only after consideration of system-wide effects.

2.2 PROJECT SELECTION

Projects are nominated for inclusion in the St Paul District's habitat program by the respective State natural resource agency or the U.S. Fish and Wildlife Service, based on agency management objectives. To assist the District in the selection process, the States and USFWS have agreed to use the expertise of the Fish and Wildlife Work Group (FWWG) of the River Resources Forum (RRF) to consider critical habitat needs along the Mississippi River and prioritize nominated projects on a biological basis.

The FWWG consists of biologists responsible for managing the river for their respective agency. Meetings are held on a regular basis to evaluate and rank the nominated projects according to the biological benefits that they could provide in relation to the habitat needs of the river system. The ranking is forwarded to the RRF for consideration of the broader policy perspectives of the agencies involved. The RRF submits the coordinated ranking to the District, and each agency officially notifies the District of its views on the ranking. The District then formulates and submits a program that is consistent with the overall program guidance as described in the UMRS-EMP General Plan and Annual Addenda and supplemental guidance provided by the Mississippi Valley Division.

Biologists knowledgeable of the river and its resources have screened potential projects. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available is being used to optimize the habitat benefits created at the most suitable locations.

The U.S. Fish and Wildlife Service and Wisconsin Department of Natural Resources identified the Pool 8 Islands project for consideration. Study on the project began in 1987. During the early stages of study it was recognized that the scope of the habitat problems in lower pool 8 were too large to address as part of a single project. At that time, the Pool 8 Islands project was divided into five phases. The initial study focused on Phase I (plate 2a), with a Definite Project Report being completed in June 1989. Construction of the Phase I project was completed in 1993.

Phases II-V were evaluated in 1989 by the FWWG and ranked for inclusion in the District's FY 1992 program. In June 1989, Pool 8 Islands Phases II-V was ranked as the second highest priority project for consideration in FY 1992. Due to other priorities, the St. Paul District did not select the project for inclusion in the FY 1992 program.

In June 1990, the FWWG ranked the Pool 8 Islands Phases II-V as the number one priority project for inclusion in the FY 1993 St. Paul District program. In response to this ranking, the St. Paul District programmed the Pool 8 Islands Phase II project for study initiation in fiscal year 1993. Study for Phase II (plate 2a) began in 1993 with the Definite Project Report completed in May 1996. Construction of the Phase II project was completed in 1999.

The FWWG ranking for the District's FY 1994 program had the Pool 8 Islands Phases III-V project as the number 1 priority project. In 1995, the Phase III project was selected for inclusion in the District's habitat projects program, pending availability of resources. Because the authorization for the UMRS-EMP expired in 2002, study was not initiated on the Pool 8 Islands Phase III project as it was projected that funds would not be available within the life of the program to construct the Phase III project. With reauthorization of the UMRS-EMP in the Water Resources Development Act of 1999, study on the Phase III project commenced in October 1999.

ASSESSMENT OF EXISTING RESOURCES

3.1 PHYSICAL SETTING

Pool 8 is part of the Upper Mississippi River system, created in 1937 by the completion of L/D 8 (Lock and Dam 8). The pool is 23.3 miles long, extending from river mile 679.2 (L/D 8) to river mile 702.5 (L/D 7). The river valley in this reach is 2 to 3 miles wide and is bordered on either side by weathered bluffs. The lower 5 miles of pool 8 is open and lake-like, with few or no islands. Above this open lake portion of the pool is a 3- to 4-mile transition zone where the presence of islands becomes more frequent. The setting for the Pool 8 Islands Phase III project is in the upper reaches of the lake-like zone.

The navigation channel in lower pool 8 abuts the Wisconsin mainland from lock and dam 8 to about river mile 683 (the lower end of the study area). At that point, the navigation channel shifts northwesterly and angles across the pool. It completes its crossing to the Minnesota side at river mile 688. A major pre-lock and dam channel, Raft Channel, runs along the Minnesota mainland in lower pool 8. The Minnesota-Wisconsin state boundary follows Raft Channel, not the navigation channel as is typical for most reaches of the river. Thus, most of lower pool 8, including much of the study area, lies within Wisconsin.

3.2 WATER RESOURCES

3.2.1 UPPER MISSISSIPPI RIVER

Early summer (June) discharges at L/D 8 generally range from 30,000 to 55,000 cubic feet per second (cfs). By late summer, discharges usually decrease to a range of 15,000 to 30,000 cfs. Winter low flows are usually in the range of 13,000 to 20,000 cfs. Table 3-1 shows the discharges and stages associated with the various high runoff events for the Mississippi River at L/D 8.

Table 3-1
Mississippi River Discharge Frequencies - L/D 8

Event	Flow	Stage @ L/D 8	Stage @ RM 685
1.5-year (67% chance)	78,000 cfs	630.0	631.0
5-year (20% chance)	134,000 cfs	632.4	633.6
10-year (10% chance)	161,000 cfs	633.8	635.0
20-year (5% chance)	192,000 cfs	635.2	636.5
50-year (2% chance)	224,000 cfs	636.8	637.9
100-year (1% chance)	254,000 cfs	638.2	639.2

3.2.1.1 Hydrodynamics

The floodplain in the Phase III study area was completely submerged when L/D 8 went into operation, greatly changing the hydrodynamic regime in the project area. The two primary changes that occurred include the continuous flow of water through the floodplain in the project area, and the creation of a lake-like lower pool that is subject to wind-driven wave action. Less than 50 percent of the total river flow is conveyed in the main channel in the project area making this a highly divided reach of the Upper Mississippi River. For the 1.5-year discharge event of about 78,000 cfs, average velocities in the main channel are 2 to 3 fps, while average velocities in the floodplain are less than 1 fps. Due to the 4- to 5-mile southerly wind fetch, wind driven wave action generates velocities that exceed river flow velocities in the floodplain of the project area.

3.2.1.2 Sediment Transport

Previous sediment transport work indicates that the project area is depositional and erosional with deposition predominating. In the Three Central and Three West study areas, the aerial distribution of deposition and erosion was approximately 75/25 percent and 80/20 percent, respectively. In both areas erosion tended to occur in areas that were within 3 feet of the average water surface elevation (i.e. elevation 628.0 or higher), while deposition occurred in deeper areas. Data is not currently available for the other study areas. Two types of erosion appear to be taking place, river current erosion in a few areas resulting in channel formation, and wave erosion of most of the islands or high spots that existed when L/D 8 was constructed. Significant deposition of sand along the navigation channel in the Three Central area is due to sediment movement from the main channel onto the floodplain.

The sediment load in the project area consists of both coarse and fine sediment. Coarse sediments are transported primarily as bed load along channel bottoms and upon entering the floodplain, form permanent deposits that might be redistributed by wind driven wave action. This is occurring along the eastern border of the Three Central area. Closing dams at the upstream end of Raft Channel greatly reduce the coarse sediment load to the Three West and the west border of the Three Central area. Fine sediments are transported primarily as suspended load in the water column, and upon entering the floodplain may deposit or may continue to be transported through. Sediments that deposit in water less than 4 feet deep can be suspended by wind-driven wave action and transported to other parts of the floodplain. Sediment loads to the Three West area and at times the Three Central area are affected by sediment inputs from the Root River which enters pool 8 upstream of the project area on the west side of the river valley. Coon Creek enters directly into the Three East area and has a significant influence on sediment transport conditions there.

3.2.2 RAFT CHANNEL

Prior to inundation of pool 8, Raft Channel was a major channel of the Mississippi River, the near equal of Coon Slough (which became the main navigation channel). Raft Channel continues to be a major secondary channel conveying approximately 20 percent of the total river flow where it leaves the main channel at river mile 688.0. Raft Channel flows in a southerly direction roughly parallel to the Minnesota shoreline, until it swings southeast and runs along the L/D 8 earthen dike. Raft Channel rejoins the main channel at about river mile 680.0, less than a mile above L/D 8.

Except for the very upper reaches, Raft Channel is not clearly defined by surface features. This is because of inundation by pool 8 and the loss of islands that defined the channel's former banks. Based on bathymetry data, the submerged channel varies in width between 500 and 1,000 feet. Raft Channel water depths in the study area generally range between 10 and 20 feet, though there are some shallower areas and a few deep spots exceeding 25 feet.

3.3 GEOLOGY AND SOIL/SUBSTRATE

The most significant geological event explaining the nature of the Mississippi River within pool 8 occurred at the end of the Pleistocene glaciation approximately 10,000 years ago. Tremendous volumes of glacial meltwater, primarily from the Red River Valley's glacial Lake Agassiz, eroded the pre-glacial Minnesota and Mississippi River valleys. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Since post-glacial times, an anastomosing stream environment has dominated this reach of the Mississippi River, due to the river's low gradient and oversupply of sediment from its tributaries. Prior to the impoundment of pool 8 in the 1930's, the broad floodplain of the river was characterized by a stream system that consisted of multiple channels, swampy depressions, sloughs, natural levees, islands, and shallow lakes.

3.4 WATER QUALITY

Richardson and Clemment (1993) summarize three years (1988-90) of water quality monitoring in pool 8 from 21 sites located in a wide variety of habitat types. This monitoring focused on basic parameters considered indicators of habitat quality.

Average weekly dissolved oxygen values during the study period ranged from 6 to 17 milligrams per liter (mg/l). Cold season values generally ranged above 10 mg/l while late summer values usually fell within the 6-10 mg/l range. Peak water temperatures in late summer were about 29 degrees Celsius (C).

Winter turbidity levels were low (2-4 Nephelometric turbidity units (NTU)), while summer values generally fell between 20 and 50 NTU. Some open river sites showed peak NTU levels near 200 during the spring thaw in 1990. Secchi disk transparency during the winter months generally ranged between 1.25 and 1.75 meters. During the summer months transparency was usually in the range of 0.25 to 0.50 meter.

The study found similar trends for all parameters in both vegetated and unvegetated habitats, with the backwater contiguous habitat exhibiting the greatest diversity in water quality.

3.5 VEGETATION

Terrestrial vegetation present on the remaining islands and island remnants in lower pool 8 is typical of the northern floodplain forest. Dominant tree species include silver maple (*Acer saccharinum*), cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), river birch (*Betula nigra*), and green ash (*Fraxinus pennsylvanica*). Mixed stands of black willow (*Salix nigra*) and sandbar willow (*S. exigua*) dominate areas along the water's edge. Common shrub species include buttonbush (*Cephalanthus occidentalis*), red osier dogwood (*Cornus stolonifera*), panicled dogwood (*C. paniculata*), silky dogwood (*C. amomum*), false indigo (*Amorpha fruticosa*), staghorn sumac (*Rhus typhina*), smooth sumac (*R. glabra*), and honeysuckle (*Rhododendron* sp.). Herbaceous layers are often dominated by poison ivy (*Rhus radicans*), and stinging nettle (*Urtica dioica*). Reed canary grass (*Phalaris arundinacea*) occurs in areas where silt, deposited during high water, remains dry during most of the summer.

Aquatic vegetation within this reach of the river is varied. Common plant species present in the shallower areas include arrowhead (*Sagittaria latifolia*), water lily (*Nuphar* sp. and *Nymphaea* sp.), river bulrush (*Scirpus fluviatilis*), giant bur-reed (*Sparganium eurycarpum*), lotus (*Nelumbo lutea*), coontail (*Ceratophyllum demersum*) and elodea (*Elodea canadensis*). Deeper areas are comprised of pondweeds (*Potamogeton* sp.), coontail, and wild celery (*Vallisneria americana*). The density and extent of vegetation within certain areas is limited due to the progressive loss of islands, the resultant increase of susceptibility to wind fetch and the associated increase in turbidity.

3.6 FISH AND WILDLIFE

Lower pool 8 provides valuable habitat for wildlife including waterfowl, wading birds, muskrats (*Ondatra zibethicus*) and bald eagles (*Haliaeetus leucocephalus*). The area is especially important for resting and feeding by diving ducks, tundra swans (*Cygnus columbianus*), Canada geese (*Branta canadensis*) and other waterfowl during migration. Because of its importance to waterfowl, a large portion of the area has been designated a closed area by the U.S. Fish and Wildlife Service during the hunting season. The importance of the area is emphasized by the designation of the upper Mississippi River as a waterfowl area of major concern in the North American Waterfowl Management Plan.

The Refuge, including the project study area, was designated a *Globally Important Bird Area* in 1997 in the America Bird Conservancy's United States Important Bird Areas Program. The justification for this designation is due to the Refuge containing "more than 1% of the breeding bald eagles in the continental United States, 22% of world's population of canvasbacks during fall migration, 20% of the biogeographic population of tundra swans during fall migration, with impressive numbers of other waterfowl, wading birds, and other species."

The mix of shallow water areas adjacent to running side channels and the main channel provides habitat for a wide variety of fish. Species commonly found in these areas include black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), sauger (*Stizostedion canadense*), walleye (*S. vitreum vitreum*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), shortnose gar (*Lepisosteus platostomus*), freshwater drum (*Aplodinotus grunniens*), carp (*Cyprinus carpio*), minnows, redhorse sucker (*Moxostoma* sp.) and white bass (*Morone chrysops*). Fish sampling was conducted from 1989 to 1993 by the Long Term Resource Monitoring (LTRM) program in shoreline areas and offshore areas in lower pool 8. The data indicated that, in general, catch rates and species richness were low in the areas sampled when compared to other habitats on the river. Shoreline areas appear to have greater species richness than offshore areas.

Extensive mussel surveys have been conducted in Stoddard Bay and in Crosby Slough. The mussel beds are fairly diverse, although they are dominated by a few species. The most common mussel species present in Stoddard Bay are the threeridge (*Amblema plicata*), mapleleaf (*Quadrula quadrula*) and the threehorn (*Obliquaria reflexa*). Other species present, but less abundant include; the giant floater (*Anodonta grandis*), pink heelsplitter (*Proptera alata*), pimpleback (*Quadrula pustulosa*), pocketbook (*Lampsilis ovata ventricosa*), white heelsplitter (*Lasmigona complanata*) and the deertoe (*Truncilla truncata*). The recent surveys in Stoddard Bay also reported extensive presence of Zebra mussels.

Surveys indicate a greater diversity of mussel species in Crosby Slough, with the following species also being present in addition to those listed above: rockshell (*Arcidens confragosus*), fat mucket (*Lampsilis radiata siliquoidea*), hickorynut (*Obovaria olivaria*), pink papershell (*Proptera laevissima*), fragile papershell (*Leptodea fragillis*), washboard (*Megalonaias gigantea*), paper floater (*Anodonta imbecellis*) and the wartyback (*Quadrula*

nodulata). The mussel beds in portions of Crosby Slough are fairly extensive and are indicative of a transition area between channel species and backwater species. The mussel beds appear to be concentrated on the eastern shelf and the side slopes of Crosby Slough. Surveys indicate that mussel beds in the upper portion of the slough are more diverse in species composition and in higher population densities.

Mussel surveys conducted in 1994 indicated that the mussel population at Raft Channel is relatively diverse, rich and evenly distributed. Common species encountered threeridge, threehorn, pimpleback, and mapleleaf. Other species encountered were pigtoe (*Fusconaia flava*), pink heelsplitter, pink papershell, fragile papershell, black sandshell (*Ligumia recta*), pocketbook, hickorynut, white heelsplitter, butterfly (*Ellipsaria lineolata*), deertoe, paper floater and giant floater. Zebra mussels were observed attached to some of the mussels (0.9% of the mussels sampled) during the survey.

There are two Federally listed threatened or endangered species that may occur in the area. The bald eagle may be sighted in the area during migration. Bald eagles occasionally use trees on the islands and in the adjacent wooded floodplain areas for roosting. The nearest bald eagle nest upstream of the project area is located near RM 692 and downstream is located near RM 679.5 in Reno Bottoms in pool 9. One historical record and one recent record of the Higgins' eye pearly mussel (*Lampsilis higginsi*) are known in the general area. Mussel surveys conducted in the early 1980's adjacent to the navigation channel, in 1989 in the Pool 8 Islands Phase I project area, and in 1991 in Crosby Slough did not indicate the presence of Higgins' eye in the general project area.

Mussel surveys conducted in August/September 1994 near the Stoddard Boat ramp and in Raft Channel did not reveal the presence of Higgins' eye pearly mussel at these sites. A mussel survey was conducted in Stoddard Bay and in the area below Heron and Trapping Islands in 1995. This survey did not reveal the presence of any Higgins' eye pearly mussels in Stoddard Bay. One Higgins' eye pearly mussel was located below Heron and Trapping Islands.

Fish sampling by the LTRM program has identified three Wisconsin-listed endangered fish species, pallid shiner (*Notropis amnis*), crystal darter (*Ammocrypta asprella*), and skipjack herring (*Alosa chrysochloris*)) and four Wisconsin-listed threatened fish species (speckled chub (*Hybopsis aestivalis*), blue sucker (*Cycleptus elongatus*), river redhorse (*Moxostoma carinatum*) and black buffalo (*Ictiobus niger*)) present in pool 8. In 1994, one young of the year blue sucker was collected near the Benover Slough opening in the Phase I project area.

3.7 HABITAT TYPES AND DISTRIBUTION

Habitat in the project area generally can best be characterized as floodplain shallow aquatic, as was described by Wilcox (1993). These areas are characterized as those areas that were portions of the former floodplain that were inundated by the construction of the navigation dams. Floodplain shallow aquatic areas contain a mosaic of open water and emergent vegetation interspersed among islands. As the islands in lower pool 8 have disappeared, open water has become a more dominant feature in the project area. For this project, it is more useful to be more specific in delineating the habitat types present within this floodplain shallow aquatic environment. Specific habitat types present in the study area include:

Islands - Low elevation islands, once fairly prevalent in the project area, have been reduced to a few scattered remnants.

Side Channels/Slough - These are characterized as deeper aquatic areas (typically 6 to 18 feet) that were usually present before river impoundment, lack rooted vegetation except along margins, and usually have flow under normal pool conditions. Crosby Slough is representative of this habitat type. These channels are important for maintaining an interspersion and diversity of habitat types and contributing to the redistribution of organic matter and dissolved oxygen. Deeper holes in these channel areas provide important winter habitat for fish.

Shallow Aquatic Habitat - Shallow aquatic habitat is characterized as those areas with water depths of 3 feet or less. Vegetation in these areas is a mix of emergent, rooted floating aquatic and submergent aquatic vegetation. Sheltered areas, those areas behind barrier islands, generally have lower water velocities than unsheltered areas and exhibit more vigorous and diverse stands of aquatic vegetation.

Deep Aquatic Habitat - This habitat is characterized as areas generally too deep to support emergent vegetation (typically 3 to 7 feet). Sheltered deep aquatic areas occur behind shallow ridges or islands and generally have higher flows than the protected shallow zones. Unsheltered deep aquatic areas generally occur in those areas that are similar in characteristics to sloughs/side channels but are not as visibly defined by extent and flow. These areas are subject to high flow and suspended sediment from the main channel and side channels, and they provide a means for suspended sediment to enter off-channel areas. Vegetation in these areas is generally lacking or composed of pondweeds and water star grass. Sheltered deep aquatic habitat in the project area is limited.

3.8 WISCONSIN ISLANDS CLOSED AREA

The Pool 8 Islands Phase III project area has been subdivided into five study areas. The Three West, Three Central, and Three North areas are part of the Wisconsin Islands Closed Area, a 5,300-acre area closed to hunting and trapping during the duck hunting season; migratory bird hunting is prohibited at all times. The purposes of closed areas are to provide resting and feeding stopovers for migratory waterfowl and to disperse waterfowl hunting opportunities on the Refuge (U.S. Fish and Wildlife Service, 1987). A history of events and issues surrounding the establishment of this closed area is provided in the following discussion.

The Wisconsin Islands Closed Area was implemented in 1957 after lengthy study. When established, this closed area offered excellent habitat for both puddle and diving ducks. The lower end was widely used by diving ducks. Puddle ducks made wide use of the upper portions of the area, where the water is fairly shallow, and filled with aquatic vegetation. About 50% of the total area had aquatic vegetation, mostly sago pondweed, American pondweed, and bulrush. Wild celery was common to locally abundant, especially at the mouths of cuts leading off the main channel.

In the 1950's, human use in the closed areas was a concern, just as it is today. Prior to 1957, three closed areas were designated in pool 8: Target Lake, Goose Island, and Crosby Slough. At one time the Goose Island and Crosby Slough Closed Areas were one unit, however, demand for permission to travel through it by boaters made it necessary to divide the area in two parts. Abandoning the three closed areas in favor of one area (Wisconsin Islands) located in the lower reach of pool 8 was proposed to minimize human disturbance. The Wisconsin Islands area was a solid block sufficiently large to afford sanctuary even though the Refuge had no control over navigation. Boat travel under normal conditions was not expected to have a deleterious effect on waterfowl use, and because of the hazard of small boat travel except in calm weather, the Refuge did not feel there would be too much boat traffic through the area. This one feature made the Wisconsin Islands area much more desirable than the Target Lake, Goose Island, and Crosby Slough closed areas, where unrestricted boat travel had reduced the use and effectiveness to a great extent.

When the Wisconsin Islands Closed Area was established, the focus was on providing migration habitat and protection for ducks. During the 1957 fall migration, the peak population of ducks recorded in the Wisconsin Islands Closed Area was 44,620 on a November 20 aerial survey (Green, 1959). A total of 1,853,026 duck use days was recorded in the Wisconsin Islands Closed Area from five aerial surveys conducted from late September through early December. Although no species breakdown was provided in the report for either the peak population or use days in the closed area, for the La Crosse District as a whole in 1957, mallards ranked first in number of use days, followed in order by wigeon, scaup, ring-necked ducks, pintail, and blue-winged teal.

In contrast to today, few geese and tundra (whistling) swans used the Upper Mississippi River in 1957. The peak population of Canada geese and snow/blue geese recorded on the La

Crosse District during the fall migration in 1957 was 150 and 160, respectively (U.S. Fish and Wildlife Service /Bureau of Sport Fisheries and Wildlife, 1957). Those that stopped remained for a short time as reflected in the use day totals of 3,752 for Canada geese and 3,199 for snow/blue geese. For tundra swans, the peak population recorded on the La Crosse District was 65 with a use day total of 1,526. The peak tundra swan count in the Wisconsin Islands Closed Area was 13 in 1957.

Over time, the number of migratory waterfowl using the river has changed. Canada geese and tundra swans are more numerous now than in 1957, while few snow/blue geese use the river. In the Wisconsin Islands Closed Area during the 1998 fall migration, the peak population of Canada geese and tundra swans observed on aerial surveys was 5,000 and 6,425, respectively. Use day totals for Canada geese and tundra swans were 143,601 and 208,463, respectively. During the waterfowl hunting season, geese and swans generally use the closed area for protection during daylight hours and fly out at night to feed in areas inaccessible by day.

The number of ducks using the Upper Mississippi River is dependent on many variables. Among the most important is the number of ducks in the fall flight and habitat conditions on the Upper Mississippi River and on other staging areas. The loss of islands and aquatic plant beds in the Wisconsin Islands Closed Area has reduced the number of ducks using the area. In 1997, fewer than 100,000 duck use days were recorded in the closed area during fall migration. Mallards and canvasbacks provided the majority of the use days recorded. In response to improved food conditions (invertebrate and submersed aquatic plant) within the closed area and prolonged mild weather that extended well into December, the number of diving ducks using the closed area increased dramatically in 1998. Peak counts from aerial surveys included: 112,300 canvasbacks on November 23 and 22,025 scaup, 7,175 common goldeneyes, and 4,500 buffleheads on December 2. Nearly 4.5 million diving duck use days were recorded in the closed area. Puddle duck numbers also rebounded in 1998, but lagged far behind diving duck numbers. Further, mallards were the sole reason for the increase. Of the 210,000 total puddle duck use days recorded in the closed area in 1998, mallards accounted for 200,500 of those use days.

3.9 CULTURAL RESOURCES

Island construction in pool 8 will affect portions of the floodplain that were inundated by construction of L/D 8 at Genoa, Wisconsin. Generally, the river terraces adjacent to this segment of the Mississippi River have abundant archaeological resources that span approximately 10,000 years of human occupation in the valley. However, inundation and post-settlement (after 1850) alluviation has complicated the identification of archaeological resources on the floodplain.

In 1989, an archaeological survey conducted by the Mississippi Valley Archaeology Center (MVAC) for Phase I of the Pool 8 Island project located only recent historic cultural debris and suggested that the remnants of Island 120 are covered by more than a meter of post-settlement alluvium. Island 120 is located at the northern end of the current project.

In 1997, MVAC conducted a phase I archaeological survey of the pool 8 floodplain. This survey covered about 60 miles of shoreline locating 9 nine archaeological sites of which 3 were prehistoric. Most of the shoreline surveyed was located in the upper half of pool 8. The investigation concluded that the lower third of pool 8 had the most disturbed portion of the pool's floodplain. Considerably more of the floodplain had been inundated and subjected to rapid erosion within the first few decades of the pool's existence.

There are no historic properties listed on the National Register of Historic Places within the project area nor are there any known cultural resources located on the island remnants to be affected by the project. However, there may be deeply buried or inundated resources that have not yet been discovered in locations proposed for island construction. A review of known shipwreck locations in relation to proposed dredge/borrow locations for the project suggests that the project would not affect any of those resources.

3.10 SOCIOECONOMIC SETTING

The setting of the upland areas bordering lower pool 8 can be characterized as rural-small town. The developed communities bordering the study area include Brownsville on the Minnesota side of the river, and Stoddard and Genoa on the Wisconsin side. Brownsville has an approximate population of 500, while the approximate populations of Stoddard and Genoa are 800 and 300, respectively. The rural areas bordering lower pool 8 contain a mixture of agriculture and wooded areas. Flat areas on the bluff tops and in the stream valleys are farmed. Those areas too steep for farming are wooded.

Transportation corridors bound both sides of lower pool 8. Railroad tracks border both sides of the river in lower pool 8. On the Wisconsin side, State Highway 35 parallels the river, while in Minnesota, State Highway 26 follows the river.

The only public recreation area in lower pool 8 in proximity to the study area is Wildcat Park. Wildcat Park covers 105 acres and is on the Minnesota side of the main channel at river mile 688. The focus of this park is for picnicking, camping, and as an access point to the river. Public boat accesses are also available in Stoddard and Genoa.

PROBLEM IDENTIFICATION

4.1 EXISTING HABITAT CONDITIONS

4.1.1 THREE WEST AREA

Habitat conditions for wildlife in the Three West area are considered to be fair. Aquatic vegetation in this area is more prevalent when compared to many areas of lower pool 8. In addition, the presence of the aquatic vegetation in close proximity to a shoreline increases habitat value to species such as turtles, muskrats, and herons. The Three West area serves as a good resting and feeding area for waterfowl during migration. The U.S. Fish and Wildlife Service has designated this area as a closed area during the waterfowl hunting season.

Habitat conditions for fish in the Three West area are below average for Upper Mississippi River backwater habitats. There is a general lack of deepwater habitat, and that which is present is concentrated in the lower end of the study area. The vegetation is primarily floating-leaved species that do not provide as much cover or habitat for fish and their food organisms as submersed aquatic vegetation. No winter monitoring has been conducted in this area, but it is likely that winter habitat conditions are poor. Most of the area is shallow and likely suffers from dissolved oxygen depletion. In the channels where flows are present, excess current velocities and low water temperatures are likely limiting.

4.1.2 THREE CENTRAL AREA

Habitat conditions for wildlife in the Three Central area are generally poor. The loss of islands and decline of aquatic vegetation have resulted in an open water environment with little value for wildlife. The remaining vegetation beds do provide feeding areas for migrating waterfowl, but their decline in extent and density limits their value. Likewise, importance of this area for other species such as turtles, herons, and invertebrates diminishes as these vegetated areas become more isolated in large expanses of open water. The primary value of this area at this time is as a resting area for migrating waterfowl. The U.S. Fish and Wildlife Service has designated this area as a closed area during the waterfowl hunting season.

Habitat conditions for fish are very poor for a number of reasons. There is a lack of deep water for cover. There is a lack of vegetation for use as cover and to provide a base for food organisms. The lack of shallow water limits spawning habitat for nesting Centrarchids. There is a lack of protected, vegetated shallows that are important as habitat for many backwater and riverine fish species. Though no winter monitoring in this area has been conducted, it is expected that excessive current velocities and low water temperatures create poor winter habitat conditions for fish.

4.1.3 THREE NORTH AREA

Habitat conditions for wildlife in the Three North area are considered moderate to good. The restoration of islands and part of the Pool 8 Islands Phase I habitat project and the resurgence of aquatic vegetation have resulted in an environment used by waterfowl, wading birds, furbearers, and other wildlife associated with shallow aquatic habitats. This is not to say that the habitat could not be of higher quality. The emergent vegetation beds present in the 1970's have not returned. The loss of islands to the south results in this area being exposed to a considerable wind fetch which in turn can result in water quality degradation when strong southerly winds resuspend the fine sediments found over much of this area. The U.S. Fish and Wildlife Service has designated this area as a closed area during the waterfowl hunting season.

Habitat conditions for fish are considered modest for a number of reasons. There is a lack of deep water for cover. Due to the shallow water conditions, the area is probably more important for forage fish and young-of-the-year sport fish than for adult fish. Winter habitat conditions are probably marginal at best because of shallow water depths.

4.1.4 THREE EAST AREA

Habitat conditions for wildlife in the Three East area is considered to be good. As the delta for Coon Creek the area is a mix of terrestrial, emergent marsh and shrub wetland habitat for a variety of wildlife including fox, muskrats, turtles, herons, waterfowl and songbirds.

The emergent marsh area of the Coon Creek delta complex provides good spawning and nursery habitat for some species of fish. The submersed vegetation beds along the edge of the delta provides provided fairly good habitat conditions for fish and their food organisms, although the amount of this type of habitat varies with the extent of the vegetation beds in any given year.

4.1.5 THREE NORTHWEST AREA

Habitat conditions for wildlife in the Three Northwest area is considered to be fair. It provides a mix of emergent marsh, mudflats and shrub marsh conditions for a variety of wildlife including waterfowl, muskrats, turtles, herons, shorebirds and songbirds. Monotypic stands of willow and cattail limit to some extent the habitat value of the area.

Habitat conditions for fish in the Three Northwest area is considered to be average. About 5 acres of the Three Northwest area was dredged in 1992 and restored as spawning, and nursery habitat for fish. The spawning and nursery value of the area is gradually declining with the delta growth of Wildcat Creek as fine sediments accumulate and water depths decline.

4.2 HISTORICALLY DOCUMENTED CHANGES IN HABITAT CONDITIONS

Prior to inundation, the area now occupied by lower pool 8 consisted of two major channels, Raft Channel and Coon Slough (the present-day navigation channel), and a floodplain dominated by islands intertwined with sloughs, ponds, and marshes. Completion of L/D 8 and the creation of pool 8 in 1937 inundated low-lying areas, creating a wide variety of aquatic habitats. Higher areas remained as wooded islands. Plates 3a through 3c show lower pool 8 in 1947, 1954, and 1961.

4.2.1 HYDRODYNAMIC CHANGES

The creation of pool 8 changed the hydrologic and hydraulic conditions from those that previously existed. A discussion of these changes can be found in sections 3.2.1.1 and 3.2.1.2.

4.2.2 ISLAND LOSS

As soon as the pool was formed, natural processes began to alter the character of lower pool 8. Wave and current action began eroding away the islands. Table 4-1 shows the progressive loss of islands in lower pool 8 as measured from aerial photographs. This loss is readily evident when comparing plates 3a through 3c with plate 2a. Plate 3d also illustrates this loss.

Table 4-1
Island Loss in Lower Pool 8 (1939-89)

Year	Acres	Acres Lost	Percent Remaining
1939	624	-	-
1947	400	224	64
1954	345	55	55
1961	317	28	51
1967	274	44	44
1983	112	162	18
1989	129	(+17)[1]	21

source: EMTC

[1] In some instances it is difficult to accurately define the boundary between islands and emergent aquatic vegetation. It is believed that the gain in island acreage between 1983 and 1989 is actually the result of emergent aquatic vegetation being interpreted as islands.

Table 4-2 shows the progressive loss of islands in the Three West, Three Central, and Three East study areas. The acres for the Three West and Three Central areas were measured from aerial photographs. The values for the Three East area are visual estimates.

Table 4-2
Island Loss in Three Study Sub-areas*

	3-West			3-Cent			3-East		
Year	Acres	Acres Lost	% Left	Acres	Acres Lost	% Left	Acres	Acres Lost	% Left
1939	61	-	-	95	-	-	15-20	-	-
1954	35	26	57	44	51	46	< 5	10-15	-
1967	31	4	51	20	24	21	< 5	< 5	-
1989	3	28	5	4	16	4	0	0	0

* 3-West area totals 550 acres; 3-Central area totals 1,591 acres; 3-East area totals 698 acres

4.2.3 BATHYMETRIC CHANGE

At the same time as the islands were eroding away, sediments carried by the river and sediments eroded from the islands began to fill in some of the newly created aquatic habitats. Historic elevation data is sparse. A comparison of post-impoundment and 1989 water depths is shown in table 4-3 for the Three West and Three Central areas.

Table 4-3
Bathymetric Change (1938-89)

	3-West*		3-Central*	
Depth	1938 acres	1989 acres	1938 acres	1989 acres
< 1 foot	23	38	58	11
1-6 feet	295	344	642	845
> 6 Feet	94	30	244	88

* total acres for the sub-areas may vary from later tables due to adjustments in area boundaries

Table 4-4 shows depth distributions within four of the study sub-areas. This information is illustrated on plates 4 through 7.

Table 4-4
Depth Distribution in Four Study Sub-areas

		3-W			3-C			3-N			3-E	
Depth Range	Ac.	%	Cum %	Ac.	%	Cum %	Ac.	%	Cum	Ac.	%	Cum %
< 1	43	8	8	1	0	0	41	9	9	61	9	9
1-2	91	17	24	4	0	0	58	12	21	30	4	13
2-3	125	23	47	76	5	5	136	29	50	35	5	18
3-4	95	17	64	673	42	47	117	25	75	119	17	35
4-5	50	9	73	335	21	68	35	7	83	152	22	57
5-6	29	5	79	181	11	80	21	4	87	110	16	73
6-8	36	7	85	149	9	89	26	6	93	91	13	86
8-10	28	5	90	44	3	92	15	3	96	30	4	90
> 10	53	10	100	128	8	100	18	4	100	70	10	100
Total	550			1591			467			698		

source: EMTC data circa 1989-1991

As can be seen from the depth distribution data, the Three West and Three North areas are generally more shallow, with nearly 65 percent and 75 percent of these areas 4 feet deep or less, respectively. The Three Central area contains very little shallow water, though the data in the table may be somewhat dated. Since the surveys were taken, natural changes and construction of seed islands along the eastern edge of the Three Central area has resulted in some increase in shallow water in this area.

4.2.4 AQUATIC VEGETATION

In general, there has been an observed decline in aquatic vegetation in pool 8 and other Upper Mississippi River navigation pools. Changes were being noted as early as the 1950's and 1960's. During the last three decades, the most noticeable river-wide decline has been the loss of emergent vegetation. In the early 1990's there was as river-wide crash in submersed aquatic vegetation as well. Recently, submersed aquatic vegetation has shown some recovery in pool 8 and other pools.

There are a number of theories pertaining to the decline of aquatic vegetation. A number of causative factors have been identified, and it is likely most or all of them have had some effect. Among the factors have been:

- o disruption of natural hydrology
- o the loss of islands and the shelter they provided
- o changes in bathymetry
- o increased turbidity due to wave suspended sediments
- o drought of the late 1980's

The creation of the locks and dams system has altered the natural river hydrology. The largest effect has been the loss of the natural late summer decline in water levels that would be associated with a natural riverine system. The navigation pools maintain a minimum water level that is higher than what would occur in an unimpounded system. This maintenance of artificially high water levels is believed to be an important factor in the decline of emergent aquatic vegetation (due to the loss of the natural process of sediment exposure). This is believed to substantially inhibit the reproductive capabilities of many species of emergent vegetation.

The erosion of islands has resulted in the loss of the physical shelter islands provide to aquatic vegetation. With the loss of islands, aquatic vegetation becomes more exposed to the physical stresses associated with larger wind fetches and larger wind generated waves. All forms of aquatic vegetation can be affected to some degree, but the direct physical effects on emergent aquatic vegetation are probably the greater than those on submersed vegetation.

Changes in bathymetry can have mixed effects on aquatic vegetation. Erosion of shallow areas can make them too deep to support emergent vegetation. Conversely, the filling of deeper areas can bring them within the photic zone and capable of supporting submersed vegetation.

The loss of islands and the subsequent increase in wind fetches and the size of wind-generated waves increases ambient turbidity due to the resuspension of fine sediments. This in turn can reduce the photic zone and the productivity of submersed vegetation. The effect on emergent vegetation is probably not as significant.

A significant decline in aquatic vegetation of all types occurred on the Upper Mississippi River during the early 1990's. This followed three years of low river discharges in the late 1980's. River managers and scientists believe the decline in aquatic vegetation was related to the

drier conditions of the late 1980's, though no direct link has ever been shown.

Table 4-5 shows changes in aquatic vegetation for three of the study sub-areas since 1975. These changes are illustrated on plates 8 through 11.

Table 4-5
Changes in Land Use/Land Cover (acres*) (1975-98)

	3-W				3-C				3-E			
	1975	1989	1994	1998	1975	1989	1994	1998	1975	1989	1994	1998
S	58	296	2	54	496	509	32	430	252	52	39	58
RFA	24	0	41	12	22	0	0	0	0	0	0	0
E	123	6	2	3	132	1	1	0	81	52	27	25
subtot. aq. veg	205	302	45	69	650	510	33	430	333	104	66	83
OW	350	251	512	493	1157	1310	1784	1385	360	609	618	601
Total	555	553	557	562	1807	1820	1817	1815	693	713	684	684

OW = open water (little or no vegetation); S = submersed vegetation; RFA = rooted floating aquatics; E = emergents

* total acres for the sub-area may vary from other tables due to adjustments in area boundaries made subsequent to the analysis

4.3 FACTORS INFLUENCING HABITAT CHANGE

A number of factors have been identified that are believed to be influencing habitat changes in the lower pool 8. Many of these factors are synergistic, combining to affect both the physical and biological environment.

Construction of L/D 8 submerged the natural levees and floodplain in the lower end of pool 8 resulting in continuous flow of water and sediment through the floodplain for all conditions. The higher parts of the natural levee became islands. Submergence caused changes in the vegetation communities resulting in decreased floodplain resistance and increased floodplain conveyance with time. For river flows near and well above bank full, the majority of the conveyance is now in the floodplain in the lower pools. This has decreased the hydraulic slope in the pools and subsequently the fluvial processes of erosion and deposition in channels. In the floodplain, there is not enough hydraulic energy for river currents to erode sediments. The result is a less dynamic, depositional river system.

Wind generated waves are believed to be the primary erosive forces that have led to the loss of islands in lower pool 8. Island loss in lower pool 8 has generally progressed from south to north. The islands in the southern portion of the pool would have been inundated the greatest by the creation of pool 8 and were likely the most susceptible to erosion by wave action. As island loss occurred, the remaining islands became exposed to considerable wind fetch from the south (SE to SW), which produces some of the most frequent and highest velocity winds during the open water season.

Wave action is believed to be one of the factors contributing to the general loss of aquatic vegetation in the area. Wind generated waves suspend material in the water, increasing turbidity and reducing light penetration, and the waves exert a physical force on aquatic vegetation. In addition, the effects of wind-generated waves on aquatic vegetation have probably increased over recent time as the islands and the protection they afforded have decreased.

The resuspension and subsequent resettlement of sediment particles is believed to be a factor in the decline of bathymetric diversity in lower pool 8. This results in the general leveling of the bottom as material is resuspended from shallower areas by wave action and redeposited in deeper areas.

4.4 ESTIMATED FUTURE HABITAT CONDITIONS

Erosion of the few remaining islands and the loss of bathymetric diversity seen in the past are expected to continue into the future. Aquatic vegetation abundance is likely to wax and wane in response to water levels, water clarity, nutrient availability, and other factors. However, it is unlikely that vegetation will recover to the extent present in 1975.

Eight seed islands were constructed in the northeastern portion of the Three Central area in 1995 (2) and 1997-98 (6). If these structures perform as expected, islands should form below them with the next 5 years and continue to grow over time. These islands will improve conditions for the growth of aquatic vegetation in the shallows adjacent to the islands and within their wind-wave shadow zones.

A partial drawdown (1.5 feet) of pool 8 was conducted during the summer of 2001 as a test of this management measure on a pool-scale basis for improving conditions for the growth of aquatic vegetation. The drawdown was successful in stimulating growth of emergent aquatic plants on exposed substrates. A follow-up drawdown to further enhance plant growth is under consideration for the summer of 2002. Periodic drawdowns may become part of the management of pool 8 in the future.

4.4.1 THREE WEST AREA

Future habitat conditions in the Three West area are likely to be variable in the future depending upon the presence or absence of aquatic vegetation. Based on changes observed during the period 1975-1998, in both the Three West area and lower pool 8 in general, it is expected that aquatic vegetation in the future will be dominated by submersed species with some floating-leaved aquatics present. A resurgence of emergent aquatic vegetation is not expected.

The few acres of islands left in the Three West area will likely be gone within 10 years. During the period 1938-1989, there was a loss of deep water (> 6 feet) and a gain in shallow water in the Three West area. This trend is likely to continue into the future, though probably not at the rate exhibited in the past. The navigation pools are approaching more of an equilibrium state and there is less deep water left available for conversion in the Three West area.

4.4.2 THREE CENTRAL AREA

Future habitat conditions in the Three Central area are expected to be similar to those described for the Three West area. The only exception would be in the eastern portion of the area where the seed islands described above were constructed. If successful, there should be an increase in islands in the eastern portion of the Three Central area with the potential for some scattered recovery of emergent vegetation along the island shorelines. Because the seed islands are designed to accrete sediment, there will be a general reduction of water depths in much of this area. In compensation, the channels between the islands should scour somewhat deeper. Because seed islands are a new habitat restoration technique, it is difficult to project what the future may hold for this portion of the Three Central area.

4.4.3 THREE NORTH AREA

Future habitat conditions in the Three North area are not expected to appreciably change. The islands located to the north are fairly substantial and should persist. Aquatic vegetation in the Three North area will likely fluctuate up and down depending upon annual conditions. The aquatic vegetation community will likely continue to be dominated by submersed and floating-leaved species. There may be temporary resurgence of emergent species following drawdown events. However, a return to the abundance of emergent plants that occurred in 1975 is considered highly unlikely.

4.4.4 THREE EAST AREA

Substantial changes in future habitat conditions in the Three East area are not envisioned. An analysis for the period 1973 through 1998 using aerial photographs indicate that the Coon Creek delta has been relatively stable, save for the loss of some land mass at the very tip of the delta. The mix of vegetation types varies during this period, with the biggest change being the loss of emergent vegetation along the southwest face of the delta.

Based on the changes evidenced in the photographic record, it is expected that the delta should maintain its general size and shape into the foreseeable future. Vegetation conditions within the delta will vary from year to year depending on water conditions, as will vegetation growth along the margins of the delta.

There is a spit of land that defines the southwest margin of the delta. This spit probably formed from deposition of Coon Creek sediments. Minor variations in the shape and location of this spit of land are evident on the aerial photos, probably a reflection of the dynamic nature of the area. This spit of land protects a large interior wetland within the delta. If this spit of land were to be breached or erode away, this interior wetland would be exposed to large wind fetches from the southwest. This is turn could result in erosion of this wetland if it has predominantly fine soils.

4.4.5 THREE NORTHWEST AREA

In the early 1970's, Wildcat Creek was rerouted to discharge into Schnick's Bay. This now results in the sediment load from Wildcat Creek being deposited in Schnick's Bay. An analysis conducted in 1991 indicated that for the period 1975 to 1990, an average of .56 acres per year of the bay was being converted to "delta" (to emergent marsh and eventually, to wood wetland) (Hendrickson, internal memorandum). The shallow aquatic portion of Schnick's Bay in 1994 covered about 75 acres. Future conversion rates are probably not going to be greater than .56 acres/year because the deeper portions of Schnick's Bay still remain. Assuming an approximate conversion rate of 0.5 acres/year into the future, shallow aquatic habitat in Schnick's Bay will be reduced to about 60 acres in 2025 and about 45 acres in 2050.

PROJECT OBJECTIVES

5.1 INSTITUTIONAL FISH AND WILDLIFE MANAGEMENT GOALS

Fish and wildlife management goals and objectives for the project area fall under those defined more broadly for the Upper Mississippi River National Wildlife and Fish Refuge, and those designated specifically in the Refuge Master Plan. The management objectives of the Upper Mississippi River National Wildlife and Fish Refuge which apply most directly to the study area include:

Environmental Quality

Reduce the adverse impacts of resuspension and movement of sediments within the project area.

Eliminate or reduce adverse impacts of water quality degradation.

Migratory Birds

Restore species that are in critical condition (such as canvasbacks) and achieve national population or distribution objectives.

Maintain or improve habitat of migrating waterfowl using the Upper Mississippi River.

Contribute to the achievement of national population and distribution objectives identified in the North American Waterfowl Management Plan and flyway management objectives.

Maintain or improve habitat for other migratory birds.

Fisheries and Aquatic Resources

Maintain and enhance, in cooperation with the States, the habitat of fish and other aquatic life (furbearers, reptiles, amphibians, and invertebrates) on the Upper Mississippi River.

Because the study area is within the Upper Mississippi River National Wildlife and Fish Refuge, these management objectives, together with input from State and Federal agency natural resource managers, were used to guide the development of specific project objectives. However, this study is only one part of a larger cooperative natural resource management effort on the river. The long-term effectiveness of any project will eventually be evaluated from such a system-wide perspective.

5.2 PROJECT GOALS AND OBJECTIVES

Earlier sections of this report discussed in detail existing habitat conditions and problems (see "Assessment of Existing Resources" and "Problem Identification"). The habitat goals and objectives were developed as part of a coordinated effort on the part of all of the resource agencies involved in the study. Important factors considered in the development of the goals and objectives were:

a. Management objectives of the Upper Mississippi River National Wildlife and Fish Refuge and of the Wisconsin and Minnesota Departments of Natural Resources

b. Historic and existing fish and wildlife habitat conditions

c. Resource capabilities, opportunities, and constraints

d. Habitat deficiencies, now and in the future for pool 8 in general

e. Species groups and individual species habitat requirements

f. Desirable hydraulic and sediment transport conditions to sustain habitat

5.2.1 MIGRATORY WATERFOWL GOALS/OBJECTIVES - THREE WEST, THREE CENTRAL, AND THREE NORTH AREAS

Goals and objectives to improve waterfowl habitat conditions were defined for the Three West, Three Central, and Three North areas, all of which are located within the Wisconsin Closed Area. These areas have different habitat potential for waterfowl due to geomorphic and land/water conditions, and currently support different migratory waterfowl use.

5.2.1.1 Three West Area

The Three West study area consists of about 550 acres. In 1939 about 60 acres of islands were present in this study area; by 1991, less than 5 acres remained. In 1975, the study area contained about 205 acres of aquatic plant beds, including about 125 acres of emergent plants. By 1998, emergent plant beds were reduced to about 3 acres. The complex of islands/peninsulas/ shoreline and aquatic plant beds that remain still provide important habitat to migrant waterfowl, including swans, geese, and puddle ducks. These habitat features are attractive to waterfowl for the following reasons:

a. The area is within the Wisconsin Islands Closed Area of the Refuge. Hunting and trapping are prohibited during the migratory waterfowl hunting season; migratory bird hunting is not permitted at any time. Disturbance from boat traffic has been minimal during fall migration.

b. The "zone of influence" in and around the remaining islands, peninsulas, and the shoreline is large because of the expanse of shallow water and the orientation of the islands and peninsulas. The few remaining islands/peninsulas and the expanse of shallow water breaks up wind fetch and allow aquatic plants to grow in selected sites.

The overall management goal of the Refuge is to manage the Three West area as puddle duck migration habitat. The Refuge also would like to improve habitat conditions for other fish and wildlife uses compatible with the goal of providing puddle duck migration habitat.

GOAL W-1: Restore high quality puddle duck habitat to 550 acres and then maintain.

The study area formerly provided high quality puddle duck habitat throughout the entire annual cycle including spring and fall migration, nesting, brood rearing, and molting. The combination of island loss and reduction in acres of aquatic plant beds, particularly emergent plants, are factors in the decline of puddle duck use during fall migration and in low mallard duckling survival rates.

From a system wide perspective, it is important to increase the habitat available to puddle ducks. The Three West area currently contains fewer than 100 acres of habitat considered high quality puddle duck habitat. The goal of restoring 550 acres of high quality habitat for puddle ducks was based on the habitat that existed in the area in 1975. This is the earliest time period

for which there is specific quantifiable habitat information (aquatic vegetation mapping). Because of the aquatic plant coverage and habitat diversity that existed in 1975, habitat conditions in the Three West area were considered excellent for puddle ducks. Other migratory birds, among them diving ducks, swans, coots, shorebirds, herons, and raptors will also benefit form the restoration of puddle duck habitat.

OBJECTIVE W-1: Increase and then maintain 550 acres of habitat meeting the following criteria.

Federal and State wildlife biologists identified these criteria as those needed to have high quality puddle duck habitat.

A. Provide 125 acres with the physical conditions considered important for the growth of emergent aquatic vegetation. These are:

(1) water depths less than 2 feet

(2) protected from dominant wind fetches

(3) current velocities generally less than 0.5 feet per second

Emergent aquatic vegetation is an important habitat component of high quality waterfowl habitat. Flooded, robust emergent species such as cattail, bulrush, and arrowhead provide shelter and food (seeds, tubers, browse, and aquatic invertebrates) for migrant and molting waterfowl, and broods. The value of an emergent plant community increases if beds of rooted floating plants and submersed aquatic plants are located nearby. Emergent vegetation has declined in the Three West area and on the Upper Mississippi River in general. The parameters listed under above are considered important to the growth of emergent vegetation and are those that can be modified through habitat restoration measures. There are other factors affecting the growth of emergent vegetation such as water level regulation that cannot be as easily modified on a site-specific basis.

Though there may be exceptions for individual species, in general, water depths of less than 2 feet are considered necessary for the growth of emergent vegetation. Protection from large wind fetches is important as large wind-generated waves can make conditions physically inhospitable for the growth of emergent vegetation. Finally, it is recognized that excessive current velocity can also make conditions unsuitable for emergent vegetation. The amount of current velocity tolerated by emergent vegetation probably varies by species and time of year. Current velocities of less than 0.5 foot per second should be suitable for the majority of emergent species indigenous to the area.

B. Provide 300 acres with the physical conditions considered necessary for the growth of submersed aquatic vegetation. These are:

(1) water depths less than 4 feet

(2) protected from dominant wind fetches

Submersed vegetation is also important to waterfowl, primarily as a food source. These parameters are considered important to the growth of submersed vegetation. While submersed vegetation can be found at depths greater than 4 feet on the Upper Mississippi, growth is most successful in water depths less than 4 feet. Protection from wind-generated waves is important, primarily due the secondary effect of resuspended sediments reducing light penetration. Reduced light penetration can affect the growth and productivity of submersed vegetation.

C. Restore islands to meet puddle duck habitat needs.

Puddle ducks use islands to meet a number of habitat requirements. Islands are used for nesting (depending upon vegetative cover). Shoreline vegetation provides cover for broods. Certain species of puddle ducks may feed on insects and plants found on islands. Island shoreline features such as snags, sand spits, and shallow shelves provide loafing sites for waterfowl. In addition, for puddle ducks, the islands can provide a visual barrier to human disturbances. This is believed to be important for resting puddle ducks during the migration season (Nissen, personal communication).

D. Provide 40 acres of sand/mudflats within the study area (areas with water depths less than 0.5 foot at normal summer pool elevations).

Shallow flooded sand/mudflats are important to a wide variety of waterbirds. These flats may vegetate with aquatic plants, providing a food resource. Shallow water areas and/or exposed sand/mudflats support invertebrates that a variety of species feed upon. Without vegetation, the flats serve as important loafing sites used by migrant waterfowl or other waterbirds.

E. Provide waterfowl loafing sites (10-20 per acre) at scattered locations throughout the study area.

Waterfowl use stumps, logs, muskrat houses, and shallow flooded sand flats for loafing. Federal and State waterfowl biologists consider ten to twenty loafing sites per acre in preferred locations as the desired condition. The best loafing sites for broods and molting ducks are surrounded by water, have good visibility, and are near escape cover. For migrant waterfowl, visibility and access to water are important. In addition, it is important that some waterfowl loafing sites be located in areas where there is thermal protection from northwesterly winds.

5.2.1.2 Three Central Area

The Three Central area consists of about 1,600 acres. Due to the expanse and mix of aquatic vegetation in the area, this portion of lower pool 8 has been an important area for migrating waterfowl, especially diving ducks. In 1975 almost 650 acres of submersed, floating, and emergent vegetation were present in this study area; by 1991, less than 50 acres remained. There has been a substantial recovery of submersed vegetation (430 acres in 1998). However, emergent and floating-leaved aquatic vegetation have not recovered.

The complex of islands that provided protection from wind fetch and helped to create conditions for large expanses of aquatic vegetation has shrunk from 95 acres in 1939 to less than 4 acres.

Some habitat improvement projects have been recently completed in the northeastern quadrant of the study area. In 1992, Grassy Island was rehabilitated as part of the Pool 8 Islands Phase I project. In 1995, Heron and Trapping Islands were stabilized. Two seed islands were also constructed in an effort to induce the formation of islands through natural sediment transport processes. As part of the Pool 8 Islands Phase II project, six additional seed islands were constructed along the main channel below Heron and Trapping Islands.

Aquatic plant beds, particularly submersed plants such as wild celery, began to rebound beginning in 1996. By 1998, nearly 430 acres of submersed aquatic plant beds were delineated in the current study area. Much of the bed expansion has occurred in proximity to the recently completed habitat projects. Plant beds are generally lacking along the Raft Channel in the western half of the study area.

During the early 1990's, few migrant waterfowl, including ducks, geese, swans, and coots used the study area. The combination of an increase in the density and distribution of submersed aquatic plants in the study area (beginning in 1996) and an increase in invertebrate numbers in the study area and lower reach of pool 8 (beginning in 1997), has resulted in a dramatic increase in the number of diving ducks using the study area. Use of the area by puddle ducks and coots is generally limited to the shallow eastern portion of the Three Central area, in the area of the seed island construction. The Three Central area is attractive to waterfowl for the following reasons:

a. The area is within the Wisconsin Islands Closed Area of the Refuge. Hunting and trapping are prohibited during the migratory waterfowl hunting season; migratory bird hunting is prohibited at all times. In addition, human disturbance from boat traffic has been limited, generally occurring in proximity to the main channel.

b. Within the past 2-3 years, beds of submersed aquatic vegetation and invertebrate populations have been increasing. A portion of the increase, particularly the vegetation, has been in and around the "zone of influence" associated with the recent habitat projects.

c. The recently completed habitat projects have provided additional loafing sites.

The overall management goal of the Refuge is to manage the Three Central area as diving duck migration habitat, with management for puddle duck, Canada geese, tundra swan, and other waterbird migration habitat occurring as opportunities arise. The Refuge also would like to improve habitat conditions for other fish and wildlife uses compatible with the goal of providing diving duck migration habitat.

GOAL C-1: Increase high quality waterfowl habitat to 950+ acres and then maintain.

The Three Central area primarily provides habitat for diving ducks. The number of diving ducks concentrated in the Three Central area and lower pool 8 has rebounded in the last 2 years in response to increasing number of invertebrates and expansion of submersed aquatic plant beds.

From a system wide perspective, it is important to increase the amount of habitat available for migrating waterfowl. Although the Three Central area does provide important resting habitat for migrating waterfowl, it currently contains fewer than 450 acres of habitat considered high quality waterfowl habitat. The goal of restoring 950+ acres of high quality habitat for migratory waterfowl was based on the habitat that existed in the area in 1975. This is the earliest time period for which there is specific quantifiable habitat information (aquatic vegetation mapping). The conditions that existed in 1975 in terms of habitat diversity and aquatic plant coverage were considered excellent for migratory waterfowl.

<u>OBJECTIVE C-1</u>: Increase and then maintain 950+ acres of habitat meeting the following criteria.

Federal and State wildlife biologists identified these criteria as those needed to have high quality waterfowl habitat in the Three Central area.

A. Provide 700 acres with the physical conditions considered necessary for the growth of submersed aquatic vegetation. These are:

(1) water depths less than 4 feet

(2) protected from dominant wind fetches

Submersed vegetation is important to waterfowl, primarily as a food source. These parameters are considered important to the growth of submersed vegetation. While submersed vegetation can be found at depths greater than 4 feet on the Upper Mississippi, growth is most successful in water depths less than 4 feet. Protection from wind-generated waves is important, primarily due the secondary effect of resuspended sediments reducing light penetration. Reduced light penetration can affect the growth and productivity of submerged vegetation.

B. Where practicable, maintain and/or enhance conditions preferred by fingernail clams, e.g., water depths 3-8 feet, flat bottoms, and current velocities 0.1 - 0.3 ft/sec.

Fingernail clams are an important food resource for migrating waterfowl. Any measures that can be implemented that would improve conditions for the growth and abundance of fingernail clams will benefit migratory waterfowl.

OBJECTIVE C-2: Create 2-3 acres of nesting habitat meeting the following criteria:

A. Located 0.5 miles from land-based predators.

To provide safe refuge for land-based predators such as fox and raccoon, nesting habitat for waterfowl should be located 0.5 miles from the nearest land. This isolation greatly reduces the potential for nest predation.

B. Located within 0.5 miles of brood habitat.

Suitable brood habitat is critical for the growth of ducklings into adult birds. If newly hatched ducklings have to travel across large expanses of open water to reach suitable brood habitat, their chances of survival are greatly diminished. If good brood habitat is located within 0.5 miles of the nesting island, there is a reasonable chance that the brood will survive the journey.

C. Less than 1.0 (and preferably less than 0.5) acres in size.

Smaller islands are less likely to attract predators, and are less likely to provide the habitat necessary for a predator to take up residence on an island.

D. Vegetative cover with an average obscurity rating of 1.5 dm.

Waterfowl nesting success is related to the available of dense nesting cover, usually in the form of grasses. On the Mississippi River, wooded islands meeting isolation requirements are producing high nesting densities of nesting mallards. However, given the option, it is believed that grass would be the preferred nesting cover.

5.2.1.3 Three North Area

The Three North area consists of about 470 acres. Due to the expanse and mix of aquatic vegetation in the area, this portion of lower pool 8 has been an important area for migrating waterfowl. During the period 1975 through 1991 there was a substantial decline in aquatic vegetation in this area. There has been a substantial recovery of submersed vegetation and floating-leaved aquatic vegetation. However, emergent aquatic vegetation has not recovered.

During the early 1990's, few migrant waterfowl, including ducks, geese, swans, and coots used the study area. The combination of an increase in the density and distribution of submersed aquatic plants in the study area (beginning in 1996), and an increase in invertebrate numbers in the study area and lower reach of pool 8 (beginning in 1997), has resulted in a dramatic increase in the number of diving ducks using the study area. Use of the area by puddle ducks, Canada geese, tundra swans, and coots is generally limited to the recent habitat projects and their zone of influence. These habitat features are attractive to waterfowl for the following reasons:

a. The area is within the Wisconsin Islands Closed Area of the Refuge. Hunting and trapping are prohibited during the migratory waterfowl hunting season; migratory bird hunting is prohibited at all times. In addition, human disturbance from boat traffic has been limited, generally occurring in proximity to the main channel.

b. Within the past 2-3 years, beds of submersed aquatic vegetation and invertebrate populations have been increasing. A portion of the increase, particularly the vegetation, has been in and around the "zone of influence" associated with the recent habitat projects.

c. The recently completed habitat projects have provided additional loafing sites.

The overall management goal of the Refuge is to manage the Three North area as puddle duck migration habitat. The Refuge also would like to improve habitat conditions for other fish and wildlife uses compatible with the goal of providing puddle duck migration habitat.

GOAL N-1: Increase high quality waterfowl habitat to 470 acres and then maintain.

The Three North area provides habitat for puddle ducks, Canada geese, tundra swans, and coots. Use by puddle ducks formerly covered the entire annual cycle, including habitat used by spring and fall migrants, and for nesting, brood rearing, and molting. With the loss of emergent plants, puddle duck use in the last 10 years has generally been limited to fall migration. Large numbers of Canada geese and tundra swans also continue to use portions of the Three North area.

From a system wide perspective, it is important to increase the amount of habitat available for migrating waterfowl. Although the Three North area does provide important resting habitat for migrating waterfowl, its value could be increased. The goal of restoring 470+ acres of high quality habitat for migratory waterfowl was based on the habitat that existed in the area in 1975. This is the earliest time period for which there is specific quantifiable habitat information

(aquatic vegetation mapping). The conditions that existed in 1975 in terms of habitat diversity and aquatic plant coverage were considered excellent for migratory waterfowl.

OBJECTIVE N-1: Increase and then maintain 470 acres of habitat meeting the following criteria.

Federal and State wildlife biologists identified these habitat criteria as those needed to have high quality waterfowl habitat in the Three North area. The rationale for the criteria is the same as discussed for these same criteria under objective W-1.

A. Provide 100 acres with the physical conditions considered necessary for the growth of emergent aquatic vegetation. These are:

(1) water depths less than 2 feet

(2) protected from dominant wind fetches

(3) current velocities generally less than 0.5 feet per second

B. Provide 300 acres with the physical conditions considered necessary for the growth of submersed aquatic vegetation. These are:

(1) water depths less than 4 feet

(2) protected from dominant wind fetches

C. Restore islands to meet puddle duck habitat needs.

D. Provide 15 acres of sand/mudflats within the study area (areas with water depths less than 0.5 foot at normal summer pool elevations).

E. Provide waterfowl loafing sites (10-20 per acre) scattered throughout the study area.

5.2.2 GOALS AND OBJECTIVES FOR OTHER FISH AND WILDLIFE SPECIES - ENTIRE STUDY AREA

Lower pool 8 has undergone a simplification of habitat types for many aquatic organisms. Impoundment of the Mississippi River in this reach inundated large areas of the river valley leaving higher portions of the floodplain as islands. Over time, wind induced wave action and river currents have caused the erosion of these islands. Wave action has resulted in the resuspension of bottom sediment resulting in the erosion of high areas underwater; and sedimentation in deeper water areas. This has, in combination with the other factors, reduced the habitat availability and quality for a variety of species.

The following goals and objectives were developed to improve habitat availability and quality for a variety of species. Goals and objectives for improving habitat conditions for other fish and wildlife species are for the entire Phase III area and the potential for providing habitat to meet their life requisites exists at several locations within the Phase III area.

GOAL O-1: Create habitat for migratory birds other than waterfowl (Neotropical migrants, marsh and water birds, and shorebirds); increase turtle nesting habitat; restore habitat for mammals (primarily beaver, mink, and muskrats), reptiles, and amphibians; and improve conditions for the reestablishment of roosting habitat for species such as bald eagles and other raptors.

With the loss of islands and associated shallow water and shoreline zones in the Phase III area, there has been a near total loss of habitat suitable for Neotropical migrants, marsh and water birds (grebes, white pelicans, double-crested cormorants, bitterns, herons, egrets, rails, and terns), and shorebirds.

With a loss of islands, there has been a loss of suitable nesting habitat for turtles in the Phase III area. In addition, there has been a near total loss of suitable habitat for aquatic or semi-aquatic mammals, many reptile species, and amphibians.

With a loss of islands in the area, there has been a loss of trees for roosting habitat for species such as bald eagles and other raptors.

No numerical habitat goal for these particular species groups has been established for the Phase III area. For all of these species groups, there are no specific thresholds identifying the amount of habitat required within the river corridor to meet the needs of these species. Any restoration of habitat for these species would benefit their overall population levels.

OBJECTIVE O-1: When planning/designing habitat features for the Phase III area, the following habitat types or conditions should be provided:

a. For Neotropical migrants (grassland and woodland), provide islands seeded to grass and/or planted to trees.

b. For marsh and water birds, provide habitat consisting of an interspersion of submersed, rooted floating aquatics, emergent plants, and open water, in proximity to islands.

c. For shorebirds provide gradual sloping beaches and/or shallow backwater lagoons.

d. For nesting turtles, provide isolated islands having gently sloping beaches with sparse vegetation and a substrate capable of maintaining soil moisture suitable for turtle egg incubation.

e. For aquatic and semi-aquatic mammals, reptiles, and amphibians, provide wetland habitat consisting of an interspersion of submersed, rooted floating aquatics, emergents, and open water in proximity to islands.

f. For raptors, maintain existing mature trees and accelerate succession on new islands to mature trees.

Federal and State wildlife biologists identified these basic habitat conditions as those most limiting in the Phase III area for the various species groups. Their findings were based on a review of the habitat requirements of the wide variety of species that would be expected to use the area. In addition, the biologists identified specific criteria to be used in the design of specific project features that would promote the development of the diverse habitat conditions necessary to benefit the wide variety of species found in the study area.

GOAL O-2: Create and maintain protected lacustrine habitat for backwater fish species.

Habitat conditions in the Phase III area are considered suboptimal during the winter, spawning, and summer growing seasons for a variety of backwater species. Improving overall habitat conditions for backwater species in this area is a high priority goal of the Wisconsin DNR. The emphasis was placed on improving conditions for Centrarchids because these species are a major component of the Upper Mississippi River backwater fisheries and habitat used by this group of species is well documented. Additionally, many other species use the same habitat considered good for Centrarchids.

OBJECTIVE O-2A: Create overwintering habitat for Centrarchids meeting the following criteria:

The lack of overwintering habitat for backwater fish species has been identified by the Wisconsin DNR as a critical habitat problem in the lower portion of lower pool 8. Currently, the most of the Phase III area has no areas that would meet the environmental conditions considered suitable for overwintering habitat. The opportunity exists to provide this critical habitat due to the physical characteristics in some of the area, i.e., deeper water bounded on the upstream side by a zone of shallow water.

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what would be desirable to provide suitable overwintering habitat for backwater fish species. Also considered were the results of monitoring efforts conducted by the Wisconsin DNR in pool 10 (Welke, 1993) and of the biological response monitoring conducted in association with the Finger Lakes project in pool 5 (Barko, et al., 1994).

A. A minimum of three discrete areas.

State and Federal biologists familiar with the Phase III study area believe, based on its size and other factors that a minimum of three overwintering areas should be provided.

B. A minimum size of 60 acres per site.

Based on knowledge of known overwintering sites, State and Federal biologists believe 60 acres is about the minimum size necessary for a high quality overwintering site for Centrarchids and associated species.

C. Dissolved oxygen levels > 5 mg/l.

The State water quality standard for dissolved oxygen is 5 mg/l. While it is known that Centrarchids and associated species can survive over winter at lower dissolved oxygen levels, it is felt that meeting water quality standards is a reasonable criterion.

D. Current velocity < 0.3 cm/sec over 80% of the area.

Centrarchids prefer little or no current velocity during the winter, though they can tolerate some current if water temperatures and dissolved oxygen levels are in acceptable ranges. It is recognized in a riverine system that it is probably not practical to expect to be able to meet this criterion over 100% of an overwintering area.

E. Water temperature as follows:

4° C over 35% of the area
2-4° C over 30% of the area
0-2° C over 35% of the area

The optimum condition would be have water temperature in the entire overwintering area as near 4 degrees C as possible. It is recognized that this does not occur naturally in river backwaters and would be very difficult to accomplish. The criteria shown are considered reasonable both for fish survivability and for what can be practically achieved.

F. Water depths > 4 feet over 40% of the wintering area.

This criterion is based on the observations of State and Federal biologists of water depth conditions in known high quality overwintering areas.

<u>OBJECTIVE O-2B</u>: Enhance and/or create backwater fisheries summer habitat meeting the following criteria:

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what is considered critical to providing suitable summer habitat for Centrarchids in Mississippi River backwaters.

a. Dissolved oxygen levels > 5 mg/l.

Maintaining adequate dissolved oxygen levels is critical for fish survival

b. Aquatic vegetation cover in the range of 25-50%.

Aquatic vegetation is a significant habitat component because it provides food and cover for a wide variety of species. Habitat models indicate that providing aquatic vegetation cover in the range of 25-50 percent would create high quality habitat conditions for the Centrarchid species commonly found in backwater habitats, i.e., largemouth bass, bluegill, and crappie.

<u>OBJECTIVE O-2C</u>: Enhance and/or create spawning, rearing, and juvenile backwater fisheries habitat in three locations, each approximately 5 acres in size and meeting the following criteria:

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what is required to provide suitable spawning, rearing, and juvenile habitat for Centrarchids and other backwater fish species.

a. Dissolved oxygen levels > 5 mg/l

Maintaining adequate dissolved oxygen levels is critical to fish survival.

b. Current velocity < 0.5 cm/sec

Low or nonexistent current velocities are important for spawning of most Centrarchids. In addition, little or no current is important for the survival of most Centrarchids during early life stages.

c. Aquatic vegetation cover of approximately 80%

Relatively dense aquatic vegetation is important for the survival of young fish, primarily as protection from predators. Aquatic vegetation is also important as a substrate for food organisms.

d. Substrates of sand and/or gravel available for spawning

Most Centrarchids are adaptable in their spawning habits, though they do prefer sand and/or gravel substrates. Providing preferred substrates would be expected to enhance spawning success.

GOAL 0-3: Enhance habitat for riverine fish species and mussels.

Prior to impoundment, the Phase III study area had two well-defined channels, Coon Slough (which is now the main navigation channel) and Raft Channel, and 4 smaller channel systems. Following construction of the dam and impoundment of pool 8, portions of some of these channels were still definable by islands, but over time, many of the islands in this area have disappeared. Loss of bathymetric and topographic diversity has affected the habitat quality of the remnant channels that are still evident on bathymetric maps of the area.

The existing secondary and main channel border habitats in the project area are important areas for riverine fish species and mussels. However, in general, these habitats lack diversity in the form of cover, velocity and shelter. Creation of more diverse substrate, bathymetric and cover conditions would enhance the area for riverine fish species and mussels. No numerical habitat goals for riverine fish species and mussels have been established for the Phase III area. There are no specific thresholds identifying the amount of habitat required within the river corridor to meet the needs of these species. Any restoration of habitat would benefit their overall population levels.

<u>OBJECTIVE O-3</u>: Enhance habitat for riverine fish species and mussels meeting the following criteria:

a. Continuous flowing channel (bordered by islands) of at least 2,000 feet.

Submerged flowing channels are still present within the study area. However, the loss of islands that bordered these channels has substantially reduced their habitat value. The presence of land bordering flowing channels increases the habitat value of the channel because of the variety of habitat niches provided in the shallow transition zones adjacent to the islands. In addition, there is usually structure in the form of fallen trees, snags, and other woody debris in areas adjacent to islands that provide important food and cover habitat for fish.

b. Areas of scour, eddies, and varying velocities.

Scour holes, eddies, and a variety of current velocities provide diverse habitat conditions for food organisms and the fish themselves.

c. Variety of substrates (sand, silt, clay, gravel, cobble, etc.).

A variety of substrates provide diverse habitat conditions for food organisms.

d. Connectivity with other channels.

Connectivity with other flowing channels provides avenues of passage for fish to use other habitats, which can be important depending on seasonal and river stage conditions.

5.2.3 THREE EAST AREA

The Three East study area consists of about 700 acres. In 1975, almost 335 acres of submersed and emergent vegetation were present in this study area. In 1998, less than 75 acres remained. The small complex of islands was also reduced from the about 10 acres in 1939 to less than 1 acre in 1994. Although the quantity of vegetation and islands has been reduced, the study area still provides habitat used by ducks (puddle and diving), coots, Canada geese, and tundra swans.

The study area is open to hunting in accordance with all federal, state, county, and local ordinances. The goals and objectives described earlier for waterbirds, other wildlife, and fish also apply in general to the Three East area. However, the Three East area contains a unique habitat feature warranting special consideration, the Coon Creek delta.

GOAL E-1: Maintain the Coon Creek delta as a geomorphic feature providing a variety of habitat types.

The Coon Creek delta is a natural geomorphic feature located at the outlet of Coon Creek to the Mississippi River immediately below Stoddard, Wisconsin. This delta provides a highly diverse mix of bottomland forest, shrub wetland, and emergent marsh wetlands. This area is especially important because of the lack of this type of habitat in lower pool 8 below the Brownsville-Stoddard area.

OBJECTIVE E-1: As a minimum, maintain the Coon Creek delta at its current size, and if possible, create conditions that would stimulate the growth of the delta.

As noted above, the Coon Creek delta is a unique and valuable resource in lower pool 8. As a minimum, efforts need to be made to insure the delta does not decline in size, which would reduce its habitat value. In addition, if feasible measures can be identified to stimulate the natural growth of this delta, they should be pursued.

5.2.4 THREE NORTHWEST AREA

The Three Northwest area is of an entirely different character than the other study sub-areas. The Three Northwest area consists of a shallow bay (Schnick's Bay) bounded on the west by the Minnesota mainland, on the north by an access road to Wildcat Park, and on the east by emergent and shrub wetland that grades into the higher ground occupied by Wildcat Park. Because this area provides markedly different habitat conditions than what is found in the other study sub-areas, habitat goals and objectives specific to this area were developed.

GOAL NW-1: Maintain Schnick's Bay as protected shallow aquatic habitat.

Protected shallow aquatic habitat such as Schnick's Bay is a declining habitat type in lower pool 8. The loss of islands has been a significant factor in this decline. In some areas, sedimentation and subsequent succession to marsh and willow shrub wetlands is also resulting in declining acreage of this habitat type.

Schnick's Bay has physical characteristics that enhance its habitat value. It is protected on three sides from river currents, providing protected spawning, nursery, rearing, and feeding habitat that can be used by a variety of fish species.

OBJECTIVE NW-1: Reduce sedimentation in Schnick's Bay from Wildcat Creek

In the early 1970's, Wildcat Creek was rerouted to discharge into Schnick's Bay. Wildcat Creek carries a sediment load that is being deposited in Schnick's Bay. An analysis conducted in 1991 indicated that for the period 1975 to 1990, an average of .56 acres per year of the bay was being converted to "delta" (to emergent marsh and eventually, to wood wetland). The shallow aquatic portion of Schnick's Bay in 1994 covered about 75 acres. Assuming a crude conversion rate of 0.56 acres/year into the future, shallow aquatic habitat in Schnick's Bay will be reduced to about 60 acres in 2025 and 45 acres in 2050. If sediment inputs from Wildcat Creek were eliminated, the sedimentation rate in Schnick's Bay would be significantly reduced and it is likely that the amount of shallow aquatic habitat in Schnick's Bay could be maintained in the 60-70 acre range through 2050.

5.3 DESIGN CONSIDERATIONS

River managers and engineers provided a number of ideas for consideration in the planning and design of project features.

5.3.1 NATURAL PROCESSES

Restoration of natural river processes disrupted by creation of the locks and dams is an overall goal for habitat restoration on the Upper Mississippi River. It is believed that restoration of these processes will generally result in improved habitat conditions for a wide variety of fish and wildlife. While restoration of natural river processes has merit from a systemic perspective, it is difficult to define this goal on a site-specific basis in a quantifiable manner. Also, the primary source of disruption of river processes, the navigation system with regulated pools, is part of the equation. This is especially so in the lower portion of pool 8 where impoundment has its greatest effect. Planning for habitat restoration measures must take into account that there is a navigation project in place, the operation of which is going to effect what can be accomplished with various restoration measures. As long as the navigation project is in place there will be limitations on the restoration of natural river processes. Therefore, the approach selected is to view restoration of natural river processes as a long-term systemic goal. Restoration of these processes was incorporated into the development of the habitat restoration project where possible.

5.3.2 ISLANDS

a. Islands should be located in locations and configurations comparable to the natural islands that previously existed in the study area.

b. A mix of high and low elevation islands is preferred.

c. Use of rock should be minimized to allow for more aesthetic and natural looking conditions. Shorelines deemed critical to maintaining the integrity of an island or an overall island complex should be protected using bioengineering techniques, if possible. Non-critical shorelines should be vegetated with grass or left as sand.

d. Slopes of 10:1 extending from the toe of islands outward for 30' or more are desirable. This could be accomplished either through direct construction or providing sufficient material in an island berm for beach formation.

e. Do not plant willows on every portion of an island. Create dynamic shorelines with a transition zone (i.e., an above water beach) to provide more habitat suitable for shorebirds.

f. Locate islands to induce the maintenance and/or formation of channels to maintain/improve bathymetric diversity.

g. Islands should be located in shallow water to reduce costs and increase stability.

h. Existing island remnants should be incorporated into restored islands for aesthetics.

i. Position so that shoreline stabilization is in shallow water.

j. Minimize secondary effects and costs by minimizing access dredging.

k. Position islands to have the greatest effect on hydraulic and sediment regimes

5.3.3 SAND/MUDFLATS

a. Sand/mudflats located in proximity to islands is the optimum condition.

b. It is important to maintain and enhance microtopography within expanses of sand and mudflats.

ALTERNATIVES

6.1 PLANNING OPPORTUNITIES

In many locations within the study area remnants of eroded islands still exist just beneath the surface of the water. These underwater remnants provide a solid base upon which to reconstruct islands. In addition, constructing new islands on top of these remnants reduces material requirements, thereby reducing costs.

The Coon Creek delta (Three East area) and Schnick's Bay (Three Northwest area) contain relatively high quality habitat for a variety of species. The opportunity exists to maintain these high quality habitats before they become degraded.

6.2 PLANNING CONSTRAINTS

6.2.1 INSTITUTIONAL

The Pool 8 Islands Phase III project lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge. Refuge management goals and objectives must be complied with, as well as the laws and regulations governing Refuge management. The Three West, Three North and Three Central areas are within the portion of the Refuge closed to migratory bird hunting at all times and to hunting and trapping during the duck hunting season. Maintaining minimal human disturbance is considered by the Refuge as significant to meeting the management objectives provided by the closed areas. Alternatives or project features that would substantially increasing human activity in the closed areas during the fall migration were not pursued.

The cost of human disturbance in the Wisconsin Islands Closed Area is more of an issue today than when the closed area was created in 1957 because of the loss of most islands and emergent marsh over the much of the area. Puddle ducks, tundra swans, and Canada geese using the closed area have limited habitat available to them. When disturbance does occur, it can result in birds leaving the closed area. Conversely, because of the abundant habitat available in the 1950's, when disturbance occurred, ducks could move to alternative sites within the closed area.

Flight requires considerably more energy than any other activity, except egg laying. Therefore, migratory waterfowl generally attempt to minimize time spent in flight and maximize time for feeding. In response to repeated disturbance, waterfowl may change their food habitats, feed only at night, lose weight, or abandon an area.

6.2.2 ENGINEERING

Because of shallow water depths, access for construction equipment would be difficult in many areas without dredging. Construction access was considered in the planning and design of habitat restoration features.

The amount of sediment being transported past the existing seed islands along the main channel should not be changed.

6.2.3 ENVIRONMENTAL

Potential sources of borrow material such as Raft Channel and the main channel may support healthy mussel populations. The selection of borrow areas needed to avoid affecting productive mussel beds.

6.2.4 CULTURAL

No specific cultural resource constraints have been identified for the study area. Compliance with cultural resource laws and regulations is required.

6.2.5 SOCIOECONOMIC/RECREATIONAL

No specific socioeconomic constraints were identified. There is no appreciable development located within or adjacent to the study area. The study area is not heavily used by recreational boaters due to shallow waters, a general lack of beach sites, and a relatively poor sport fishery.

Modifications considered for the Three Northwest area needed to take into account potential effects on Wildcat Park and its users.

6.3 ALTERNATIVES IDENTIFIED

6.3.1 NO ACTION

The no action alternative is defined as no implementation of a project to modify habitat conditions in the study area.

6.3.2 THREE WEST, THREE CENTRAL, AND THREE NORTH AREAS

Island restoration was the primary habitat restoration feature evaluated for the Three West, Three Central, and Three North areas. Restoration of islands protects shallow areas from wind and wave action. This in turn protects existing aquatic vegetation beds and improves conditions for the growth of aquatic vegetation in other shallow areas.

Islands provide terrestrial habitat, and their restoration increases habitat diversity and provides habitat niches that have been lost through the erosion of islands in this area. Islands can also be designed in a manner to channel flows to maintain bathymetric diversity.

6.3.3 THREE EAST AREA

Measures were evaluated that would reduce the exposure of the Coon Creek delta to the erosive forces of southerly winds. Breakwater structures or islands were possible options. In addition, measures to stimulate increased sediment deposition to encourage the growth of the delta were considered.

6.3.4 THREE NORTHWEST AREA

6.3.4.1 Dredging

The Three Northwest area is comprised primarily of a shallow backwater called Schnick's Bay. Schnick's Bay is filling due to sediments being deposited by Wildcat Creek. Portions of this area were dredged in 1992 to obtain topsoil for the Phase I islands. Since that time, portions of the dredged area have filled back in. Dredging in Schnick's Bay was evaluated as a source of material for islands that may be constructed in other study areas.

6.3.4.2 Wildcat Creek Rediversion

Wildcat Creek was diverted in 1972 to discharge into Schnick's Bay. It originally flowed north of Wildcat Park directly to the main channel. Diversion of the creek back to its original channel was considered, along with a diversion along its existing route.

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

Each study area was treated separately for the development and evaluation of alternatives. Synergistic and cumulative effects were considered in the development and evaluation of alternatives for each study area.

The St. Paul District has completed island restoration projects in pool 5 (Weaver Bottoms-1986), pool 7 (Lake Onalaska-1989), pool 8 (Pool 8 Islands Phase I-1993 and Phase II -1999), and pool 5A (Polander Lake-2000). The lessons learned from the construction of these projects and the results of monitoring of physical and biological responses were applied to the development of alternative island restoration plans for the Phase III project area. How the lessons learned were applied in the development of the island designs are discussed in more detail in the Hydraulics Appendix (attachment 5). The monitoring of past projects, especially the Lake Onalaska, Pool 8 Islands Phase I, and Pool 8 Islands Phase II projects, has shown that if the proper physical conditions are provided, such as shallow water (< 4') protected from wind and currents, aquatic plants and the fish and wildlife that use them will respond.

7.1 THREE WEST AREA

7.1.1 ISLAND ALTERNATIVES

The U.S. Fish and Wildlife Service prepare an initial island concept plan for the Three West area using the islands present in 1939 as a guide. The District took the Service plan and developed the preliminary island restoration plan shown on plate 12. The plan shown on plate 12 was designed to maximize meeting project objectives; to incorporate lessons learned from previous island restoration projects; and to take advantage of existing conditions to limit costs and minimize construction difficulties. For example, all of the islands were located on top of old island remnants or other shallow areas to minimize the amount of material needed to construct an island and the amount of rock required for stabilization. Islands were located so that at least some portion was adjacent or close to deep water for access by construction equipment.

The plan shown on plate 12 was used as the basis for defining alternatives and to serve as the basis for incremental analysis. With six islands being evaluated for the Three West area, a large number of alternatives could be developed when considering all of the possible combinations. A balance was struck as to the level of detail necessary to make reasonable decisions without making the process so complex as to become unmanageable.

The first task was to identify the minimum plan that would achieve some measure of the habitat objectives such that it would warrant consideration as a stand-alone project. The construction/restoration of Islands W1 and W2 was determined to be the base or minimum plan. Islands W3 through W6 in any combination would likely not be pursued

if Islands W1 and W2 were not constructed. Islands W5 and W6 were considered as a single increment for purposes of project planning. Once the base plan was identified, the other alternatives considered were the various possible island combinations. They were:

Plan West A (W-A)	Islands 1 and 2
Plan W-B	Islands 1, 2, and 3
Plan W-C	Islands 1, 2, and 4
Plan W-D	Islands 1, 2, and 5/6
Plan W-E	Islands 1, 2, 3, and 4
Plan W-F	Islands 1, 2, 3, and 5/6
Plan W-G	Islands 1, 2, 4, and 5/6
Plan W-H	Islands 1, 2, 3, 4, and 5/6

Island designs were developed to the depth of detail necessary to obtain reasonable material quantity and cost estimates. This included development of typical cross-sections, shoreline stabilization designs, planting plans, and special features such as mudflats.

During the later stages of planning, an informal value engineering process was used involving the District planning team and the resource management agencies to identify areas where the design of the Three West islands could be modified to reduce costs. Changes made to the Three West islands included narrowing the top width of Islands W1, W2, W4, and W5; and removing a rock core from Island W2 included in the original design as an added precautionary measure should the overflow section of this island fail. The savings from these design modifications were estimated to be approximately $465,000.

7.1.2 ALTERNATIVES EVALUATION

7.1.2.1 Costs

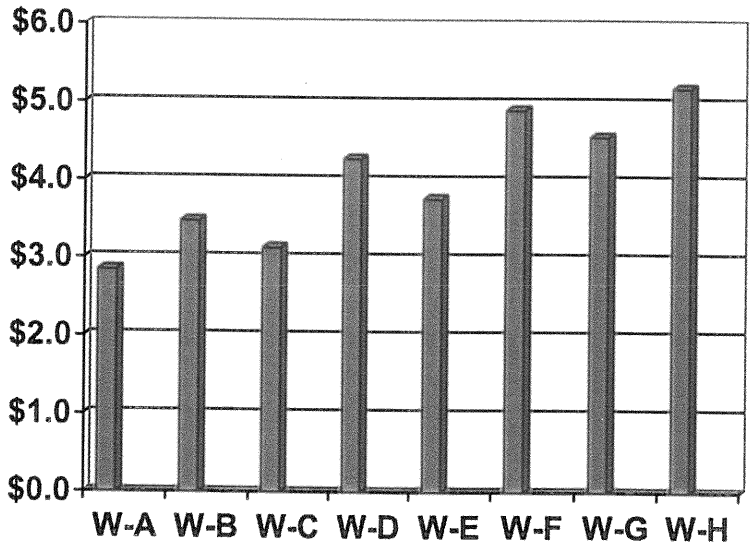
Table 7-1.1 and figure 7-1.1 summarize the estimated costs of the alternative plans evaluated for the Three West area. The costs are rounded to the nearest $5,000. Average annual costs are based on the current interest rate of 6 1/8% and are rounded to the nearest $1,000. As would be expected, the alternatives involving construction of a larger number of islands would have greater costs.

Table 7-1.1
Summary of Estimated Costs for the Three West Alternatives

	Construction	PED	S&A	Total	Ave Annual
Plan W-A	$2,630,000	$ 95,000	$120,000	$2,845,000	$184,000
Plan W-B	$3,205,000	$120,000	$150,000	$3,475,000	$224,000
Plan W-C	$2,890,000	$105,000	$135,000	$3,130,000	$202,000
Plan W-D	$3,945,000	$145,000	$180,000	$4,270,000	$276,000
Plan W-E	$3,470,000	$130,000	$160,000	$3,760,000	$243,000
Plan W-F	$4,520,000	$170,000	$210,000	$4,900,000	$316,000
Plan W-G	$4,210,000	$155,000	$195,000	$4,560,000	$294,000
Plan W-H	$4,785,000	$175,000	$225,000	$5,185,000	$334,000

PED = planning, engineering, and design
S&A = construction contract supervision and administration

Figure 7-1.1
Cost of the Three West Area Alternatives ($ millions)



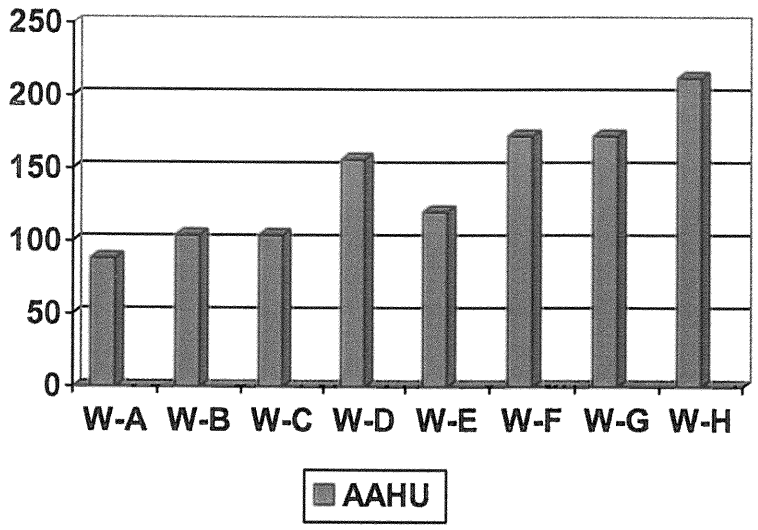
7.1.2.2 Quantifiable Habitat Benefits

The potential habitat benefits of the various alternatives were quantified using habitat evaluation procedures (see attachment 4 – Habitat Evaluation Appendix). The results are summarized in table 7-1.2 and figure 7-1.2.

Table 7-1.2
Summary of Quantified Habitat Benefits for the Three West Area

	AAHU	AAHU Gain
Future without Condition (no action alternative)	126	-
Alternative W-A	214	88
Alternative W-B	230	104
Alternative W-C	230	104
Alternative W-D	282	156
Alternative W-E	246	120
Alternative W-F	298	172
Alternative W-G	298	172
Alternative W-H	338	212

Figure 7-1.2
Three West AAHU Gains by Alternative



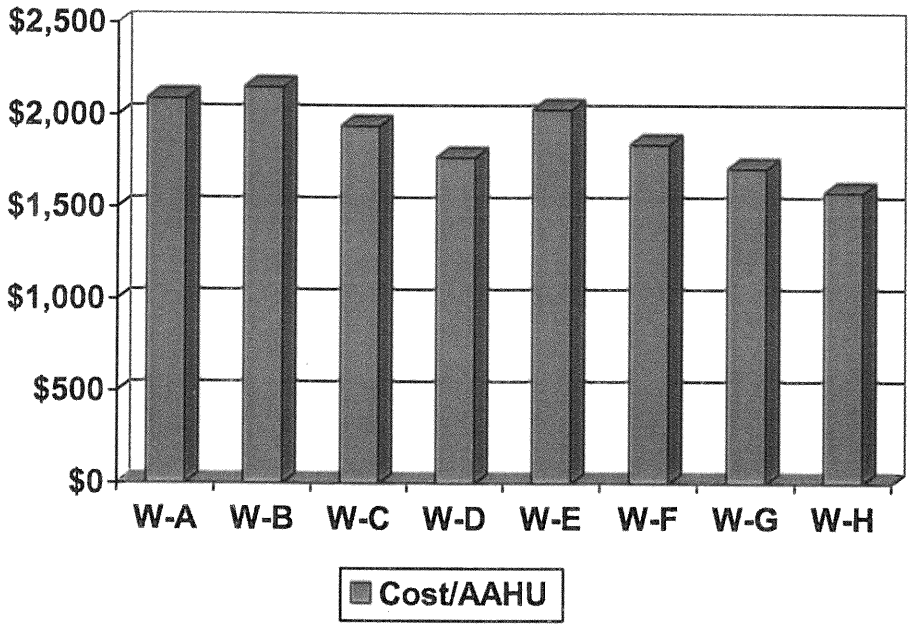
7.1.2.3 Cost/Benefit Evaluation

An analysis of costs versus quantifiable habitat benefits was conducted to identify the most cost-effective alternative. Table 7-1.3 and figure 7-1.3 show a comparison of the alternatives as total plans. The cost/AAHU is rounded to the nearest $10.

Table 7-1.3
Comparison of Costs/AAHU for the Three West Alternatives

Plan	Average Annual Cost	AAHU Gain	Cost/ AAHU
Alternative W-A	$ 184,000	88	$ 2,090
Alternative W-B	$ 224,000	104	$ 2,150
Alternative W-C	$ 202,000	104	$ 1,940
Alternative W-D	$ 276,000	156	$ 1,770
Alternative W-E	$ 243,000	120	$ 2,030
Alternative W-F	$ 316,000	172	$ 1,840
Alternative W-G	$ 294,000	172	$ 1,710
Alternative W-H	$ 334,000	212	$ 1,580

Figure 7-1.3
Cost per AAHU – Three West Area



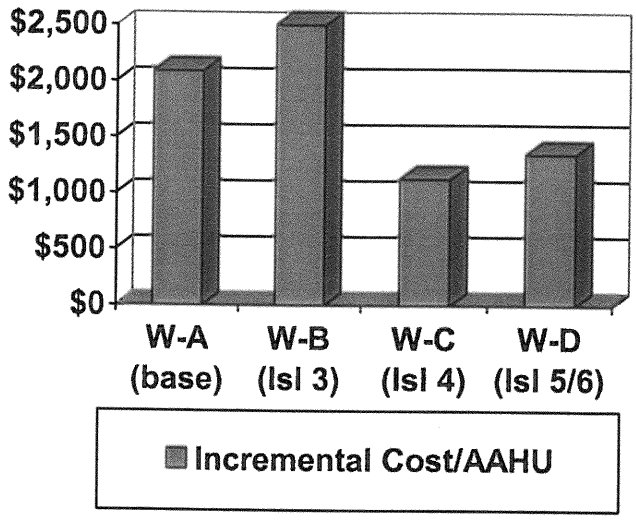
Based on the analysis, alternative W-H is the most cost effective overall plan. If the quantified habitat benefits represented all of the potential habitat benefits associated with a particular alternative, then alternatives W-B and W-F would be considered economically inefficient alternatives, i.e., another alternative provides the same benefits at a lesser cost (in this instance alternatives W-C and W-G, respectively). As such, these alternatives could have been eliminated from further consideration. However, for continuity purposes, they were carried through the remainder of the evaluation.

An incremental analysis of the alternatives was conducted. Alternative W-A (construction of Islands W1 and W2) is considered the base plan. Table 7-1.4 and figure 7-1.4 summarize the initial incremental analysis whereby Islands W3 (alt. W-B), W4 (alt. W-C) and W5/W6 (alt. W-D) are added to the base plan.

Table 7-1.4
Incremental Analysis of Three Additions to the Base Plan W-A

Increment	Incremental Cost	Incremental Average Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. W-A	$2,845,000	$184,000	88	-	$2,090
Alt. W-B	$ 630,000	$ 40,000	104	16	$2,500
Alt. W-C	$ 285,000	$ 18,000	104	16	$1,130
Alt. W-D	$1,425,000	$ 92,000	156	68	$1,350

Figure 7-1.4
Incremental Analysis of Three Additions to the Base Plan W-A



The addition of Island W4 (alt. W-C) would be the most cost effective increment to the base plan at a cost of about $1,130/AAHU. The addition of Island W3 (alt. W-B) would be the least cost effect increment. Since alternative W-C is more cost effective than alternative W-A, both as a total plan and incrementally, it becomes the preferred plan over alternative W-A.

Table 7-1.5 and figure 7-1.5 show the incremental analysis with alternative W-C as the preferred or base plan, and Islands W3 (alt. W-E) or Islands W5/W6 (alt. W-G) are the added increments. This analysis shows that the next most cost effective increment to construct would be Islands W5/W6 (alt. W-G). This analysis shows that alternative W-G is more cost effective than alternative W-C, both as a total plan and incrementally, and thus it becomes the new preferred plan.

Table 7-1.5
Incremental Analysis of Two Additions to the Base Plan W-C

Increment	Incremental Cost	Incremental Average Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. W-C	$3,310,000	$202,000	104	-	$1,940
Alt. W-E	$ 630,000	$ 41,000	120	16	$2,560
Alt. W-G	$1,430,000	$ 92,000	172	68	$1,350

Figure 7-1.5
Incremental Analysis of Two Additions to the Base Plan of W-C

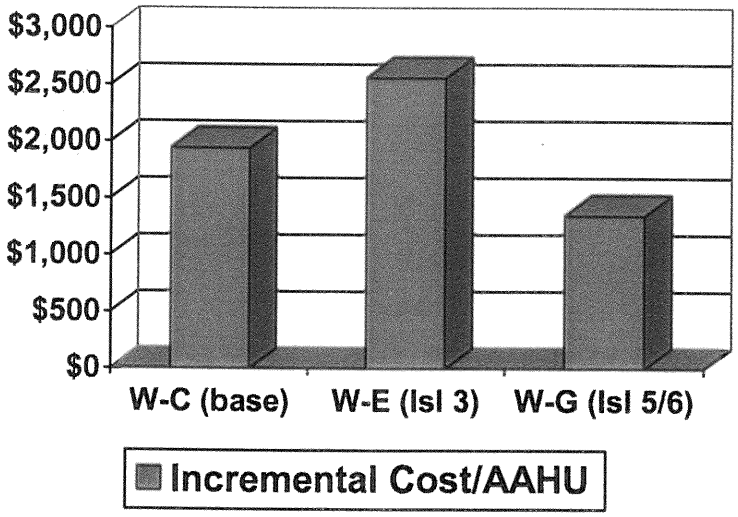


Table 7-1.6 shows the last step in the incremental analysis with alternative W-G considered the base plan and Island W3 (alt. W-H) is the final increment. The results indicate that the addition of Island W3 would be a cost effective increment.

Table 7-1.6
Incremental Analysis of Adding Island W3 to the Base Plan W-G

Increment	Incremental Cost	Incremental Average Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. W-G	$4,560,000	$294,000	172	-	$1,710
Alt. W-H	$ 625,000	$ 40,000	212	40	$1,000

7.1.2.4 Unquantified Habitat Benefits

Numerous other fish and wildlife benefits, not quantified by the habitat models, would accrue with project construction. Island construction would create conditions allowing for the re-establishment of extensive and diverse aquatic vegetation beds and restore bathymetric and flow diversity to the area. These conditions would result in the creation of microhabitats conducive to increases in the diversity and population levels of aquatic invertebrates including: aquatic insects, amphipods, gastropods, and mussels. Likewise, habitat conditions for a wide variety of fish species would be expected to improve as food and cover resources become more widespread and diverse. The islands and associated vegetation would provide habitat for a wide variety of wildlife species including: roosting, nesting and migration habitat for many species of birds, including neotropical migrants, and nesting habitat for turtles. The islands and associated shoreline and shallow water zones would provide marsh habitat for marsh and water birds such as grebes, bitterns, herons, egrets, terns and shorebirds and improved habitat conditions for many species of reptiles and amphibians.

The islands in the Three West area were located to maintain and/or increase current velocities in the two channels flowing through the area for the purpose of maintaining and improving habitat conditions for lotic fish species and mussels. These types of channels have been in decline in the inundated portions of lower pool 8.

Construction of the features in the Three West, Central and North areas would also have additional waterfowl habitat benefits not quantified in the HEP analysis. Construction of all the features in the in the North, Central and West areas would result in the restoration of an integrated island complex in a 2,800-acre portion of lower pool 8, offering an area diverse in vegetation types and microhabitats. The synergistic effects of these features when evaluated as a single project were not quantified. The restoration of this major migration staging area in lower pool 8 would result in an area that provides the diversity in vegetation, preferred organisms and protection from severe weather and

disturbance to ensure that waterfowl depart for wintering grounds in good condition. This would be a substantial contribution to meeting the goals of the North American Waterfowl Management Plan.

7.1.3 PLAN SELECTION

The selected plan for the Three West area was alternative W-H, construction of all six islands considered. The selection was based on the following:

a) Alternative W-H was the most cost-effective plan at a cost of about $1,580/AAHU.

b) The cost/AAHU of this plan is within the range normally considered justified within the St. Paul District HREP program for the types of habitat benefits provided.

c) All plan increments are incrementally justified.

d) There are substantial additional unquantifiable habitat benefits associated with this plan.

e) Alternative W-H was supported by Federal and State resource agencies as the best plan for the Three West area.

7.2 THREE NORTH AREA

7.2.1 ISLAND ALTERNATIVES

Following the same process as discussed earlier for the Three West area, a preliminary island restoration plan (plate 12) was developed for the Three North area. During the planning process, the configuration of Island N8 was changed to as shown on plate 21.

The preliminary plan was used as the basis for defining alternatives and to serve as the basis for incremental analysis. Islands N1 and N2 were considered a single planning increment, i.e., construction of one without the other would serve no appreciable habitat purpose. Five alternative plans were identified for evaluation as follows.

Plan North A (N-A)	Islands 1 and 2
Plan N-B	Islands 7 and 8
Plan N-C	Islands 1, 2, and 7
Plan N-D	Islands 1, 2, and 8
Plan N-E	Islands 1, 2, 7, and 8

Seed islands N3, N4, N5, and N6 were evaluated independently.

Island designs were developed to the depth of detail necessary to obtain reasonable material quantity and cost estimates. This included development of typical cross-sections, shoreline stabilization designs, planting plans, and any special features such as mudflats.

During the later stages of planning, an informal value engineering process was used involving the District planning team and the resource management agencies to identify areas where the design of the Three North islands could be modified to reduce costs. Changes made to the Three North area islands included narrowing the top width of Islands N1, N2, and N5; reducing the top elevation of Island N7 by 2 feet; and elimination of sand berms along the rock sill portions of Islands N1 and N8. The sand berms had been in the original design to improve the aesthetic appearance of the rock sills. The savings from these design modifications were estimated to be approximately $365,000.

7.2.2 ALTERNATIVES EVALUATION

7.2.2.1 Costs

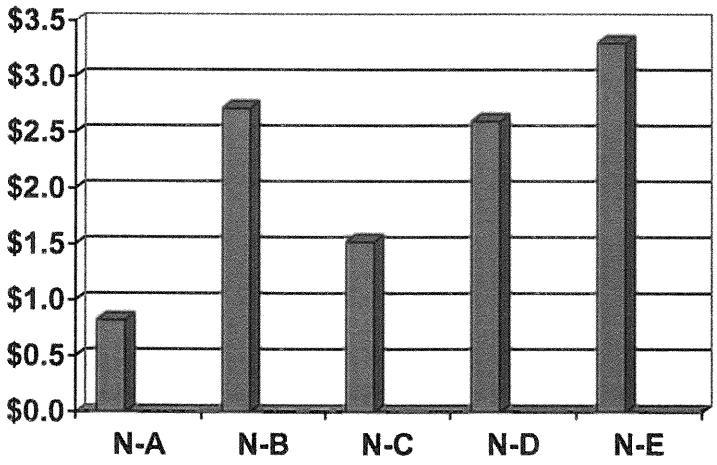
Table 7-2.1 and figure 7-2.1 summarize the estimated costs of the alternative plans evaluated for the Three North area. The costs are rounded to the nearest $5,000. Average annual costs are based on the current discount rate of 6 1/8% and are rounded to the nearest $1,000.

Table 7-2.1
Summary of Estimated Costs for the Three North Alternatives

	Construction	PED	S&I	Total	Ave Annual
Plan N-A	$ 760,000	$ 25,000	$ 35,000	$ 820,000	$ 53,000
Plan N-B	$2,510,000	$ 90,000	$115,000	$2,715,000	$175,000
Plan N-C	$1,405,000	$ 50,000	$ 65,000	$1,520,000	$ 98,000
Plan N-D	$2,375,000	$ 85,000	$105,000	$2,565,000	$166,000
Plan N-E	$3,025,000	$110,000	$135,000	$3,270,000	$211,000

PED = planning, engineering, and design
S&A = construction contract supervision and administration

Figure 7.2-1
Cost of the Three North Area Alternatives ($ millions)



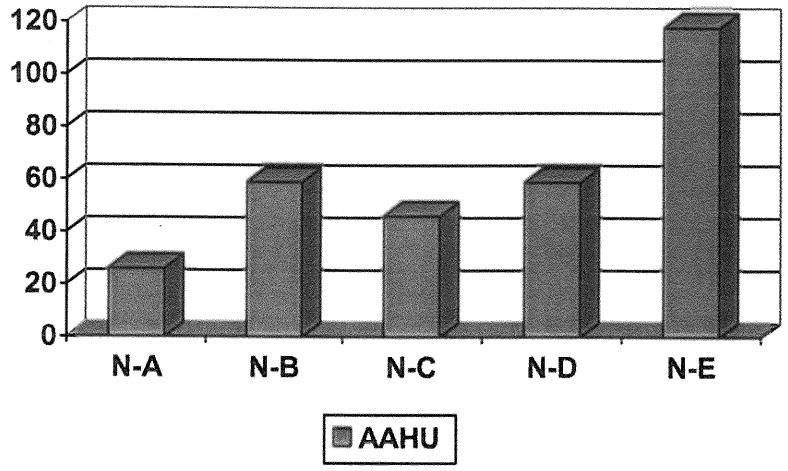
7.2.2.2 Quantifiable Habitat Benefits

The potential habitat benefits of the various alternatives were quantified using habitat evaluation procedures (see attachment 4 – Habitat Evaluation Appendix). The results are summarized in table 7-2.2 and figure 7.2-2.

Table 7-2.2
Summary of Quantified Habitat Benefits for the Three North Area

	AAHU	AAHU Gain
Future without Condition (no action alternative)	294	-
Alternative N-A	320	26
Alternative N-B	353	59
Alternative N-C	340	46
Alternative N-D	353	59
Alternative N-E	412	118

Figure 7-2.2
Three North AAHU Gains by Alternative



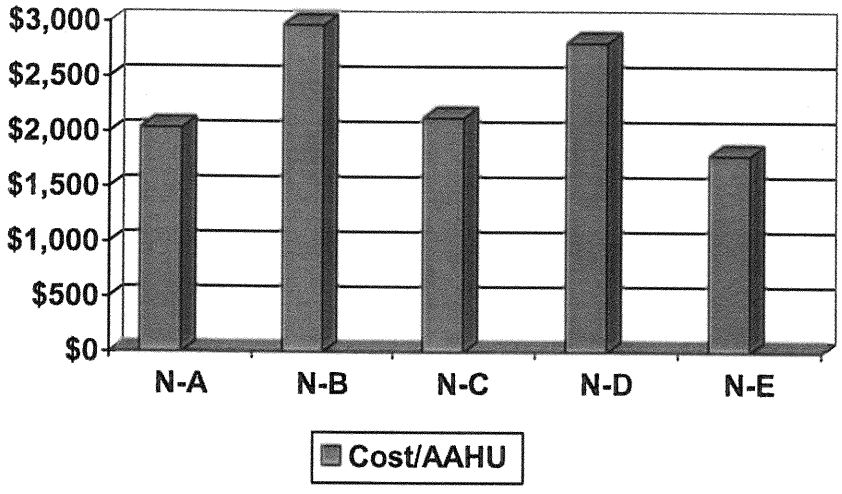
7.2.2.3 Cost/Benefit Evaluation

An analysis of costs versus quantifiable habitat benefits was conducted to identify the most cost-effective alternative. Table 7-2.3 and figure 7-2.3 show a comparison of the alternatives as total plans. The cost/AAHU is rounded to the nearest $10. Alternative N-E is the most cost effective plan.

Table 7-2.3
Comparison of Costs/AAHU for the Three North Alternatives

Plan	Average Annual Cost	AAHU Gain	Cost/ AAHU
Alternative N-A	$ 53,000	26	$ 2,040
Alternative N-B	$ 175,000	59	$ 2,970
Alternative N-C	$ 98,000	46	$ 2,130
Alternative N-D	$ 166,000	59	$ 2,810
Alternative N-E	$ 211,000	118	$ 1,790

Figure 7-2.3
Cost per AAHU – Three North Area

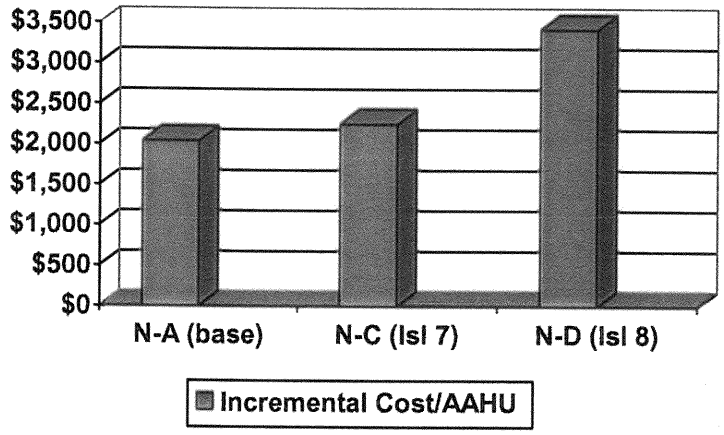


An incremental analysis of the alternatives was also conducted. Alternative N-A (construction of Islands N1 and N2) would be more cost effective than construction of alternative N-B (Islands N7 and N8). Therefore, alternative N-A was considered the base plan with the additions of Islands N7and N8 (alts. N-C and N-D) as the added increments. Table 7-2.4 and figure 7-2.4 summarize the first step in the incremental analysis.

Table 7-2.4
Incremental Analysis of Adding Islands N7 (Alt. N-C) or N8 (Alt. N-D) to the Base Plan N-A (Islands N1 and N2)

Increment	Incremental Cost	Incremental Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. N-A	$ 820,000	$ 53,000	26	-	$2,040
Alt. N-C	$ 700,000	$ 45,000	46	20	$2,250
Alt. N-D	$1,745,000	$113,000	59	33	$3,420

Figure 7-2.4
Incremental Analysis of Adding Islands N7 (Alt. N-C) or N8 (Alt. N-D) to the Base Plan N-A (Islands N1 and N2)



The analysis indicates the addition of Island 7 would be a more cost effective increment than Island N8. The incremental cost/AAHU of adding Island 7 is higher than the cost/AAHU of the base plan ($2,250 vs. 2,040). However, it is still within the range of costs considered justified within the St. Paul District HREP program for the types of habitat benefits provided.

Table 7-2.5 shows the incremental analysis whereby Island N8 would be added to Islands N1, N2, and N7. The analysis shows that it would be cost effective to add Island N8 as an added increment to Alternative N-C.

Table 7-2.5
Incremental Analysis of Adding Island N8 (Alt. N-E)
to Plan N-C (Islands N1, N2, and N7)

Increment	Incremental Cost	Incremental Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. N-C	$1,520,000	$ 98,000	46	-	$2,130
Alt. N-E	$ 705,000	$113,000	118	72	$1,570

7.2.2.4 Unquantified Habitat Benefits

Numerous other fish and wildlife benefits, not quantified by the habitat models, would accrue with project construction. Island construction would create conditions allowing for the re-establishment of extensive and diverse aquatic vegetation beds and restore bathymetric and flow diversity to the area. These conditions would result in the creation of microhabitats conducive to increases in the diversity and population levels of aquatic invertebrates including: aquatic insects, amphipods, gastropods, and mussels. Likewise, habitat conditions for a wide variety of fish species would be expected to improve as food and cover resources become more widespread and diverse. The islands and associated vegetation would provide habitat for a wide variety of wildlife species including: roosting, nesting and migration habitat for many species of birds, including neotropical migrants, and nesting habitat for turtles. The islands and associated shoreline and shallow water zones would provide marsh habitat for marsh and water birds such as grebes, bitterns, herons, egrets, terns and shorebirds and improved habitat conditions for many species of reptiles and amphibians.

Additional unquantified benefits for waterfowl migration habitat were presented in the discussion for the Three West area.

Overwintering habitat for fish, primarily Centrarchids, would be created within the protected area of Island N8. These benefits were not quantified but are considered important to meeting fishery project goals and objectives for the Phase III study area. Approximately 60 acres of overwintering habitat would be created by Island N8.

The islands in the Three North area would provide additional wind/wave action protection for portions of the area protected by the Pool 8 Islands Phase I project. The Phase I project has stabilized the vegetation beds in this area and Islands N7 and N8 will complement the Phase I project.

7.2.2.5 Seed Islands

Costs

Table 7-2.6 summarizes the costs of the alternative plans evaluated for the Three North seed islands. The costs are rounded to the nearest $5,000. Average annual costs are based on the current discount rate of 6 1/8% and are rounded to the nearest $1,000. These cost are strictly construction costs. It was assumed that these islands would not be constructed as stand alone features and that their incremental PED and S&A cost as part of a larger project would be negligible.

Table 7-2.6
Summary of Costs for the Three North Seed Islands

Island	Construction	Ave Annual
Island N3	$ 30,000	$1,940
Island N4	$ 25,000	$1,610
Island N5	$ 50,000	$3,230
Island N6	$ 45,000	$2,900
Total	$150,000	$9,680

Habitat Benefits

The purpose of the seed islands is to encourage the restoration of four islands in Raft Channel through natural processes. These islands have eroded away such that there are only small remnants remaining. It is believed there is sufficient sand transport in this area such that if a hard point was provided at the head of the remnant islands, accretion of sediment and island formation will take place.

The construction of Islands N3-N6 would provide an estimated 6 AAHU of habitat benefits at an approximate cost of $1,610/AAHU. This cost per AAHU compares favorably with the costs/AAHU for the larger islands considered for the Three North area.

7.2.3 PLAN SELECTION

The selected plan for the Three North area is alternative N-E, construction of four islands, and the construction of four seed islands. This selection was based on the following:

a) Alternative N-E was the most cost effective plan at a cost of about $1,790/AAHU.

b) The cost/AAHU of this plan is within the range normally considered justified within the St. Paul District HREP program for the types of benefits provided.

c) All plan increments are incrementally justified.

d) There are substantial additional unquantifiable habitat benefits associated with this plan.

e) Alternative N-E is supported by Federal and State resource agencies as the best plan for the Three North area.

f) The expected benefits of the seed islands justify their estimated costs.

7.3 THREE CENTRAL AREA

7.3.1 ISLAND ALTERNATIVES

A preliminary island restoration plan (plate 12) was developed for the Three Central area. The preliminary plan was used as the basis for defining alternatives to be evaluated and to serve as the basis for incremental analysis. Because of the number of islands involved, the number of combinations that could be used to develop alternative would be substantial enough to be excessively cumbersome. Therefore, the Three Central area islands were broken down into geographic groups for evaluation as follows.

Group 1	Plan Central A (C-A)	Island 1
	Plan C-B	Island 6
	Plan C-C	Islands 1 and 6
Group 2	Plan C-D	Islands 2 and 3
	Plan C-E	Islands 4 and 5
	Plan C-F	Islands 2, 3, 4, and 5
Group 3	Plan C-G	Island 8
	Plan C-H	Islands 7 and 8

Island designs were developed to the depth of detail necessary to obtain reasonable material quantity and cost estimates. This included development of typical cross-sections, shoreline stabilization designs, planting plans, and special features such as mudflats.

During the later stages of planning, an informal value engineering process was used involving the District planning team and the resource management agencies to identify areas where the design of the Three Central islands could be modified to reduce costs. Changes made to the Three Central area islands included narrowing the top width of portions of all of the islands; reducing the length of Island C5 by 610 feet and the length of Island C8 by 900 feet; elimination of a sand berm along the rock sill portion of Island C8; and replacing the upper leg of Island C2 with three rock mound islands. The savings from these design modifications were estimated to be approximately $900,000.

7.3.2 ALTERNATIVES EVALUATION

7.3.2.1 Costs

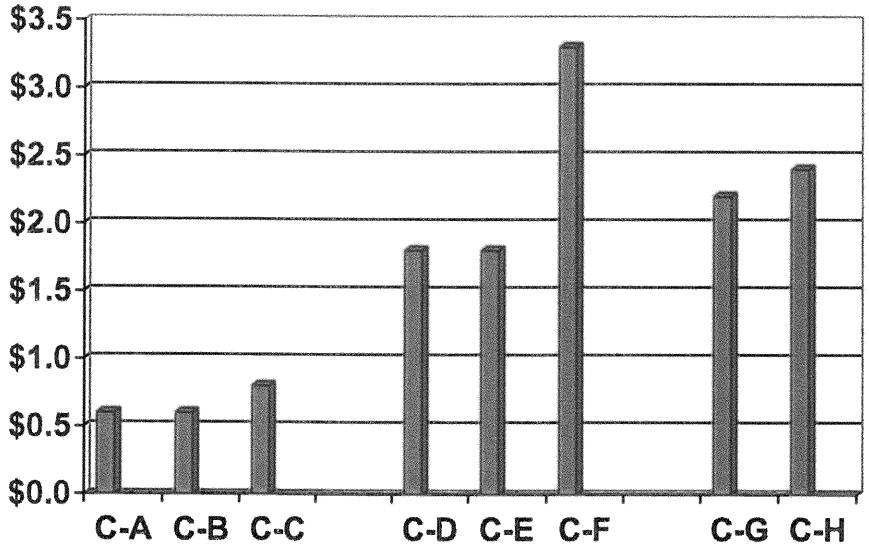
Table 7-3.1 and figure 7-3.1 summarize the estimated costs of the alternative plans evaluated for the Three Central area. The costs are rounded to the nearest $5,000. Average annual costs are based on the current discount rate of 6 1/8% and are rounded to the nearest $1,000.

Table 7-3.1
Summary of Estimated Costs for the Three Central Alternatives

	Construction	PED	S&I	Total	Ave Annual
Plan C-A	$ 550,000	$ 20,000	$ 25,000	$ 595,000	$ 38,000
Plan C-B	$ 550,000	$ 20,000	$ 25,000	$ 595,000	$ 38,000
Plan C-C	$ 780,000	$ 30,000	$ 35,000	$ 845,000	$ 55,000
Plan C-D	$1,835,000	$ 65,000	$ 85,000	$1,985,000	$128,000
Plan C-E	$1,805,000	$ 65,000	$ 85,000	$1,955,000	$126,000
Plan C-F	$3,320,000	$ 120,000	$155,000	$3,595,000	$232,000
Plan C-G	$2,045,000	$ 75,000	$ 90,000	$2,210,000	$143,000
Plan C-H	$2,240,000	$ 80,000	$100,000	$2,420,000	$156,000

PED = planning, engineering, and design
S&A = construction contact supervision and administration

Figure 7-3.1
Cost of the Three Central Alternatives ($ millions)



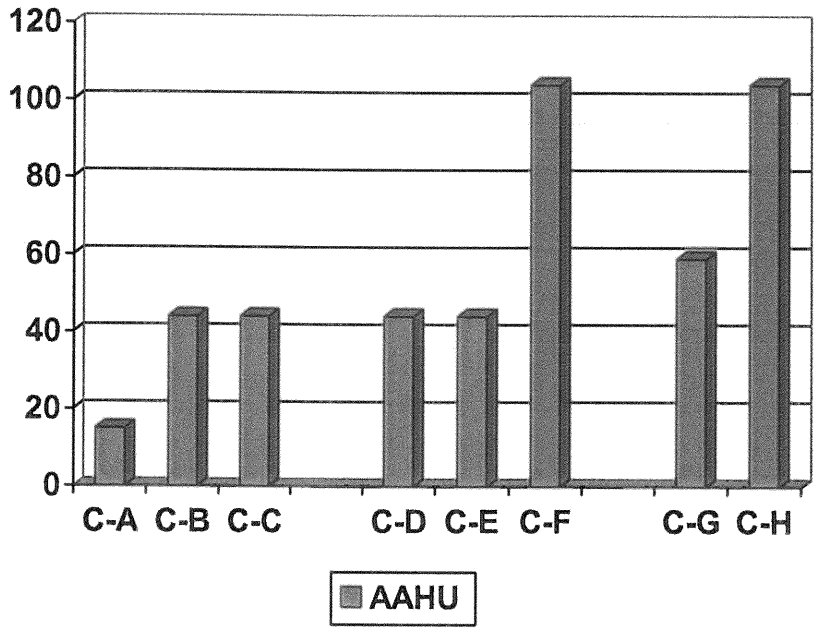
7.3.2.2 Quantifiable Habitat Benefits

The potential habitat benefits of the various alternatives were quantified using habitat evaluation procedures (see attachment 4 – Habitat Evaluation Appendix). The results are summarized in table 7-3.2 and figure 7-3.2.

Table 7-3.2
Summary of Quantified Habitat Benefits for Three Central Area

	AAHU	AAHU Gain
Future without Condition (no action alternative)	700	-
Alternative C-A	715	15
Alternative C-B	744	44
Alternative C-C	744	44
Alternative C-D	744	44
Alternative C-E	744	44
Alternative C-F	804	104
Alternative C-G	759	59
Alternative C-H	804	104
Alternatives C-B + C-F	819	119
Alternatives C-B + C-H	819	119
Alternatives C-F + C-H	834	134
Alternatives C-B + C-F + C-H	924	224

Figure 7-3.2
Three Central AAHU Gains by Alternative



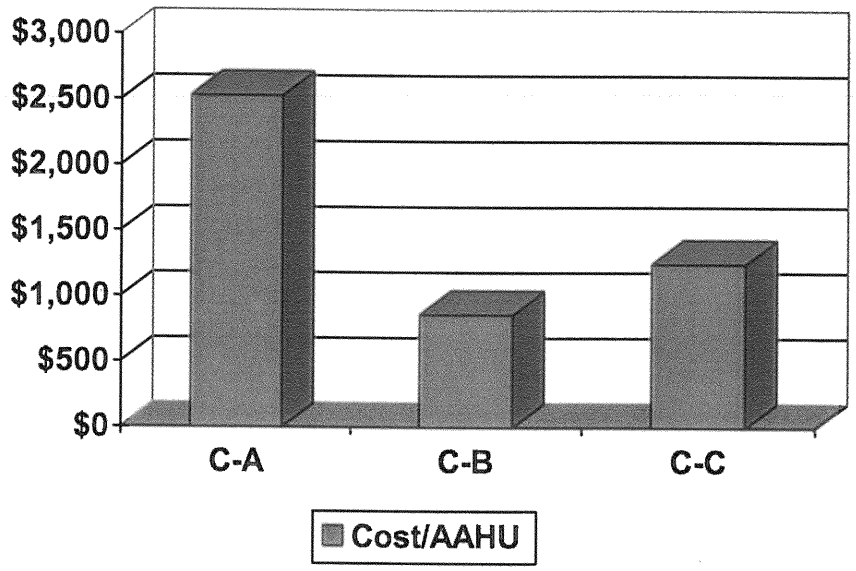
7.3.2.3 Cost/Benefit Evaluation – Initial Island Groupings

An analysis of costs versus quantifiable habitat benefits was conducted to identify the most cost-effective alternatives. Table 7-3.3 and figure 7-3.3 show the analysis for alternatives C-A through C-C, the Island C1 and C6 combinations. The analysis shows that the construction of Island C6 (alt. C-B) would be much more cost effective than the construction of Island C1 ($860/AAHU vs. $2,530/AAHU). As would be expected with a cost spread of this magnitude, the cost/AAHU of constructing both of the islands (alt. C-C) falls in between the individual island costs.

Table 7-3.3
Comparison of Costs/AAHU for the C-A, C-B, and C-C Alternatives

Plan	Average Annual Cost	AAHU Gain	Cost/ AAHU
Alternative C-A	$ 38,000	15	$ 2,530
Alternative C-B	$ 38,000	44	$ 860
Alternative C-C	$ 55,000	44	$ 1,250

Figure 7-3.3
Cost per AAHU – Alternatives C-A, C-B, and C-C



If Island C6 were constructed (alt. C-B), adding Island C1 (alt. C-C) would not provide any appreciable additional quantifiable habitat benefits (no additional AAHU). Therefore, there would be no reason for constructing Island C1 unless there were significant unquantifiable benefits associated with its construction.

Table 7-3.4 and figure 7-3.4 show the analysis for alternatives C-D through C-F, the Island C2/C3 and C4/C5 combinations. The analysis shows that construction of Islands C4/C5 (alt. C-E) would be slightly more cost effective than the construction of Islands C2/C3 (alt. C-D), $2,860/AAHU vs. $2,910/AAHU, respectively. However, all four islands combined (alt. C-F) produces greater habitat benefits at a lower cost/AAHU.

Table 7-3.4
Comparison of Costs/AAHU for C-D, C-E, and C-F Alternatives

Plan	Average Annual Cost	AAHU Gain	Cost /AAHU
Alternative C-D	$128,000	44	$ 2,910
Alternative C-E	$126,000	44	$ 2,860
Alternative C-F	$232,000	104	$ 2,230

Figure 7-3.4
Cost per AAHU – Alternatives C-D, C-E, and C-F

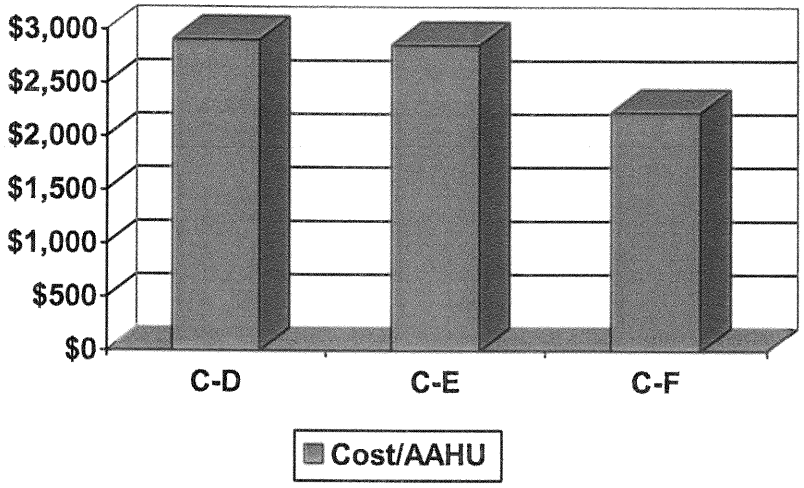


Table 7-3.5 shows the incremental analysis if Islands C4/C5 (alt C-E) is considered first in place, with Islands C2/C3 (alt. C-F) as the added increment. The analysis shows that the incremental cost of adding Islands C2/C3 is substantially lower than the cost of the base plan.

Table 7-3.5
Incremental Analysis of Adding Islands C4/C5 to the Base Plan C-D

Increment	Incremental Cost	Incremental Average Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alt. C-E	$1,955,000	$126,000	44	-	$2,860
Alt. C-F	$1,640,000	$106,000	104	60	$1,770

Table 7-3.6 shows the analysis for alternatives C-G (Islands C8) and C-H (Islands C7 and C8). The assumption was made that if Island C8 were not constructed, then Island C7 would not be constructed. Therefore, only Island C8 was evaluated as a stand-alone island (alt. C-G). The analysis shows that construction of both islands (alt. C-H) would be more cost effective than the construction of Island C8 alone, $1,500/AAHU vs. $2,420/AAHU, respectively. The incremental cost of adding Island C7 would be $290/AAHU.

Table 7-3.6
Comparison of Costs/AAHU for C-G and C-H Alternatives

Plan	Average Annual Cost	AAHU Gain	Cost/ AAHU
Alternative C-G	$143,000	59	$ 2,420
Alternative C-H	$156,000	104	$ 1,500

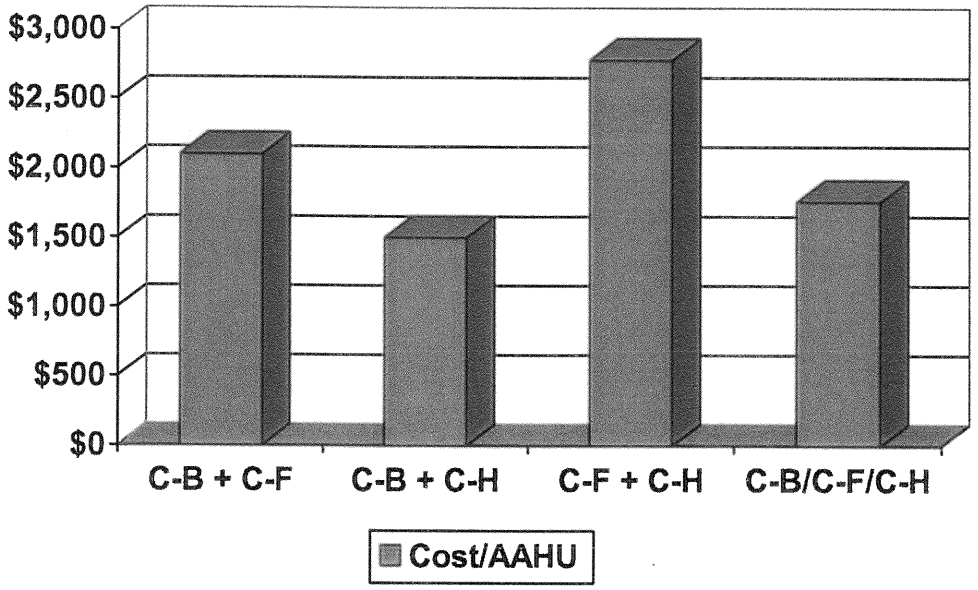
7.3.2.4 Cost/Benefit Evaluation – Larger Island Groupings

The initial cost/benefit evaluation (section 7.3.2.3 above) indicated that alternatives C-B, C-F, and C-H would be the most cost effective alternatives to pursue from the three island groupings. An analysis was then conducted for combinations of these three alternatives. Table 7-3.7 and figure 7-3.7 show the initial analysis. This analysis indicates that the most cost-effective combination would be to construct alternatives C-B + C-H (Island C6, C7, and C8).

Table 7-3.7
Comparison of Costs/AAHU for Combinations of Alternatives C-B, C-F, and C-H

Plan	Average Annual Cost	AAHU Gain	Cost/ AAHU
Alternatives C-B + C-F	$250,000	119	$ 2,100
Alternatives C-B + C-H	$178,000	119	$ 1,500
Alternatives C-F + C-H	$372,000	134	$ 2,780
Alternatives C-B + C-F + C-H	$394,000	224	$ 1,760

Figure 7-3.7
Cost per AAHU – Three Central Combination Plans



The cumulative cost of a plan consisting of alternatives C-B + C-H + C-F would be $1,760/AAHU, while the incremental cost of adding alternative C-F to the C-B + C-H combination would be $2,060/AAHU (table 7-3.8). While the incremental cost of this final increment (C-F) is greater than that of the base plan (C-B + C-H), it is still well within the range of costs/AAHU considered justified within the St. Paul District HREP program for the types of habitat benefits provided.

Table 7-3.8
Incremental Analysis of Adding Alternative C-F to a Base Plan of Alternatives C-B + C-H

Increment	Incremental Cost	Incremental Average Annual Cost	AAHU Gain	Incremental AAHU Gain	Incre. Cost/ AAHU
Alts. C-B + C-H	$2,760,000	$178,000	119	-	$1,650
Alts. C-B + C-H + C-F	$3,340,000	$216,000	224	105	$2,060

7.3.2.5 Unquantified Habitat Benefits

Numerous other fish and wildlife benefits, not quantified by the habitat models, would accrue with project construction. Island construction would create conditions allowing for the re-establishment of extensive and diverse aquatic vegetation beds and

restore bathymetric and flow diversity to the area. These conditions would result in the creation of microhabitats conducive to increases in the diversity and population levels of aquatic invertebrates including: aquatic insects, amphipods, gastropods, and mussels. Likewise, habitat conditions for a wide variety of fish species would be expected to improve as food and cover resources become more widespread and diverse. Dredging activities of obtain material for island construction would result in the creation of deep holes that provide over wintering habitat for many species of fish, especially Centrarchids. Studies have indicated that winter habitat on the river may be a critical component to maintaining fish populations on the river. The establishment of additional winter fish habitat in this part of pool 8 could contribute to maintaining healthy fish populations in the pool.

The islands and associated vegetation would provide habitat for a wide variety of wildlife species including: roosting, nesting and migration habitat for many species of birds, including neotropical migrants, and nesting habitat for turtles. The islands and associated shoreline and shallow water zones would provide marsh habitat for marsh and water birds such as grebes, bitterns, herons, egrets, terns and shorebirds and improved habitat conditions for many species of reptiles and amphibians.

Restoration of the island complex in the Three Central Area would likely have other, unquantifiable effects on the other evaluation areas in lower pool 8. The re-establishment of islands in this portion of the pool, and the expected vegetation response, will likely have a significant effect on wind fetch in the Three North Area, in the Three West area, and to a smaller degree the Three East area and Phase II area, increasing the effectiveness of the features proposed or already constructed in those areas.

Additional unquantified benefits for waterfowl migration habitat were presented in the discussion for the Three West Area.

7.3.3 PLAN SELECTION

The selected plan for the Three Central area was the combination of alternatives C-B, C-F, and C-H, construction of seven of the eight islands considered. The selection was based on the following:

a) Alternatives C-B, C-F, and C-H were the most cost-effective plans for their respective island groupings.

b) While alternatives C-B + C-H is the most cost effective combination plan, the incremental cost of adding alternative C-F is considered justified for the types of habitat benefits provided.

c) There are substantial additional unquantified habitat benefits associated with the plans.

d) Alternatives C-B, C-F, and C-H are supported by Federal and State resource agencies as the best plan for the Three Central area.

7.4 SUMMARY OF SELECTED PLANS - THREE WEST, THREE NORTH, AND THREE CENTRAL AREAS

Table 7-4.1 summarizes the costs and benefits of the selected plans for the Three West, North, and Central areas. The costs/AAHU for the Three West are 10-12 percent lower than those for the Three North and Three Central areas (which are essentially equal). This would indicate that unless there are other overriding factors, the selected plan for the Three West area should be implemented first.

Table 7-4.1
Summary of Selected Plans

Area	Selected Plan	Cost	Average Annual Cost	AAHU Gain	Cost/ AAHU
Three West	W-H	$ 5,185,000	$334,000	212	$1,580
Three North	N-E	$ 3,270,000	$211,000	118	$1,790
	Seed Islands	$ 150,000	10,000	6	$1,610
Three Central	CB+CF+CH	$ 6,100,000	$394,000	224	$1,760
	Total	$14,920,000	$963,000	560	$1,720

Over the past two decades, many islands, and their associated protected side channel habitats have disappeared, resulting in large, unprotected open water areas. These conditions have contributed to some degree to the loss of large stands of aquatic vegetation, and resulted in the simplification of the mosaic of habitat types within the corridor. The result has been a gradual decline in the quality and integrity of fish and wildlife habitat along the river. On a pool wide basis, the restoration of islands and their associated side channel habitat may be considered as one of the key components in maintaining the integrity of the existing river corridor community.

7.5 THREE EAST AREA

7.5.1 ALTERNATIVES DEVELOPMENT

7.5.1.1 Coon Creek Delta

Project objective E-1 is to maintain and if possible, increase the size of the Coon Creek delta. Currently, the Coon Creek delta appears to be at equilibrium. Sediment that enters the Mississippi River from Coon Creek is transported out of the delta area immediately or shortly after deposition. The two forces causing this transport are river currents and wave action. To negate these forces, three rock breakwater-type islands were designed (plate 13).

Island E1 would shelter the delta from river currents and northerly winds. Islands E2 and E3 would shelter the delta from southerly winds. All three islands would be constructed of rock to elevation 632.0. They would have 3-foot top widths and side slopes of 1V:3H. Island E1 would be about 600 feet long and Island E2 and E3 would be about 800 feet long. The islands would be designed to have the exterior toe follow the 3-foot contour line as much as practical.

The upstream slope of Island E1 would be flattened to a slope of 1V:10H using small rock to create the type of habitat preferred for spawning by walleye.

7.5.1.2 East Island

East Island is located in the upper portion of the Three East area. The U.S. Fish and Wildlife has riprapped the head of the island to control erosion. They asked that adding rock protection to the downstream side of the island be considered to protect the island from southerly winds. A rock mound was designed for the lower side of East Island to provide this erosion protection.

7.5.2 ALTERNATIVES EVALUATION AND PLAN SELECTION

7.5.2.1 Coon Creek Delta

Costs

The estimated costs of the three-breakwater island design developed for protecting the Coon Creek delta is $596,000 (table 7-5.1). The average annual cost for this feature would be $38,470.

Table 7-5.1
Cost Estimate for Coon Creek Delta Design

Mobilization	$102,700
Island E1	310,900
Island E2	57,100
Island E3	71,600
Construction Subtotal	$542,300
Planning, engineering, & design	23,900
Supervision & administration	29,800
Total	$596,000

Habitat Benefits

The quantifiable habitat benefits associated with the three islands considered for the Three East area are 11 AAHU (see attachment 4 for details). At an average annual cost of $38,470 the cost/AAHU would be about $3,500.

Construction of the proposed features would preserve, and possibly expand, the fish spawning and nursery habitat that is currently provided by the Coon Creek delta complex. It would also preserve the mix of terrestrial, emergent marsh and shrub wetland vegetation types that provide habitat for a variety of wildlife species.

Plan Selection

The selected plan for the Three East area is to construct the three breakwater-type islands. The selection was based on the following:

a) The cost/AAHU of this plan is on the high side of the range normally considered justified within the St. Paul District HREP program for the types of benefits provided. However, there are substantial additional unquantified habitat benefits associated with this plan.

b) The plan is supported by Federal and State resource agencies.

7.5.2.2 East Island Bank Protection

Costs

Table 7-5.2 summarizes the estimated costs for bank protection on East Island. No cost for mobilization is included as it was assumed this work could be completed incidental to other work in the area. PED and S&A costs would be minimal as the additional effort of including this work as part of other construction contracts would be negligible. The average annual cost would be approximately $3,140.

Table 7-5.2
Cost Estimate for East Island Bank Protection

Rock Mound	$ 44,000
PED	2,000
S&A	1,000
Total	$ 47,000

Habitat Benefits

The protection of the downstream side of East Island would prevent the eventual loss of about 2 acres of the type of island feature that is the major component of other parts of this project. The benefits of habitat provided by East Island are similar to the habitat benefits of island features discussed elsewhere in this report.

Plan Selection

The selected plan is to construct the rock mound bank protection at East Island. East Island is considered valuable habitat by the U.S. Fish and Wildlife Service, especially for turtle and waterfowl nesting. They have invested approximately $35,000 in protecting the upstream and channel sides of the island. This additional work would assist in maintaining East Island and protecting the previous Federal investment.

7.6 THREE NORTHWEST AREA

7.6.1 ALTERNATIVES DEVELOPMENT

7.6.1.1 Wildcat Creek

Two alternatives were identified for Wildcat Creek, other than the no action alternative. The first alternative (WC-1) is to reroute the creek below the Wildcat Park access road so that it deposits most of its sediment load directly into wetland/shallow aquatic habitat rather than Schnick's Bay (plate 14).

The second alternative (WC-2) is to reroute Wildcat Creek directly to the main channel north of Wildcat Park (plate 14). This would approximate the condition that existing prior to the diversion of the creek in the late 1960's or early 1970's.

Alternative WC-1

Under alternative WC-1, a 1,330-foot channel would be excavated from where Wildcat Creek passes beneath the Wildcat Park access road in a southeasterly direction toward the main channel. The channel would have a bottom width of 20 feet with side slopes of 1V:4H, except in locations where riprap is used. In those locations the side slopes would be 1V:3H. The bottom elevation of the channel would range from elevation 630.0 at the upstream end to elevation 629.0 at the downstream end. Construction of this channel would require excavation of approximately 2,800 cy of earthen material. This material would be placed to form a berm along downstream side of the channel to further keep Wildcat Creek flows from entering Schnick's Bay.

Alternative WC-2

Under alternative WC-2, a 1,440-foot channel would be excavated from where Wildcat Creek passes beneath the railroad tracks in a northeasterly direction to the main channel. The existing culvert under the Wildcat Park access road would be plugged. The channel design would be similar to that described for alternative WC-1 described above. Construction of this channel would require clearing an estimated 2 acres of willows and bottomland trees and excavation of approximately 3,030 cy of earthen material.

The excavated material would be used to construct an earthen berm on the upstream side of the channel. Riprap would be place on the downstream side of the channel for its first 150 feet.

7.6.2 ALTERNATIVES EVALUATION AND PLAN SELECTION

7.6.2.1 Costs

Table 7-6.1 shows the cost estimate developed for the two alternatives considered for Wildcat Creek. Both alternatives would be considered relatively inexpensive, and thus costs were not a major consideration in the evaluation of the two plans.

Table 7-6.1
Cost of Wildcat Creek Diversion Alternatives

	Construction	PED	S&I	Total	Ave Annual
Plan WC-1	$45,100	$6,800	$3,400	$55,300	$3,570
Plan WC-2	$65,300	$9,800	$4,900	$80,000	$5,160

7.6.2.2 Habitat Costs and Benefits

Both plans would meet the primary objective of diverting Wildcat Creek sediments from Schnick's Bay proper. As indicated earlier in Section 4.4.5, it is expected under no action, sedimentation in Schnick's Bay would result in the conversion of shallow aquatic habitat to marsh (and eventually wooded wetland) habitat at the approximate long-term rate of 0.5 acres/year. Plan WC-2 would probably be slightly more effective in reducing sedimentation and habitat conversion rates in that Wildcat Creek would be totally diverted from Schnick's Bay. Under plan WC-1, there likely would be some instances where Wildcat Creek flows would overtop the berm, resulting in sediment inputs to Schnick's Bay.

Both plans would result in the conversion of about 2 acres of wetland habitat to creek channel. With alternative WC-1, the habitat that would be converted is currently emergent marsh with some scattered willows present. The habitat at the upstream route (WC-2) is currently a mixture of willows and relatively dense stands of bottomland forest trees that appear to be 10-20 years old.

The discharge of Wildcat Creek sediments to the main channel (WC-2) would probably have no measurable habitat effects due to the dilution capacity of the main channel. Under alternative WC-1, Wildcat Creek sediments would be discharged to marsh/shallow aquatic habitat lying east of Schnick's Bay proper. The long-term effect would likely be accelerated conversion of this habitat to marsh and eventually wooded wetland habitat. No estimate was made of the number of acres that would be converted or at what rate.

7.6.2.3 Plan Selection

While sedimentation is filling in Schnick's Bay, converting shallow aquatic habitat to marsh (and eventually to wooded habitat), this conversion is a natural process associated with stream deltas, and not considered inherently good or bad in this particular location. Some wildlife species will benefit from this change while others will be negatively affected. The area being affected at the head of Schnick's Bay is small and the effect of the natural changes occurring on the general ecology of lower pool 8 are negligible.

The general consensus of the Federal and State agencies was that any potential habitat benefits to be achieved by rerouting Wildcat Creek was not warranted given the adverse habitat effects of construction. Therefore, the selected plan for the rerouting of Wildcat Creek is the **no action plan**. The selection of this plan is not irreversible. Federal and State resource management agencies can monitor the situation at the Wildcat Creek delta and revisit this decision at a future date should changing conditions so warrant.

7.7 MUSSEL HABITAT RESTORATION

During project planning, the Wisconsin DNR submitted a proposal for the addition of mussel habitat enhancement features to the Three West area, primarily in the form of flow modification structures and the addition of gravel and cobble beds to create more favorable substrate conditions for mussel colonization (attachment 8). A preliminary estimate for these features is that implementation would cost in the range of $400-500,000. Given the substantial cost, the following basic concerns arose:

- What is the probability that the features would be colonized by native mussel species, especially protected species?
- What is the potential for providing additional substrate for zebra mussel colonization and/or for zebra mussel infestation of native mussels colonizing the site?
- Is the state of the art in mussel habitat restoration advanced sufficiently to adequately design such features?

The Mussel Coordination Team (MCT) is an interagency group of biologists working on the Upper Mississippi River who are tasked with identifying and coordinating efforts to restore or maintain mussel resources. The MCT was asked to review the Wisconsin DNR proposal and provide feedback concerning its implementation. The feedback received can be highlighted as follows:

- The state of the art of mussel habitat restoration is in its infancy and it can only be speculated whether native mussels would colonize the constructed habitat. The same holds true for questions concerning zebra mussel colonization.
- There are questions concerning making large investments in man-made habitat features for mussel habitat restoration vs. restoring natural hydraulic processes on the river and allowing mussels to naturally colonize these areas.
- There are questions concerning making large investments in habitat restoration while the long-term effects of zebra mussels in UMR are still unknown.
- There is an on-going zebra mussel control study that will address the feasibility of multiple scale habitat modifications to reduce zebra mussel populations, while maintaining or enhancing habitat conditions for native mussels. As this study progresses, pilot habitat restoration projects to control zebra mussels and provide suitable native mussel habitat will be developed and may be suitable for incorporation into UMRS-EMP and other environmental restoration projects.

- There is also an on-going effort to establish new populations of the Federally endangered Higgins' eye pearlymussel in areas with low potential for zebra mussel infestation. A variety of relocation techniques are being evaluated to determine the most effective means of establishing new populations. Lessons learned from these relocation efforts can be used to increase the likelihood of the successful establishment of native mussels, especially Federal and State protected species, in these habitat restoration areas.

Based on the feedback received from the MCT, it was decided not to recommend any specific mussel habitat restoration features for the Pool 8 Islands Phase III project area at this time. Construction of the project is not scheduled to commence until 2005 and would not be completed until 2009. Incorporating mussel habitat restoration features into the project design can be reevaluated during this time period. Knowledge concerning the state of mussel resources, their predicted future condition, and the art of mussel habitat restoration will advance in the interim, allowing for better decision-making in 2005 and later than what can occur at this time.

SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

The selected features for the Pool 8 Island Phase III project are listed in table 8-1 and shown on plate 15.

Table 8-1
Summary of Selected Features

Three West Area	Three North Area	Three Central Area	Three East Area
Island W1	Island N1	Island C2a	Island E1
Island W2	Island N2	Island C2b	Island E2
Island W3	Island N3	Island C2c	Island E3
Mudflat W3	Island N4	Island C2	East Is. rock mound
Island W4	Island N5	Island C3	
Island W5	Island N6	Island C4	
Mudflat W5	Island N7	Mudflat C4	
Island W6	Mudflat N7	Island C5	
	Island N8	Island C6	
		Island C7	
		Island C8	

8.1 THREE WEST AREA

8.1.1 ISLANDS

The selected plan for the Three West area is the construction of six islands as shown on plate 16. Plate 17 shows a typical cross section for the islands, while plate 18 shows other features. Table 8-2 summarizes the design data for the islands.

Table 8-2
Summary of Design Data for Three West Islands

Island	Length (ft)	Base Width (ft)	Top Width (ft)	Exterior Berm (ft)	Interior Berm (ft)	Top Elevation	Berm Elevation
W1	2270	135	40	45	30	634.0	632.0
W2 (upper)	2025	135	40	45	30	634.0	632.0
W2 (middle)	2200	155	80	45	30	632.0	632.0
W2 (lower)	2645	130	40	45	30	633.5	632.0
W3	730	105	45	30	30	632.0	632.0
W4	900	130	40	60	30	632.0	632.0
W5 (west)	1675	105	45	30	30	632.0	632.0
W5 (east)	1195	120	40	30	30	634.0	632.0
W6	1598	105	45	30	30	632.0	632.0

Island	End Protection	Exterior Protection	Interior Protection	Sand Fill (cy)	Random Fill (cy)	Fine Fill (cy)	Rock (cy)
W1	Riprap	Groins	none	25,714	8,484	8,340	2,344
W2	Riprap	Groins	Groins	123,140	14,407	25,958	4,498
W3	Riprap	Groins	none	14,417	-	2,584	1,335
W3 mudflat	n.a.	n.a.	n.a.	6,085	-	19,660	-
W4	Riprap	Groins	Groins	14,024	-	2,842	1,278
W5	Riprap	Groins	none	42,890	4,497	8,664	1,498
W5 mudflat	n.a.	n.a.	n.a.	3,865	-	23,130	-
W6	Riprap	Groins	none	27,826	-	4,991	369
Total				257,961	27,388	96,169	11,322

8.1.1.1 Island W1

Island W1 is located at the head of the Three West area. Its primary function is to protect the interior of the area from flows coming down Raft Channel. Island W1 will also function to concentrate flows in and help maintain the two channels within the Three West area.

Since it is at the upstream end of the Three West area, Island W1 is one of the highest islands with a top elevation of 634.0. The ends of the island would be protected with riprap, while the Raft Channel side of the island would be protected with groins and vanes.

It is expected that scour holes may form in the two channels on either end of Island W1. Rather than allow this material to scour and be deposited within the Three West area, pre-formed scour holes may be excavated in these locations. The material would be used for island fill.

Two rows of willows/indigobush would be planted on the outer shoreline. A native grass/forb mix would be planted on the island, leaning heavily toward switchgrass and other tall, robust cool and warm season grasses.

8.1.1.2 Island W2

Island W2 serves two major functions. First, it isolates the Three West area from Raft Channel flows. Secondly, it provides protection to the Three West area from wind and waves from the northeasterly around to the southeasterly direction.

The upper end of the island would be protected with riprap, while the Raft Channel side of the island would be protected with groins and rock mounds. The lower end of Island W2 would have a sand tip, which will be allowed to erode to form a sand spit or some other natural feature. A layer of riprap will be buried in the island 50 feet from the tip to limit the amount of erosion that could occur.

Two rows of willows/indigobush would be planted along outer shoreline and along the interior shoreline of the middle section. The island would be planted with a grass/forb mix as described for Island W1.

8.1.1.3 Island W3

Island W3 is designed to provide habitat diversity within the Three West area and help concentrate flows to maintain one of the two channels flowing through the area.

Island W3 is protected by Island W2, thus, it has a lower top elevation and narrower berms. The west side of Island W3 would be protected by riprap. Like Island W2, the lower end of the island would be a sand tip with a buried layer of riprap to prevent excessive erosion.

Willow/indigobush plantings on this island would be minimized to the extent possible to prevent these species from overtaking the island. The island would be planted to a grass/forb mix emphasizing wildrye, switchgrass, Indiangrass, and big bluestem.

8.1.1.4 Island W4

Island W4 is primarily designed to provide the interior of the Three West area with protection from wind and waves from the southerly direction. The island would be a relatively low island (632.0) with a wider than normal exterior berm (60' instead of 45').

The ends of the island would be protected with riprap, while the downstream side of the island would be protected with groins.

Willows/indigobush would be planted along the shoreline on both sides of the island. The island would be planted with the same seed mix as Island W3.

8.1.1.5 Islands W5/W6

Islands W5 and W6 form a smaller island complex within the Three West area, increasing habitat diversity. In addition, the islands are situated to help concentrate flows in the two channels flowing through the area.

Vanes would be on the exterior sides of the islands for stabilization. Like Island W2, the lower tips of Island W5 and W6 would be sand with a buried layer of riprap to prevent excessive erosion.

The planting of willows/indigobush along the shorelines would be minimized to the extent practical to keep them from colonizing the entire islands. The west portion of Island W5 would be seeded with the same mix used on Islands W1 and W2. The east portion of Island W5 and Island W6 would be seeded with the same mix used on Islands W3 and W4.

8.1.1.6 Construction Methods

How islands are constructed is generally left to the discretion of the contractor. The contractor is responsible for providing the finished product (the islands as designed) in a manner best suited to his operation. Experience with construction of other island projects within the St. Paul District (17 islands in 5 different locations) has shown that there is a general pattern to cost effective construction of islands.

The sand base for an island is placed using hydraulic dredging equipment. Due to the quantities involved, it usually much more cost effective to use hydraulic dredging equipment than mechanical dredging equipment. The sand, as it is discharged from the pipeline, firms up quite rapidly and is capable of supporting bulldozers that are then used to generally shape the island.

The random fill sections of the island can be filled using either hydraulic or mechanical dredging equipment. If the contractor does not need the random fill sections do dispose of access dredging materials, the most cost effective approach is to fill these sections with sand as part of the sand placement process. If excess access dredging material is used, the method of placement will depend upon the type of equipment the contractor uses for access dredging.

Fine material is placed on islands by a variety of methods. Placement of fine material using mechanical equipment is slower and more costly in terms of actual placement. However, mechanically placed material dries quicker, so that it can be shaped and graded in a shorter time following placement. Initial placement of fine material using hydraulic dredging equipment is faster. However, hydraulically placed material must be contained and takes longer to dry before it can be shaped and graded. Meeting water quality limitations for the discharge of the dredge carriage water may affect the operation. These factors may negate the initial cost savings associated with the hydraulic placement.

New technologies are evolving which involve dredging of fine materials with a small hydraulic dredge and passing them through a mechanical dewatering process using flocculents and presses. The end product is dewatered fine material that can then be placed, shaped, and graded without an extensive drying period. This process was used on an island construction project in the St. Paul District in 2000 and holds promise in the future as a cost effective method of fine material placement.

Rock is barged to the islands and placed using hydraulic backhoes. The most limiting factor on rock placement is usually water depths for the rock barges and push boats. To limit the amount of access dredging or double handling of rock along the islands, contractors may place rock protection during periods of high water.

There is nothing in the design of the Three West islands and other features to suggest that any innovative or unusual construction methods would be necessary.

8.1.1.7 Construction Restrictions

Construction restrictions can be applied for any number of reasons. Restrictions are generally applied in the construction of habitat projects to minimize the adverse effects of construction and to protect valuable habitats. The following are the basic construction restrictions that would likely be applied in the Three West area.

a. Construction would not be allowed during the fall waterfowl migration season (October-November).

b. Access dredging would be limited to the minimum considered necessary to construct the project. Due to concerns with creating boat access channels that would allow undesirable

boat entry into the Wisconsin Closed Area, in some instances, it may be necessary to plug construction access channels at project completion.

c. Water quality limitations would be imposed on the hydraulic placement of sand material for island bases. The criterion used in past island construction projects has generally been that a specified suspended solids concentration has to be met within a certain distance from the discharge point, e.g., 500 mg/l at 500 feet below the discharge point.

d. Water quality limitations would be imposed on the hydraulic placement of fine material. The criterion used in past island construction projects has generally been that a specified suspended solids concentration has to be met at the discharge point for the dredge carriage water.

e. Silt curtains would be required at hydraulic carriage water discharge points when fine sediments are dredged.

f. A closing dam at the head of Raft Channel will need to be breached for equipment access, along with old submerged roadbed. The closing dam may need to be restored when construction is completed.

g. Contractors are usually allowed to propose alternative borrow sites. The contract documents will define areas where the Government will not approve alternative borrow sites in areas such as existing aquatic plant beds, mussel beds, or other environmentally sensitive areas.

8.1.2 MUDFLATS

A mudflat would be constructed in the bay formed by Islands W5 and W6 and the bay formed by Islands W2 and W3 (plate 16). A low sand berm would be constructed along the outside edge of the designated mudflat area. This sand berm would serve as the containment berm for the material used to create the mudflat. Material would most likely be placed within the mudflat area by a small hydraulic dredge. The design elevation of the mudflat is 630.4, however, a relatively wide tolerance will be allowed (such as $\pm$ 0.5 foot) to provide a diversity of elevations within the mudflat to promote vegetation by a variety of species.

The sand berm would be breached or allowed to erode naturally. The decision would be made after the mudflat is constructed and it can be determined how stable the material is.

8.1.3 ACCESS DREDGING

Access dredging will be required to construct the project. Generally, a balance must be struck to provide reasonable access for the contractor while minimizing the environmental disturbances associated with the dredging. In addition, being able to incorporate the access dredging material into the islands avoids the costs of having to transport this material elsewhere

for disposal. As noted earlier under construction restrictions, access channels may be plugged at the end of construction to minimize creating permanent access channels.

Plate 19 shows proposed access routes for construction of the Three West islands that should provide adequate access for construction while minimizing secondary effects. It should be noted that these are routes where dredging could occur to obtain access. If a contractor can access other portions of the construction without dredging, he is generally free to do so. Contractors are allowed (and occasionally do) request alternate access routes. These would be evaluated on a case-by-case basis for approval.

8.1.4 SOURCES OF MATERIAL

Table 8-3 summarizes the expected sources of fill material for the Three West area.

8.1.4.1 Sand

A number of options for obtaining sand fill for the islands were evaluated and still may be considered during preparation of plans and specifications for project construction.

Main Channel of the Mississippi River

The main channel of the river is a known source of sand. This source is considered the fall back alternative, i.e., a known source if no better source can be found. The main channel would be a better source for the Three North and Three Central areas than the Three West area because of the distances involved.

The main channel is not considered a preferred source for sand for a couple of reasons. First, excavating holes in the main channel of the river would provide only limited secondary habitat benefits. Second, borrowing approximately 800,000 cubic yards within a limited reach of the river may have unknown undesirable effects on the bed load sediment transport system in lower pool 8. Finally, substantial borrow dredging from the main channel has the potential for temporarily interrupting the normal bed load transport system which in turn could slow the rate of growth of the seed islands constructed under the Pool 8 Islands Phase II project.

The most logical area for borrowing material from the main channel for use in the Three West area would be in the area of river mile 687.0 (plate 31). This area is periodically dredged for channel maintenance and as such contains no mussel beds. It is located at the head of Raft Channel such that the hydraulic pipeline could be run directly down Raft Channel. The main channel is approximately 400 feet wide and 12 feet deep in this reach. If the entire 259,000 cubic yards of sand required for the Three West area was excavated from this reach, a dredge cut with the dimensions of 400 feet wide x 2,200 feet long x 8 feet deep (20 feet total depth) would be required. Increasing the dredging depth by 5 feet would reduce the length of the dredge cut to 1,350 feet.

Table 8-3
Three West and Three North Material Sources

Feature	Sand Fill Required	Sand Fill Source	Random Required	Random Source	Fine Fill Required	Fine Fill Source	Rock
Island W1	26,000	Schnick's Bay/Raft Channel/main channel at mile 687	8,000	access dredging	8,000	access dredging/ Schnick's Bay	2,344
Island W2	123,000	Schnick's Bay/Raft Channel/main channel at mile 687	14,000	access dredging	26,000	access dredging/ Schnick's Bay	4,498
Island W3	14,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	3,000	access dredging/ Schnick's Bay	1,335
Island W4	14,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	3,000	access dredging/ Schnick's Bay	1,278
Island W5	43,000	Schnick's Bay/Raft Channel/main channel at mile 687	4,000	access dredging	9,000	access dredging/ Schnick's Bay	1,498
Island W6	23,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	5,000	access dredging/ Schnick's Bay	369
W3 Mudflat	-	n.a.	-	n.a.	20,000	access dredging/ Schnick's Bay	-
W3 Sandflat	6,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	-
W5 Mudflat	-	n.a.	-	n.a.	23,000	access dredging/ Schnick's Bay	-
W5 Sandflat	4,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	-
W6 Sandflat	5,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	-
	258,000		26,000		97,000		11,322

Feature	Sand Fill Required	Sand Fill Source	Random Required	Random Source	Fine Fill Required	Fine Fill Source	Rock
Island N1	1,000	Schnick's Bay/Raft Channel/main channel at mile 687	3,000	access dredging	3,000	access dredging/ Schnick's Bay	1,690
Island N2	21,000	Schnick's Bay/Raft Channel/main channel at mile 687	3,000	access dredging	5,000	access dredging/ Schnick's Bay	1,013
Island N3	3,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	255
Island N4	2,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	189
Island N5	4,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	463
Island N6	4,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	-	n.a.	406
Island N7	40,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	n.a.	7,000	access dredging/ Schnick's Bay	1,736
N7 Mudflat	-	n.a.	-	n.a.	16,000	access dredging/ Schnick's Bay	-
Island N8	60,000	Schnick's Bay/Raft Channel/main channel at mile 687	-	access dredging	10,000	access dredging/ Schnick's Bay	15,726
	135,000		6,000		41,000		21,478

Raft Channel

Raft Channel would be an option for all three areas, but especially for the Three West area, which is somewhat remote from the main channel of the river. Borings indicate there is sand available in Raft Channel downstream of the lower end of the Three West area (plate 31). In some locations there is an overburden of fine material that would have to be removed to access the sand. Concerns have been expressed with borrowing sand from Raft Channel for the following reasons:

a. Raft Channel, though impounded, is a major secondary channel that has not been disturbed to any degree by human activity.

b. Raft Channel contains mussel beds that appear to be less infested with zebra mussels than mussel beds in other areas in pool 8. There is concern that dredging could impact these relatively healthy mussel beds.

The current position of river resource management agencies is that limited borrow from Raft Channel is acceptable, as long as mussel resources are not appreciably affected and the dredging provides secondary fish habitat benefits.

Off Channel Areas

Borrow dredging from off channel areas would also be an option. Borrow dredging from off channel areas, depending on location, can provide substantial secondary fish habitat benefits. There would be constraints associated with off channel borrow areas for this project. One of the primary objectives is to protect shallow aquatic areas to promote the growth of aquatic vegetation. It would be counter-productive to dredge such areas to the extent that they would become too deep to support aquatic vegetation. Borings indicate there are some accessible sand deposits in the Three West and Three Central areas. Due to habitat objectives and physical constraints, it is unlikely that any significant amount of sand could be borrowed from within the Three West area.

Sand is also present in Schnick's Bay, northwest of the Three North area (plate 31). There is 5-10 feet of fine material overburden atop the sand. Dredging in Schnick's Bay would provide the opportunity to create protected deep habitat for fish. At present, it appears that Schnick's Bay could provide between 150,000 and 200,000 cy of sand. Further investigations would be required to assess the amount of sand available and its accessibility.

Dredged Material Containment Sites

The St. Paul District maintains designated sites for the placement of material (sand) dredged to maintain the navigation channel. Two of these sites are located in some proximity to the project area. The Brownsville site is located on the right bank of the navigation channel at

river mile 688.7, about 3.2 miles from the center of the Three West area. This site has land access and is an active beneficial use removal site.

The Above Brownsville site is located on the left bank of the navigation channel at river mile 690.4, about 5 miles from the center of the Three West area. This site is a temporary placement site that must be periodically emptied to maintain capacity. Approximately 300,000 cubic yards of material was removed from this site in 1999-2001 and transferred to the Brownsville site for use by the Minnesota Department of Transportation in a highway project. No further excavation from this site is planned for 2002.

Due to their distances from the project area, it would not be cost-effective to use material from either of these sites for construction of islands in the Three West area solely under the UMRS-EMP. Use of these sites would cost more than obtaining sand material from the other sources discussed above, and would provide no habitat benefits commensurate with the increased cost.

Use of these sites could be considered cost effective if cost-shared with the St. Paul District's channel maintenance program for the 9-Foot Navigation Channel project. The UMRS-EMP program benefits in that sand can be obtained at a lower cost than from an alternative source. (The potential habitat benefits foregone at the alternative borrow site must also be considered.) The District's channel maintenance program benefits in that the habitat project may offer a lower cost dredged material placement alternative. Cooperative use of channel maintenance material has been successfully implemented in a limited manner with the Pool 8 Islands Phase I project, and more extensively with the Polander Lake Stage 2 project in pool 5A.

The potential for use of material from the Brownsville site in a cost-shared manner was evaluated. At the present time, there in no financial incentive for the District's channel maintenance program to participate in removal of material from this site. Current beneficial use removal is sufficient to maintain capacity at the site. Excavation of a hole to provide future capacity at this site may not be desirable because material used to fill the hole would not be available for beneficial use by contractors and others who have become accustomed to using material placed at this site. It has taken some time to build up public demand for sand at this site and it would not be prudent to negate these efforts by suddenly cutting off the supply. This effect could be mitigated by placement of material at the site in a manner that would insure some of it was accessible for beneficial use removal.

A similar evaluation was conducted for the Above Brownsville site. The 2000-2001 excavation has provided capacity at this site such that there is not a pressing need for additional excavation at this time. However, the site will eventually need to be excavated and the opportunity may offer itself to use this material for island construction for the Phase III project. There are uncertainties associated with use of material from the Above Brownsville site in terms of meshing Phase III project construction with the channel maintenance program's placement site unloading priorities. Because of these uncertainties, this site has not been identified as a definite

source of sand material for the Phase III project. The situation will be reassessed during the preparation of construction plans and specifications to determine if use of sand from the Above Brownsville containment site is feasible and cost effective. A preliminary assessment indicates the potential for substantial costs savings ($2-3.00/cubic yard) with use of sand from this site for island construction in the Three West and Three North areas. Because of the distances involved, the potential for savings in the Three Central area are smaller.

Currently Proposed Source

The current proposed source of sand material from the Three West area islands is a combination of Schnick's Bay, Raft Channel, and the main channel. It is proposed to construct the Three West Islands concurrent with the Three North Islands. Raft Channel or main channel sand would be used to construct the initial islands to provide a place to use the fine material overburden from Schnick's Bay. The amount of sand dredged from Schnick's Bay would be maximized to the extent practical. It is currently estimated that in combination, the Three West and Three North area islands would require about 356,000 cy of sand. If 150,000-200,000 cy can be obtained from Schnick's Bay, then the amount dredged from Raft Channel and/or the main channel would be in the range of 150,000 to 200,000 cy.

Additional investigations (borings/testing) will be required to better define the amount of sand available at Schnick's Bay. Once that information is available an excavation plan would need to be developed to obtain the sand while minimizing the effects on nearby aquatic plant beds.

8.1.4.2 Random Fill

It is expected that most random fill will come from access dredging material that contains too much fine material to be used in the sand sections of the islands and too little fine material to be considered fine fill for topsoil. If the contractor does not need to use the random fill island sections for disposal of access dredging material, it is expected that it would be most cost effective for the contractor to use sand for the random fill.

8.1.4.3 Fine Fill

It is expected that the fine fill (topsoil) would come from access dredging within the Three West area and overburden material dredged from Schnick's Bay.

8.1.4.4 Rock

New rock for the project would come from quarries in Wisconsin or Minnesota. The location of the loading site would depend upon the location of the quarry. Sites used in the past for rock loading for projects in this area include Stoddard, Brownsville, and La Crosse.

The St. Paul District is currently considering rehabilitation measures for the L/D 8 earthen embankment. The rehabilitation may require removal of some of the rock on the upstream face of the embankment. If this rock is not reused in the embankment it may be available for use on the Three West islands, reducing need to acquire new rock. This potential opportunity to reduce costs will be explored during the preparation of construction plans and specifications.

8.1.5 OTHER FEATURES

In certain locations, trees would be incorporated into the construction of the rock groins and vanes to provide additional habitat diversity. Plates 20 and 24 show conceptual designs for these features. Green trees (recently dead) or waterlogged snags would be preferred to minimize buoyancy. Dry snags could be used with additional anchoring rock. The trees and/or snags used would be obtained from the Refuge in locations approved by the U.S. Fish and Wildlife Service.

8.2 THREE NORTH AREA

8.2.1 ISLANDS

The selected plan for the Three North area is the construction of eight islands as shown on plate 21. Plate 22 shows a typical cross section for the islands, while plate 18 shows other features. Table 8-4 summarizes the design data for the islands.

8.2.1.1 Island N1 and Island N2

Islands N1 and N2 are located at the upper end of the Three North area. Their primary function is to protect the interior of the area from flows coming down Raft Channel. They also restore island area that has eroded away over the past decade or two. These islands would also increase visual isolation for waterfowl using the Three North area during migration.

Island N1 contains a 600-foot rock sill that would serve as an overflow point to equalize head differentials and prevent erosion of the earthen sections of the islands. Groins would be placed on the exterior (Raft Channel) side of the islands for stabilization.

Island N1 would be planted with a tree mix consisting of bur oak, swamp white oak, black oak, hackberry, and green ash. A grass/forb mix would be planted that would provide ground cover, but would not compete with the trees. Two rows of willows/indigobush would be planted on the Raft Channel side of the island. Trees/logs would be placed along the interior shoreline to provide loafing/basking sites for waterfowl, turtles, etc.

Willows/indigobush would be planted along the Raft Channel side shoreline of Island N2. Trees/logs would be placed along the interior shoreline. The island would be seeded with the same grass/forb mix used on Islands W1 and W2.

8.2.1.2 Islands N3 – N6

Islands N3 through N6 are seed islands, small rock berms placed perpendicular to the direction of flow in locations where accretion of sediment behind the island would be expected to result in the natural formation of islands. To "jump start" or accelerate this process, sand may be placed on the downstream sides of the rock berms. This sand would not be stabilized. River currents would be allowed to reshape the sand into more natural appearing sand spits.

Table 8-4
Summary of Design Data for Three North Islands

Island	Length (ft)	Base Width (ft)	Top Width (ft)	Exterior Berm (ft)	Interior Berm (ft)	Top Elevation	Berm Elevation
N1 (north)	1400	135	40	45	30	634.0	632.0
N1 (south)	810	rock sill	rock sill	rock sill	rock sill	631.5	n.a.
N2	1680	125	40	45	30	633.0	632.0
N3	122	105	78	n.a.	n.a.	634.5	n.a.
N4	100	105	78	n.a.	n.a.	634.5	n.a.
N5	250	130	103	n.a.	n.a.	634.5	n.a.
N6	250	130	103	n.a.	n.a.	634.5	n.a.
N7	2258	120	45	45	30	632.0	632.0
N8	5950	150	45	45	45	632.0	632.0

Island	End Protection	Exterior Protection	Interior Protection	Sand Fill (cy)	Random Fill (cy)	Fine Fill (cy)	Rock (cy)
N1	n.a.	Groins	none	1,212	3,166	3,112	1,690
N2	Riprap	Groins	none	21,471	2,791	5,464	1,013
N3	n.a.	n.a.	n.a.	2,729	-	-	255
N4	n.a.	n.a.	n.a.	2,188	-	-	189
N5	n.a.	n.a.	n.a.	4,326	-	-	463
N6	n.a.	n.a.	n.a.	3,942	-	-	406
N7	Riprap	Groins/ Vanes	Groins/ Vanes	43,034	-	6,900	1,736
N7 mudflat	n.a.	n.a.	n.a.	-	-	15,700	-
N8	Riprap	Groins/ Vanes	Groins/ Vanes	59,881	-	9,912	15,726
Total				138,783	5,957	41,088	21,478

8.2.1.3 Island N7

The purpose of island N7, aside from providing additional habitat diversity, would be to protect the shallow upper portions of the Three North area from southerly and southeasterly winds.

The ends of island N7 would be protected by rock riprap while rock groins and vanes would be placed along the sides for stabilization.

Island N7 would be seeded with same grass/forb mix used on Islands W1and W2. Willows/indigobush would be planted sparingly on the Raft Channel side of the island.

8.2.1.4 Island N8

The purpose of island N8, aside from providing additional habitat diversity, would be to protect portions of the Three North area from southerly and southeasterly winds. Island N8 was also designed to protect a deepwater area on its downstream side from river currents to create overwintering habitat for Centrarchids and other backwater fish species.

About one-half of Island N8 would be rock sills designed to be overflow sections during floods. The sill would be 0.5 foot lower than the earthen portion of the island.

The ends of island N8 would be protected by rock riprap while rock groins would be placed along the sides for stabilization.

Willows/indigobush would be planted along the shoreline on both sides of the island. On the west leg of Island N8, the same tree mix described above for Island N1. A ground cover that would not compete with the trees would be planted. The east leg of the island would be planted with the same seed mix used on Island W3.

8.2.1.5 Construction Methods

The same construction methods described previously for the Three West area would apply to the Three North area. There is nothing in the design of the Three North islands and other features to suggest that any innovative or unusual construction methods would be necessary.

8.2.1.6 Construction Restrictions

The same construction restrictions discussed previously for the Three West area would also apply to the Three North area.

8.2.2 MUDFLATS

A mudflat would be constructed at Island N7 as shown on plate 21. The method of construction would be as described earlier in Section 8.1.2.

8.2.3 ACCESS DREDGING

Access dredging will be required to construct the project. Generally, a balance must be struck to provide reasonable access for the contractor while minimizing the environmental disturbances associated with the dredging. In addition, being able to incorporate the access dredging material into the islands avoids the costs of having to transport this material elsewhere for disposal.

Plate 23 shows proposed access routes for construction of the Three North islands that should provide adequate access for construction while minimizing secondary effects. It should be noted that these are routes where dredging could occur to obtain access. If a contractor can access other portions of the construction without dredging, he is generally free to do so. Contractors are allowed (and occasionally do) request alternate access routes. These would be evaluated on a case-by-case basis for approval.

8.2.4 SOURCES OF MATERIAL

Table 8-3 summarizes the expected sources of fill material for the Three North area.

8.2.4.1 Sand

The sources of sand material considered and the proposed sources of sand for the Three North area were described in the sand material discussions for the Three West area (Section 8.1.4.1).

8.2.4.2 Random Fill

It is expected that most random fill will come from access dredging material that contains too much fine material to be used in the sand sections of the islands and too little fine material to be considered fine fill for topsoil. If the contractor does not need to use the random fill island sections for disposal of access dredging material, it is expected that it would be most cost effective for the contractor to fill out the random fill sections with sand.

8.2.4.3 Fine Fill

It is expected that most of the fine fill would come from access dredging within the Three North area and from Schnick's Bay.

8.2.4.4 Rock

The sources of rock for the Three North area would be the same as previously discussed for the Three West area.

8.2.5 OTHER FEATURES

As discussed previously in Section 8.1.5, trees would be incorporated into the construction of the rock groins and vanes to provide additional habitat diversity. Plates 20 and 24 show conceptual designs for these features. In addition, trees would be incorporated into the Island N1 and Island N8 rock sills to increase habitat diversity. A conceptual design is shown on plate 25.

8.3 THREE CENTRAL AREA

8.3.1 ISLANDS

The selected plan for the Three Central area is the construction of seven islands as shown on plate 26. Plate 27 shows a typical cross section for the islands, while plate 18 shows other features. Table 8-5 summarizes the design data for the islands.

8.3.1.1 Island C2

Island C2 would be constructed along the left bank of Raft Channel. The primary function of the island is to restore river flow regimes by increasing velocities in adjacent channels and reducing velocities in backwater areas protected by the island.

Under an earlier design, Island C2 had an upper leg. To reduce costs, this upper leg has been replaced by three small rock mounds (C2a, C2b, C2c) similar in design to seed Islands N3-N6 previously described. The only difference is that in this area, the accretion of sand behind the rock mounds is expected to be minimal. The only "islands" that will form will be sand placed on the downstream sides of the rock mounds and subsequently shaped by river flows.

Island C2c would be constructed using a combination of woody material (snags) and rock (plate 28). The purpose would to test an innovative design to improve habitat diversity. This same design would be used in a 500-foot section of the west leg of Island C2, again as a test of this design concept.

The ends of island C2 would be protected by rock riprap while rock groins and vanes would be placed along the sides for stabilization.

Willows/indigobush would be planted along the shoreline on both sides of the island. The island would be seeded with the same grass/forb mix used on Island W3.

8.3.1.2 Island C3

Island C3 would be constructed below Island C2 and is designed to work in concert with Island C2 by protecting the area sheltered by Island C2 from southerly and southeasterly winds.

The ends of island C3 would be protected by rock riprap while rock groins would be placed along the downstream side for stabilization.

Island C3 would be planted/seeded in the same manner as Island C2.

Table 8-5
Summary of Design Data for Three Central Islands

Island	Length (ft)	Base Width (ft)	Top Width (ft)	Exterior Berm (ft)	Interior Berm (ft)	Top Elevation	Berm Elevation
C2a	200	105	78	n.a.	n.a.	634.5	n.a.
C2b	220	105	78	n.a.	n.a.	634.5	n.a.
C2c	140	105	78	n.a.	n.a.	634.5	n.a.
C2	4470	150	60	45	45	632.0	632.0
C3	900	115	40	45	30	632.0	632.0
C4 (west)	2430	130	40	45	20	634.5	632.0
C4 (east)	1270	150	60	45	45	632.0	632.0
C5	1200	115	40	45	30	632.0	632.0
C6	1220	130	40	45	45	632.0	632.0
C7	890	130	40	45	45	632.0	632.0
C8 (west)	2920	150	40	45	45	634.0	632.0
C8 (u. east)	1030	rock sill	rock sill	rock sill	rock sill	631.5	n.a.
C8 (l. east)	1500	150	60	45	45	632.0	632.0

Island	End Protection	Exterior Protection	Interior Protection	Sand Fill (cy)	Random Fill (cy)	Fine Fill (cy)	Rock (cy)
C2a	n.a.	n.a.	n.a.	4,314	-	-	618
C2b	n.a.	n.a.	n.a.	4,618	-	-	669
C2c	n.a.	n.a.	n.a.	3,035	-	-	449
C2	Riprap	Groins/ Vanes	Groins/ Vanes	124,567	-	17,384	2,294
C3	Riprap	Groins	Groins	24,921	-	2,591	997
C4	Riprap	Groins/ Vanes	Groins/ Vanes	89,799	11,865	13,730	1,867
C4 mudflat	n.a.	n.a.	n.a.	-	-	42,122	-
C5	Riprap	Groins	Groins	28,016	-	3,587	1,209
C6	Riprap	Groins	Groins	26,739	-	3,867	984
C7	Riprap	Groins	Groins	19,445	-	2,802	890
C8	Riprap	Groins/ Vanes	Groins/ Vanes	127,669	11,099	31,491	8,346
Total				453,123	22,964	117,574	18,323

8.3.1.3 Island C4

Island C4 would be constructed along the left bank of Raft Channel downsteam of Island C2. Like Island C2, the primary function of Island C4 is to restore river flow regimes by increasing velocities in adjacent channels and reducing velocities in backwater areas protected by the island.

The ends of island C4 would be protected by rock riprap while rock groins and vanes would be placed along the sides for stabilization.

Willows/indigobush would be planted along the outer shoreline only. The west portion of Island C4 would be seeded with the same mix used on Islands W1 and W2. The east portion of Island would be seeded with the same mix used on Islands W3 and W4. The goal is to maintain herbaceous vegetation along the shoreline, rather than shrubs, to increase use by loafing waterbirds.

8.3.1.4 Island C5

Island C5 would be constructed below Island C4 and is designed to work in concert with Island C4 by protecting the area sheltered by Island C4 from southerly and southeasterly winds.

The ends of island C5 would be protected by rock riprap while rock groins would be placed along the downstream side for stabilization.

Island C5 would be planted/seeded in the same manner as Island C2.

8.3.1.5 Island C6

Island C6 would be constructed east of Island C2. The primary function of Island C6 is to provide protection to shallow areas from southerly winds. Rock groins would be placed along the sides for stabilization.

Island C6 would be planted/seeded in the same manner as Island C2.

8.3.1.6 Island C7

Island C7 would be constructed west of Island C8. Like Island C6, the primary function of Island C7 is to provide protection to shallow areas from southerly winds. Rock groins would be placed along the sides for stabilization.

The ends of island C7 would be protected by rock riprap while rock groins and vanes would be placed along the sides for stabilization.

Island C7 would be planted/seeded in the same manner as Island C2.

8.3.1.7 Island C8

Island C8 would be constructed in the southeast portion of the Three Central area. As with Islands C2 and C4, the primary function of Island C8 is to restore river flow regimes by increasing velocities in adjacent channels and reducing velocities in backwater areas protected by the island. The island is also designed to provide current protection for an area of deeper water located within the interior of the island.

The upper east leg of Island C8 would be a 1,100-foot long rock sill. As with other rock sill described previously, the primary purpose is to provide an overflow section for flood flows. The rock sill would 0.5 foot lower than the earthen sections of the island.

The ends of island C8 would be protected by rock riprap while rock groins and vanes would be placed along the sides for stabilization. Sand tips would be placed on Island C8 similar as discussed previously for many of the Three West area islands.

On the west leg, a tree mix comparable to that described for Island N1 would be planted, along with a non-competing ground cover. The east leg would be planted/seeded as described for Island C2.

8.1.1.8 Construction Methods

The same construction methods described previously for the Three West area would apply to the Three Central area. There is nothing in the design of the Three Central islands and other features to suggest that any innovative or unusual construction methods would be necessary.

8.1.1.9 Construction Restrictions

The same construction restrictions discussed previously for the Three West area would also apply to the Three Central area.

8.3.2 MUDFLATS

A mudflat would be constructed at Island C4 as shown on plate 26. The method of construction would be as described earlier in Section 8.1.2.

8.3.3 ACCESS DREDGING

Access dredging will be required to construct the project. Generally, a balance must be struck to provide reasonable access for the contractor while minimizing the environmental

disturbances associated with the dredging. In addition, being able to incorporate the access dredging material into the islands avoids the costs of having to transport this material elsewhere for disposal.

Plate 29 shows proposed access routes for construction of the Three Central islands that should provide adequate access for construction while minimizing secondary effects. It should be noted that these are routes where dredging could occur to obtain access. If a contractor can access other portions of the construction without dredging, he is generally free to do so. Contractors are allowed (and occasionally do) request alternate access routes. These would be evaluated on a case-by-case basis for approval.

8.3.4 SOURCES OF MATERIAL

Table 8-6 summarizes the expected sources of fill material for the Three Central area.

8.3.4.1 Sand

The same sources of sand material considered for the Three West area (Section 8.1.4.1) were considered for the Three Central area. As noted earlier, some accessible sand has been identified within the Three Central area in the old channel between Islands C7 and C8 (plate 31).

The currently proposed source of sand material for the Three Central area is a combination a site within the Three Central area, Raft Channel, and the main channel. The amount of sand fill obtained from within the Three Central area would be maximized. It is currently estimated that about 200,000 cy can be obtained from within the Three Central area. That would require obtaining about 250,000 cy from the main channel.

The proposed borrow location in the main channel is an area between river miles 683 and 684 (plate 31). This area was selected because it has been determined to be relatively free of mussels. In addition, it is located downstream of the Phase II seed islands such that borrow in this location should have little potential for affecting sand transport in the seed island area. The main channel is about 500 feet wide and 13 feet deep in this reach. Excavation of 250,000 cubic yards would require a dredge cut 500 feet wide x 1,125 feet long x 12 feet deep (25 foot total depth).

8.3.4.2 Random Fill

It is expected that most random fill will come from access dredging material that contains too much fine material to be used in the sand sections of the islands and too little fine material to be considered fine fill for topsoil. If the contractor does not need to use the random fill island sections for disposal of access dredging material, it is expected that it would be most cost effective for the contractor to fill out the random fill sections with sand.

Table 8-6
Three Central Material Sources

Feature	Sand Fill Required	Sand Fill Source	Random Required	Random Fill Source	Fine Fill Required	Fine Fill Source	Rock
Island C2a	4,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	618
Island C2b	5,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	669
Island C2c	3,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	449
Island C2	118,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	17,000	access dredging	3,274
Island C3	20,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	3,000	access dredging	997
C3 Sand Berm	5,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	-
Island C4	83,000	Raft Channel/Three Central area/main channel at mile 683	12,000	access dredging	12,000	access dredging	1,867
C4 Mudflat	-	n.a.	-	n.a.	42,000	access dredging	-
C4 Sand Berm	6,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	-
Island C5	22,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	4,000	access dredging	1,209
C5 Sand Berm	6,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	-	n.a.	-
Island C6	27,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	4,000	access dredging	984
Island C7	19,000	Raft Channel/Three Central area/main channel at mile 683	-	n.a.	3,000	access dredging	738
Island C8	128,000	Raft Channel/Three Central area/main channel at mile 683	11,000	access dredging	31,000	access dredging	8,346
	446,000		23,000		116,000		19,151

8.3.4.3 Fine Fill

It is expected that most of the fine fill would come from access dredging within the Three Central area.

8.3.4.4 Rock

The sources of rock for the Three North area would be the same as previously discussed for the Three West area.

8.3.5 OTHER FEATURES

As discussed previously in Section 8.1.5, trees would be incorporated into the construction of the rock groins and vanes to provide additional habitat diversity. In addition, trees would be incorporated into the Island C8 rock sill to increase habitat diversity.

8.4 THREE EAST AREA

The selected plan for the Three East area is the construction of three rock breakwater-type islands (E1, E2, E3) off the Coon Creek delta (plate 30). Island E1 is designed to protect the delta from river flows, while the primary purpose of Islands E2 and E3 are to protect the delta from southerly and southwesterly winds.

Plate 18 shows typical cross sections for these features. Also included in the selected plan is the construction of rock mound bank protection at East Island (river mile 685.1 left bank). A typical cross section is shown on plate 18.

Islands E1 and E3 would be constructed of rock. Island E2 would be constructed of a combination of woody material (snags) and rock. A total of about 5,740 cubic yards of rock will be required. It is expected that the rock would be loaded at whichever site is selected as the rock loading point for the islands being constructed in the Three West, North, and Central areas. As discussed previously, the snags would be obtained from within the Refuge in locations approved by the U.S. Fish and Wildlife Service.

During the preparation of plans and specifications, consideration will be given to placing fill material on the landward sides of Islands E2 and E3 to promote the growth of vegetation to screen these structures from a nearby highway that is part of the Great River Road system.

The upstream side of Island E1 would be constructed at an approximate slope of 1V:10H using gravel/cobble fill. The purpose is to provide the type of substrate preferred by walleye and other species for spawning. Due to its location, it is expected that this substrate will be kept free of silt and other fine particles by river currents and wave action.

No access dredging is expected to be required for these features. A sufficiently long construction window can be provided such that the contractor should be able to take advantage of high water periods to construct these features without access dredging.

No unique construction restrictions are foreseen for construction of the Three East features. The area lies outside of the closed portion of the Refuge so construction could take place during the fall waterfowl migration season.

8.5 CONSTRUCTION SCHEDULE

The scope of the project will require multi-year construction. Due to the location and nature of the construction, nearly all of the work will require use of marine equipment. Construction of this type is limited to the open water season on the Upper Mississippi River. Construction in certain years can begin in April, but May is a more typical for beginning construction due to the constraints associated with spring high water. At the other end of the spectrum, late November is the end of the construction season due to winter freeze-up.

All of the Pool 8 Islands Phase III project features, except for the Three East area breakwaters, are located within a closed area of the Upper Mississippi River National Wildlife and Fish Refuge. As such, the U.S. Fish and Wildlife Service has indicated that construction will not be allowed in these areas during the fall migration season (essentially October and November).

The construction schedule for the project will be dependent upon the funds available for construction and other factors such as the potential for meshing construction with District operation and maintenance activities or the need to accommodate other habitat measures such as pool drawdown. Based on current and expected UMRS-EMP budgets, and project priorities within the St. Paul District, it is most likely that construction for the Pool 8 Islands Phase III project will begin in 2005. If future UMRS-EMP budgets were to be higher than projected, the District would have the capability to begin construction as early as the summer of 2003.

Project construction is scheduled in three stages. Stage 1 would be construction of the Three West and Three North features. Stage 2 would be construction of the Three Central features. Stage 3 would be construction of the Three East features. The construction of the island features as one large contract is not considered desirable for a couple of reasons. First, a single large contract would reduce competition because of the limited number of firms that would be able to bid on the project. Secondly, commitment of a significant portion of St. Paul District habitat program funds to one large contract extending over a number of years would reduce program flexibility.

The Three West and Three North features combined would be about equal in scope to the Three Central features. The resource management agencies participating in the planning of the project recommend that the Three West and Three North areas be constructed first. The Three West features are slightly more cost effective than the Three North and Three Central features (table 7-4.1) though the difference is relatively insignificant. From a constructibility perspective, there would be no appreciable difference in which island group was constructed first. The construction of the Three West and Three North features is scheduled to take place before construction of the Three Central features, primarily based on the recommendations of the participating resource management agencies.

There would be some flexibility in island construction sequencing depending upon funds availability and management priorities. For example, some of the Three Central islands could be included in the first construction contract and/or some of the Three North or Three West islands could be delayed until the second construction contract.

The Three East features would be constructed under a separate contract, as they are entirely rock features. There would be increased competition for this work. In addition, this would increase program flexibility as the contract could be awarded in any given year, depending up funds availability. If funds do become constraining, the Three East features would be the last to be constructed.

Table 8-7 shows the projected construction schedule for the project. The five-year construction schedule assumes the availability of approximately $3.0 million/year for construction. Given the relatively short construction window (5 months) in any given year, the availability of additional funds during this period would probably not appreciably shorten the five-year schedule. If less funds are available, the construction schedule would be stretched out as necessary.

Table 8-7
Construction Schedule*
Pool 8 Island Phase III Project

May-Sep 2005	Initiate construction of Three West and Three North features
May-Sep 2006	Continue construction of Three West and Three North features
May-Sep 2007	Complete construction of Three West and Three North features Initiate construction of Three Central features
May-Sep 2008	Continue construction of Three Central features
May-Sep 2009	Complete construction of Three Central features

* The construction of the Three East features could be constructed in any given year depending on the availability of funds. As noted earlier, the Three East features could also be constructed during the Oct-Nov time frame.

ENVIRONMENTAL ASSESSMENT

An environmental assessment has been conducted for the proposed action and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors act, the categories of impacts listed in the impact assessment matrix (table 9-1) were reviewed and considered in arriving at the final determination. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation was prepared (attachment 3). The Minnesota Pollution Control Agency has waived its water quality certification authority under Section 401 of the Clean Water Act. It is Wisconsin Department of Natural Resources policy not to issue water quality certification until they have the opportunity to review construction plans and specifications. The Finding of No Significant Impact has been signed and is attached at the end of the report.

TABLE 9-1

IMPACT ASSESSMENT MATRIX

NAME OF PARAMETER	MAGNITUDE OF PROBABLE IMPACT						
	<— INCREASING BENEFICIAL IMPACT			NO APPRECIABLE	INCREASING ADVERSE IMPACT —>		
A. SOCIAL EFFECTS	SIGNIFICANT	SUBSTANTIAL	MINOR	EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
1. Noise Levels					X		
2. Aesthetic Values				X			
3. Recreational Opportunities				X			
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth & Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality				X			
2. Terrestrial Habitat			X				
3. Wetlands					X		
4. Aquatic Habitat		X					
5. Habitat Diversity and Interspersion		X					
6. Biological Productivity		X					
7. Surface Water Quality					X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Hist & Historic Archeological Values				X			

9.1 RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

The proposed action would comply with all applicable Federal environmental laws, executive orders, and policies, and State and local laws and policies including the Clean Air Act, as amended; the Clean Water Act of 1977, as amended; the Endangered Species Act of 1973, as amended; the Land and Water Conservation Fund Act of 1965, as amended; the National Environmental Policy Act of 1969, as amended; the Fish and Wildlife Conservation Act of 1958, as amended; the National Wildlife Refuge System Administration Act; Executive Order 11988 - Floodplain Management; and Executive Order 11990 - Protection of Wetlands. The proposed action would not result in the conversion of farmland to non-agricultural uses. Therefore, the Farmland Protection Policy Act of 1981 does not apply to this project.

9.2 NATURAL RESOURCE EFFECTS

9.2.1 FISH AND WILDLIFE RESOURCES

The proposed island features would improve aquatic habitat on approximately 2,840 acres in lower pool 8. The restoration of island complexes and the expected increase in vegetation and diversity in this area would improve migration habitat for waterfowl. Increased vegetation diversity and extent, the creation of deep holes in selected areas, and the restoration of channel flows in key areas would improve habitat for fish as well as many other aquatic species.

The proposed features would restore over 100 acres of island habitat in this reach of the pool. These islands, and associated mudflats, would provide important habitat for a wide variety of wildlife species, as well as important migration habitat for neotropical migrants.

The construction of barrier islands at the mouth of Coon Creek would preserve, and possibly result in the expansion of, the diverse delta habitat that is present. Placement of a rock mound on the downstream side of East Island would prevent the loss of habitat, due to erosion from wind fetch, on this established island.

In order to quantify habitat benefits of the proposed actions, The U.S. Fish and Wildlife Services' Habitat Evaluation Procedure (HEP) was used. The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing existing HU's to HU's expected to be gained with the proposed action, the benefits can be quantified. Based on the management objectives of the U.S. Fish and Wildlife Service for this portion of the Upper Mississippi River Wildlife and Fish Refuge, waterfowl models were used to quantify habitat benefits and evaluate the effectiveness of the proposed project features. A detailed discussion of the habitat evaluation procedures conducted for this project is presented in Attachment 4.

9.2.1.1 Waterfowl

It is anticipated that the construction of the islands in lower pool 8 will result in conditions conducive to the re-establishment of extensive aquatic vegetation beds and an increase in the diversity of vegetation species present. Vegetation beds in the West, Central and North areas are expected to expand from an aerial extent of 632 acres, to over 1,390 acres, a 120-percent increase. Increased vegetation extent and diversity, restoration of island complexes affording protection from prevailing winds and disturbance, and the increased presence of mudflats would all contribute to an increase in the value of the project area as waterfowl migration habitat. The models used for this evaluation indicates that the migration habitat value increases would range from 32 percent in the Central area to about 120 percent in the West area.

Construction of barrier islands at the mouth of Coon Creek would maintain this small but important resting area for waterfowl, and could lead to a 15-acre increase in delta habitat.

9.2.1.2 Fish

Although habitat benefits were not quantified, substantial improvements in the fish habitat would occur as a result of the proposed action. As the barrier islands have been lost, areas of concentrated channel flow have been diminished, with the area becoming more characteristic of a lacustrine system. Construction of the island complexes would restore to a great degree the riverine process in the evaluation areas, especially as it relates to channel flow, thus reducing sedimentation in key areas and restoring bathymetric and flow diversity. Dredging activities to obtain material for island construction would result in the creation of deep holes that could provide over wintering habitat for many species of fish, especially Centrarchids. Studies have indicated that winter habitat on the river may be a critical habitat component to maintaining fish populations on the river. Some species have been tracked traveling several miles to winter habitat. The establishment of additional winter fish habitat in this part of pool 8 could contribute to maintaining healthy fish populations in the pool.

9.2.1.3 Other Wildlife

Numerous other wildlife benefits, not quantified by the habitat models, would accrue with project construction. The islands and associated vegetation would provide habitat for a wide variety of species including; roosting habitat for raptors, migration and nesting habitat for neotropical migrants and nesting habitat for turtles. The island and associated shallow water zones would provide marsh habitat for marsh and water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and shorebirds. Aquatic and semi-aquatic mammals, such as muskrats, and many species of reptiles and amphibians would have improved habitat conditions with the increased aquatic vegetation and associated marsh habitat that would develop around the islands.

9.2.2 WETLANDS

The construction of the islands in lower pool 8 would result in the placement of fill material in about 130 acres of riverine habitat. In addition, about 22 acres of mudflats would be constructed as part of these features, and an additional 7 acres of shallow water or island habitat would accrete behind the seed islands in the North area. The cumulative effect of the proposed action would be the conversion/restoration of a total of between 130 – 160 acres of riverine habitat to terrestrial habitat. The quality of the aquatic habitat in these areas currently is limited due to sedimentation, lack of flow diversity, extensive susceptibility to wind fetch and lack of aquatic vegetation. The expected increase in habitat quality in the affected areas would more that offset aquatic habitat losses associated with construction.

Fill material for the islands may be obtained by dredging in selected areas of Raft Channel, the Central area, access dredging, Schnick's Bay and, if necessary, the main channel. Dredge material from channel maintenance activities may also be used if the opportunity becomes available. Numerous mussel surveys have been conducted in Raft Channel and proposed access or borrow areas. Except for portions of Raft Channel, mussel resources in most of the area are limited and of low diversity. Activities in Raft Channel will be planned to avoid affecting established mussel beds. Riprap and rock fill for the proposed project would come from established quarries in the area.

9.2.3 WATER QUALITY

The proposed action would result in short-term decreases in water quality because of localized increases in turbidity during construction or dredging.

8.2.4 ENDANGERED SPECIES

No state listed or federally listed threatened or endangered species would be adversely affected by the project. No threatened or endangered mussel species were identified during extensive mussel surveys that have been conducted in the project area over the last several years (2000 and 2001).

9.3 CULTURAL RESOURCES EFFECTS

Overall, the recommendations that have resulted from cultural resource investigations pertaining to the barrier island construction projects have concluded that they provide long-term preservation of the remnant natural islands. Therefore, we believe that there will be no adverse effect to as yet undiscovered archaeological sites. In addition, the review of known shipwreck locations in relation to proposed dredge/borrow locations indicates that the project will not affect any of those structures. Both the Minnesota and Wisconsin state historic preservation offices concur with the no adverse effect determination.

9.4 SOCIOECONOMIC EFFECTS

The proposed action would have minimal or no impacts on the following socioeconomic categories: transportation, public health and safety, aesthetics, recreation opportunities, community cohesion, community growth and development, business or home relocations, land use, property values, tax revenues, regional growth, employment, business activity, food supply, navigation, flooding effects or energy resources.

9.4.1 NOISE

The immediate vicinity around the project area, and at the boat landings may be temporarily disrupted by construction activities. Some disturbance may occur from noise and human activity. These effects would be temporary and adverse effects to the general public would be short-term and insignificant.

9.5 CUMULATIVE EFFECTS

The proposed project is the third phase of a five-phase plan to rehabilitate habitat in lower pool 8. Phase I, the construction of Horseshoe and Boomerang Islands was completed in 1993, and Phase II, near Stoddard, was completed in 1999. While each phase was designed to function as a complete stand-alone project, the synergistic effects of the combined phases enhance the habitat benefits that are derived from each project individually. Combined with Phase I and Phase II, over 4,000 acres of fish and wildlife habitat would be improved in this reach of Pool 8. If all five phases were constructed, the cumulative effect would be to restore and improve habitat conditions over a 5,000-acre portion of lower pool 8. Additional information concerning the cumulative effects of the proposed action is presented in the Summary of Plan Accomplishments section of this report.

SUMMARY OF PLAN ACCOMPLISHMENTS

The selected plan will substantially improve habitat conditions over a large portion of lower pool 8. The habitat improvements, while focusing on improving conditions for migratory waterfowl within a critical component of the Upper Mississippi River National Wildlife and Fish Refuge, will also improve habitat for a variety of other fish and wildlife such as shorebirds, wading birds, aquatic mammals, terrestrial wildlife, turtles, lacustrine and lotic fish, and mussels.

The project will restore and/or create about 123 acres of islands, nearly doubling the amount of island acreage remaining in lower pool 8 in 1989. Since that time, the completion of the Pool 8 Islands Phase I and Phase II projects have added about 59 acres of islands to this area. The addition of the Phase III islands would bring the total island acreage in lower pool 8 to over 300 acres, approximately the amount present in 1961 (see table 4-1, page 4-3).

The islands recommended for construction will protect about 1,000 acres of shallow aquatic habitat from large wind fetches, improving conditions for the growth of aquatic vegetation. This constitutes about 10 percent of the lake-like portion of lower pool 8. Additional areas of deeper water will also be within the areas protected by the islands.

Habitat quality in the Three West area for migratory waterfowl is projected to improve by about 120 percent, resulting in about a 170-percent increase in available average annual habitat units. The comparable increases projected for the Three North area are both about 40 percent. For the Three Central area, they are about 35 and 30 percent, respectively.

Substantial habitat benefits to shorebirds and wading birds are expected to accrue due to the creation of about 80,000 linear feet of sandy shoreline and four mudflats totaling about 22 acres. The sand berms of the islands will also provide a substantial amount of area available for turtle nesting.

The 123 acres of islands created will provide habitat for terrestrial and semi-aquatic species of wildlife. This type of habitat is nearly non-existent in the areas where the islands would be constructed.

The islands will help maintain about 20,000 linear feet of submerged channel, which will contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. Islands N8 and C8 will create two protected deepwater areas about 60 and 40 acres in size, respectively, that will provide overwintering habitat for Centrarchids and other backwater fish species. This type of habitat is of critical importance in the project area where overwintering habitat is almost non-existent due to the loss of islands.

The project would contribute significantly to the cumulative long-term habitat restoration goals for lower pool 8 by supplementing the habitat gains already realized by Phases I and II of the comprehensive Pool 8 Island project. When combined, the three phases of the Pool 8 Islands project will improve habitat over about a 4,500-acre portion of lower pool 8.

Plates 32 and 33 show the Pool 8 Islands Phase II habitat project. They illustrate the types of habitat changes that are expected with the Phase III project. The 1961 photo (plate 32) shows habitat conditions in the Phase II project area in 1961. This is the general habitat condition the project was designed to achieve. The 1994 photo (plate 32) shows the Phase II project area prior to construction of the project. The 2000 (plate 32) and 2001 photos (plate 33) show the Phase II project area after completion of the project in 1999.

Table 10-1 summarizes how the recommended Phase III project meets the planning goals and objectives established at the beginning of the study.

TABLE 10-1
Meeing Project Goals and Objectives

Goal	Project Objective	Met/Not Met	Discussion
Goal W-1 - Restore 550 acres of puddle duck habitat.	W-1(A): Provide 125 acres with conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Met	130 acres provided meeting these conditions.
	W-1(B): Provide 300 acres with conditions important for the growth of submersed aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Partially Met	270 acres provided meeting these conditions.
	W-1(C): Restore islands to meet puddleduck habitat needs.	Met	45 acres of islands restored in a manner to improve puddleduck habitat needs.
	W-1(D): Provide 40 acres of sand/mudflats.	Partially Met	32 acres provided
	W-1(E): Provide waterfowl loafing sites (10-20 per acres).	Met	30,000+ linear feet of island shoreline created that will be available for waterfowl loafing.
Goal N-1 - Restore 470 acres of puddle duck habitat.	N-1(A): Provide 100 acres with conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Met	105 acres provided meeting these conditions.
	N-1(B): Provide 300 acres with conditions important for the growth of submersed aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Met	325 acres provided meeting these conditions.
	N-1(C): Restore islands to meet puddleduck habitat needs.	Met	24 acres of islands restored in a manner to improve puddleduck habitat needs.
	N-1(D): Provide 15 acres of sand/mudflats.	Partially Met	5 acres provided
	N-1(E): Provide waterfowl loafing sites (10-20 per acres).	Met	15,000+ linear feet of island shoreline created that will be available for waterfowl loafing.
Goal C-1 - Restore 950 acres of waterfowl habitat.	C-1(A): Provide 700 acres with conditions important for the growth of submersed aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Partially Met	430 acres provided meeting these conditions.
	C-1(B): Maintain/enhance conditions preferred by fingernail clams.	Met	Conditions within the Three Central area should remain suitable for fingernail clams.
	C-2(A): Create 2-3 acres of nesting habitat.	Met	54 acres of island created, some of which will provide nesting habitat.

TABLE 10-1 CONT'D
Meeing Project Goals and Objectives

Goal	Project Objective	Met/Not Met	Discussion
Goal O-1 - Create habitat for migratory birds, turtle nesting, mammals, reptiles, amphibians, and raptors.	O-1: Provide a diversity of habitat conditions suitable for a wide variety of species.	Met	Restoration of 123 acres of islands in the manner proposed should result in substantial improvements in habitat diversity and habitat quality for a wide variety of wildlife species.
Goal O-2 - Create and maintain protected lacustrine habitat for backwater fish species.	O-2(A): Create overwintering habitat for centrarchids in three locations with a minimum size of 60 acres; D.O. > 5 mg/l; current velocity < 0.3 cm/sec; suitable water temperatures; and depths > 4 ft over 40% of area.	Partially Met	Overwintering habitat created in two locations, one approximately 60 acres and one approximately 40 acres in size.
	O-2(B): Create fishery summer habitat with dissolved oxygen > 5 mg/l and aquatic vegetation cover.	Met	The island restoration project is expected to substantially improve growing conditions for aquatic vegetation. Dissolved oxygen levels are expected to be > 5 mg/l.
	O-2(C): Enahance or create spawning, rearing, and juvenile backwater fisheries habitat.	Met	The island shorelines, underwater slopes and protected areas will create substantial areas with conditions favored by spawning Cenrarchids and preferred habitat for juvenille fish of a variety of species.
Goal O-3 - Enhance habitat for riverine fish species and mussels.	O-3: Enhance habitat by creating flowing channel bordered by islands at least 2,000 feet; provide areas of scour and eddies; a variety of substrates; and connectivevity with other channels.	Met	The project will create 40,000 linear feet of islands. A substantial portion of these islands border flowing channel or are configured in a manner to stimulate the formation of flowing channels.
Goal E-1 - Maintain Coon Creek delta.	E-1: Maintain Coon Creek delta at current size.	Met	The recommended plan to construct 3 breakwaters should as a minimum maintain the Coon Creek delta at its current size.
Goal NW-1 - Maintain Schnick's Bay as shallow aquatic habitat.	NW-1: Reduce sedimentation in Schnick's Bay from Wildcat Creek.	Not Met	The costs and environmental effects of rerouting Wildcat Creek were not considered justified.

OPERATION AND MAINTENANCE

11.1 GENERAL

Upon completion of construction, the U.S. Fish and Wildlife Service would accept responsibility for the project in accordance with Section 107(b) of the Water Resources Development Act of 1992. The operation and maintenance responsibilities of the U.S. Fish and Wildlife Service are addressed in the Memorandum of Agreement for the project (attachment 7).

Specific operation and maintenance requirements would be defined in project operation and maintenance (O&M) manuals, which would be prepared by the Corps of Engineers, and coordinated with the U.S. Fish and Wildlife Service.

11.2 OPERATION

There are no specific operational requirements associated with any of the project features that would be the responsibility of the U.S. Fish and Wildlife Service. The Service would be required to conduct periodic inspections of their portions of the project and submit reports of inspection activities and maintenance performed.

11.3 MAINTENANCE

The U.S. Fish and Wildlife Service will perform maintenance on the project as necessary for it to remain functional. The estimated average annual operation and maintenance costs for the U.S. Fish and Wildlife Service maintained portion of the project are shown in table 11-1. The average annual costs are shown in September 2001 price levels.

Table 11-1
Average Annual Operation and Maintenance Costs - U.S. Fish and Wildlife Service

Feature	O&M Cycle	Average Annual Cost
a. Rock replacement	10-yr	$18,200
b. Period inspections	5-yr	$ 1,735
c. Annual inspections	1-yr	$ 2,500
Average annual amount		$22,435

Not all project features will require maintenance. Table 11-2 categorizes project features as to the expected level of maintenance. Critical features are those that must be maintained for structural integrity or for the feature to provide the majority of the habitat benefits for which it was designed. Non-critical features are those where minor change is acceptable and the need for maintenance will be considered on a case-by-case basis. Dynamic features are those where river forces will be allowed to shape the features with no future maintenance anticipated.

Table 11-2
Maintenance Categorization of Project Features

Critical – Must Be Maintained or Repaired

Rock sill tie-in points with islands
Rock end protection
Rock groin or vane tie-in points with islands
Major damage to rock sills

Non-Critical – Maintained or Repaired if Determined Necessary

Individual rock groins or vanes
Island shorelines
Rock seed islands
Minor damage to rock sills

Dynamic – No Maintenance

Mudflats
Sandflats
Sand tips on islands
Sand placed on seed islands
Wooden habitat structures
Borrow sites
Access channels

PROJECT PERFORMANCE EVALUATION

Project performance evaluation was designed to directly measure the degree of attainment of the project objectives. Table 12-1 summarizes the overall monitoring approach used for UMRS-EMP habitat projects. Table 12-2 summarizes the specific monitoring that would be conducted for the recommended features of the Pool 8 Islands Phase III project.

The project is located within pool 8, a key pool intensively monitored under the Long Term Resource Monitoring Program. A substantial amount of physical, chemical, and biological data will be collected within the project area as part of routine LTRMP monitoring. This information will contribute substantially to the evaluation of the success of the project in meeting project objectives.

TABLE 12-1
UMRS-EMP Monitoring and Performance Evaluation Matrix

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Problem Analysis	System-wide problem definition. Evaluate planning assumptions.	USGS	USGS (UMESC)	LTRM	Lead into pre-project monitoring; define conditions for plan formulation.
Pre-project Monitoring	Identify and define problems at specific sites.	Sponsor	Sponsor	Sponsor	Should attempt to begin defining baseline.
Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field stations or sponsors thru Agreements, or Corps.*	HREP	Should be over several years to reconcile perturbations.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	After fact sheet. Data aid in defining baseline.
Construction Monitoring	Assure permit conditions met.	Corps	Corps	HREP	
Performance Evaluation Monitoring	Determine success of projects.	Corps	Field stations or sponsors thru Cooperative Agreements, sponsor thru O&M**, or Corps.*	HREP	After construction.
Analysis of Biological Responses to Projects	1. Determine critical impact levels, cause-effect relationships, and long-term losses of significant habitat.	USGS	USGS (UMESC)	LTRM	Biological Response tasks beyond scope of Performance Problem Analysis, and Trend Analysis.
	2. Demonstrate success or response of biota.	Corps	Corps/USGS (UMESC)/Others	HREP	

*Choice depends on logistics. When done by the States under a Cooperative Agreement, the role of the UMESC will be to: (1) advise and assist in assuring QA/QC consistency, (2) review and comment on reasonableness of cost estimates, and (3) be the financial manager. If a private firm or State is funded by contract, coordination with the UMESC is required to assure QA/QC consistency.

**Some limited reporting of information for some projects (e.g., waterfowl management areas) could be furnished by on-site personnel as part of O&M.

TABLE 12-2
POST-CONSTRUCTION MONITORING

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
Goal W-1 - Restore 550 acres of puddle duck habitat.	W-1(A): Provide 125 acres with conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Islands	Emergent vegetation % cover and species; current velocities (ft/sec)	Emergent vegetation, and current velocities.	Emergent vegetation would be monitored at 5 year intervals. Current velocities would be measured 1 year post-construction.	$10,000
	W-1(B): Provide 300 acres with conditions important for the growth of submergent aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Islands	Submergent vegetation % cover and species	Submergent vegetation.	Submergent vegetation would be monitored at 5 year intervals.	Covered in the cost for W-1(A)
	W-1(C): Restore islands to meet puddleduck habitat needs.	Islands	Acres	Island area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	$5,000
	W-1(D): Provide 40 acres of sand/mudflats.	Mudflats and sand flats.	Acres	Sand and mudflat area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
	W-1(E): Provide waterfowl loafing sites (10-20 per acres).	Mudflats, sand flats, stumps.	Number	Presence or absence of features (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
Goal N-1 - Restore 470 acres of puddle duck habitat.	N-1(A): Provide 100 acres with conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Islands	Emergent vegetation % cover and species; current velocities (ft/sec)	Emergent vegetation, and current velocities.	Emergent vegetation would be monitored at 5 year intervals. Current velocities would be measured 1 year post-construction.	Covered in the cost for W-1(A)
	N-1(B): Provide 300 acres with conditions important for the growth of submergent aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Islands	Submergent vegetation % cover and species	Submergent vegetation.	Submergent vegetation would be monitored at 5 year intervals.	Covered in the cost for W-1(A)

TABLE 12-2 Cont'd
POST-CONSTRUCTION MONITORING

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
	N-1(C): Restore islands to meet puddleduck habitat needs.	Islands	Acres	Island area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
	N-1(D): Provide 15 acres of sand/mudflats.	Mudflats and sand flats.	Acres	Sand and mudflat area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
	N-1(E): Provide waterfowl loafing sites (10-20 per acres).	Mudflats, sand flats, stumps,	Number	Presence or absence of features (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
Goal C-1 - Restore 950 acres of waterfowl habitat.	C-1(A): Provide 700 acres with conditions important for the growth of submergent aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Islands	Submergent vegetation % cover and species	Submergent vegetation.	Submergent vegetation would be monitored at 5 year intervals.	Covered in the cost for W-1(A)
	C-1(B): Maintain/enhance conditions preferred by fingernail clams.	* No features specifically proposed for this objective.	N/A	N/A	N/A	N/A
	C-2(A): Create 2-3 acres of nesting habitat.	Islands	Nesting cover	Visual survey and evaluation.	5, 10, 25, and 50 years post-construction.	$3,000
Goal O-1 - Create habitat for migratory birds, turtle nesting, mammals, reptiles, amphibians, and raptors.	O-1: Provide a diversity of habitat conditions suitable for a wide variety of species.	Islands	Islands (ac), beaches (lf), mudflats (ac)	Visual and aerial photos.	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)
Goal O-2 - Create and maintain protected lacutrine habitat for backwater fish species.	O-2(A): Create overwintering habitat for centrarchids in three locations with a minimum size of 60 acres; D.O. > 5 mg/l; current velocity < 0.3 cm/sec; suitable water temperatures; and depths > 4 ft over 40% of area.	Deep protected areas.	Acres, dissolved oxygen levels (mg/l), current velocities (cm/sec), water temperatures (degrees C), and depths (feet).	Dissolved oxygen, current velocity, water temperature, and depth during the winter.	Water depths would be monitored periodically as part of the LTRMP key pool monitoring program. The other parameters would be monitored 2, 5, 10, 20, 30, 40, and 50 years post-construction.	$4,000

TABLE 12-2 Cont'd
POST-CONSTRUCTION MONITORING

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
	O-2(B): Create fishery summer habitat with dissolved oxygen > 5 mg/l and aquatic vegetation cover.	Islands	Dissoved oxygen (mg/l), aquatic vegetation	Dissolved oxygen, aquatic vegetation	5 year intervals post-construction	Vegetation covered in the costs for W-1A. Dissolved oxygen - $2,000
	O-2(C): Enahance or create spawning, rearing, and juvenile backwater fisheries habitat.	Islands	Dissoved oxygen (mg/l), aquatic vegetation	Dissolved oxygen, aquatic vegetation	5 year intervals post-construction	Covered in the costs for W-1(A) and/or O-2(B).
Goal O-3 - Enhance habitat for riverine fish species and mussels.	O-3: Enhance habitat by creating flowing channel bordered by islands at least 2,000 feet; provide areas of scour and eddies; a variety of substrates; and connectivevity with other channels.	Islands	Acres	Island area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Cover in the cost for W-1(C).
Goal E-1 - Maintain Coon Creek delta.	E-1: Maintain Coon Creek delta at current size.	Breakwaters	Acres	Delta area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for W-1(C)

* While the island complexes were designed to contribute to these desired habitat conditions as much as possible, no independent features are proposed for these objectives.

COST ESTIMATE

The total project cost for the selected plan is estimated to be $15,214,000 as summarized in table 13-1. This cost does not include prior allocations of $500,000 for general design (planning). A detailed cost estimate is contained in attachment 2. The fully funded cost of the project for budgeting purposes is estimated to be $17,724,000.

Table 13-1
Summary of the Selected Plan and Costs*

Mobilization	$ 913,000
Three West Islands	4,540,000
Three North Islands	2,928,000
Three Central Islands	5,152,000
Three East Structures	311,000
Construction Subtotal	$13,844,000
Planning, Engineering, and Design	$ 609,000
Construction Management	$ 761,000
Total Cost	$15,214,000

*August 2001 price levels

REAL ESTATE REQUIREMENTS

This Environmental Management Program project is located in pool 8 of the Upper Mississippi River in Houston County, Minnesota, and Vernon County, Wisconsin. This direct Federal project will be constructed entirely on lands owned by the United States of America. Additionally, the navigational servitude applies to any work performed within the river. The project is located on lands are administered by the U.S. Fish and Wildlife Service and are managed by the Service as part of the Upper Mississippi River National Wildlife and Fish Refuge. No additional interest in any lands will be necessary to complete this project.

SCHEDULE FOR DESIGN AND CONSTRUCTION

A schedule for review and approval, major work tasks, and project construction is shown below. This schedule is based on current and projected UMRS-EMP budgets.

Requirement	Scheduled Date
Submit final Definite Project Report to Mississippi Valley Division (MVD), U.S. Army Corps of Engineers	Apr 2002
MVD submits final Definite Project Report to Headquarters, U.S. Army Corps of Engineers	Jul 2002
Headquarters, U.S. Army Corps of Engineers approves project for construction	Oct 2002
Complete plans and specifications	Sep 2004
Advertise for bids	Oct 2004
Award initial construction contract	Dec 2004
Complete construction	Sep 2009

IMPLEMENTATION RESPONSIBILITIES

The responsibility of plan implementation and construction fall to the Corps of Engineers as the lead Federal agency. After construction of the project, project operation and maintenance would be required for features of the project as outlined in the OPERATION AND MAINTENANCE section of this report. The U.S. Fish and Wildlife Service would be responsible for operation and maintenance of the project upon completion.

Should rehabilitation of those portions of the Pool 8 Islands Phase III project located on the Refuge be needed which exceeds the annual maintenance requirements (as a result of a specific storm or flood), a mutual decision between the participating agencies will be made whether or not to rehabilitate those portions of the project. If rehabilitated, the Federal share of rehabilitation would be the responsibility of the Corps of Engineers.

Performance evaluation, which includes monitoring of physical/chemical conditions and some limited biological parameters, would be a Corps of Engineers responsibility.

Attachment 7 contains a draft of the formal agreement that would be entered into by the Corps of Engineers and the U.S. Fish and Wildlife Service. The Memorandum of Agreement formally establishes the relationships between the Department of the Army, represented by the Corps of Engineers, and the U.S. Fish and Wildlife Service in constructing, operating, and maintaining the project.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

The planning for the Pool 8 Islands Phase III project has been an interagency effort involving the St. Paul District, the U.S. Fish and Wildlife Service, and the Minnesota and the Wisconsin Departments of Natural Resources. Interagency coordination meetings and site visits were held on a periodic basis throughout the study phase. In additions to the meetings, informal coordination took place on an as-needed basis to address specific problems, issues, and ideas.

Initial public meetings were held in Brownsville, Minnesota, and Stoddard, Wisconsin, on 24 and 25 April 2000, respectively, to inform the public of the study and solicit input concerning fish and wildlife habitat conditions and problems within the project area. The Brownsville meeting was attended by 16 private citizens, while 29 private citizens attended the Stoddard meeting.

A Problem Appraisal Report was completed for the project in June 2000 which addressed the existing conditions and habitat problems in the project area, identified habitat goals and objectives, and identified alternatives to be studied in detail that would address the habitat goals and objectives.

Public meetings were held in Brownsville, Minnesota, and Stoddard, Wisconsin, on 05 and 19 September 2001, respectively, to present the results of the study and the preliminary recommended plan. The Brownsville meeting was attended by 10 private citizens, while 14 private citizens attended the Stoddard meeting.

The draft Definite Project Report/Environmental Assessment was sent to Congressional interests; Federal, State and local agencies; special interest groups; interested citizens; and others as listed in attachment 1.

CONCLUSIONS

The Pool 8 Islands Phase III habitat rehabilitation and enhancement project provides the opportunity to restore habitat for fish, migratory birds, and other forms of fish and wildlife indigenous to the Upper Mississippi River. The loss of islands, decline in aquatic vegetation, and changes in bathymetry have significantly reduced the value of the project area to fish and wildlife. Similar changes occurred throughout the lower reaches of pool 8.

A number of measures are aimed at correcting existing habitat problems and improving habitat conditions. Construction of the proposed islands will substantially improve conditions for the growth of aquatic plants and improve overall habitat diversity in the project area.

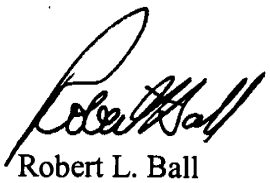
Most of the project lies within a closed area of the Upper Mississippi River National Wildlife and Fish Refuge significant to the protection and well being of migrating waterfowl. The islands will improve conditions for migratory waterfowl by increasing food resources, improved migratory resting areas, and by creating areas that will provide thermal protection during severe weather conditions.

The islands and associated habitats will provide improved habitat conditions for a wide variety of wildlife ranging from shorebirds to mammals to neotropical songbirds. The islands are designed to maintain and enhance flowing channels within the lake-like portion of lower pool 8 which in turn will improve conditions for lotic fish species and mussels. Some of the islands are designed to protect deep-water habitats from currents such that they would provide suitable overwintering habitat for Centrarchids and other lentic fish species. The lack of overwintering habitat has been identified by natural resource agencies as an important limiting factor to overall fish habitat quality in lower pool 8.

The habitat benefits that would be gained by the Upper Mississippi River System from implementation of the project justify expenditure of public funds for preparation of plans and specifications and for construction.

RECOMMENDATION

I have weighed the accomplishments to be obtained from the Pool 8 Islands Phase III project against its cost and have considered the alternatives, impacts, and scope of the proposed project. The total estimated cost of the project at current price levels is $15,714,000 (including sunk general design costs of $500,000). As the project located on national wildlife refuge lands, project costs would be 100-percent Federal in accordance with Section 906 (e) of Public Law. In my judgement, the cost the project is a justified expenditure of Federal funds. Therefore, I recommend that the Pool 8 Islands Phase III Project for habitat restoration and enhancement in pool 8 of the Upper Mississippi River be approved for construction.



Robert L. Ball
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

Environmental and Economic Analysis Branch
Planning, Programs, & Project Management Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the St. Paul District, Corps of Engineers has assessed the impacts of the following project.

POOL 8 ISLANDS PHASE III
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN AND HOUSTON COUNTY, MINNESOTA

The intent of the proposed project is to improve fish and wildlife habitat, especially waterfowl migration habitat, along the Upper Mississippi River near Stoddard, Wisconsin and Brownsville, Minnesota. The proposed project involves the construction of islands to reduce wind fetch, increase vegetation extent and diversity, and restore channnel flows to selected areas. The proposed features would improve aquatic habitat on approximately 2,800 acres in lower Pool 8.

This Finding of No Significant Impact is based on the following factors: the proposed project would have beneficial impacts on wildlife and fishery resources; the project would have no impacts on the social environment; the project would have no impacts on the aesthetic/recreation environment; and the project would have no impacts on the cultural environment.

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the environment. Therefore, an environmental impact statement will not be prepared.

18 APRIL 02
Date

Robert L. Ball
Colonel, Corps of Engineers
District Engineer

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PLATES

UPPER MISSISSIPPI RIVER SYSTEM

(9 FOOT NAVIGATION CHANNEL PROJECT AREA)

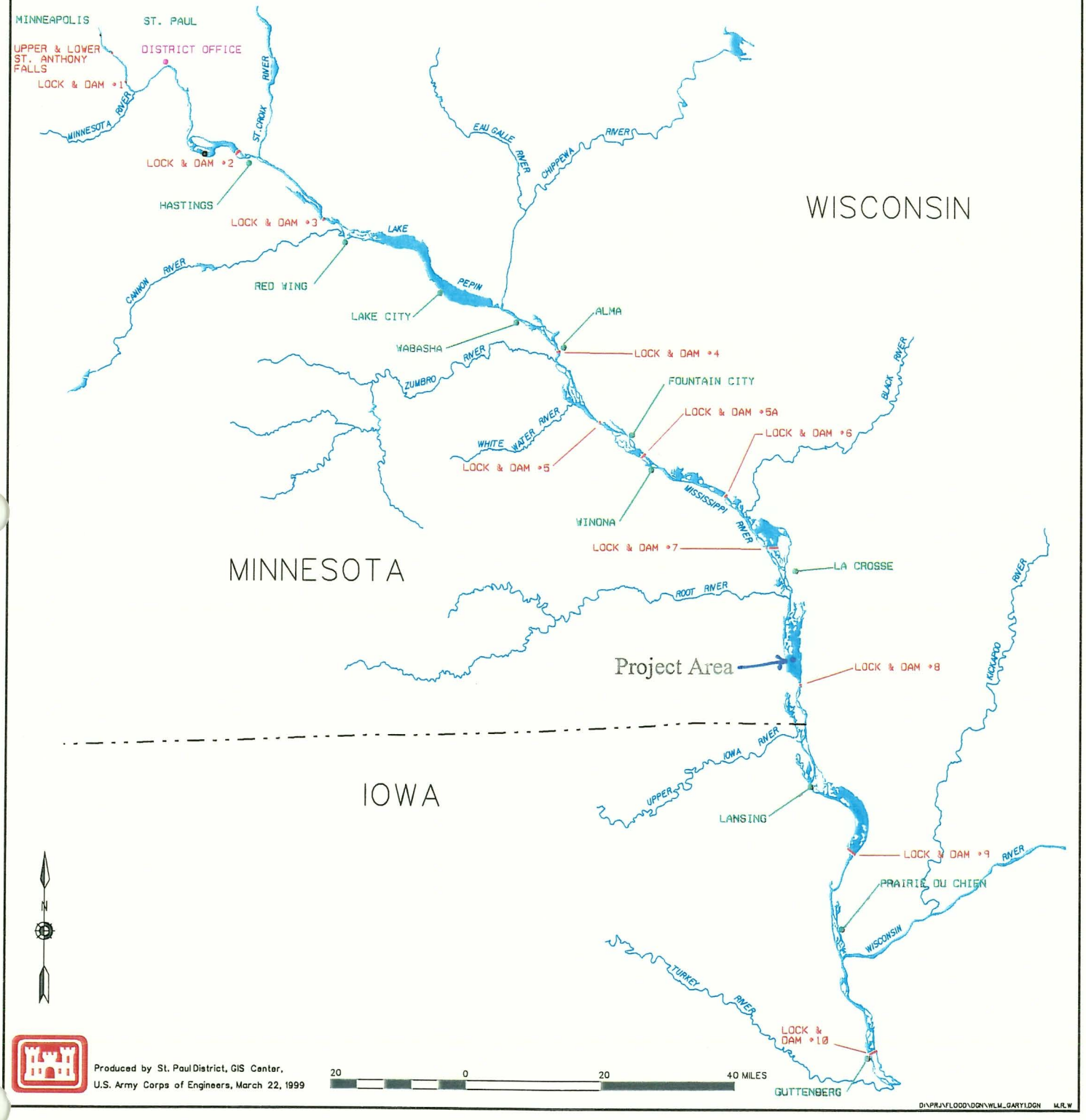
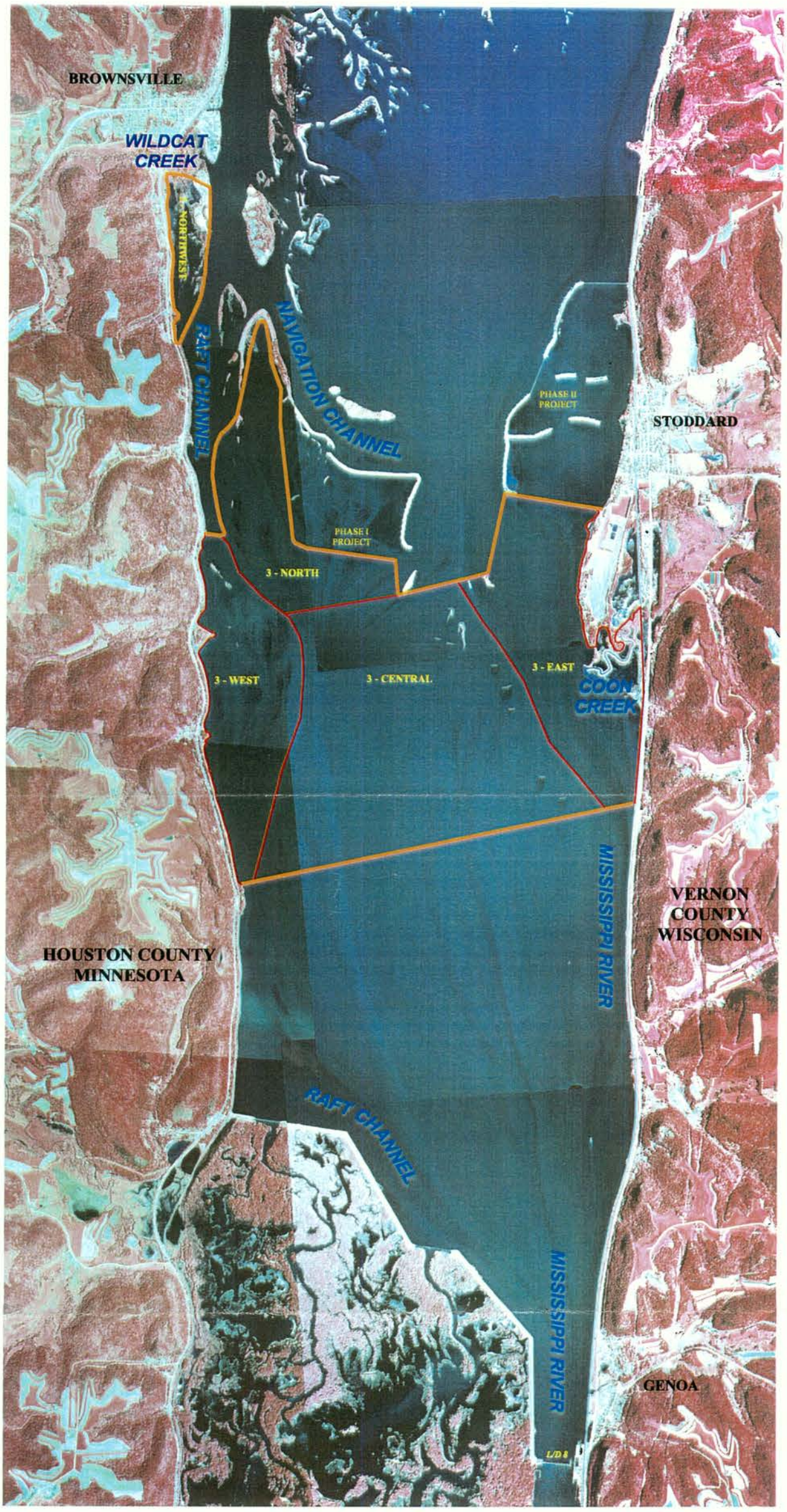


Plate 1

POOL 8 ISLANDS - PHASE III PROJECT AREA



4000 0 4000 8000 Feet

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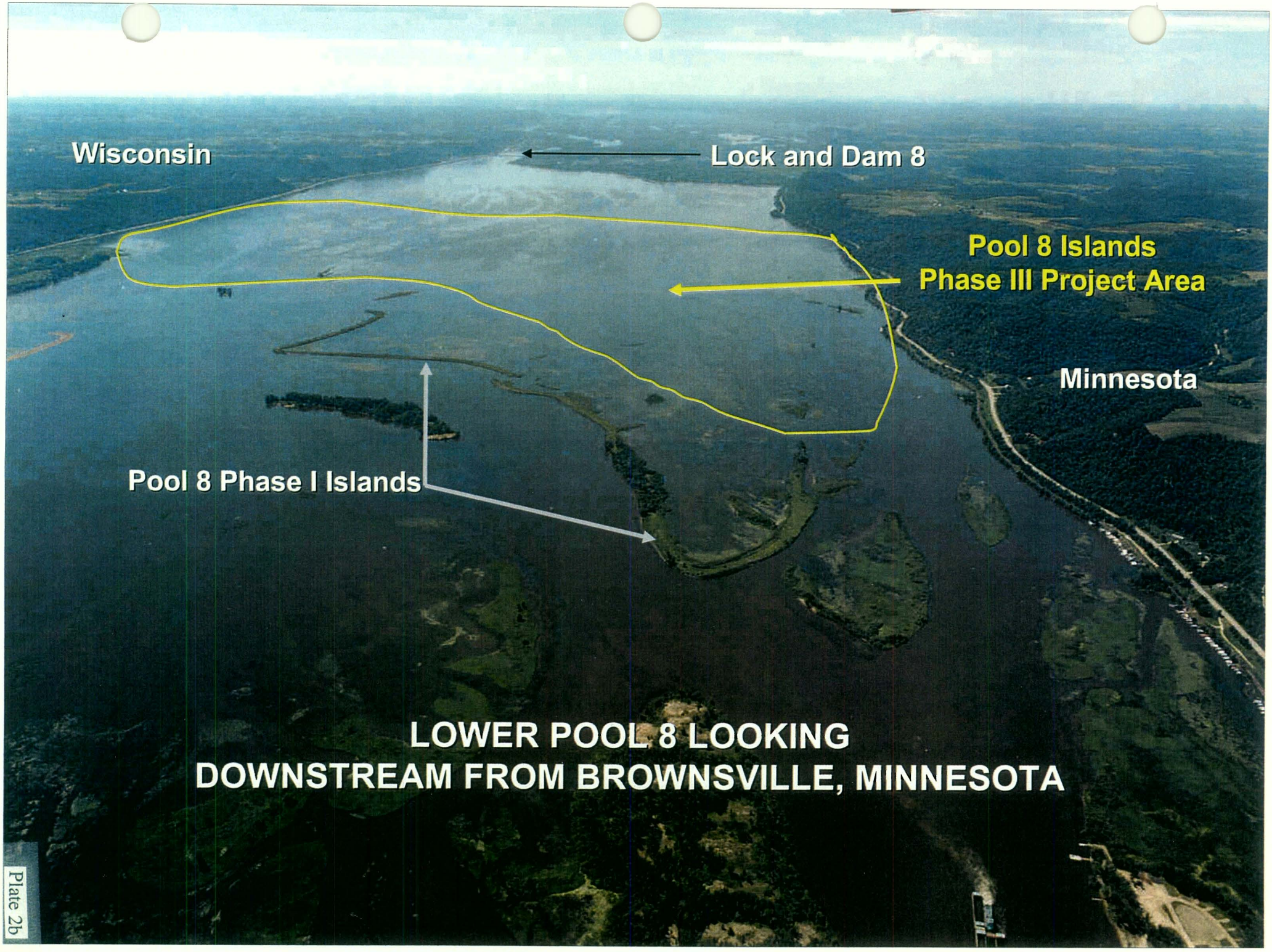
Infrared Photo Base: May 26, 1999 (Water Level: 632.0)

N
W E
S

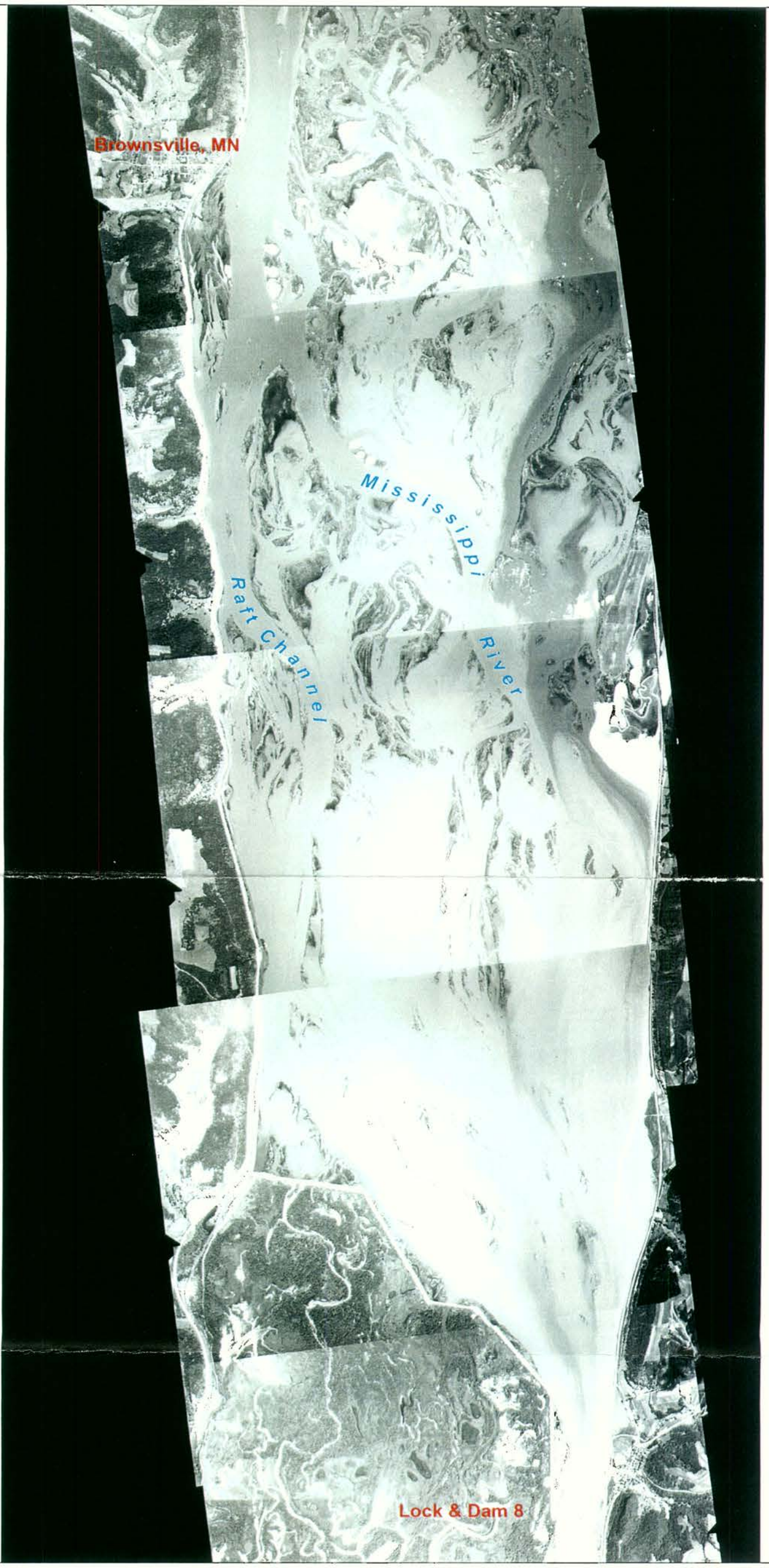
02-22-00 M.R.W p8_isle3.apr

Plate 2a



LOWER POOL 8 LOOKING DOWNSTREAM FROM BROWNSVILLE, MINNESOTA

Plate 2b



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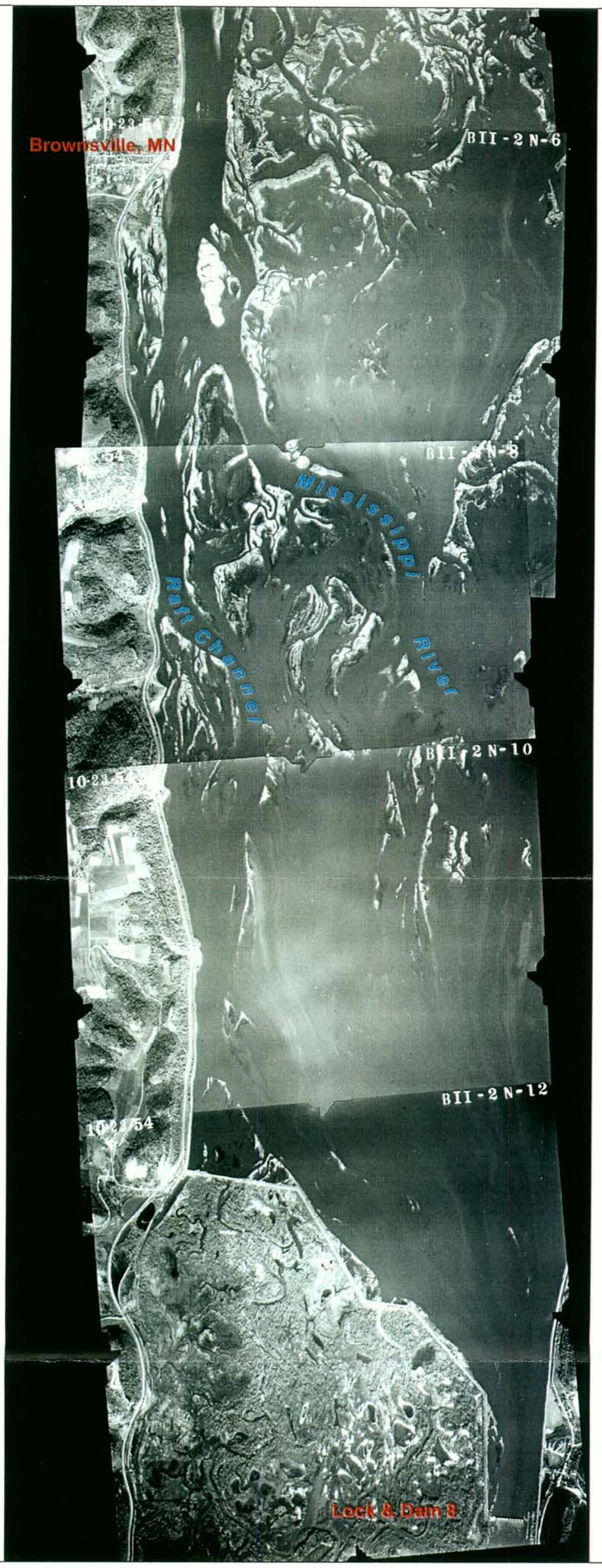
POOl 8 - 1947 IMAGERY

0 0.5 1 2 3 Miles

N

PME62540 C:/BYRON/ARCMAP_PROJECTS/POOL9.MXD BGW

Plate 3a



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POOl 8 - 1954 IMAGERY

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PME62540 C:/BYRON/ARCMAP_PROJECTS/POOL9.MXD BGW

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POOl 8 - 1961 IMAGERY

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Miles

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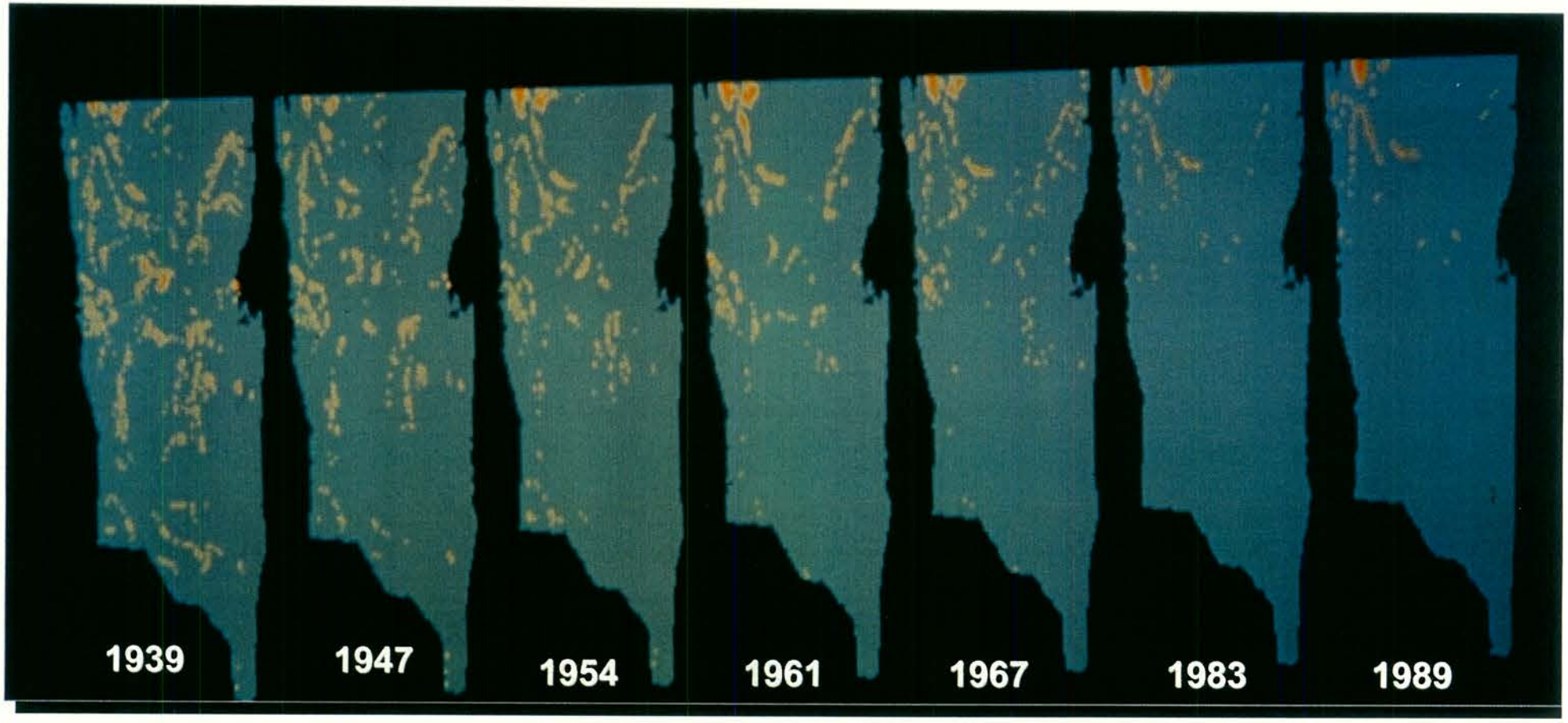
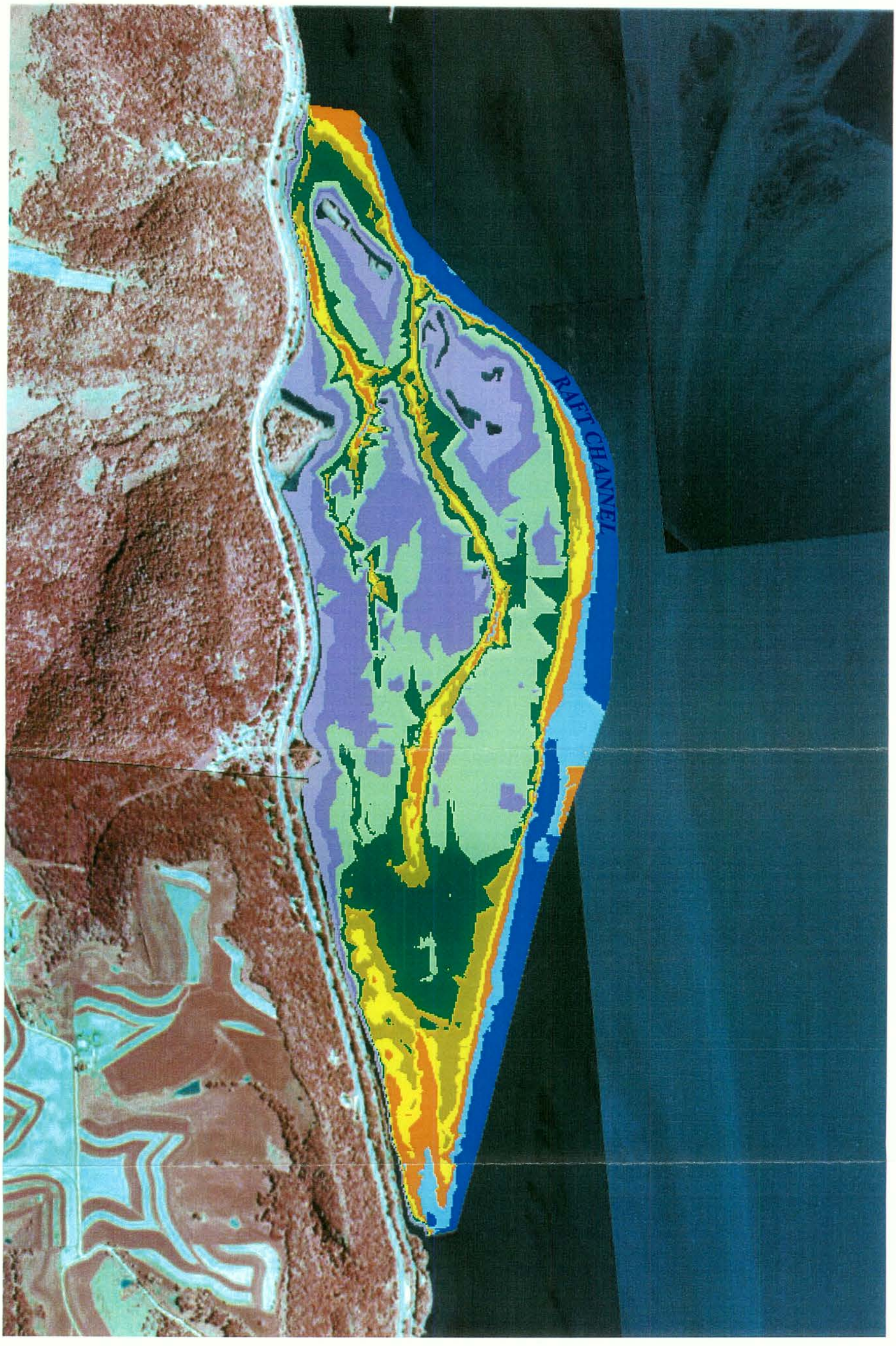
Plate 3c



Lower Pool 8 Island Loss

Plate 3d



1000 0 1000 2000 Feet

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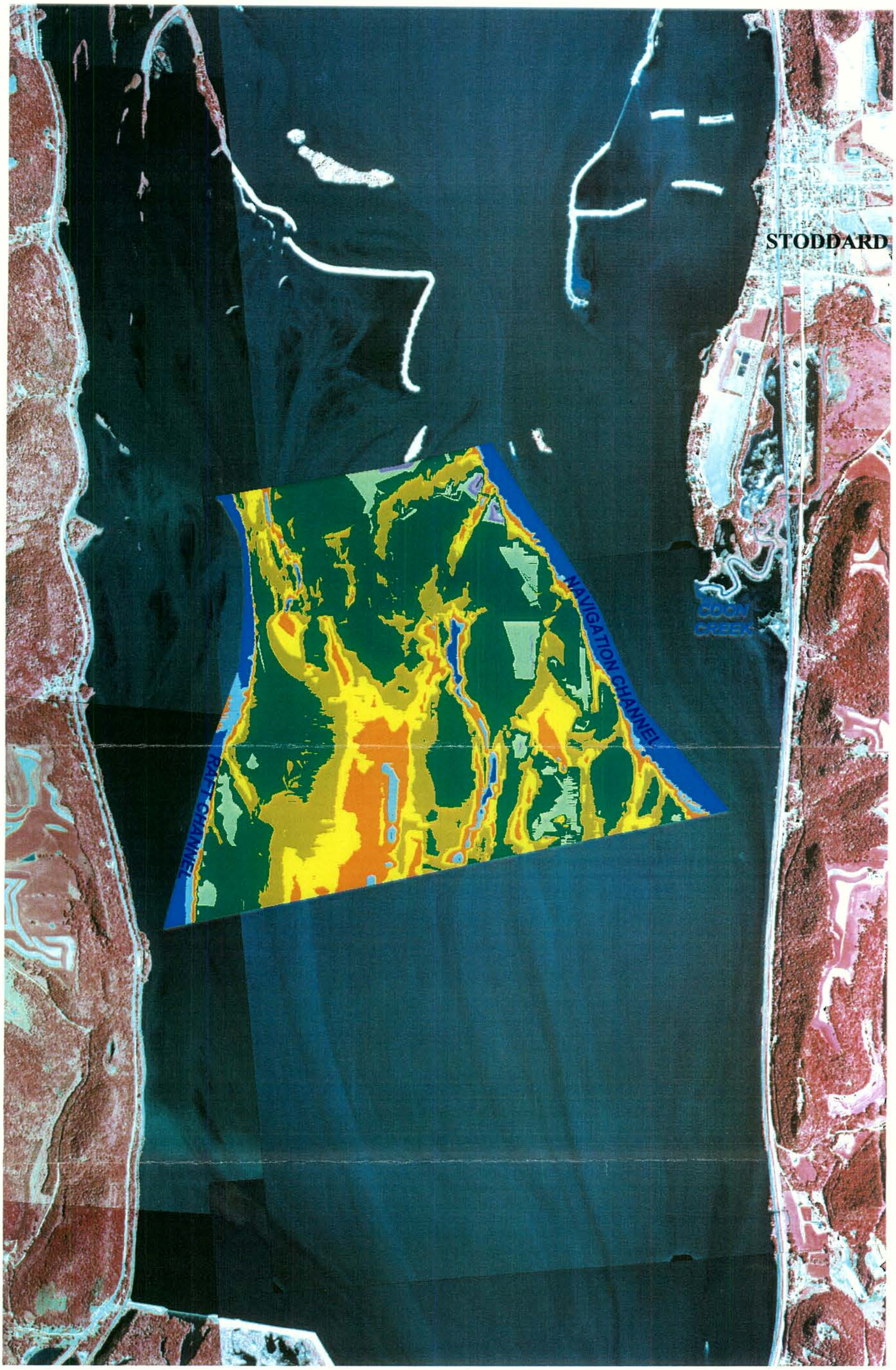
POOL 8 ISLANDS PHASE 3 - WEST
HABITAT RESTORATION AND ENHANCEMENT PROJECT
Image Data: Rectified Color IR 05-26-99
Bathymetry: UMESC, La Crosse WI

N
W E
S

0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
No Data

Plate 4



2000 0 2000 4000 Feet

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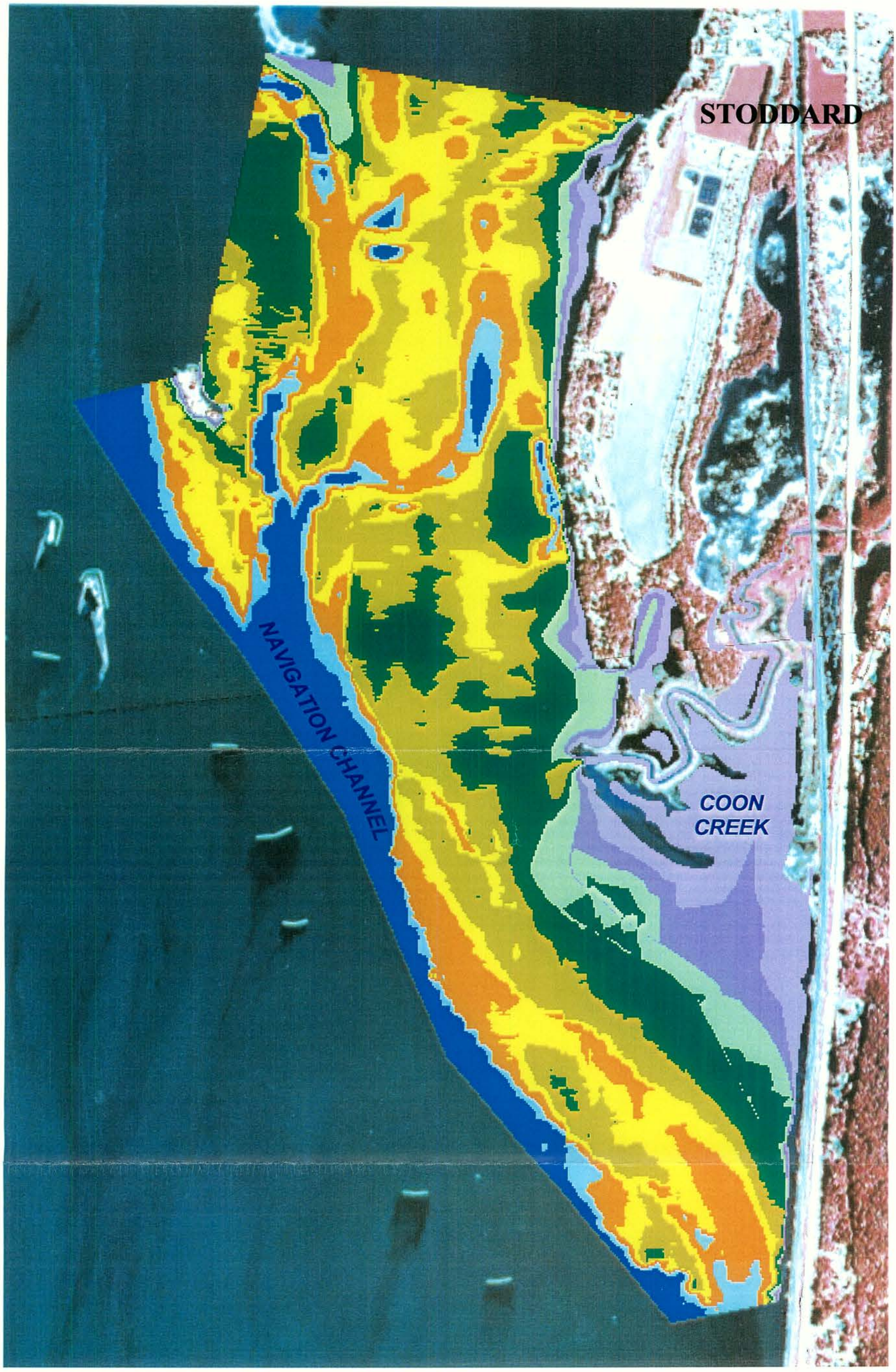
POOL 8 ISLANDS PHASE 3 - CENTRAL
HABITAT RESTORATION AND ENHANCEMENT PROJECT
Image Data: Rectified Color IR 05-26-99
Bathymetry: UMESC, La Crosse WI

N
W E
S

0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
No Data

Plate 5



800 0 800 1600 Feet

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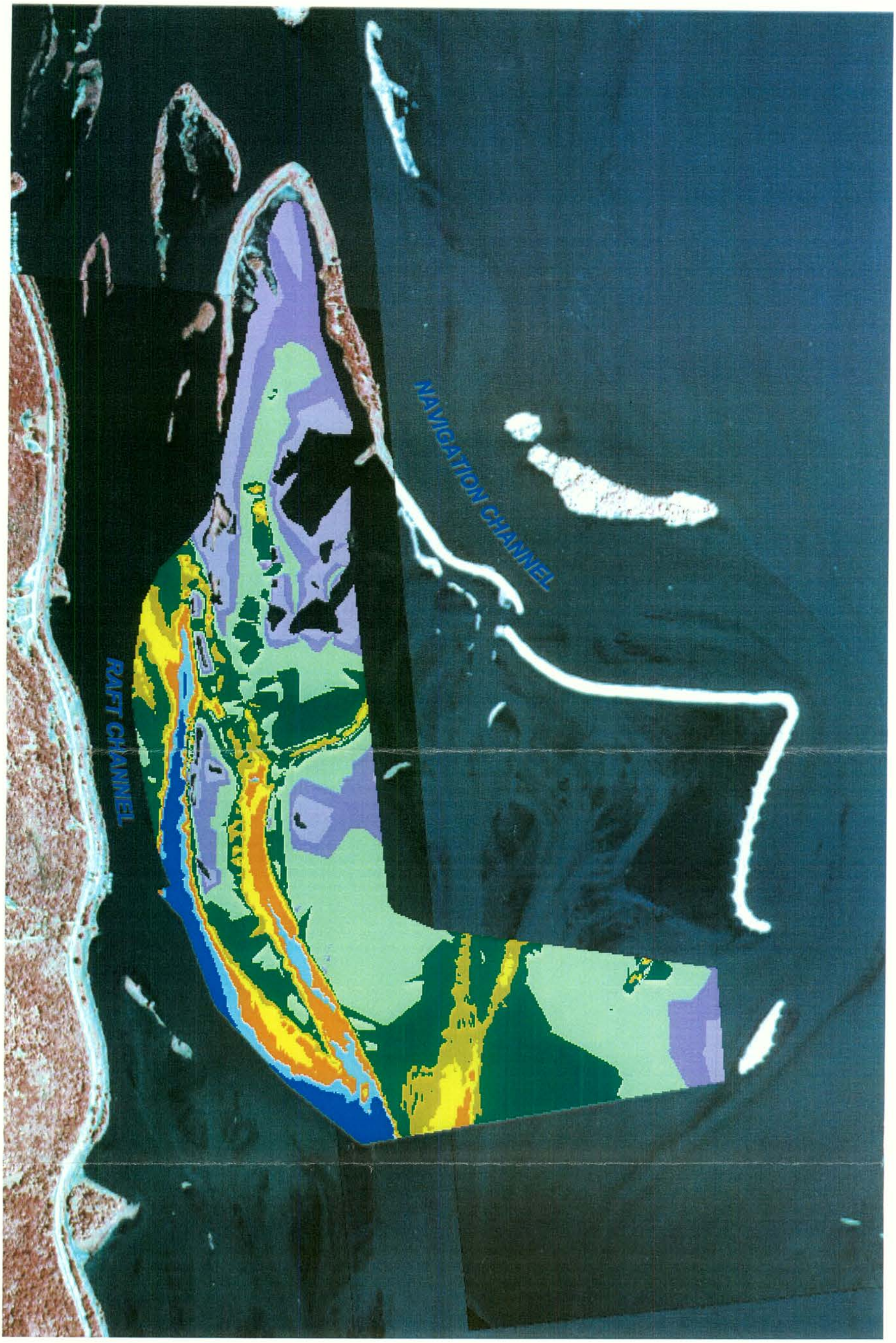
POOL 8 ISLANDS PHASE 3 - EAST
HABITAT RESTORATION AND ENHANCEMENT PROJECT
Image Data: Rectified Color IR 05-26-99
Bathymetry: UMESC, La Crosse WI

N
W E
S

0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
No Data

Plate 6



1000 0 1000 2000 Feet

St. Paul District
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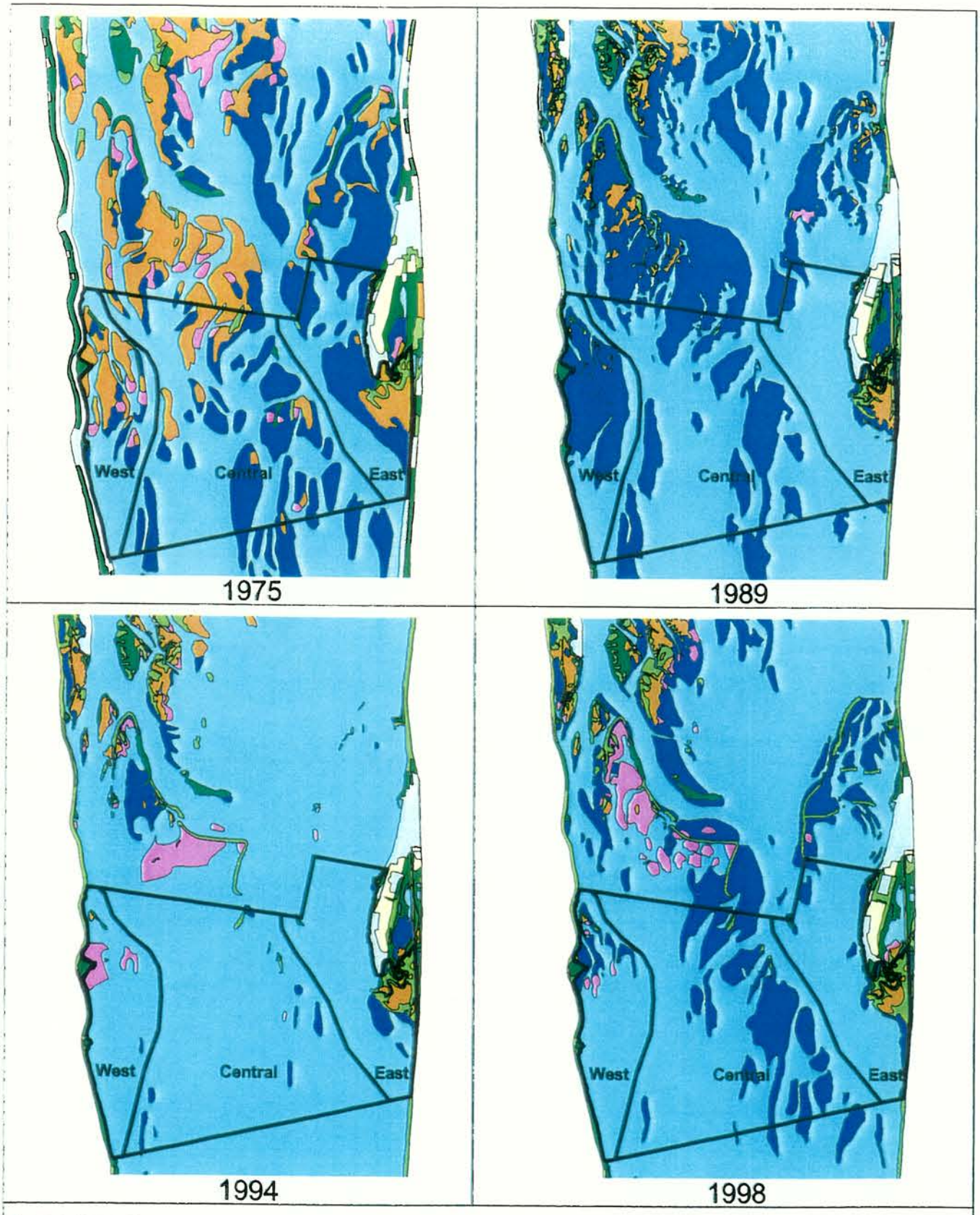
POOL 8 ISLANDS PHASE 3 - NORTH
HABITAT RESTORATION AND ENHANCEMENT PROJECT
Image Data: Rectified Color IR 05-26-99
Bathymetry: UMESC, La Crosse WI

N
W E
S

0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
No Data


West
Central
East
1975
West
Central
East
1989
West
Central
East
1994
West
Central
East
1998
Location Pool 8
Land Cover - Land Use, Pool 8
Open Water
Submergents
Rooted, Floating Aquatic
Emergent
Terrestrial, Non-Wooded
Terrestrial, Wooded
Agriculture
Urban, Developed
0 400 800 Meters
0 1500 3000 Feet
N
W
E
S
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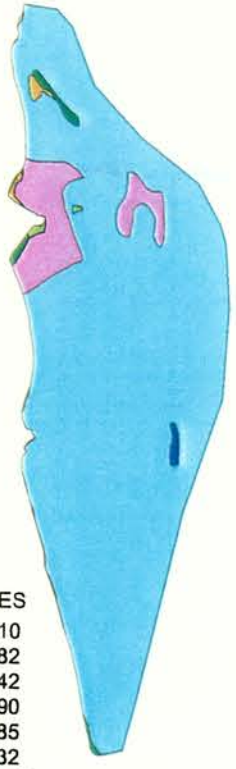
1975

CLASS	FREQ.	ACRES
Open Water	1	349.60
Submergent	9	58.47
Emergent	10	123.38
Rooted, Floating Aqua.	5	24.09
Terr., Wooded	7	7.40
Urban, Developed	5	1.47
	37	564.41

1989

CLASS	FREQ.	ACRES
Open Water	1	251.29
Submergent	3	296.35
Emergent	19	6.42
Terr., Non-Wooded	8	3.77
Terr., Wooded	15	6.55
Urban, Developed	1	0.03
	47	564.41

1994



CLASS	FREQ.	ACRES
Open Water	1	512.10
Submergent	1	1.82
Emergent	2	2.42
Rooted, Floating Aqua.	2	40.90
Terr., Non-Wooded	11	2.85
Terr., Wooded	4	4.32
	21	564.41

1998

CLASS	FREQ.	ACRES
Open Water	1	492.69
Submergent	8	53.75
Emergent	2	3.02
Rooted, Floating Aqua.	6	12.39
Terr., Non-Wooded	19	1.47
Terr., Wooded	3	1.09
	39	564.41

Land Cover - Land Use, Pool 8 (Phase 3 - West)

- Open Water
- Submergents
- Rooted, Floating Aquatic
- Emergent
- Terrestrial, Non-Wooded
- Terrestrial, Wooded
- Agriculture
- Urban, Developed

0 250 500 Meters

0 1500 Feet

N W E S

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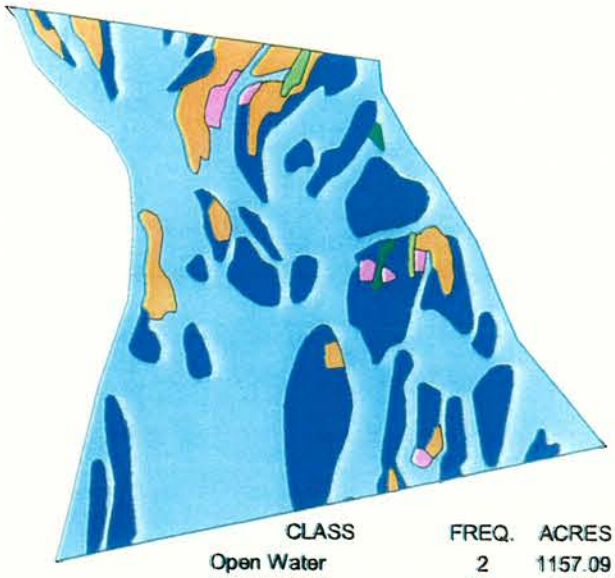
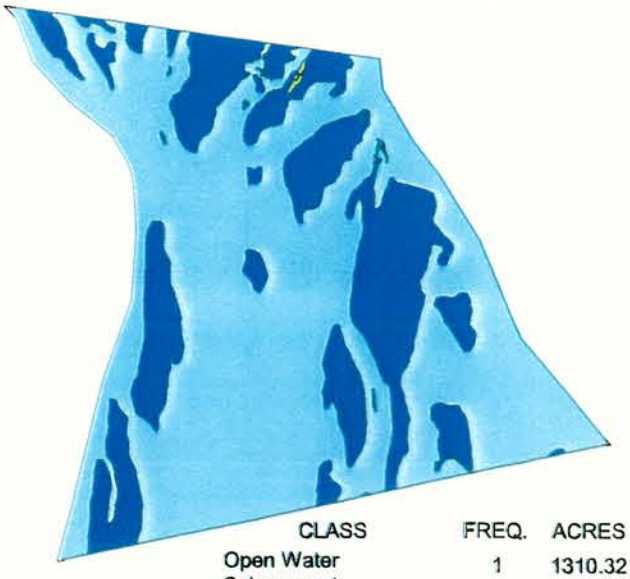
1975



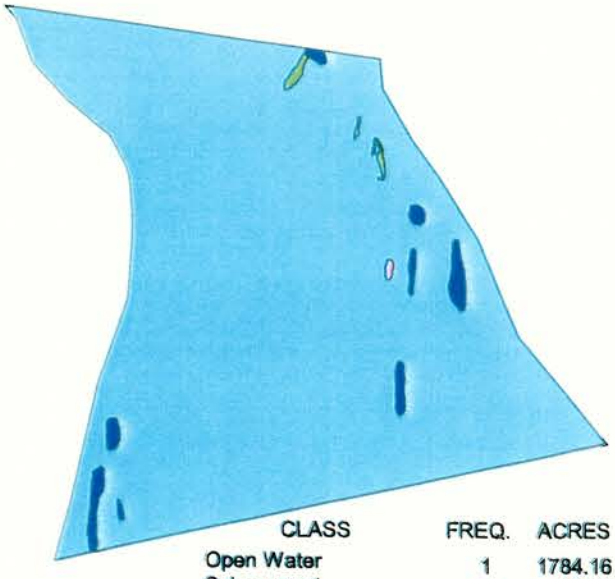
CLASS	FREQ.	ACRES
Open Water	2	1157.09
Submergent	30	496.16
Rooted, Floating Aqua.	6	22.22
Emergent	12	131.57
Terr., Non-Wooded	2	8.57
Terr., Wooded	2	6.97
	54	1822.58

1989



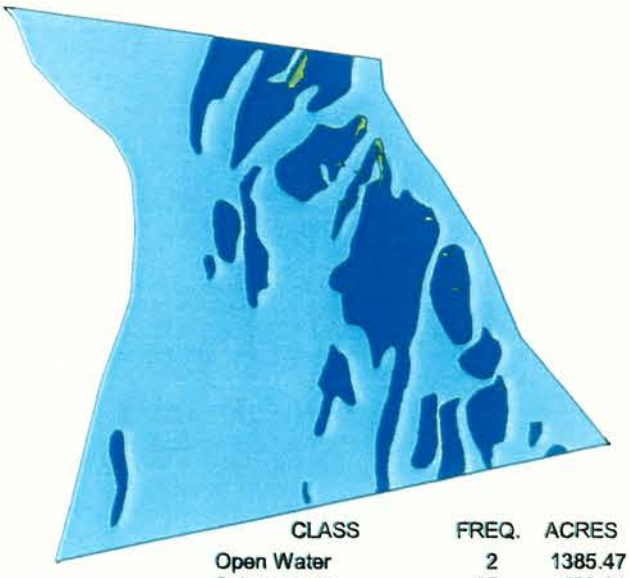
CLASS	FREQ.	ACRES
Open Water	1	1310.32
Submergent	27	509.46
Emergent	2	0.96
Terr., Non-Wooded	2	1.23
Terr., Wooded	2	0.61
	34	1822.58

1994



CLASS	FREQ.	ACRES
Open Water	1	1784.16
Submergent	8	31.88
Emergent	1	1.17
Terr., Non-Wooded	3	4.65
Terr., Wooded	1	0.72
	14	1822.58

1998



CLASS	FREQ.	ACRES
Open Water	2	1385.47
Submergent	17	429.64
Terr., Non-Wooded	3	5.81
Urban, Developed	8	1.66
	30	1822.58

Land Cover - Land Use, Pool 8 (Phase 3 - Central)

- Open Water
- Submergents
- Rooted, Floating Aquatic
- Emergent
- Terrestrial, Non-Wooded
- Terrestrial, Wooded
- Agriculture
- Urban, Developed

0 250 500 Meters

0 1500 Feet

N W E S

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1975

CLASS	FREQ.	ACRES
Open Water	1	359.75
Submergent	7	252.00
Emergent	9	81.45
Terr., Non-Wooded	2	28.94
Terr., Wooded	7	9.07
Urban, Developed	4	17.56
	30	748.77

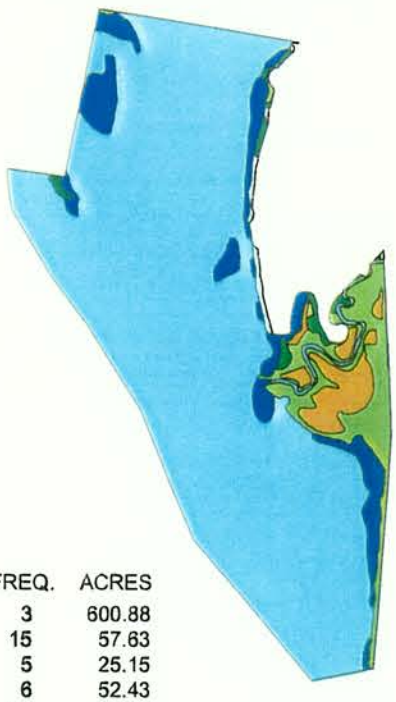
1989

CLASS	FREQ.	ACRES
Open Water	2	608.72
Submergent	19	52.17
Emergent	13	38.25
Terr., Non-Wooded	7	37.14
Terr., Wooded	21	10.66
Urban, Developed	8	1.83
	70	748.77

1994

CLASS	FREQ.	ACRES
Open Water	4	618.49
Submergent	6	38.89
Emergent	6	26.96
Terr., Non-Wooded	5	52.11
Terr., Wooded	12	8.46
Urban, Developed	5	3.86
	38	748.77

1998



CLASS	FREQ.	ACRES
Open Water	3	600.88
Submergent	15	57.63
Emergent	5	25.15
Terr., Non-Wooded	6	52.43
Terr., Wooded	12	8.38
Urban, Developed	4	4.30
	45	748.77

Land Cover - Land Use, Pool 8 (Phase 3 - East)

- Open Water
- Submergents
- Rooted, Floating Aquatic
- Emergent
- Terrestrial, Non-Wooded
- Terrestrial, Wooded
- Agriculture
- Urban, Developed

0 250 500 Meters

0 1500 Feet

N W E S

St. Paul District GIS CENTER
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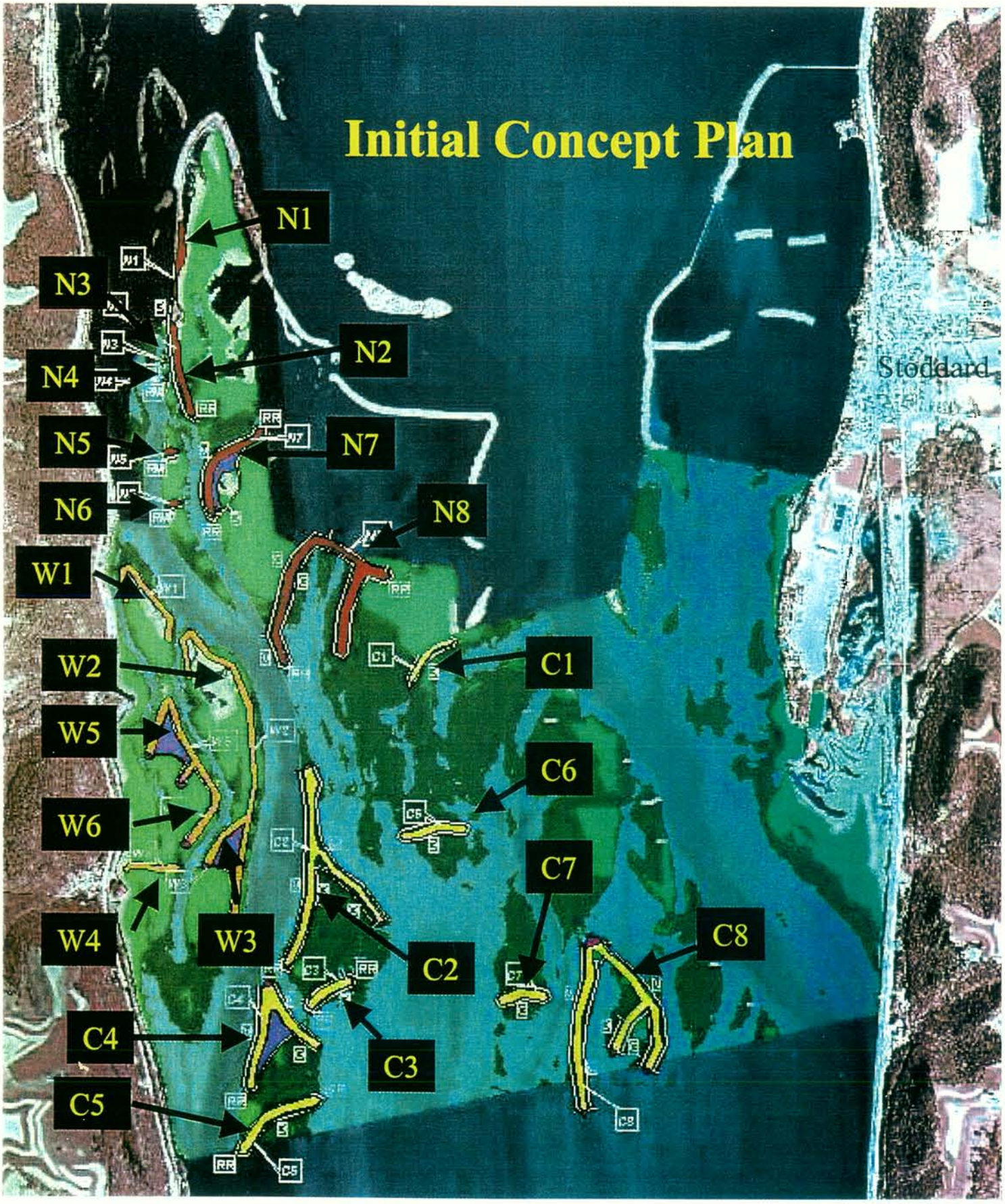

Initial Concept Plan
N1
N3
N2
N4
N5
N7
N6
N8
W1
W2
C1
W5
C6
W6
C7
W4
W3
C2
C8
C4
C3
C5
Stoddard

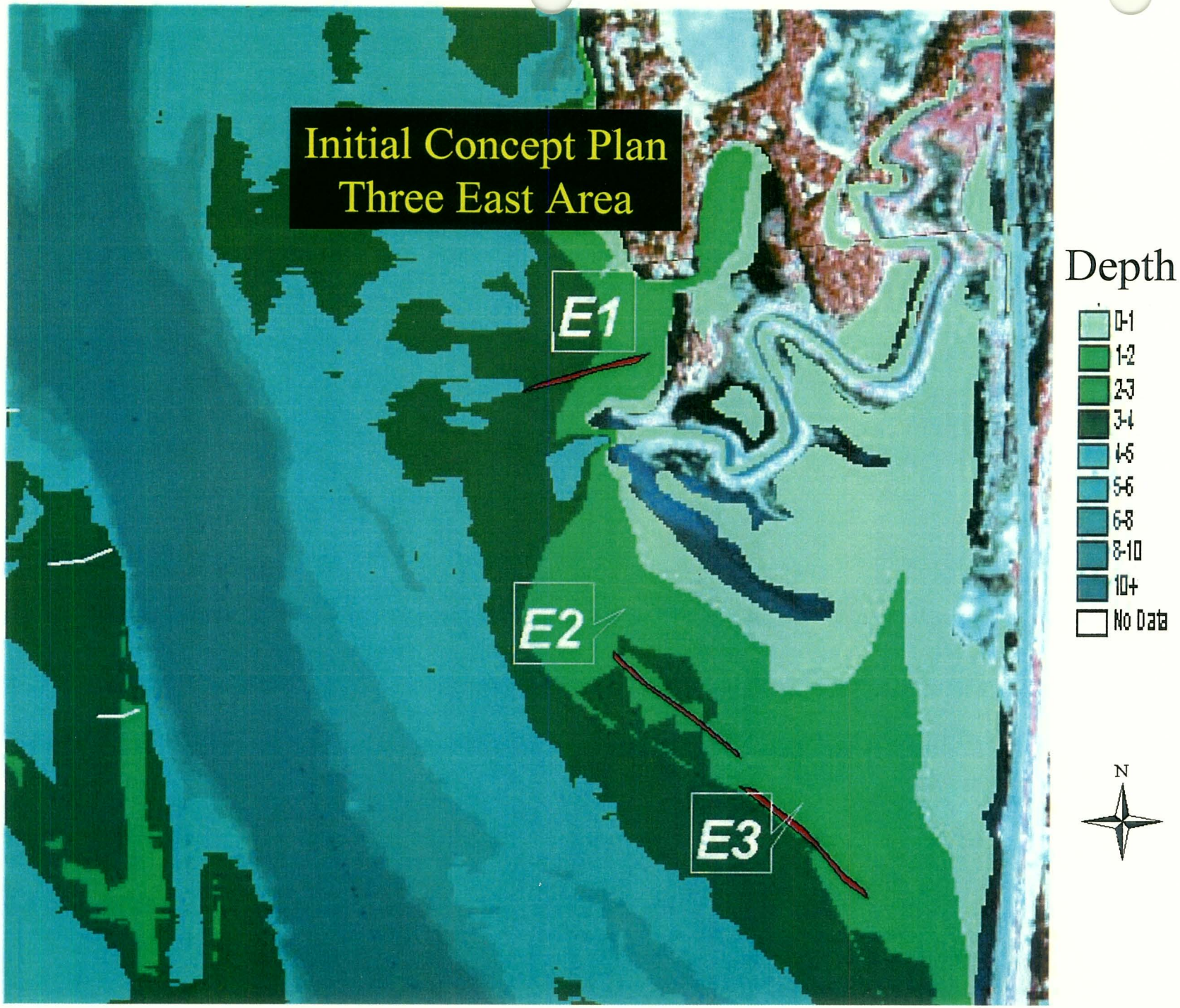

Initial Concept Plan
Three East Area
E1
E2
E3
Depth
0-1
1-2
2-3
3-4
4-5
5-6
6-8
8-10
10+
No Data
N

Plate 13

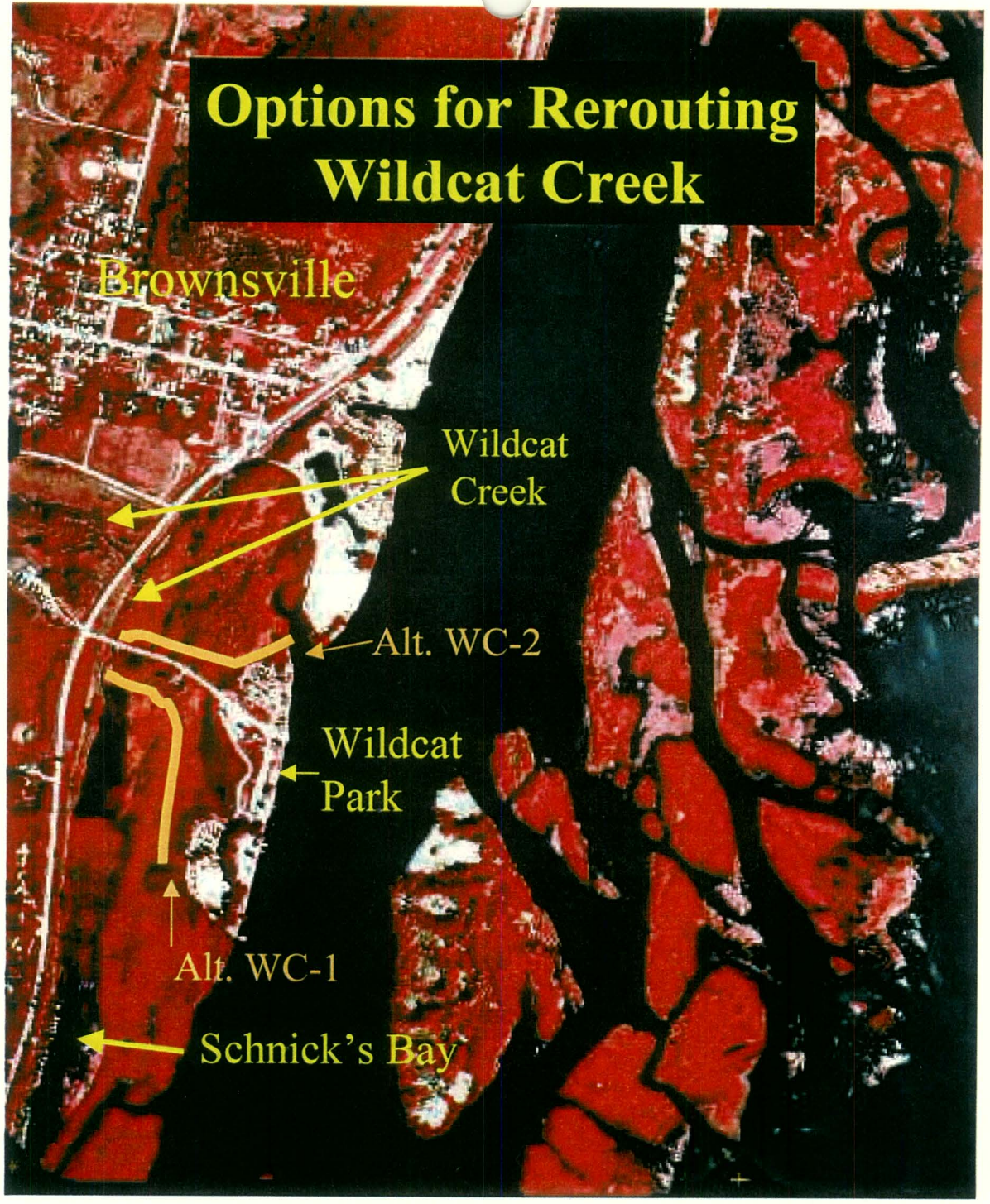
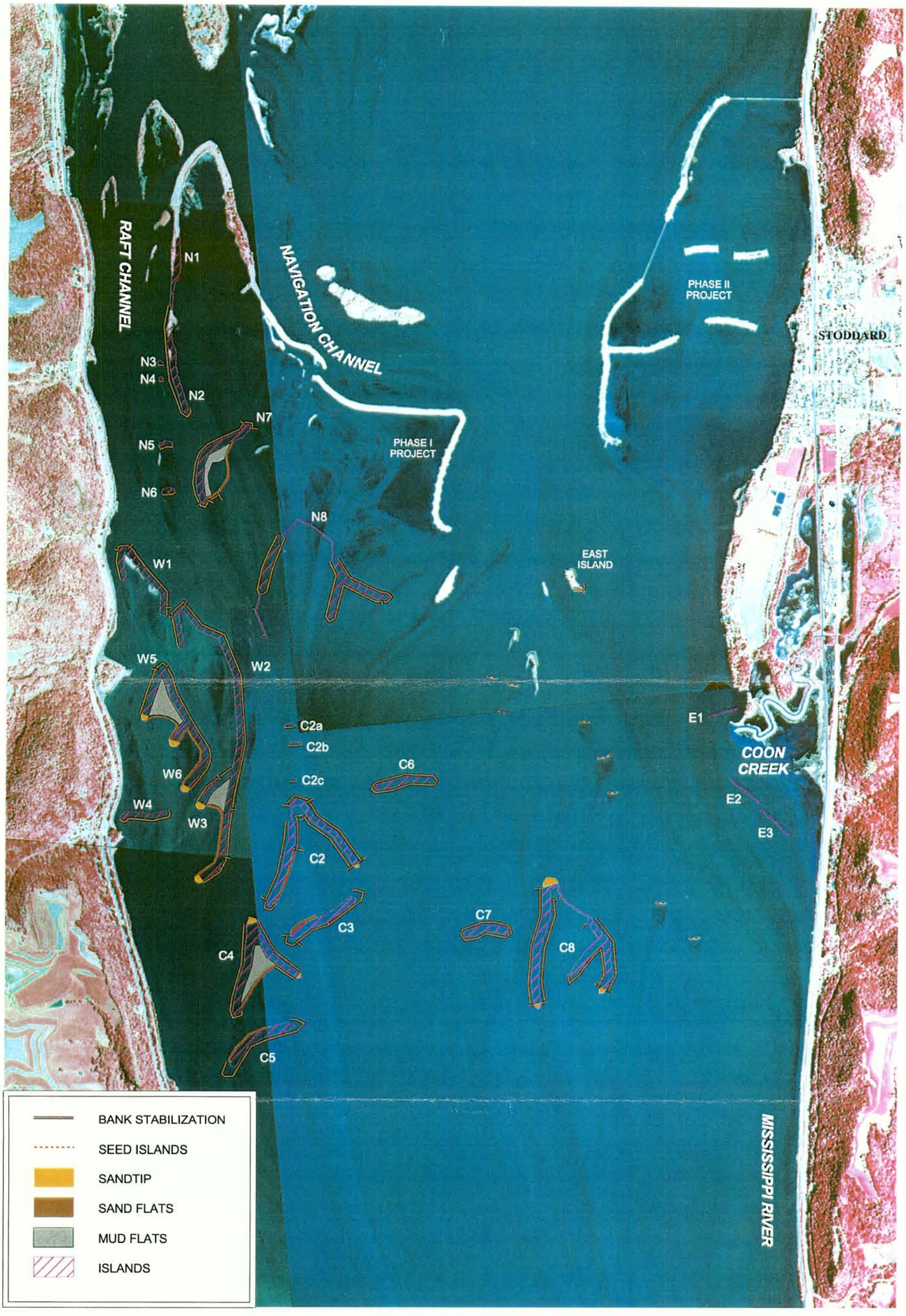

Options for Rerouting
Wildcat Creek
Brownsville
Wildcat
Creek
Alt. WC-2
Wildcat
Park
Alt. WC-1
Schnick's Bay

Plate 14



POOL 8 ISLANDS - PHASE III PROJECT AREA

St. Paul District
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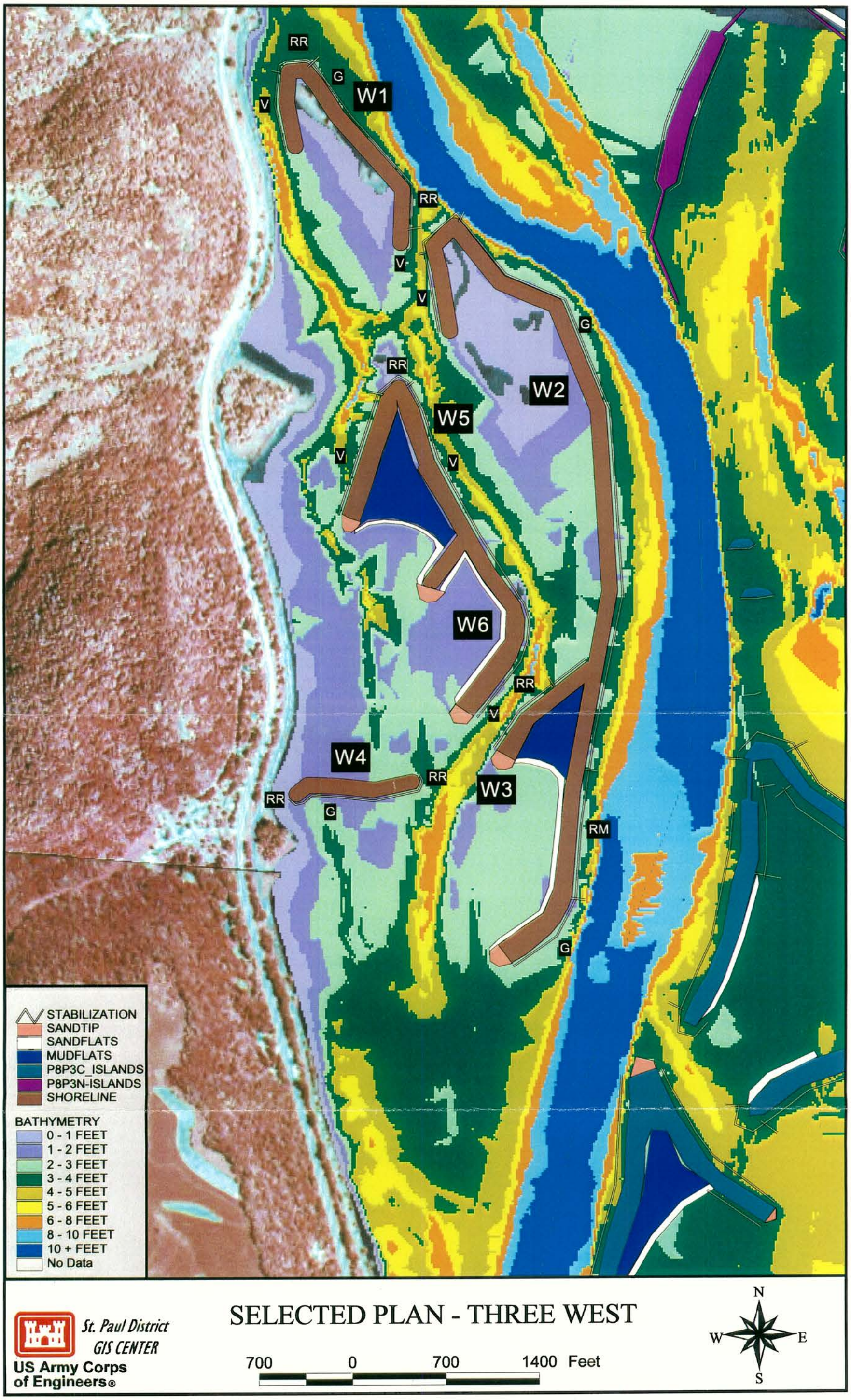
4000 0 4000 8000 Feet

N
W E
S

Infrared Photo Base: May 26, 1999 (Water Level: 632.0)

02-22-00 M.R.W p8_isle3.apr

Plate 15



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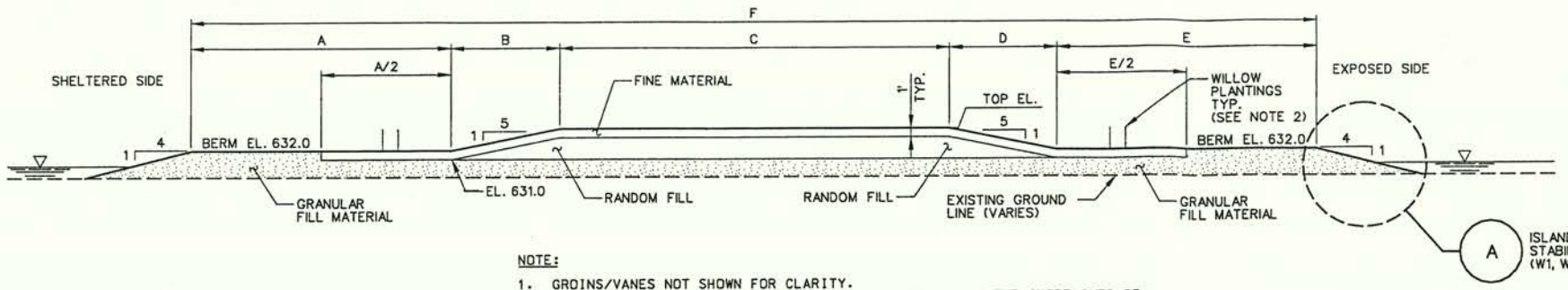
SELECTED PLAN - THREE WEST

700 0 700 1400 Feet

N
W E
S

Plate 16



NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

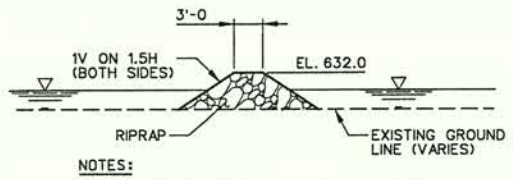
SECTION
TYPICAL ISLAND
SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

NOTES:

1. FOR TYPICAL GROIN AND VANE DETAILS. SEE PLATE 4

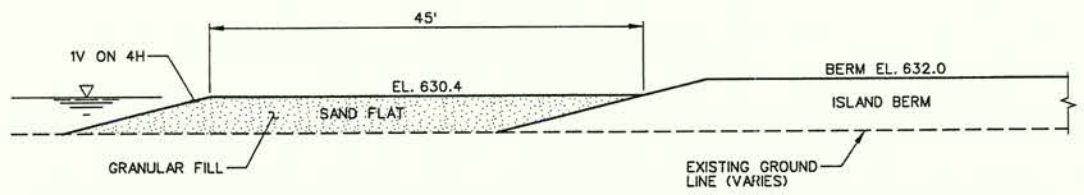
ISLAND DIMENSIONS - 3 WEST (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND W1	30	10.0	40	10.0	45	135	634.0
ISLAND W2 STA. 0+00 TO 20+00	30	10.0	40	10.0	45	135	634.0
ISLAND W2 STA. 20+50 TO 42+00	30	0	80	0	45	155	632.0
ISLAND W2 STA. 42+50 TO 68+70	30	7.5	40	7.5	45	130	633.5
ISLAND W3 STA. 0+00 TO 7+30	30	0	45	0	30	105	632.0
ISLAND W4 STA. 0+00 TO 9+00	30	0	40	0	60	130	632.0
ISLAND W5 STA. 0+00 TO 16+50	30	0	45	0	30	105	632.0
ISLAND W5 STA. 17+00 TO 28+70	30	10.0	40	10.0	30	120	634.0
ISLAND W6 STA. 0+00 TO 15+98	30	0	45	0	30	105	632.0



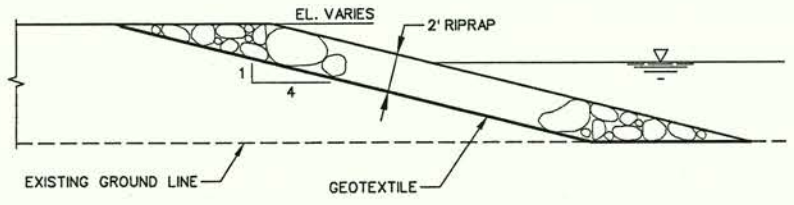
NOTES:

1. ISLAND W2 STA. 5+00 TO STA. 15+00
2. ~~ISLAND W3 STA. 5+00 TO STA. 9+30~~

SECTION
TYPICAL RIPRAP ROCK MOUND BANK STABILIZATION ISLANDS W2 AND W3
SCALE: 1" = 10'-0"



SECTION
TYPICAL SAND FLAT ISLAND W2 AND W6
SCALE: 1" = 10'-0"

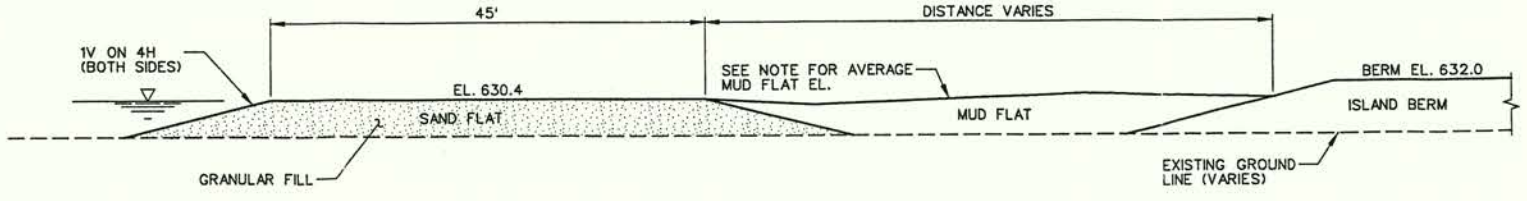


NOTES:

1. RIPRAP REQUIRED TO TOP OF ISLAND OR BERM AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL
ISLAND RIPRAP END PROTECTION/ BANK STABILIZATION (A)
SCALE: 1" = 5'-0"

5 0 5 10
SCALE IN FEET



NOTES:
ISLAND W2/3: AVERAGE MUD FLAT ELEVATION = 630.4.
ISLAND W5: AVERAGE MUD FLAT ELEVATION = 630.5.

SECTION
TYPICAL MUD/SAND FLAT ISLANDS W2, W3, AND W5
SCALE: 1" = 10'-0"

US Army Corps of Engineers
St. Paul District

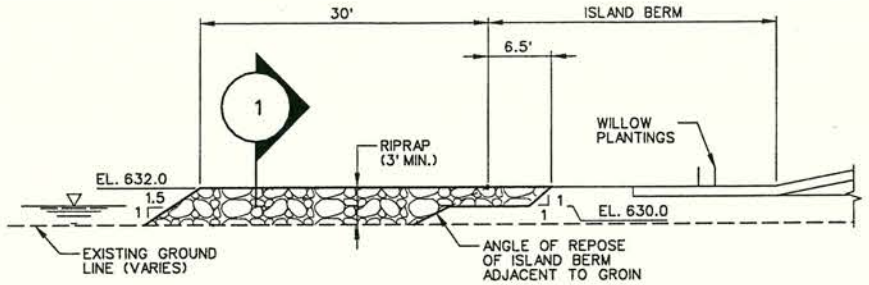
Symbol	Description	Date	Appr.

DESIGNED: TLW/JJF 0-03 | CHECKED: XXX/XXX | DRAWN: TLW/LKT | DESIGNED: JSH 11-03 | CHECKED: XXX/XXX
SCALE: AS SHOWN | DATE: JAN 2002
CADD FILE NAME: W1_SEC.DGN
SOL. NO: N/A
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

POOL 8 ISLANDS, PHASE 3 - WEST
ENVIRONMENTAL
ISLAND & SAND/MUD FLAT TYPICAL SECTIONS

DRAWING NUMBER:
Plate 17
SHT 2 OF 4



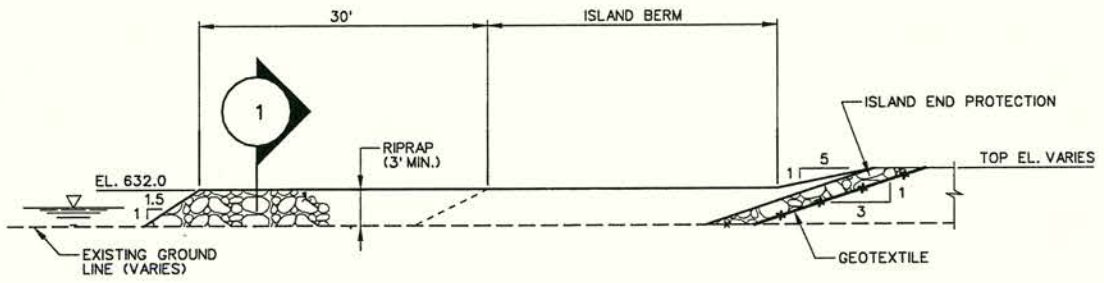
TYPICAL ELEVATION

GROIN

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



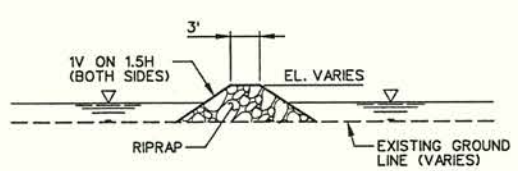
TYPICAL ELEVATION

TERMINAL GROIN

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



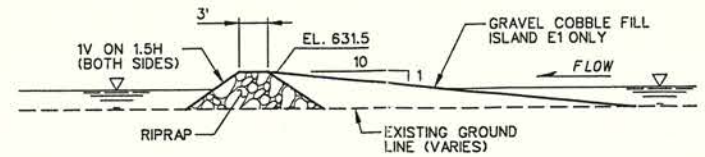
SECTION 1

RIPRAP GROIN/VANE

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



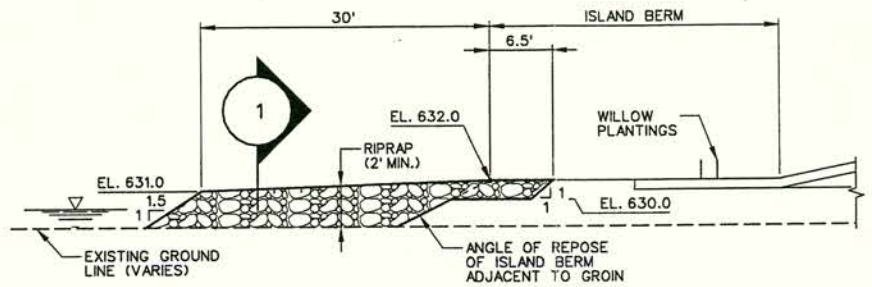
TYPICAL SECTION

ISLANDS E1& E3 - ROCK SILL

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



TYPICAL ELEVATION

VANE

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: TLW/AJF
DRAWN: TLW/LKT
CHECKED: XXX/XXX
DESIGNED: JSC/XXX
DRAWN: TLW/LKT
CHECKED: XXX/XXX
SCALE: AS SHOWN
DATE: JAN 2002
CADD FILE NAME: W2_SEC.DGN
SOL. NO: N/A
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

POOL 8 ISLANDS, PHASE 3

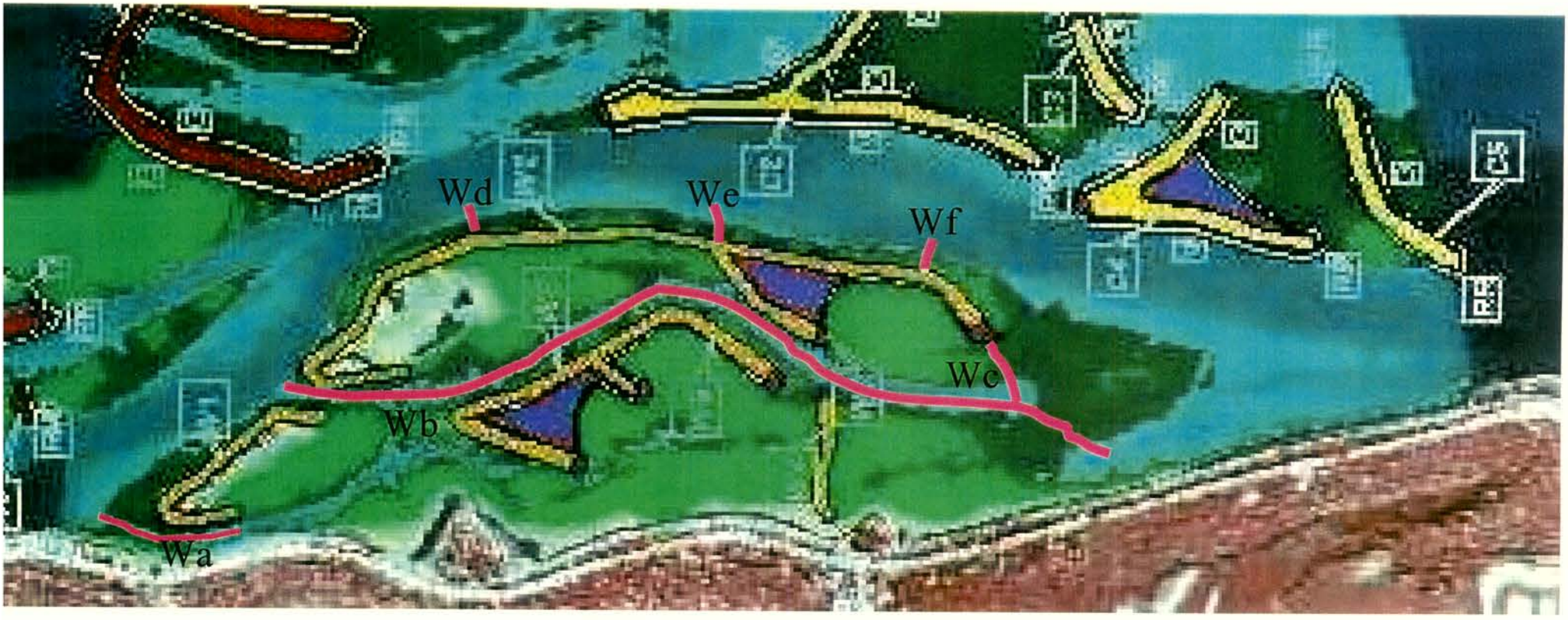
ENVIRONMENTAL

GROINS, VANES & EAST ISLANDS
TYPICAL SECTIONS & DETAILS

DRAWING NUMBER:
Plate 18

SHT 4 OF 4

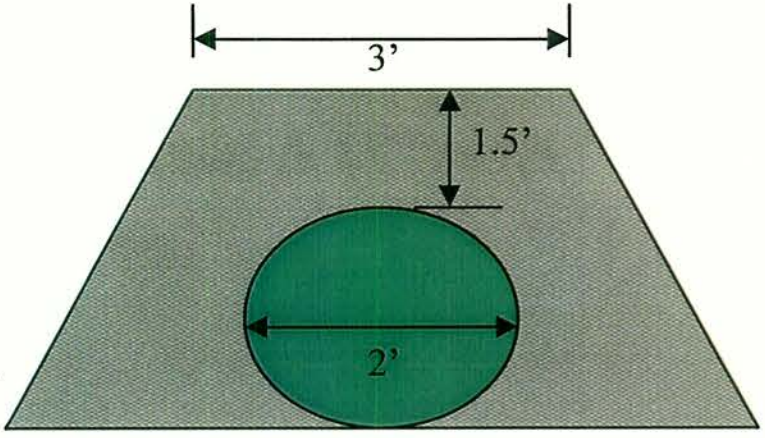
Three West

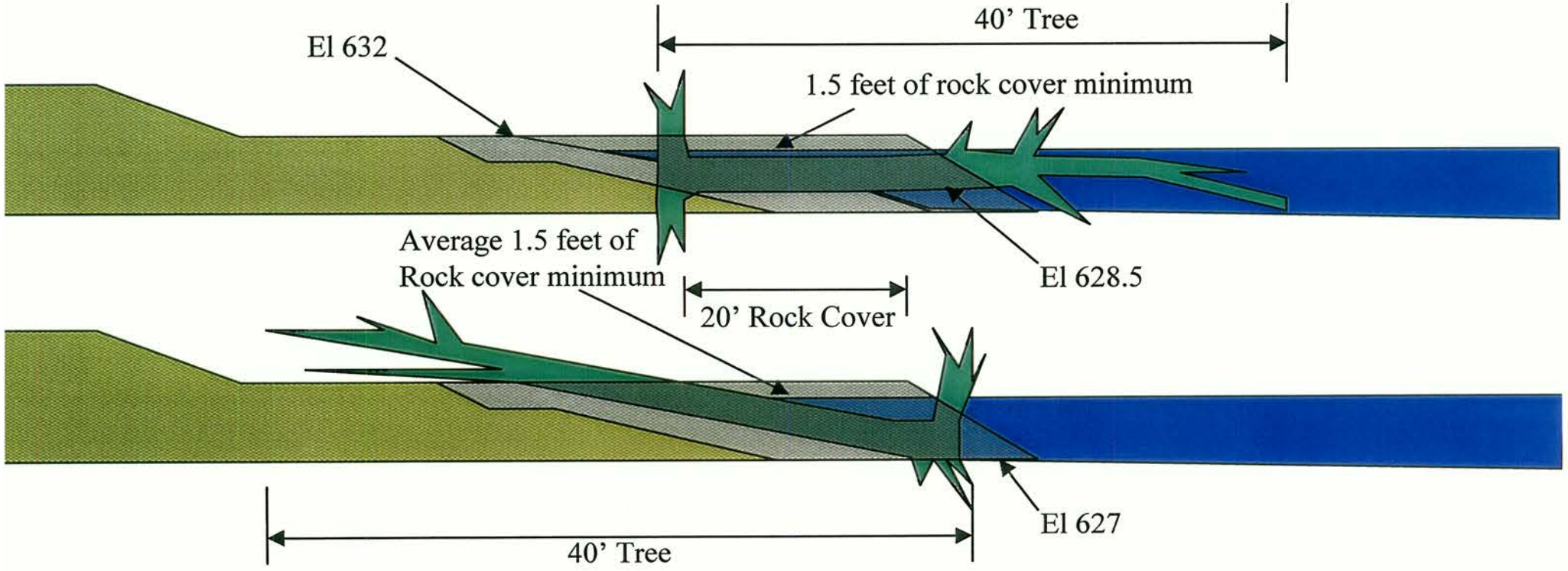


Potential Access Routes/Points =

Plate 19

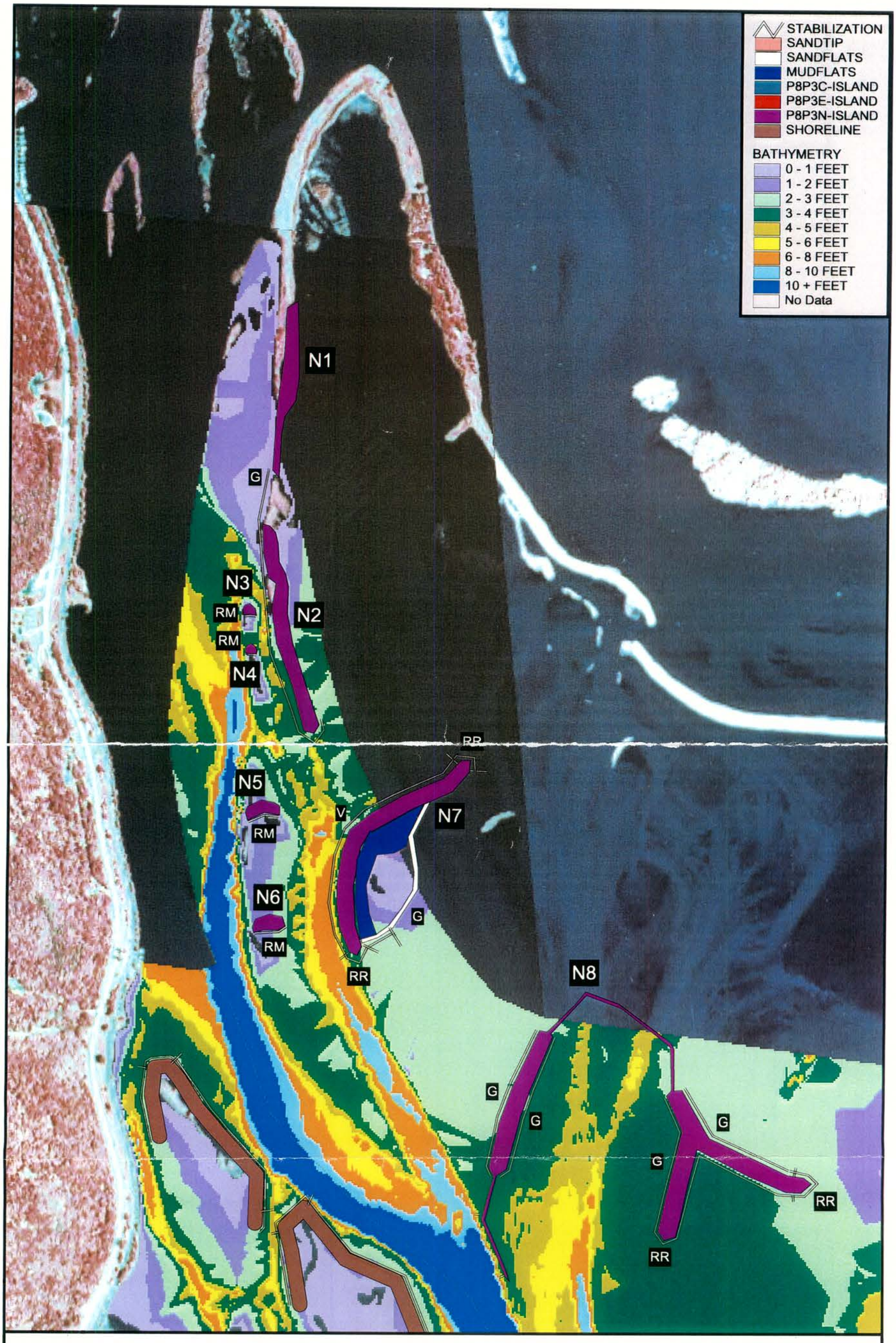
Pool 8, Phase 3 Groins With Trees





Note: If only 15' of tree is covered, need 2 feet of rock cover.

Plate 20



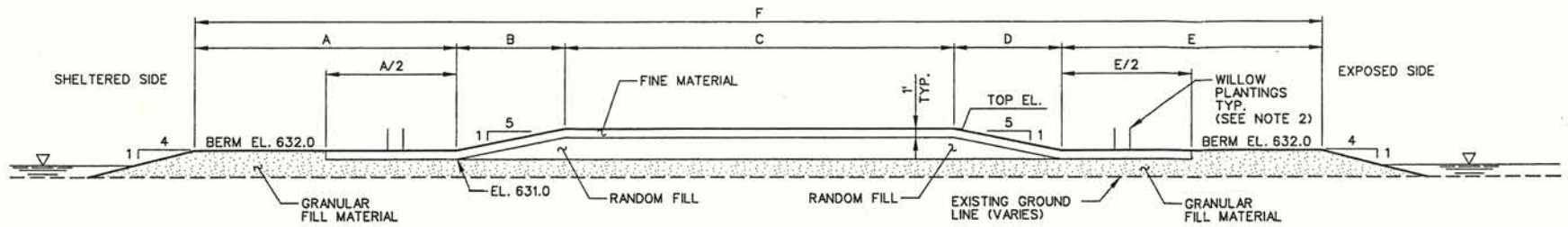
St. Paul District
GIS CENTER
US Army Corps of Engineers®

SELECTED PLAN - THREE NORTH

800 0 800 1600 Feet

N
W E
S

Plate 21



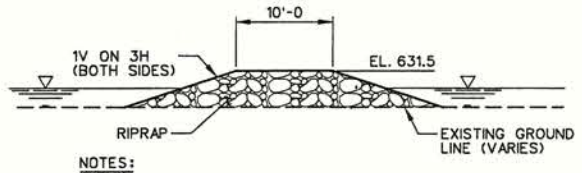
NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

SECTION

TYPICAL ISLAND
SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

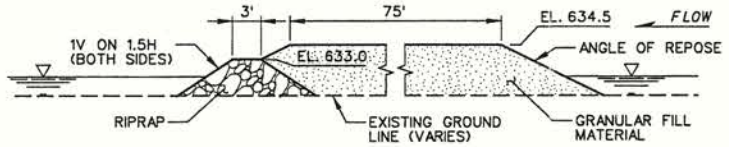


NOTES:

1. ISLAND N1 STA. 14+00 TO STA. 22+10
2. ISLAND N8 STA. 0+00 TO STA. 25+50

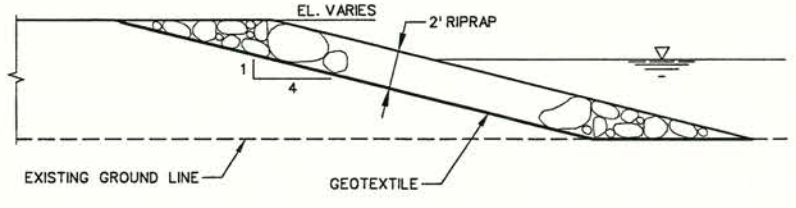
SECTION

TYPICAL RIPRAP ROCK SILL
ISLANDS N1 AND N8
SCALE: 1" = 10'-0"



SECTION

TYPICAL SEED ISLAND
ISLANDS N3, N4, N5 & N6
SCALE: 1" = 10'-0"



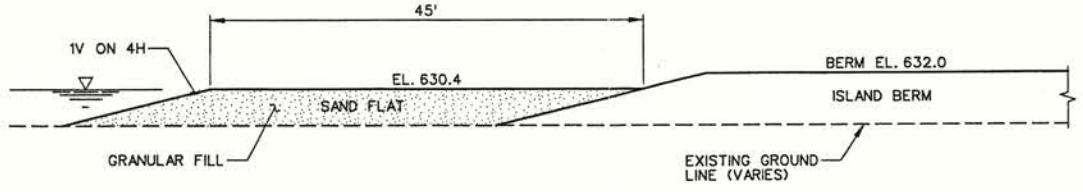
NOTES:

1. RIPRAP REQUIRED TO TOP OF ISLAND OR BERM AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL

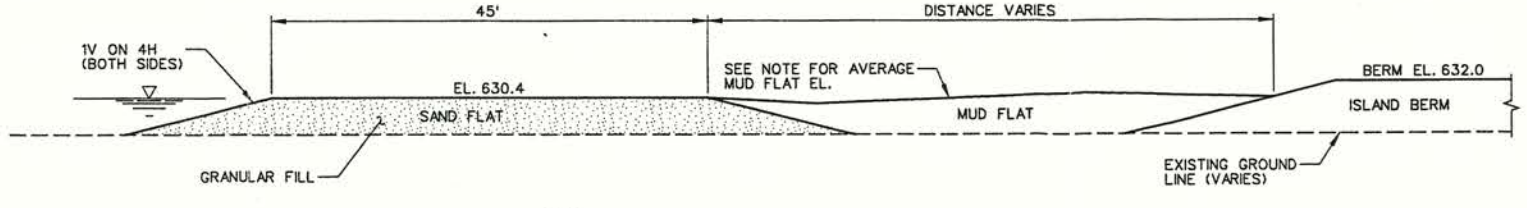
TYPICAL RIPRAP END PROTECTION
ISLANDS N2, N7, AND N8
SCALE: 1" = 5'-0"

5 0 5 10
SCALE IN FEET



SECTION

TYPICAL SAND FLAT
ISLAND N8
SCALE: 1" = 10'-0"



NOTE:
ISLAND N7: AVERAGE MUD FLAT ELEVATION = 630.5.

SECTION

TYPICAL MUD/SAND FLAT
ISLAND 7
SCALE: 1" = 10'-0"

NOTES:

1. FOR TYPICAL GROIN AND VAIN DETAILS. SEE PLATE 4.

ISLAND DIMENSIONS - 3 NORTH (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND N1 STA. 0+00 TO 14+00	30	10.0	40	10.0	45	135	634.0
ISLAND N1 STA. 14+00 TO 22+10	ROCK SILL						
ISLAND N2 STA. 0+00 TO 16+80	30	5.0	40	5.0	45	125	633.0
ISLAND N3 STA. 0+00 TO 1+22	SEED ISLAND						
ISLAND N4 STA. 0+00 TO 1+00	SEED ISLAND						
ISLAND N5 STA. 0+00 TO 2+50	SEED ISLAND						
ISLAND N6 STA. 0+00 TO 2+50	SEED ISLAND						
ISLAND N7 STA. 0+00 TO 22+58	30	0	45	0	45	120	632.0
ISLAND N8 STA. 0+00 TO 12+00	ROCK SILL						
ISLAND N8 STA. 12+00 TO 21+50	45	0	45	0	45	135	632.0
ISLAND N8 STA. 21+50 TO 37+50	ROCK SILL						
ISLAND N8 STA. 37+50 TO 50+50	45	0	45	0	45	135	632.0
ISLAND N8 MIDDLE LEG STA. 0+00 TO 9+00	45	0	45	0	45	135	632.0

US Army Corps of Engineers
St. Paul District

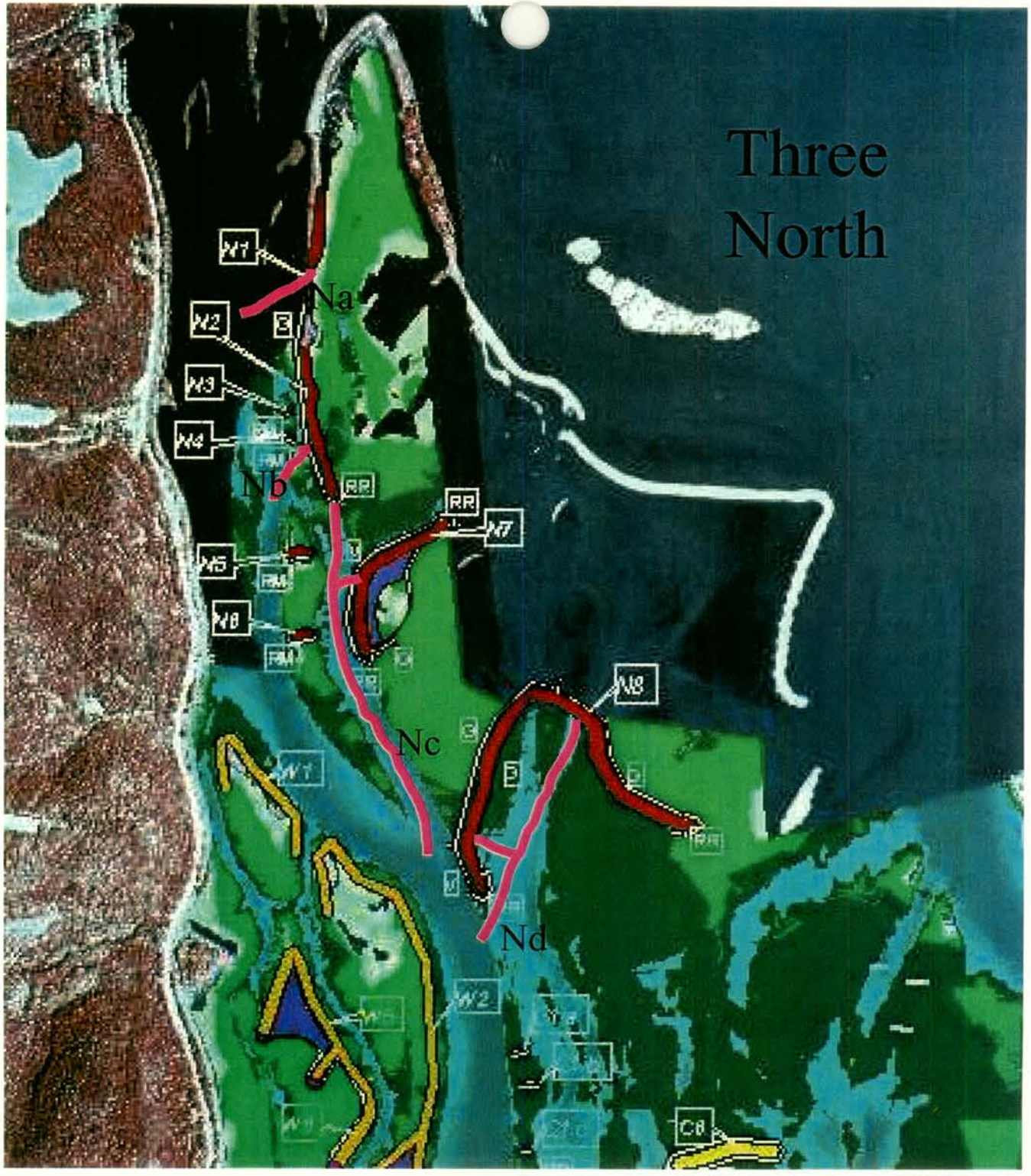
Symbol	Description	Date	Appr.

DESIGNED: SCALE: AS SHOWN
CHECKED: DATE: JAN 2002
DRAWN: CADD FILE NAME: N1_SEC.DGN
CHECKED: SOL. NO: NA
DESIGNED: APPROVING OFFICIAL: AE
CHECKED:
D-03 H-03

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

POOL 8 ISLANDS, PHASE 3-NORTH
ENVIRONMENTAL
ISLAND & SAND/MUD FLAT TYPICAL SECTIONS

DRAWING NUMBER:
Plate 22
SHT 1 OF 4



Potential Access Routes/ Points = ——

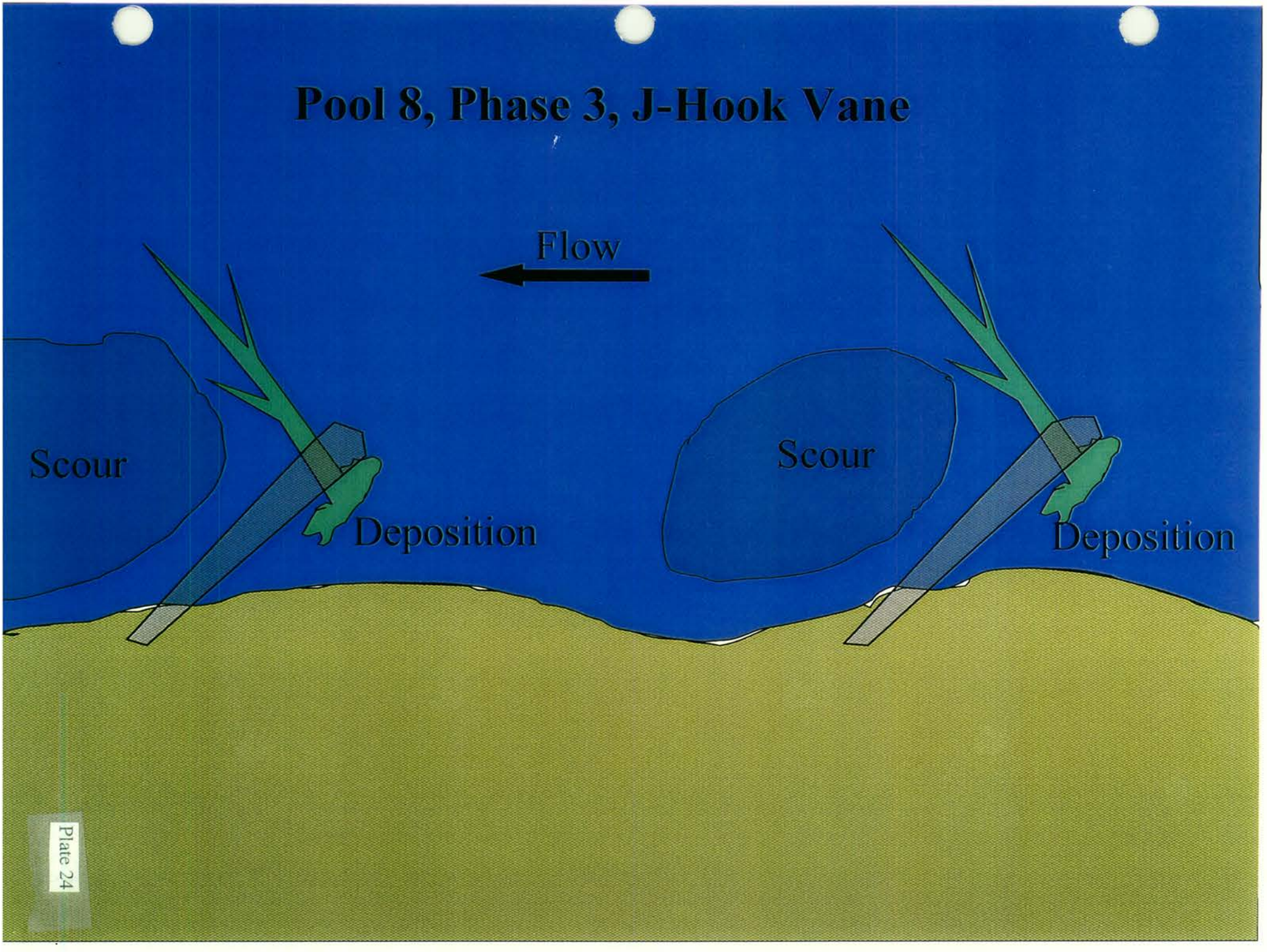

Pool 8, Phase 3, J-Hook Vane
Flow
Scour
Deposition
Scour
Deposition

Plate 24

Pool 8, Phase 3, Rock Sill Enhancements

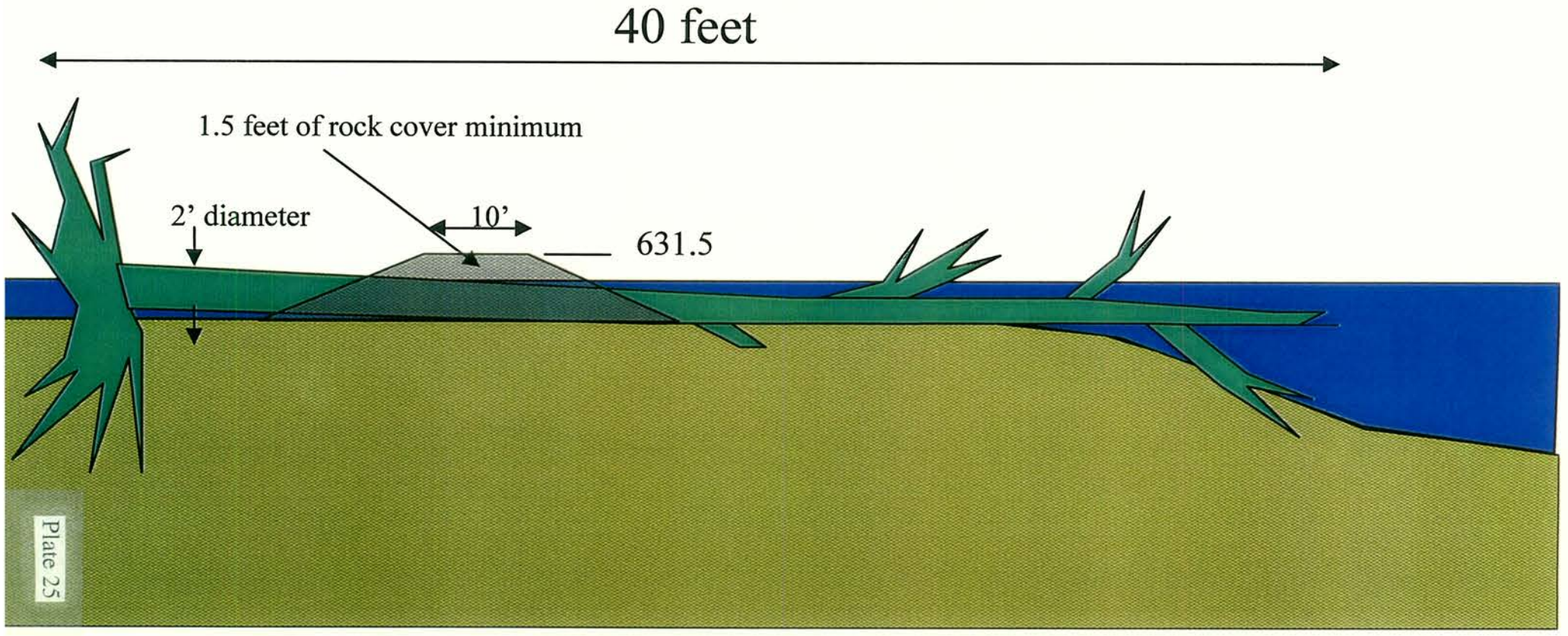
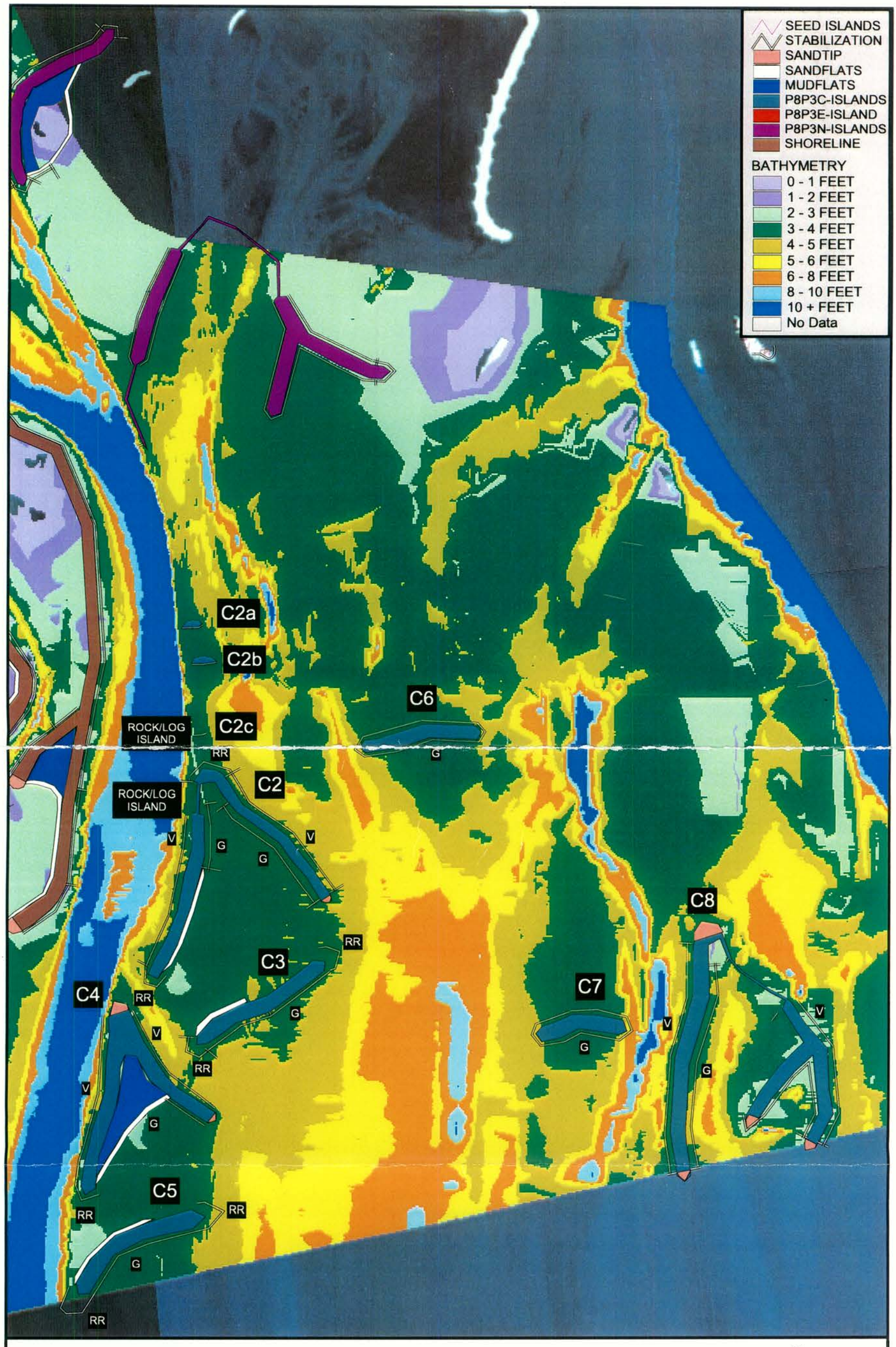


Plate 25



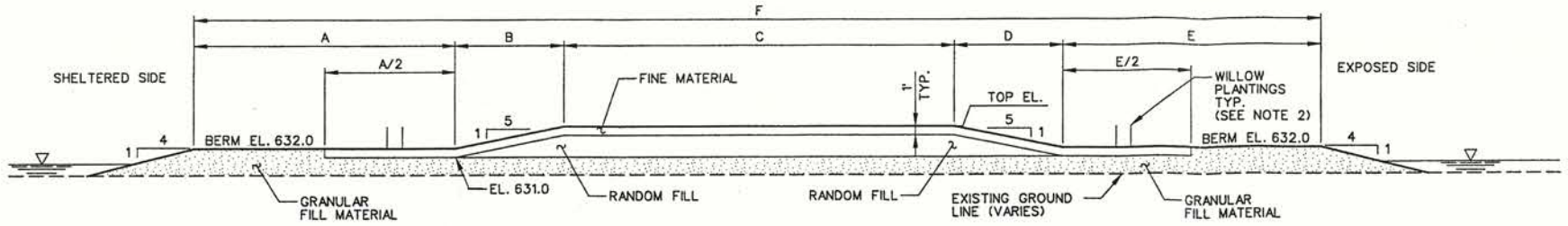
St. Paul District
GIS CENTER
US Army Corps of Engineers®

SELECTED PLAN - THREE CENTRAL

1000 0 1000 2000 Feet

N W E S

Plate 26



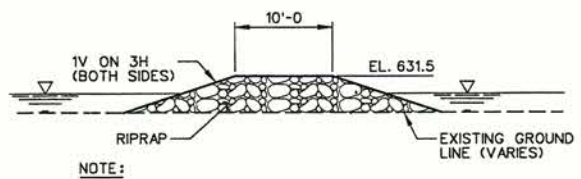
NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

SECTION

TYPICAL ISLAND
SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

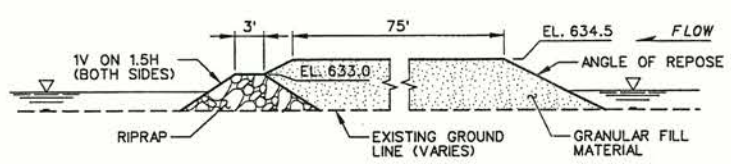


NOTE:

1. ISLAND C8 STA. 34+20 TO STA. 44+50

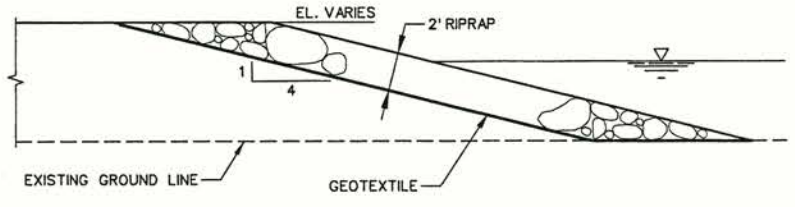
SECTION

TYPICAL RIPRAP ROCK SILL
ISLAND C8
SCALE: 1" = 10'-0"



SECTION

TYPICAL SEED ISLAND
ISLANDS C2A AND C2B.
SCALE: 1" = 10'-0"



NOTES:

1. RIPRAP REQUIRED TO TOP OF ISLAND OR BERM AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL

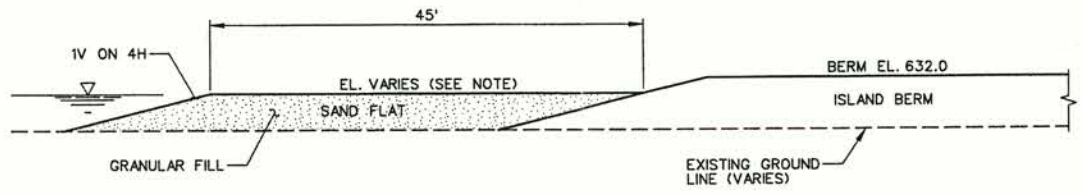
TYPICAL RIPRAP END PROTECTION
ISLANDS C2, C3, C4, AND C5
SCALE: 1" = 5'-0"

5 0 5 10
SCALE IN FEET

NOTES:

1. FOR TYPICAL GROIN AND VANE TDETAILS. SEE PLATE 4

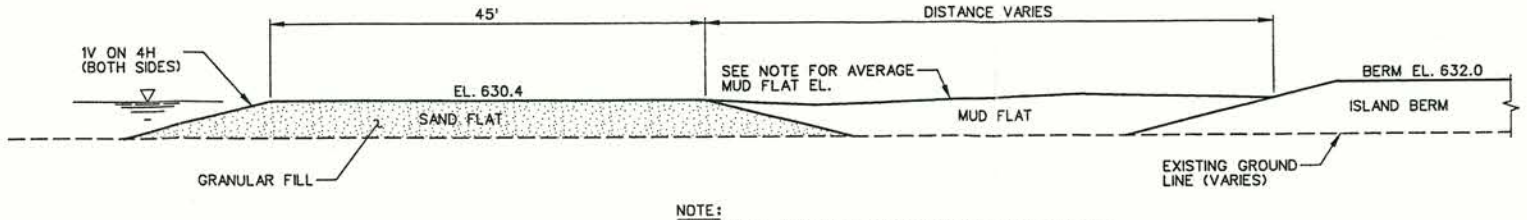
ISLAND DIMENSIONS – 3 CENTRAL (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND C2A STA. 0+00 TO 2+00	SEED ISLAND						
ISLAND C2B STA. 0+00 TO 2+20	SEED ISLAND						
ISLAND C2C STA. 0+00 TO 1+40	ROCK/LOG ISLAND (SEE PLATE 28)						
ISLAND C2 STA. 0+00 TO 17+00	45	0	60	0	45	150	632.0
ISLAND C2 STA. 17+00 TO 22+00	ROCK/LOG ISLAND (SEE PLATE 28)						
ISLAND C2 STA. 22+00 TO 44+70	45	0	60	0	45	150	632.0
ISLAND C3 STA. 0+00 TO 9+00	45	0	40	0	30	115	632.0
ISLAND C4 STA. 0+00 TO 24+10	20	12.5	40	12.5	45	130	634.5
ISLAND C4 STA. 24+50 TO 37+00	45	0	60	0	45	150	632.0
ISLAND C5 STA. 0+00 TO 12+00	45	0	40	0	30	115	632.0
ISLAND C6 STA. 0+00 TO 12+20	45	0	40	0	45	130	632.0
ISLAND C7 STA. 0+00 TO 8+90	45	0	40	0	45	130	632.0
ISLAND C8 STA. 5+00 TO 34+20	45	10.0	40	10.0	45	150	634.0
ISLAND C8 STA. 34+20 TO 44+50	ROCK SILL						631.5
ISLAND C8 STA. 44+50 TO 59+30	45	0	60	0	45	150	632.0



NOTES:
ISLAND C2: ELEVATION = 630.4.
ISLAND C3 & C5: ELEVATION = 630.5.

SECTION

TYPICAL SAND FLAT
ISLANDS C2, C3, AND C5
SCALE: 1" = 10'-0"



NOTE:
ISLAND C4: AVERAGE MUD FLAT ELEVATION = 630.4

SECTION

TYPICAL MUD/SAND FLAT
ISLAND C4
SCALE: 1" = 10'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: SCALE: AS SHOWN DATE: JAN 2002
CHECKED: CADD FILE NAME: C1_SEC.DGN
DRAWN: SOL. NO: NA
DESIGNED: APPROVING OFFICIAL: AE
CHECKED:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

POOL 8 ISLANDS, PHASE 3-CENTRAL
ENVIRONMENTAL
ISLAND & SAND/MUD FLAT TYPICAL SECTIONS

DRAWING NUMBER:
Plate 27
SHT 3 OF 4

Pool 8, Phase 3, Rock/ Log Island For Use on Island C2c, C2 Upper West Leg, and E2

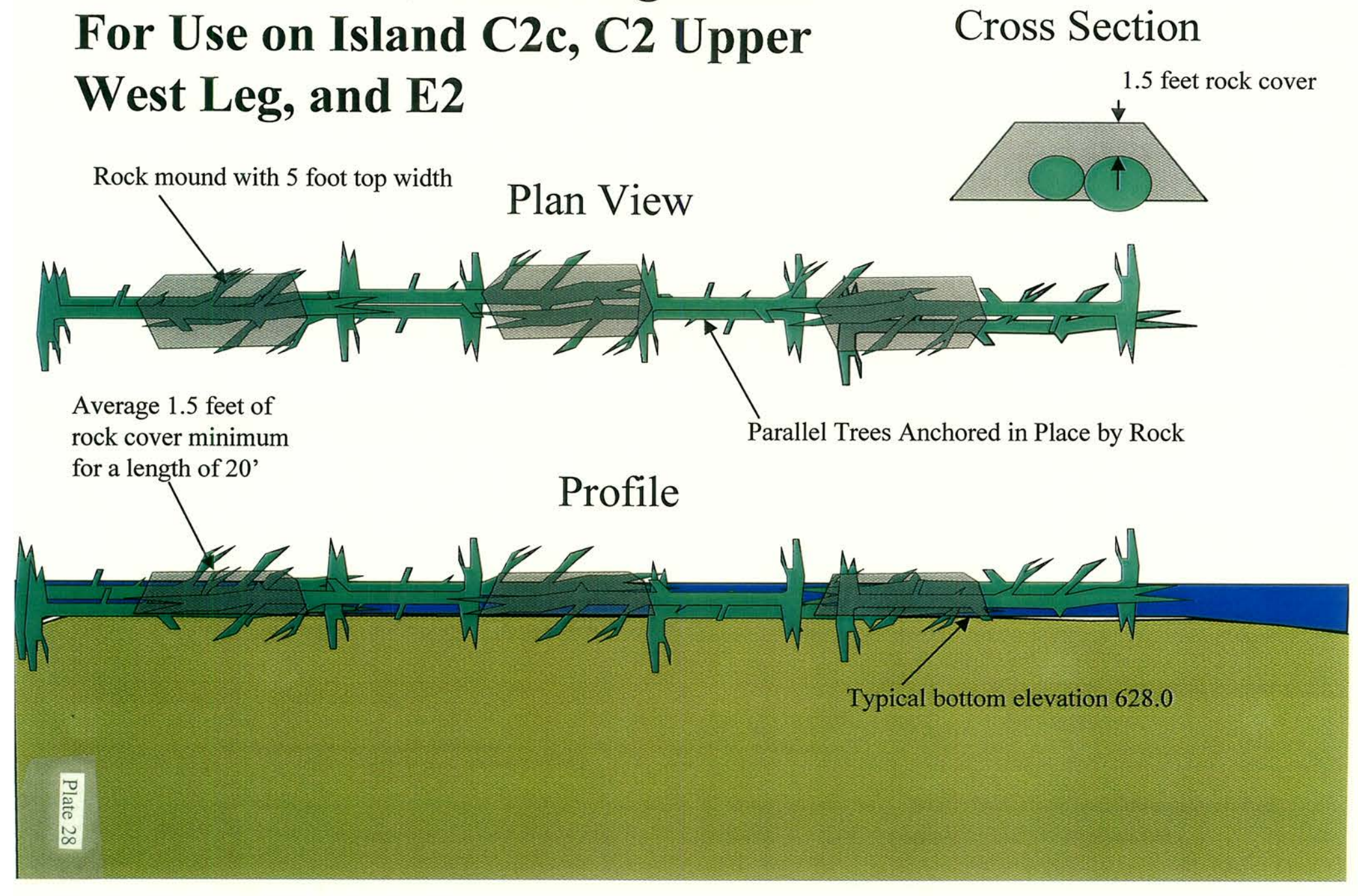
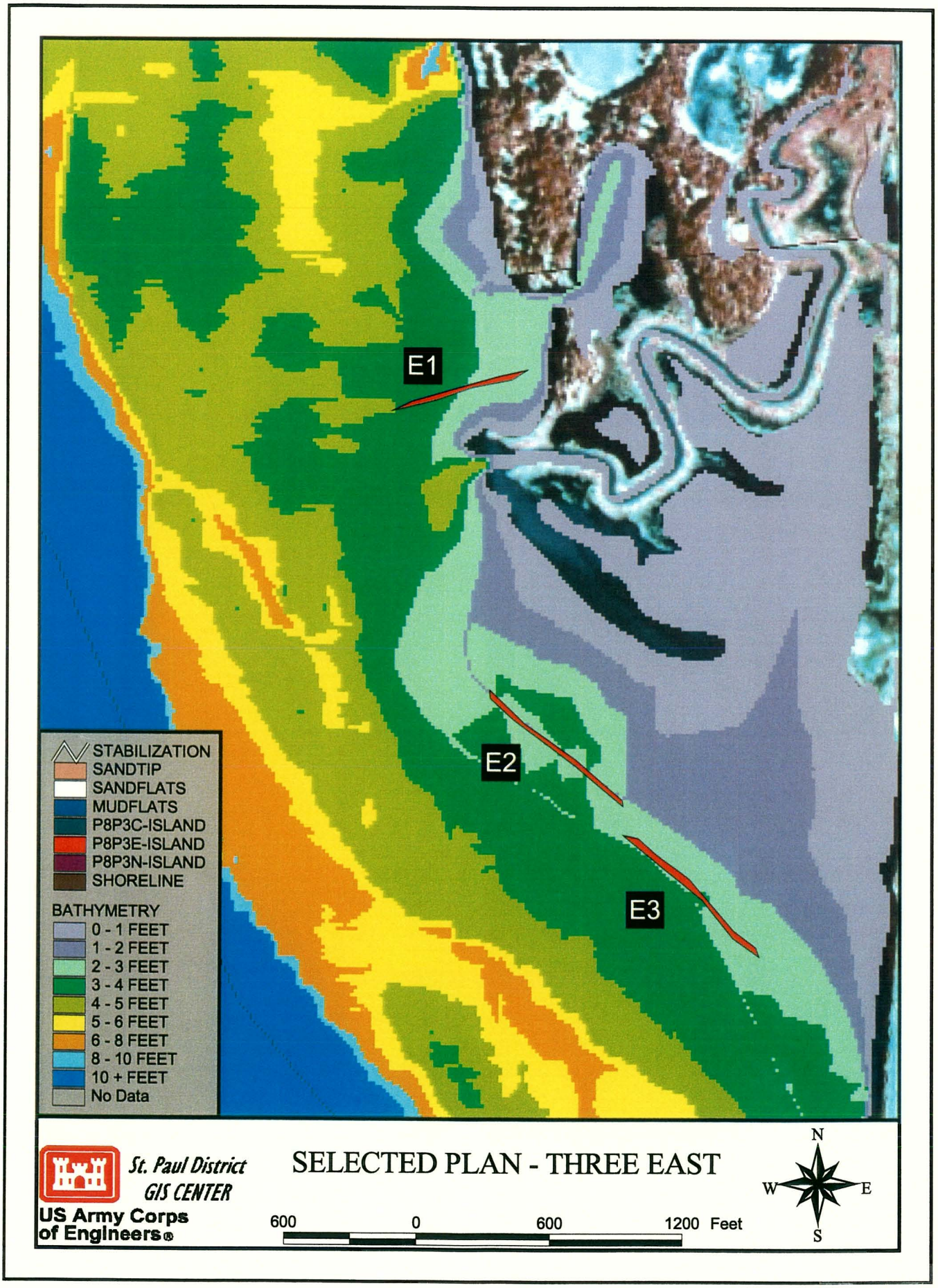
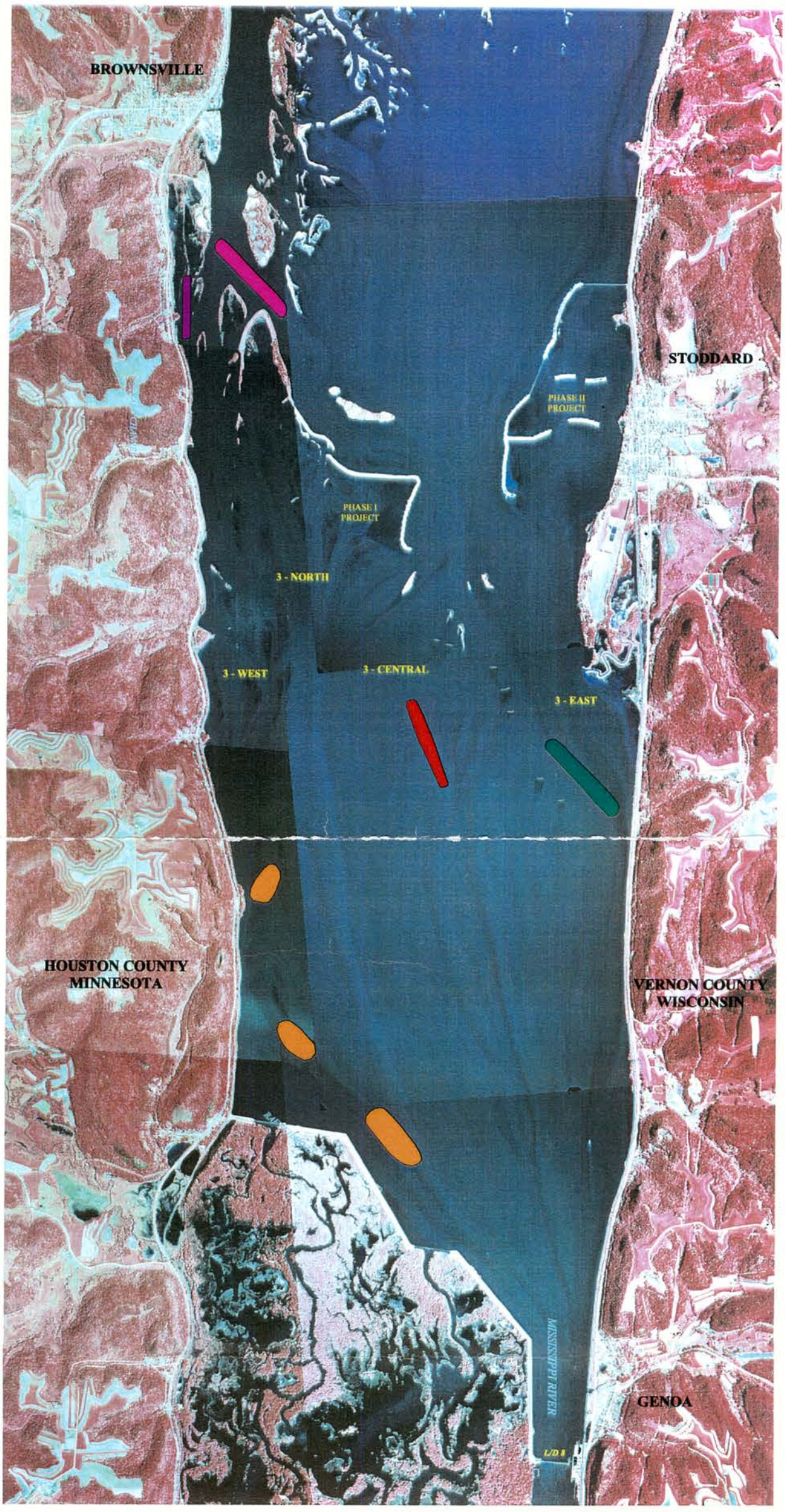


Plate 28


Ca
Cb
Cc
Cd
Ce
Cf
Cg
Ch
Three Central
ential Access Routes/Points =


E1
E2
E3
STABILIZATION
SANDTIP
SANDFLATS
MUDFLATS
P8P3C-ISLAND
P8P3E-ISLAND
P8P3N-ISLAND
SHORELINE
BATHYMETRY
0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
No Data
St. Paul District
GIS CENTER
US Army Corps
of Engineers®
SELECTED PLAN - THREE EAST
600
0
600
1200 Feet
N
W
E
S

POOL 8 ISLANDS - PHASE III PROJECT AREA



POTENTIAL SAND MATERIAL BORROW SITES

4000 0 4000 8000 Feet

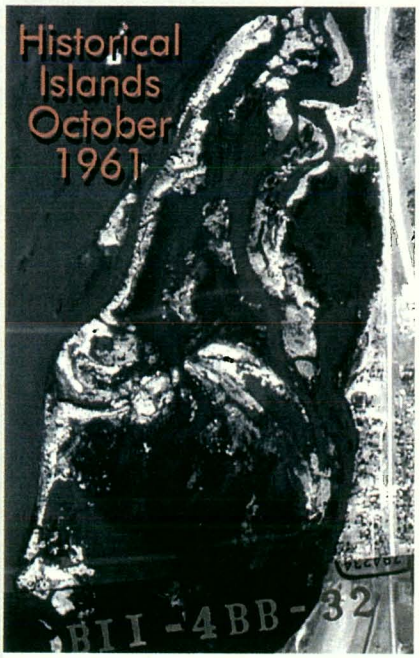
St. Paul District GIS CENTER
US Army Corps of Engineers®

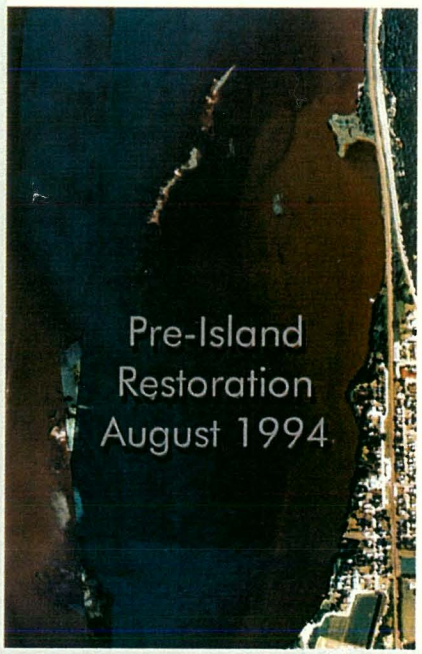
N W E S

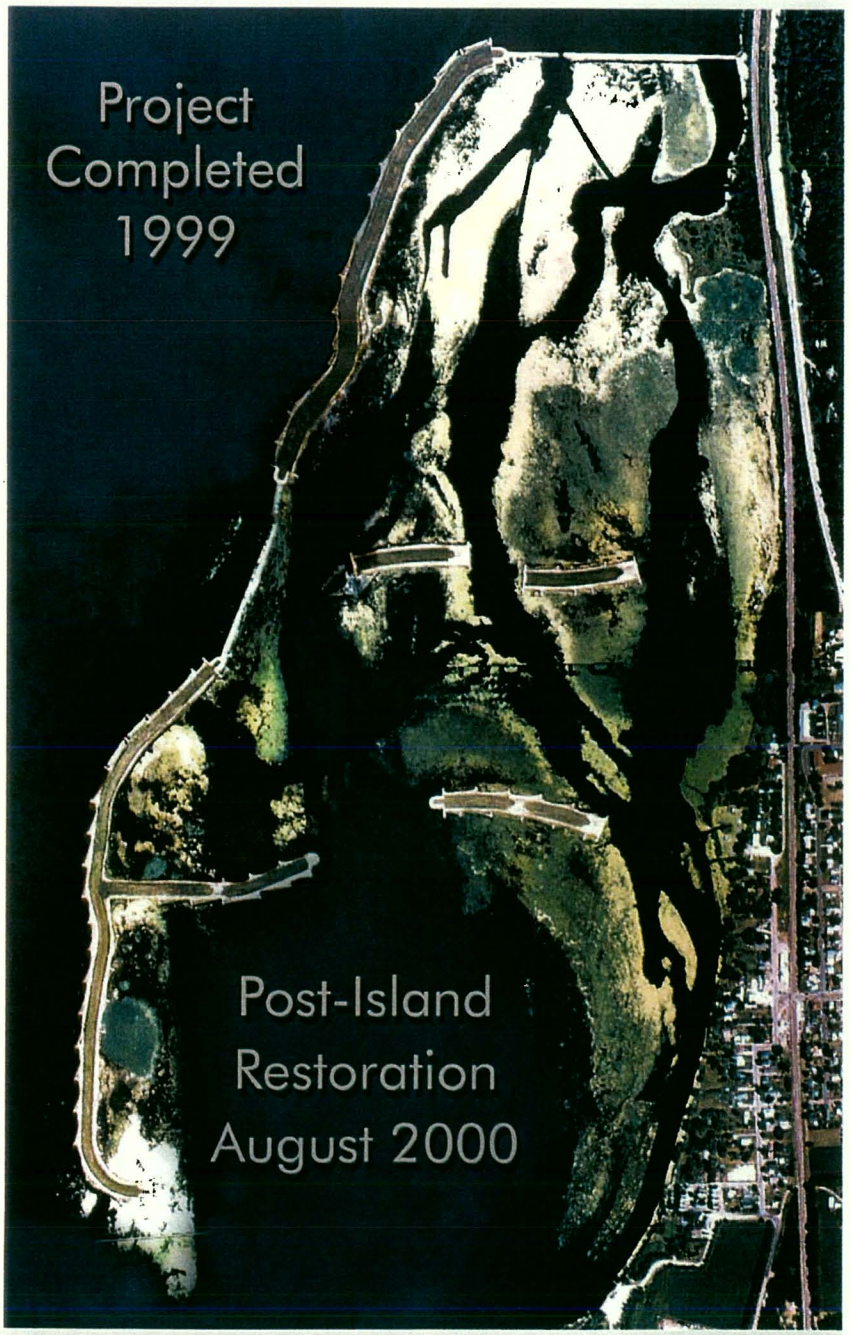
Infrared Photo Base: May 26, 1999 (Water Level: 632.0)

- 3-CENTRAL SITE
- MISSISSIPPI RIVER - MAIN CHANNEL - SITE 683
- MISSISSIPPI RIVER - MAIN CHANNEL - SITE 687
- RAFT CHANNEL SITES
- SCHNICK'S BAY SITE

C:\arcview\apr_files\pool_8\p8_isle3.apr MRW 10-09-01


Historical
Islands
October
1961
BII-4BB-32


Pre-Island
Restoration
August 1994


Project
Completed
1999
Post-Island
Restoration
August 2000

Pool 8 Islands Phase II

11 July 2001

Plate 33