US Army Corps
of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/

ENVIRONMENTAL ASSESSMENT (SP-16)

PETERSON LAKE

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 4
UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

MARCH 1994

PETERSON LAKE HABITAT REHABILITATION AND ENHANCEMENT PROJECT

EXECUTIVE SUMMARY

Peterson Lake is located immediately upstream of lock and dam 4 on the Minnesota side of the Upper Mississippi River. This 500-acre backwater lake supports fish and wildlife species typical of many backwater lakes on the river. Peterson Lake lies within the Upper Mississippi River National Wildlife and Fish Refuge. The lake has good water quality, good water depths and bathymetric diversity, and supports good submergent aquatic plant growth.

Sedimentation is becoming an evident problem in the lake and if left unchecked, will result in a significant loss of aquatic habitat in the lake. It is estimated that sedimentation will result in the loss of over 75 percent of the lake's volume over the next 50 years. The barrier islands separating the lake from the river are eroding away. Further loss of the islands will, aside from the loss of their intrinsic habitat value, result in an increase in river flow and associated sediment entering the lake. Flows entering the lake already create substandard winter habitat conditions for fish due to high current velocities and low water temperatures. Loss of the barrier islands would subsantially reduce habitat diversity and values in the Peterson Lake area of lower pool 4. Over the years, emergent aquatic vegetation has nearly disappeared from the lake, reducing habitat value for both fish and wildlife.

The plan formulation process considered several alternatives for preventing further habitat degradation at Peterson Lake and for rehabilitating and improving habitat conditions. These centered on methods to reduce flow and sediment entering Peterson Lake and to prevent further island loss. The alternative that most closely achieved the habitat objectives for Peterson Lake and provided the greatest habitat benefits for the cost was selected.

The selected plan calls for six of the upper seven openings into the lake to be totally closed and the seventh to be partially closed to reduce flows and sediment entering the lake through these openings. In addition, weirs would be placed in two of the central openings into the lake to reduce bed load sediment entering the lake while still allowing current levels of flow into the lake. It is estimated that the closures and weirs would reduce sedimentation in the lake by over 50 percent, significantly extending the ecological life of Peterson Lake as a backwater lake and maintaining aquatic habitat values. In addition, the closures would create an area in the upper portion

of the lake that fish, primarily Centrarchids, could use as a refuge from current velocities and cold water during the winter. Some of the closures would constructed of rock, while others would be constructed of the sand excavated to provide construction access to the site.

Rock bank protection would be used to prevent further erosion of the lower islands in the barrier island chain. The purpose is to maintain these islands for their habitat value and to prevent further degradation of habitat conditions in Peterson Lake due to increased flows and sedimentation.

Total direct construction costs for the selected plan for Peterson Lake are $746,000. Costs for plans and specifications and for construction management bring the total cost to $986,000. Because the project is located entirely within the National wildlife refuge, the construction cost of the project would 100 percent Federal, in accordance the Section 906(e) of the Water Resources Development Act of 1986. Average annual operation and maintenance costs for the project are estimated to be $3,125. The operation and maintenance requirements would be the responsibility of the U.S. Fish and Wildlife Service.

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 4, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

TABLE OF CONTENTS

TABLE OF CONTENTS CONT'D

TABLE OF CONTENTS CONT'D

Tables

<u>Attachments</u>

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 4, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

INTRODUCTION

AUTHORITY

The authority for this report is provided by Section 1103 of the Water Resources Development Act of 1986 (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 1966.

(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)(1) The Secretary, in consultation with the Secretary of the Interior and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, is authorized to undertake, as identified in the Master Plan -

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

PARTICIPANTS AND COORDINATION

Participants in the planning for the Peterson Lake project include the Upper Mississippi River National Wildlife and Fish Refuge and the Region 3 Offices of the U.S. Fish and Wildlife Service (USFWS), the Minnesota and Wisconsin Departments of Natural Resources (MDNR and WDNR), and the St. Paul District, Corps of Engineers.

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

ST. PAUL DISTRICT, CORPS OF ENGINEERS

Name	Discipline	Contribution
Gary Palesh	Fishery Biologist	Study Manager
John Shyne	Fishery Biologist	Environmental analyses, NEPA doc., HEP eval.
Sissel Johannessen	Archaeologist	Cultural resources
Mark Rodney	Hydraulic Engineer	Hydraulic analyses
Jon Hendrickson	Hydraulic Engineer	Hydraulic analyses
James Sentz	Civil Engineer	Water Quality studies
Joel Face	Civil Engineer	Geotechnical analyses
Winston Riedesel	Civil Engineer	Design and layout
Mike Dahlquist	Civil Engineer	Cost estimating

U.S. FISH AND WILDLIFE SERVICE

Name	Position
Keith Beseke	Habitat Projects Coordinator
Robert Drieslein	Refuge District Manager
Tony Batya	Refuge Asst. District Manager

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Name	Position
Mike Davis	Habitat Projects Coordinator
Tim Schlagenhaft	Area Fisheries Manager
Nick Gulden	Area Wildlife Manager
Dan Dieterman	Area Fisheries Specialist
Scott Johnson	Mississippi River Team Hydrologist

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Name	Position
Jeff Janvrin	Mississippi River Habitat Specialist
Ron Benjamin	Mississippi River Fisheries Supervisor
Brian Brecka	Area Fisheries Manager
John Wetzel	Mississippi River Wildlife Biologist
John Sullivan	Mississippi River Water Quality Specialist

PROJECT PURPOSE

RESOURCE PROBLEMS/OPPORTUNITIES

The purpose of this Definite Project Report is to document existing habitat conditions, predict future habitat conditions, identify existing and future habitat deficiencies, define specific habitat objectives, and identify alternative plans that would address the objectives.

PROJECT BOUNDARIES

Peterson Lake is a 500-acre backwater lake located between an unnamed side channel of the Upper Mississippi River and the Minnesota shoreline. The lake is triangular in shape and is located immediately above the earthen dike at lock and dam 4. Peterson Lake lies between river mile 753.0 and river mile 754.8. The project area is defined as Peterson Lake, including the lock and dam 4 dike, the Minnesota shoreline, and the barrier islands separating Peterson Lake from the side channel. Figure 1 shows the location of Peterson Lake, while figure 2 shows the project area.

GENERAL PROJECT SELECTION PROCESS

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. Programatic updates of the General Plan for budget planning and policy development are accomplished annually.

Coordination with the States and the USFWS during the preparation of the General Plan and Addendums 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 (for wetland restoration and protection) Note: By letter of 5 February 1988, Headquarters, U.S. Army Corps of Engineers directed that such projects not be pursued.

(2) A number of innovative structural and nonstructural solutions which 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 which include 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.

PROJECT SELECTION

Projects are nominated for inclusion in the 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 utilize 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 Addendums and supplemental guidance provided by the North Central Division.

Projects consequently have been screened by biologists closely acquainted with the river. 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.

Lower pool 4 consists of the area from the mouth of the Chippewa River to lock and dam 4. The floodplain or river corridor in lower pool 4 covers approximately 20,600 acres, of which approximately 7,800 acres are aquatic habitat (source: Environmental Management Technical Center). Of these 7,800 acres of aquatic habitat, approximately 2,000 are main channel, main channel border, and side channel habitat (Olson and Meyer, 1976). The remaining 5,800 acres, including Peterson Lake, are backwater lakes, ponds, and sloughs. Peterson Lake represents about 6 percent of the total aquatic habitat and about 8 percent of the backwater aquatic habitat in lower pool 4.

There are three major backwater lakes in lower pool 4, Big Lake, Robinson Lake, and Peterson Lake. Each is unique because of their particular morphologic and hydrologic characteristics. Peterson Lake is considered a valuable fish and wildlife habitat resource in lower pool 4 because it represents an appreciable portion of the aquatic habitat in lower pool 4, and because of its own unique characteristics which add to the overall habitat diversity and quality in lower pool 4.

The Peterson Lake project was co-sponsored by the USFWS and the MDNR. The primary resource problem identified by these agencies was the loss of barrier islands to erosion and sand sedimentation in the lake. The Peterson Lake project was assessed and ranked by the FWWG in 1987 in their initial ranking of projects. The Peterson Lake project received a high score (38) by the FWWG and was ranked 8th in overall priority. Peterson Lake received this high ranking because it is a valuable resource of high importance, the ongoing and potential loss of habitat to sedimentation was clearly evident, the opportunity exists to curtail or arrest the rate of resource degradation, and the opportunity exists to benefit a wide variety of fish and wildlife. Table DPR-1 shows the FWWG ranking of projects in 1987. Included are footnotes concerning the current status of these projects.

The Peterson Lake project was programed within the St. Paul District for a start of the general design phase in FY 1991. A Fact Sheet was submitted to Headquarters, Washington, D.C. in December 1990 requesting approval to begin general design (study phase). Approval was received in October 1991 and general design was initiated in November 1991.

Table DPR-1
FWWG Ranking of Projects in 1987

Rank	Pool	Project	Score	Current Status
1	5	Finger Lakes	30	1
2	8	Root River Sediment Trap	29	9
3	9	Lansing Big Lake	34	2
4	10	Bussey Lake	32	1
5	9	Cold Springs	26	1
6	5A	Kieselhorse Bay	35	9
7	4	Drury Island	38	8
8	4	Peterson Lake	38	3
9	5	Spring Lake	39	2
10	3	North Lake	38	8
11	-	Bank Stabilization	29	4
12	7	Bullet Chute	35	5
13	5	Whitewater Dike	32	7
14	8	Wildcat Landing	31	6
15	8	Smith's Slough	24	4
16	5	Island 41	32	8
17	6	Blackbird Slough	35	7
18	10	Haville Lake	24	9
19	6	Trempealeau NWR	27	3
20	-	MN Valley NWR Rice Lake	28	4

Status Code
1 - Under construction
2 - Construction approved but not initiated
3 - Study completed awaiting construction approval
4 - Under study
5 - Completed in conjunction with Winters Landing project
6 - Completed in conjunction with Pool 8 Islands project
7 - Study scheduled
8 - Project in deferred status
9 - Project no longer under consideration

ASSESSMENT OF EXISTING RESOURCES

PHYSICAL SETTING

Peterson Lake is a 500-acre backwater lake located on the Minnesota side of the Upper Mississippi River between river mile 753.0 and river mile 754.8. The lake is roughly triangular in shape, with the earthen dike at lock and dam 4 forming the base, the Minnesota mainland one side, and an unnamed side channel of the river the third side (figure 2). Historically, Peterson Lake was separated from the side channel to a large extent by islands and emergent wetlands. However, erosion has reduced this barrier island/wetland complex such that 30 to 40 percent of the riverward side of Peterson Lake is open to the river.

WATER RESOURCES

PETERSON LAKE

Peterson Lake is approximately 1.6 miles long along its axis. Except for the very upper end, the lake ranges from 2,500 to 4,000 feet wide over most of its length. Figure 3 is a bathymetric map of the lake prepared by the Minnesota Department of Natural Resources from a 1986 survey. The lake has a diversity of water depths ranging down to 13.5 feet. Most of the deeper water is located in the lower portion of the lake. There is a very deep (> 30 feet) side channel at the lower end of the lake. Table DPR-2 contains a breakdown of water depth vs. area for the lake.

Table DPR-2
Water Depth vs. Area for Peterson Lake

Depth Range (ft)	Acres	Percentage of Lake
Islands	40	8
0 - 3	105	21
3 - 7	245	49
> 7	110	22
	500	100

Table DPR-3 summarizes the width and depth of the side channels separating Peterson Lake from the major side channel that runs along the eastern side of the lake. Figure 4 shows the side channel and island numbering system used in this study.

Table DPR-3
Depths and Widths of Side Channel Openings (ft)

Side Channel	Approx. Width	Approx. Max. Depth at 667.0	Side Channel	Approx. Width	Approx. Max. Depth at 667.0
1	290	5.5	8	330	12.0
2	130	4.0	9	690	6.0
3	130	6.0	10	-	2.0
4	60	3.0	11	260	3.0
5	180	10.0	12	320	6.0
6	60	2.5	13	150	7.0
7	140	7.5	14	460	37.0

Flow Conditions

Flow conditions in and out of Peterson Lake vary with Upper Mississippi River stage. Under most conditions, flows enter Peterson Lake from the river through the upper openings (#1 through #9) and exit through the lowest opening (#14). This pattern is generally confirmed by field measurements taken in the area of openings 1 through 11 in 1991-93. These measurements were taken in four different seasons under four different flow conditions. They show the same pattern of flow into Peterson Lake through openings 1 through 9 and little flow through openings 10 and 11 due to heavy aquatic vegetation growth. Also, aerial photographs taken in 1991 strongly suggest little or no flow either way through openings 12 and 13 due to vegetation conditions in these openings. Opening 14 is the main flow outlet from Peterson Lake. Figures 5 through 8 show discharge relationships for openings 1 through 8.

Since 1967, there has been the additional outflow of up to 80 cubic feet per second (cfs) through the culvert in the lock and dam 4 dike into Lower Peterson Lake. Once the Finger Lakes Habitat Rehabilitation and Enhancement Project is completed (est. 1994), there will be additional flows out of Peterson Lake of up to 100 cfs (50 cfs through each of two new culverts). If all culverts were to be flowing at full capacity, there would be a total flow of 180 cfs leaving Peterson Lake into the Finger Lakes. This compares with the total measured inflow of about 820 cfs into Peterson Lake (table DPR-4) for the lowest of the three non-winter Upper Mississippi River flow conditions measured. The discharge of 19,300 cfs is about 2,000 cfs lower than the mean daily discharge for October in the river at lock and dam 4, and about 8,000 cfs lower than the mean daily river discharge on an annual basis. Thus, it is representative of low flow conditions in the river and into Peterson Lake.

Table DPR-4
Summary of Discharge (cfs) Measurements into Peterson Lake

Side Channel	Date	L&D 4 Discharge	Site Discharge	Percent of L&D 4 Discharge	River Mile
1-4	5/30/91	64,070	1,465	2.3	754.9
1-4	10/16/91	19,300	160	0.8	
1-4	5/27/92	28,000	557	2.0	
1-4	1/07/93	18,450	312	1.7	
1-4	2/18/93	15,600	201	1.3	
5	5/30/91	64,575	1,900	2.9	754.7
5	10/16/91	19,300	343	1.8	
5	5/27/92	28,000	690	2.5	
5	1/07/93	18,450	403	2.2	
5	2/18/93	15,600	299	1.9	
7	5/30/91	64,650	701	1.1	754.6
7	10/16/91	19,300	75	0.4	
7	5/27/92	28,000	231	0.8	
7	1/07/93	18,450	160	0.9	
7	2/18/93	15,600	76	0.5	
8-9	5/30/91	64,760	1,420	2.2	754.4
8-9	10/16/91	19,300	240	1.2	
8-9	5/27/92	28,000	450	1.6	
8-9	1/07/93	18,450	494	2.7	
8-9	2/18/93	15,600	226	1.4	
11	5/30/91	Inlet plant-choked - minimal effective flow			
Cumul.	5/30/91	64,500	5,490	8.5	
	10/16/91	19,300	820	4.2	
	5/27/92	28,000	1,928	6.9	
	1/07/93	18,450	1,369	7.4	
	2/18/93	15,600	802	5.1	

Water Quality

Peterson Lake's water quality is currently monitored by the Minnesota Field Station for the Long-term Resource Monitoring Program (LTRM) and the Minnesota Department of Natural Resources. In addition to two Peterson Lake stations, there are several other water quality monitoring stations in the area. Water quality monitoring in Peterson Lake began in 1990. This monitoring includes insitu measurements of water temperature, dissolved oxygen, transparency (Secchi depth), conductivity turbidity, and current velocity. The following nutrient and metals data are collected.

total phosphorus (TP)	total nitrogen (TN)
total soluble phosphorus (TSP)	total soluble nitrogen (TSN)
soluble reactive phosphorus (SRP)	ammonium nitrate (NH_4-N)
suspended solids (TSS)	nitrate-nitrite nitrogen (NO_2NO_3)
phaeophyton (PHAEO)	chlorophyll A (CHLA)
organic matter (ORG)	silica
chloride	dissolved calcium (DISS CA)
dissolved iron (DISS FE)	dissolved potassium (DISS K)
dissolved manganese (DISS MN)	

In several respects, Peterson Lake water quality is similar and dependent on Mississippi River water quality. Large flows entering Peterson Lake from the Mississippi River continually "flush" the lake. Table 5 lists the mean summer (June through September) concentrations for 1991 for the two Peterson Lake stations and a nearby Mississippi River station.

Data collected in Peterson Lake indicates that summertime dissolved oxygen (DO) is generally above 5 milligrams per liter (mg/l) and wintertime DO values are generally greater than 10 mg/l. Water temperatures ranged from winter lows < 1° C to a high of about 27° C during the summer months.

Turbidity levels during the summers of 1990 through 1992 ranged from 3 to 27 NTU's. During the same period, Secchi disk transparency ranged from 40 to 160 centimeters (1.3 - 5.2 ft).

Specific conductance is variable in Peterson Lake with summer values ranging from the high 200's to almost 600 umho/cm. Water temperatures at the two Peterson Lake monitoring stations did not vary between the stations regardless of the monitoring period.

Table DPR-5
Summary of Summer Water Quality Data

Parameter		Peterson L. Stat. 753.2V (vegetated)	Peterson L. Stat. 753.2S (open water)	Miss. River Stat. 761.5E
TP	(mg/l)	.199	.195	.208
TSP	(mg/l)	.164	.159	.171
SRP	(mg/l)	.142	.139	.149
TN	(mg/l)	4.74	4.47	4.80
TSN	(mg/l)	4.39	4.08	4.55
NO_2NO_3	(mg/l)	3.48	3.42	3.65
NH_4-N	(mg/l)	.05-.06	.038-.045	.163-.173
TSS	(mg/l)	-	11.2	10.0
ORG	(mg/l)	-	3.6	3.2
CHLA	(mg/m^3)	-	14.3	10.8
PHAEO	(mg/m^3)	-	2.0	2.8
Silica	(mg/l)	7.8	7.8	8.0
Chloride	(mg/l)	16	16	17*
DISS CA	(mg/l)	63	62	59
DISS FE	(mg/l)	.027-.04	.022-.035	.038-.045
DISS MN	(mg/l)	.037-.043	.027-.047	.017-.04
DISS K	(mg/l)	3.5	3.5	3.5

* possible outlier (95 mg/l) in river chloride sample not included in the average.

Summer current velocities at an open water station (753.2S) ranged from 0 to about .33 meters/second during 1990 through 1992. The vegetated station (753.2V) had lower velocities (0 - .13 m/sec), and generally higher DO than the open water station.

Data indicates that winter stratification does not occur in Peterson Lake. This is likely due to the flows passing through the lake which keep the lake mixed. Summer stratification may occur intermittently during periods of calm wind.

Peterson Lake outlets to both the Mississippi River and the Finger Lakes below the lock and dam 4 dike (see FINGER LAKES below). Currently the dissolved oxygen available in Peterson Lake is adequate for use in the Finger Lakes. Slightly higher winter water temperatures near 3° C would benefit the Finger Lakes as long as high dissolved oxygen values are maintained.

UPPER MISSISSIPPI RIVER

The main channel of the Upper Mississippi River flows somewhat parallel to the eastern side of Peterson Lake, at a distance that varies from 1,500 to 2,500 feet. The average annual discharge at lock and dam 4 is approximately 28,000 cfs. Typical late summer flows in August and September vary from 12,000 to 20,000 cfs. The flows for flood events are shown below:

Event	Flow
5-year (20% chance)	118,000 cfs
10-year (10% chance)	144,000 cfs
20-year (5% chance)	178,000 cfs
50-year (2% chance)	207,000 cfs
100-year (1% chance)	238,000 cfs

A side channel separates Peterson Lake from the main channel of the Upper Mississippi River. This side channel is about 1,500 feet wide. Water depths in this side channel generally range from 5 to 15 feet, though there are some areas greater than 20 feet.

Five wing dams (figure 4) were constructed across this side channel in the early 1900's to restrict flows to the main channel. The wing dams do not appear to rise much above the adjacent bottom. This suggests they have been substantially buried by sediments.

FINGER LAKES

The Finger Lakes are a series of backwater lakes located immediately below the L/D 4 dike. An existing culvert through the dike with approximately 80 cfs capacity carries water from Peterson Lake into Lower Peterson Lake and Schmokers Lake. As part of the Upper Mississippi River System - Environmental Management Program, culverts have been installed in the dike to convey flows from Peterson Lake into Clear Lake and Third Lake. The purpose of the existing culvert and the new culverts is to alleviate dissolved oxygen depletion problems in the Finger Lakes.

GEOLOGY AND SOIL/SUBSTRATE

The most significant geological event explaining the nature of the Mississippi River within pool 4 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 preglacial Minnesota and Mississippi River valleys. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Since post-glacial times, a braided 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 4 in the 1930's, the broad floodplain of the river was characterized by this braided stream system that consisted of swampy depressions, sloughs, natural levees, islands, and shallow lakes.

VEGETATION

The species of emergent vegetation present in Peterson Lake were identified as part of fisheries surveys conducted in 1986 and 1987 by the Minnesota DNR. According to that survey, vegetation was generally absent along the dike of lock and dam 4. The Minnesota shore is sandy with little vegetation. The islands which separate Peterson Lake from the river had stands of millet-smartweed, carex, and rice cutgrass. At the upper end, extensive stands of marginal vegetation occurred, with carex, millet-smartweed, cutgrass, Eragrostis, and Paspalum present. Other common species of vegetation were: wool grass, arrowhead, great waterdock, horsetail, reed canary grass, softstem bulrush, white waterlily, common cattail, cordgrass, chufa, giant burreed, and phragmites.

The composition and distribution of submergent vegetation in Peterson Lake were sampled by the LTRM program during the summer of 1991. In the area from the upper end of the lake to the end of the most downstream island (Area A - figure 9), vegetation was sampled in depths of 0.2 meters (m) to 2.1 m with an average depth of 0.5 m to 1.0 m. Substrates varied greatly but were mostly various mixtures of sand, silt and clay. On the downstream side of the outlet channel (Area B), depths varied from 0.6 m to 1.8 m and averaged 0.8 m. The substrate was mostly sand and silt.

The vegetation bed along the dam and extending to the downstream point of the outlet (Area C) was 0.3 m to 1.8 m with an average depth of 0.8 m. The substrate in this area was also sand and silt. In the area where the dam meets the Minnesota shore (Area D), depths were 0.5 m to 1.9 m with an average of 1.0 m. The substrate was mostly silt and detritus with some sand. Table DPR-6 shows the relative abundance of each species within each site. Filamentous algae is limited in occurrence. Algal blooms do not appear to be significant.

Table DPR-6
Peterson Lake Vegetation Survey (Relative Abundance*)

Species	Area A	Area B	Area C	Area D	Common Name
Vallisneria americana	1	1	1		Wild Celery
Zosterella dubia	2		4	4	Water Stargrass
Potamogeton foliosus	3		3		Leafy Pondweed
P. pusillus	5			2	Pondweed
P. crispus	5				Curlyleaf Pondweed
P. pectinatus	7				Sago Pondweed
P. zosteriformis	9				Flatstem Pondweed
P. nodosus	10				River Pondweed
Myriophyllum spicatum	4				Eurasian Watermilfoil
Ceratophyllum demersum	3		2	1	Coontail
Elodea canadensis	8		5	3	Canada Waterweed
Zannichellia palustris			6		Horned Pondweed

* relative abundance rating from most (1) to least (10) based on observation.

HABITAT TYPES AND DISTRIBUTION

Peterson Lake is a backwater lake bounded by uplands, a man-made dike, islands, and a side channel of the Mississippi River. Within the lake, there are different habitat types, e.g., deep water without aquatic vegetation, shallow water with and without vegetation, and riparian islands. However, from a fish and wildlife management perspective, the lake is a singular entity managed for its holistic value to fish and wildlife.

FISH AND WILDLIFE

There are 33 species of fish present in Peterson Lake. Major game fish species that use Peterson Lake for spawning, rearing, and dwelling include: bluegill, largemouth bass, channel catfish, black and white crappie, yellow perch, northern pike, walleye and sauger. A number of other fish species are also present in the lake. These include forage species like the shiners, and "rough" species such as gar, bowfin, carp, and suckers.

An evaluation of fisheries habitat by the Minnesota Department of Natural Resources (Minnesota DNR, 1987) concluded that Peterson Lake was accessible to all fish species present in the Mississippi River. There is excellent spawning habitat for northern pike in flooded riparian vegetation. There is good nursery and rearing habitat for juvenile fishes. Excellent spawning habitat for bluegill amd largemouth bass is provided by shallow flats on the eastern side of the lake. Scattered submerged stumps provided spawning habitat for channel and flathead catfish.

Pool 4 is a key pool being monitored by the LTRM. Fish data is collected from Peterson Lake as part of this program. Table DPR-7 summarizes the percent composition of fish collected from Peterson Lake during the period 1990 - 1992 by all gear types. Data from Big Lake, a large backwater lake located on the Wisconsin side of the river and approximately 5 miles upstream, is also included for comparison purposes. Two sets of data are presented as an unusually large catch of gizzard shad occurred in Big Lake in 1992.

Table DPR-7
Summary of LTRM Fish Collection Data 1990-92

	Percent of Fish Collected			
	Peterson Lake		Big Lake	
	A	B*	A	B*
Centrarchids	39	41	19	38
Percids	10	11	2	4
Carp	6	6	3	5
Redhorse/Sucker	11	11	7	13
Minnows	19	20	19	37
White Bass	3	3	2	4
Other	12	8	50	6
Total Fish #	3,138	3,004	7,496	3,968

* gizzard shad excluded

The Peterson Lake data indicates that with like many other Mississippi River backwater lakes, Centrachids are predominant. If minnows are excluded, the predominance of Centrarchids would be even more marked. When the large 1992 gizzard shad catch in Big Lake is not considered, the general composition of the fishery of Peterson Lake is similar to that of Big Lake.

Benthic surveys (Minnesota DNR, 1987) did not reveal unusual concentrations of organisms. The fauna was typical of river habitat and contained mayflies, caddis flies, chironomids and other diptera, as well as amphipods and other crustaceans, snails, and fingernail clams.

There are mussel beds in the lower portion of the lake along the lock and dam 4 dike. A mussel survey conducted during September 1992 of the side channel, side channel openings, and portions of the upper and eastern side of the lake found relatively few mussels. This survey focused on areas that could potentially be disturbed by construction activities. The majority of live mussels were threeridge or threehorn. Other live mussel species found included: pimpleback, pigtoe, pink heelsplitter, pocketbook, and paper floater. No live specimens or shells of any endangered or threatened mussel species were found.

Peterson Lake is used by a variety of waterfowl species including: mallard, blue- and green-winged teal, wood duck, scaup, American widgeon, northern shoveler, Canada geese, tundra swans, and American coot. Use varies on an annual basis depending on waterfowl populations and the presence/absence of preferred waterfowl foods in Peterson Lake and other backwaters.

Additional wildlife which observed in the area includes: great horned owl, green heron, great blue heron, great egret, belted kingfisher, red-winged blackbird, tree swallow, mourning dove, ruffed grouse, osprey, muskrat, raccoon, beaver, mink, fox, and white-tailed deer.

The barrier islands along Peterson Lake have mature trees that are used by bald eagles for roosting. Lower pool 4 is an area that receives high use by bald eagles, both during migration and as an over-wintering area.

CULTURAL RESOURCES

While the Peterson Lake project area contains no historic or prehistoric cultural resources listed on the National Register of

Historic Places, with the exception of lock and dam 4 itself, the area has high potential for the existence of cultural resources. This area of the Mississippi Valley has seen human occupation for millennia. Ten archaeological sites (eight mound groups and two village sites) are known within 2 miles of Peterson Lake; seven to the west where the Zumbro River enters the Mississippi River floodplain, and three on the Wisconsin side near the mouth of the Buffalo River. Just north of Peterson Lake, on the river itself, is Teepeeota Point, a former Sioux camping ground and the site of a historic village that burned down in 1859, and a remnant of Grand Encampment Island, the name "derived from the fact that the Dakota Indians used to hold their councils there" (Lewis, 1967 [1854]). Peterson Lake also marks the southern limits of the Wabasha Reservation, or Half-breed Tract (1830-1854). The area of Peterson Lake also coincides with the description of the location of a large fortification, consisting of a semi-circular barrier a mile long and four feet high, with each flank reaching the river, first described by Carver in 1778. Featherstonhaugh in 1847 described the location as 8 miles southeast of Rocque's post (now Reads Landing), near a village of Wabasha's band (probably at Teepeeota Point), and from there 2 miles south, placing it in the vicinity of Peterson Lake.

The pre-inundation natural river levee, now represented by the island remnants of Peterson Lake, has not previously been surveyed for cultural resources. The 1890's Mississippi River Commission (MRC) map of the area shows that the floodplain that now is the bed of Peterson Lake was uncultivated and marshy, and that the higher levee ground was bottomland forest. The MRC map shows no buildings on the old river shoreline that is now the barrier islands of Peterson Lake. However, 1932 real estate maps show several cottages and a cabin on islands VI and VII.

SOCIOECONOMIC RESOURCES

POPULATION

Peterson Lake is located in Wabasha County, Minnesota approximately 80 miles southeast of Minneapolis-St.Paul, Minnesota. The population of the Wabasha County is 19,744 in 1990, a 2.1 percentage growth from 1980. There are a number of summer cabins and some permanent residences situated around Peterson Lake. The closest cities are Wabasha and Kellogg, Minnesota, and Alma, Wisconsin. The 1990 population of city of Wabasha was 2,384, the city of Kellogg was 437, and the city of Alma, Wisconsin was 479.

INDUSTRY

The industries in Wabasha County are manufacturing employing 16 percent of persons sixteen years or older; retail/wholesale trade employing 21 percent; agriculture, forestry and fisheries employing 14 percent; health services employing 13 percent; professional services employing 6 percent; educational services employing 6 percent; and construction employing 6 percent.

In the city of Wabasha are retail/wholesale trade employ 19 percent; manufacturing employs 17 percent; health services employs 17 percent; professional services employ 9 percent; educational services employ 8 percent; and construction employs 7 percent (U.S. Census, 1990).

INCOME AND UMEMPLOYMENT

The median household income in Wabasha County is $26,998 and the median family income is $32,023, and the per capita income is $11,733 as estimated in 1990. The unemployment rate in Wabasha County is 4.7 percent. For the city of Wabasha, the median household income is $21,897, median family income is $30,673, and the per capita income is 10,737 as estimated in 1990. The unemployment rate for the city of Wabasha is 3.3 percent (U.S. Census, 1990).

COMMERCIAL NAVIGATION

Commercial navigation is a primary activity on the Mississippi River. There are five commercial navigation facilities in pool 4 which transport such commodities as grain, vegetable oils, and coal. It is estimated that approximately 29,220 vessels passed through Lock and Dam #4, downstream of Peterson Lake, in 1992. Of those 29,220 vessels, 14,474 were barges, 1309 were tows, 13,352 were recreational boats, and 85 were other vessels.

RECREATIONAL RESOUCES

There are few recreational sites available for public use in the immediate vicinity of the project. Peterson's Landing provides access to the main channel of Mississippi River for nearby residents and recreational boaters. Some of the islands near Teepeeota Point and Lock and Dam #4 are designated as low density recreational lands and can be used for picnicking, boat-beaching, and camping. These recreational areas contain no developed facilities or campsites.

PROJECT OBJECTIVES

PROBLEM IDENTIFICATION

EXISTING HABITAT CONDITIONS

Historically Documented Changes in Habitat

The only available documentation of changed conditions in the lake is a series of aerial photographs; and survey/bathymetric data from 1895, 1930, 1986, and the present.

Changes in Area of Islands and Emergent Wetlands

The extent of islands/emergent wetlands in the Peterson Lake barrier chain and the lake itself was measured from aerial photographs (figures 10-14a). The islands and emergent wetlands were lumped together because it is nearly impossible to accurately separate them on the 1938 and 1958 photographs. The results are shown in table DPR-8 below.

Table DPR-8
Amount of Islands/Emergent Wetlands Present in Peterson Lake (to nearest 5 acres)

Date of Photo	Pool Elevation at Lock & Dam 4	Approximate Acres of Islands/Emergent Wetlands
August 18, 1938	666.2	135
August 3, 1958	666.6	80
August 10, 1964	666.7	55
August 27, 1973	666.6	50
August 29, 1989	667.2	40*

* The higher water on this date should not appreciably affect the acreage calculations because the shoreline on this photograph is well defined by the presence of woody vegetation.

Based on these measurements and a visual analysis of the aerial photos, it appears that the greatest loss of islands and emergent marsh occurred during the first 20 to 25 years of inundation. This is similar to the trends observed in other navigation pools where low islands and emergent marsh dissappeared at a fast rate after inundation by the navigation pool. It appears that the vast majority of the area lost to erosion during this period was emergent marsh. These marsh areas were probably less able to withstand the erosive forces of the river than were the islands. In addition, the islands were protected to some degree for a number of years by the presence of the marshes.

Table DPR-9 shows the change in island area for the period 1964 through 1989. Figures 15 and 16 show the changes from 1964 to 1973 and 1973 to 1989, respectively. During the period 1964-73 the rate of island loss was about .67 acres/year. During the period 1973-89, the rate decreased to about .53 acres/year. Most of the island loss during both periods was from the lower islands in the chain (I - VII). During the period 1964-73, about 92 percent of the loss was from these islands, while during the 1973-89 period the loss from the lower islands was about 82 percent of the total lost.

Table DPR-9
Peterson Lake Island Acreage (1964 - 1989)

Island No.	1964 ac.	1973 ac.	1989 ac.
I - III	6.0	4.5	3.5
IV	12.0	9.5	6.5
V	5.0	4.5	4.0
VI	1.5	1.0	0.5
VII	10.0	9.5	7.5
subtotal	**34.5**	**29.0**	**22.0**
VIII	6.5	5.5	5.0
IX	2.5	2.0	1.5
X	2.5	2.0	1.5
XI	2.0	2.0	3.0
XII	2.5	3.5	3.0
XIII	1.5	1.5	1.5
XIV	3.0	3.5	3.0
subtotal	**20.5**	**20.0**	**18.5**
Total	**55.0**	**49.0**	**40.5**

Changes in Lake Bed Elevation

An analysis was made comparing the changes in lake bed elevation between 1931 and 1986/1990. This is shown on figure 17. The analysis indicates that both sedimentation and erosion of the lake bottom have occurred over the last 60 years.

Sedimentation appears to have occurred primarily in the deep basin in the western part of the lake and along the upper and mid-eastern section of the lake where sediment is entering through the openings in the island chain.

The lake volume was calculated using the available survey and bathymetric data. This information is summarized in tables DPR-10 and DPR-11. Based on the information contained in these tables, coupled with the visible changes evidenced in aerial photos and field observations, educated estimates can be made as to what has occurred in the lake relative to sedimentation since its creation in 1935. In those portions of the lake less than 5 feet deep there probably was initial scouring as the river eroded away the emergent marshes and portions of the islands. Much of this initial scouring took place by late 1950's - early 1960's as the 1964 aerial photographs show most of the emergent marshes gone and the islands in the configuration that exists today.

Since the early 1960's there has been sedimentation in the shallower portions of the lake. This is evident by the sand deltas that are clearly visible on the riverward side of the lake. Some of the more prominent sand deltas are discernible on a recent aerial photograph (figure 14b). This sedimentation appears to not have totally filled in the volume of the lake was scoured in the earlier years, as the bathymetric data still shows a net increase in volume of 52 ac-ft in those portions of the lake less than 5 feet deep.

In the deeper portions of the lake (> 5' deep), there has been a net loss of volume, primarily in those areas greater than 7 feet deep. This deep area lies in the southwesterly portion of the Peterson Lake, which actually was a lake before the present day Peterson Lake was created by the inundation of pool 4. It is likely that much of the material scoured from the shallower portions of the lake ended up settling out in this deeper part of the lake, as well as other sediments carried into the lake over the years.

Table DPR-10
Lake Volume (ac-ft)[1] by Date and Elevation

	Below Elevation 667.0	Below Elevation 665.0	Below Elevation 662.0	Below Elevation 660.0
1931[2]	2,533	1,550	693	459
1986	2,518	1,576	565	236
1990[3]	2,340	1,395	448	208

[1] Does not include the large scour hole at the lake's outlet. This hole is sufficiently deep to affect the lake volume calculations but is not pertinent to the analysis of changes within the lake.

[2] Peterson Lake was not created until 1935; data shows estimated volume of the lake had it been present in 1931.

[3] The 1990 bathymetry data did not provide coverage of areas less than 3 feet deep. The 1986 bathymetry data was used to fill in the missing data.

Table DPR-11
Lake Volume (ac-ft) by Date and Elevation Band

Elevation Band	1931	1986	1990	Net Change 1931-90	Percent Change 1931-90
665.0 - 667.0	983	942	945	-38	- 4
662.0 - 665.0	857	1,011	947	+90	+ 11
subtotal	**1,840**	**1,953**	**1,892**	**+52**	**+ 3**
660.0 - 662.0	234	329	240	+ 6	+ 3
660.0 - 654.0	459	236	208	-251	- 55
subtotal	**693**	**565**	**448**	**-245**	**- 35**
total	**2,533**	**2,518**	**2,340**	**-193**	**- 8**

Factors Influencing Habitat Change

Most dramatic changes in Peterson Lake appear to have occurred during the first 20 to 25 years following inundation by pool 4. It is likely these changes were the result of the natural forces of river flows, pool fluctuations, wave action acting on the emergent wetlands and islands, sedimentation, and ice action.

These forces are still acting on Peterson Lake. These are discussed individually as to their relative importance in effecting habitat change in Peterson Lake.

Pool Level Fluctuations

Relatively stable water levels are believed to be one of the primary factors affecting the amount of emergent vegetation present in Peterson Lake. Many emergent plant species originally present in the Mississippi River floodplain were adapted to alternating flooding and drying cycles. Their adaptation was to reproduce sexually when water levels were low and seeds could germinate on exposed mudflats. The stabilization of water levels has greatly reduced the ability of these plants to reproduce sexually. Their primary avenue of reproduction under stabilized water conditions is vegetatively, which is relatively inefficient. While stable water levels can not be proven as the primary cause for the lack of emergent aquatic vegetation in the lake, it is considered one of the more plausible reasons.

Current pool level fluctuations in Peterson Lake are relatively small for the Upper Mississippi River because the lake is located immediately above the lock and dam. Maximum fluctuation with spring high water is usually less than 4 feet over normal pool. Fluctuations during the growing season are generally less than one foot. Because of the relative water level stability, pool fluctuations likely do not have much influence on the types or quality of habitat in Peterson Lake, save for the effect on retarding emergent vegetation growth as discussed above.

Wave Action

Navigation induced waves do not have any appreciable effect on Peterson Lake because of its distance from the navigation channel and because of the remaining barrier islands. Wind induced waves have some effect on the lake, but not as great as is seen in the lower portions of some of the other navigation pools on the Upper Mississippi River. Peterson Lake is relatively small and protected when compared to areas such as Lake Onalaska (pool 7) or the lower reaches of pools 8 and 9. In addition, the deeper water depths in Peterson Lake limit wave resuspension of bottom materials.

The islands in Peterson Lake are oriented linearly with the prevailing southeast (summer) and northwest (spring and fall) winds. This maximizes the potential for littoral drift and is probably causing some wave induced erosion of the islands.

River Flows

Another factor that appears to be effecting changes in Peterson Lake is flows entering the lake from the Mississippi River. It is believed that one of the prime contributors to the loss of emergent wetland/island area in Peterson Lake has been flows from the river. This holds true especially for some of the early disappearance of the emergent wetlands. These wetlands would have been lower than the islands and would have been the primary avenues of river flow into the lake once it was inundated.

Aside from their erosive effect, river flows also exert an influence on the ecology of Peterson Lake. During the summer, flows appear to be sufficient to "flush" the lake such that algae growth does not reach nuisance levels. During the summer, flows through Peterson Lake currently range for about 800 cfs to 2,000 cfs, and residence times range accordingly from 0.5 to 1.5 days. It is believed that this frequent flushing with the relatively clean waters of lower pool 4 is one reason that water clarity in Peterson Lake is better than what is typical for backwater areas in this region of the Upper Mississippi River.

Another potential effect of these summer flows and the regular flushing of the lake is that phyto- and zooplankton, which are critical food items for the early life stages of many backwater fish species such as largemouth bass and bluegill, are also regularily flushed from the lake. It is not known if this flushing is occurring at a rate that would negatively impact fish production in Peterson Lake. It would require a major research effort to determine this.

Winter flows from the river into Peterson Lake have a much more basic effect. Backwater lakes on the Mississippi River in this region exhibit highly variable winter conditions depending on their depth and the amount of inflow they may be receiving.

Well protected deep lakes will show cold (<1 degree C) water immediately below the ice with a gradual transition for a couple of feet to water near 2 degrees C, with the deeper waters generally remaining in the 3 to 4 degrees C range. A number of factors can affect this, such as shallow depths or inflows of colder water. At a certain point, inflows become sufficient that they cool the entire water column. This is what is occurring at Peterson Lake. Winter monitoring data (appendix 7) show that the entire lake is cooled to temperatures less than 1 degree C. Current velocities are variable depending on location within the lake. Velocities were higher during the 1992 monitoring than during 1993. This is a reflection of the higher flows occurring on the river during the winter 1992 sampling (23,000 cfs) than during the 1993 sampling (16,000 cfs).

Sedimentation

It is difficult to quantify the effect sedimentation is having on Peterson Lake. Available survey and bathymetric data only give two snapshots in time, preinundation (1931) and the recent past (1986/1990). A cumulative 60-year picture of sedimentation is available, but there is little data on which to estimate current sedimentation rates. A comparison of the 1986 and 1990 bathymetric data indicates that the lake lost about 178 acre-feet of volume during this period, or about 45 acre-feet per year. However, this is a relatively short time span of record.

An analysis was conducted to estimate the current sedimentation rate based on inflows, suspended sediment data, and mathematical models (see attachment 5), and was calibrated using the volume change estimates referred to in the preceeding paragraph. This analysis indicates that the current sediment load entering Peterson Lake is about 81 tons/day of bed load sediment and 326 tons/day of suspended sediment. With a trap efficiency of 100 percent for bed load sediment and 38 percent for suspended sediment, this translates into a sedimentation rate of about 14 acre-feet per year for bed load material and 29 acre-feet per year for suspended sediment loading, for a total estimated sedimentation rate of 43 acre-feet per year. The 38-percent trap efficiency is high for Mississippi River backwater lakes, but is justified in this case for two reasons. First, Peterson Lake is relatively deep and thus acts as an efficient sediment trap. Secondly, wind fetch is generally less than 1 mile. Thus, wave action will not be as effective in keeping sediment in suspension.

Another crude technique is to estimate bed load sediment from the sand deltas in the lake. These deltas cover approximately 100 acres and borings indicate the sand layer ranges in thickness from 1 to 6 feet depending on the boring. Using an average thickness of 3.5 feet, these deltas would contain roughly 350 acre-feet of sand sediments. Based on conversations with resource managers and local citizens it appears that sand delta formation began prior to 1980 and possibly as early as the late 1960's. Using a range of 15 to 25 years, that would equate to deposition in the deltas in the range of 15-25 acre-feet/year.

Ice Effects

There are three possible causes of ice effects in and near Peterson Lake. These are ice floes coming down the Mississippi River; wind-driven ice piles, most likely to come from Peterson Lake; and freezing/thawing effects. Ice could cause upheaval of shoreline material and general deformation of shoreline areas. However, this is only a problem if material is lost from the beach zone. Often what happens is that ice will push material up in a berm along the beach and then wave action will redistribut this material back onto the beach. The barrier islands are subjected to ice action that may be having some erosive effect.

ESTIMATED FUTURE HABITAT CONDITIONS

Barrier Island Loss

An analysis was made projecting future barrier island loss (to the nearest .5 acre) based on historic aerial photographs and island elevations. This information is shown in table DPR-12.

Table DPR-12
Historic and Projected Barrier Island Acreage

Island No.	1964 ac.	1973 ac.	1989 ac.	Projected 2018 ac.	Projected 2043 ac.
I - III	6.0	4.5	3.5	2.5	1.5
IV	12.0	9.5	6.5	4.5	2.5
V	5.0	4.5	4.0	2.0	0.0
VI	1.5	1.0	0.5	0.0	0.0
VII	10.0	9.5	7.5	6.0	4.5
subtotal	**34.5**	**29.0**	**22.0**	**15.0**	**8.5**
VIII	6.5	5.5	5.0	4.0	3.0
IX	2.5	2.0	1.5	1.0	0.5
X	2.5	2.0	1.5	1.0	0.5
XI	2.0	2.0	3.0	4.0	5.0
XII	2.5	3.5	3.0	3.5	4.0
XIII	1.5	1.5	1.5	1.5	1.5
XIV	3.0	3.5	3.0	3.0	3.0
subtotal	**20.5**	**20.0**	**18.5**	**18.0**	**17.5**
Total	**55.0**	**49.0**	**40.5**	**33.0**	**26.0**

Based on observations of island loss on the Upper Mississippi River since formation of the navigation pools, it does not appear that this loss is linear. Instead, it appears that the highest rate of loss from an island occurs early during the erosion process, and the higher portions of islands persist for some time. The projections for 25 and 50 years into the future are based on the assumption that the rate of island loss will decrease from what has been observed during the period 1964-89.

The islands at the upper end of the lake (XI through XIV) have remained relatively stable and/or have grown slightly. This trend is expected to continue in the future. Much of the flow entering Peterson Lake is entering through the upper openings.

These flows appear to be carrying sufficient sediment to precipitate island accretion in this area. This is occurring in what historically was considered the better fishery habitat in Peterson Lake.

It should be noted that the above discussion only applies to the barrier islands. As discussed below under "Habitat Conditions" sedimentation is likely to result in the creation of islands within Peterson Lake, especially in the upper portions of the lake.

Flow Conditions

It is expected that, as additional island mass is lost from the barrier island chain, additional river flow will enter Peterson Lake. How much additional flow would enter the lake can not be quantified because it is not possible to predict with sufficient accuracy where exactly erosion will take place and what the ensuing water depths will be. Since most of the projected island loss would be in the lower portion of the barrier chain, it would follow that any increased inflow to the lake would occur in this area.

Sedimentation

Because of the lack of bathymetric data for Peterson Lake over the last few decades, projecting future sedimentation in the lake can only be based on mathematical projections and on observations on sedimentation patterns. It is expected that shallowing of the upper and eastern portions of the lake would continue due to bed load sediments entering the lake. It is also expected that the sand deltas would continue to grow to the south and west. Suspended sediment would continue to settle in the lake, wherever current velocities decreased sufficiently. The most likely area of fine material deposition would be the deeper basin in the southwesterly corner of the lake.

Projections have been made using calculated sedimentation rates over the next 50 years. A factor affecting future sedimentation rates is as the lake fills in, residence times will decrease, which in turn will decrease trap efficiencies for suspended sediments. Based on observed conditions in other shallow lake areas such as in lower pool 8, trap efficiencies are expected to decrease to about 30 percent. Table DPR-13 summarizes the projected loss of lake volume over the next 50 years due to sedimentation.

Table DPR-13
Projected Changes in Lake Volume Without Project

Year	Approximate* Lake Volume
Present	2,200 acre-feet
Present +10	1,775 acre-feet
Present +20	1,350 acre-feet
Present +30	900 acre-feet
Present +40	500 acre-feet
Present +50	< 500 acre-feet

* rounded to nearest 25 acre-feet

As can be seen from the table, sedimentation is going to have a significant impact on Peterson Lake. It is projected that the volume of the lake will decrease by over 75 percent over the next 50 years. It is difficult to predict what will occur as the lake approaches the point where it is nearly filled with sediment. Based on observations of sedimentation patterns in other areas, it is believed that the lake will never totally fill in with sediment. At some point, an equilibrium would likely be reached and there would be a shallow remnant lake above the L/D 4 dike that would remain for a considerable length of time. The effect that filling of the lake will have on fish and wildlife habitat is discussed in the following section.

Habitat Conditions

As illustrated by the projections in table DPR-13, sedimentation is going to have a significant impact on future habitat conditions in Peterson Lake. The projection of future habitat conditions is based on observations of what is occurring at Peterson Lake and what has been observed in other lake-like backwaters in the lower portions of the navigation pools on the Upper Mississippi River.

Heavier bed load sediments tend to settle out soon after the entering the relatively quiet waters of the lake, as evidenced by the sand deltas in the lake. It is projected that the sand deltas in the upper portion of the lake will continue to extend further down the lake. Sand bars and small islands will form in this area. Flows through this area may become more braided and confined to channels. Examples of this condition, though on a larger scale, would be the Indian Slough delta in Big Lake in pool 4 and the Burleigh Slough delta in Polander Lake in pool 5A.

The sand delta on the east central side of the lake will also extend further into the lake from bed load sediments entering openings 8 and 9. The formation of emergent sand bars and islands in this area will likely occur also.

The fine sediments, as noted earlier, will settle out in the deeper portions of the lake. As the lake fills, wind, wave, and current action will tend to redistribute the sediments such that in 50 years the lower portion of the lake will have shallow homogeneous water depths in the range of 1 to 2 feet. Some deeper channels (2-4 feet) may remain along main flow pathways. The continued loss of the barrier islands in the lower portion of the island chain will contribute to the homogenization of water depths.

Aquatic vegetation in the lake is expected to continue to grow on the sand deltas in those areas where fines become mixed in with the sands. This is based on observations of current conditions in the lake where aquatic vegetation grows on the deltas where fines have become mixed with the sands. In those portions of the lake that become filled with fine sediments, aquatic vegetation growth will occur.

As is currently the case, water quality in Peterson Lake will continue to largely reflect the water quality in the river because of the large flows passing through the lake and short residence times. Turbidity may increase over time in the lower portion of the lake as this area shallows and fine sediments reach the zone where they are susceptible to resuspension by wind and wave action.

Habitat quality for fish is expected to decline as the lake becomes shallower due to the loss of deep water cover and bathymetric diversity. Excessive aquatic growth would also be detrimental to habitat quality for fish because of the potential for increased summer dissolved oxygen depletion due to plant respiration. Increased turbidity would also adversely affect habitat quality. Centrarchids and Percids would be affected the most as they are less tolerant of these conditions than for example, carp, buffalo, and bullheads.

It is more difficult to predict future habitat conditions for waterfowl, as waterfowl habitat suitability will depend more upon the response of aquatic vegetation to lake shallowing. Based on observations of conditions in the lower reaches of other pools such as lower pool 8 and lower pool 9, habitat conditions for waterfowl are not expected to improve.

INSTITUTIONAL FISH AND WILDLIFE MANAGEMENT GOALS

Fish and wildlife management goals and objectives for the area fall under those defined more broadly for the Upper Mississippi River National Wildlife and Fish Refuge, and those designated specifically for Peterson Lake in the Refuge Master Plan. Peterson Lake is managed as a closed area of Refuge.

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 sedimentation and turbidity entering the river system.

+ 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.

Fisheries and Aquatic Resources

+ Maintain and enhance, in cooperation with the States, the habitat of fish and other aquatic life 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.

PROJECT GOALS AND OBJECTIVES

GENERAL HABITAT GOALS

Basic to developing a solution to the habitat problems in Peterson Lake is the need to develop habitat goals and objectives. The following general habitat goals were identified for Peterson Lake and provide a framework for the specific project objectives that follow.

Goal #1 - Maintain Peterson Lake as a productive backwater resource.

This is the basic goal that led to Peterson Lake being considered under the UMRS-EMP Habitat Restoration and Enhancement Projects program (see earlier discussion under "Project Selection"). Backwater habitats are some of the most productive areas on the Upper Mississippi River for a wide variety of fish and wildlife. It has long been recognized and documented that aquatic habitats on the Upper Mississippi River, especially backwater habitats, are declining in both quantity and quality due to sedimentation. The Federal and State resource agencies managing the river have determined that it is important to maintain these backwater habitats and the values they provide.

To accomplish this project goal, it was recognized that two basic problems had to be addressed. The first is sedimentation which eventually will result in the substantial filling of Peterson Lake and a concomitant significant reduction in aquatic habiat value. The second problem is the loss of the barrier islands which serve to define Peterson Lake as a backwater lake and which have intrinsic habitat value in their own right.

Goal #2 - Optimize habitat conditions for migratory waterfowl, especially migration feeding and resting habitat.

This goal was established because Peterson Lake is a designated close area of the Upper Mississippi River National Wildlife and Fish Refuge. As a closed area, it should provide high quality habitat for migratating waterfowl. To optimize conditions in Peterson Lake for migratory waterfowl, the following were identified as important:

(1) Reduce sedimentation as much as practical because sedimentation is eventually going to fill in Peterson Lake.

Reducing the rate of sedimentation will preserve Peterson Lake as a valuable aquatic resource for migrating waterfowl for as long as possible.

(2) Maintain the existing submergent aquatic plant growth which is excellent for a Upper Mississippi River backwater lake in this region. This is especially important considering the decline in aquatic vegetation that has occurred in many other backwater lakes along the river over the past decade. Submergent aquatic vegetation is important to migrating waterfowl as a food resource.

(3) Try to reestablish emergent aquatic vegetation in the lake as emergent vegetation is used by migrating waterfowl for both food and cover.

(4) Protect the barrier island chain as these islands are what define Peterson Lake as a backwater lake. It is believed that these islands are important in maintaining aquatic vegetation by providing some protection from wind and wave action and by controlling sand sediment inputs to Peterson Lake. Also, these islands provide a visual barrier that isolates Peterson Lake from navigation and other boat traffic to the east. This isolation from human activity is important to migrating waterfowl.

Goal #3 - Optimize habitat conditions for fish species typical of Upper Mississippi River backwater habitats; e.g., largemouth bass, northern pike, bluegill, crappie, and associated species.

This goal was established because one of the most significant values of backwater lakes is the fish habitat they provide. Because of its deep water, bathymetric diversity, and good water quality, Peterson Lake has the potential to support a diverse and productive fishery. To optimize conditions in Peterson Lake for fish species typical of backwater lakes, the following were identified as important:

(1) Reduce sedimentation as much as practical because sedimentation is eventually going to fill in Peterson Lake. Reducing the rate of sedimentation will preserve Peterson Lake as a valuable aquatic resource capable of supporting important backwater fish species for as long as possible.

(2) Improve winter habitat conditions for fish. Winter habitat conditions in Peterson Lake are very poor because of the amount of main channel water flowing through the lake. This flow creates current velocities and water temperature conditions unsuitable for many fish species, especially Centrarchids which are a significant component of the fish population.

(3) Maintain the existing submergent aquatic plant growth which is excellent for a Upper Mississippi River backwater lake in this region. Submergent aquatic vegetation is important in providing food and cover for fish.

(4) Protect the barrier island chain as these islands are what define Peterson Lake as a backwater lake. It is believed that these islands are important in maintaining aquatic vegetation by providing some protection from wind and wave action and by controlling flow and associated sand sediment inputs to Peterson Lake. In addition, the shallow water adjacent to the islands provides important habitat for fish for spawning and feeding and as nursery habitat.

SPECIFIC PROJECT OBJECTIVES

The following specific project objectives were developed for Peterson Lake. These specific objectives were based on information collected during the problem identification phase, information obtained from the public, and an evaluation of what could be achieved at Peterson Lake, given the various planning opportunities and constraints present.

A. Reduce sedimentation in Peterson Lake as much a practicable.

It is readily apparent from visual evidence and aerial photography that sand deltas are forming in Peterson Lake. Current sedimentation rates can be estimated using mathematical methods. Some limited empirical information is available to verify the mathematical methods. Projections are that if nothing is done to abate sediment inputs to the lake, sedimentation will fill in most of Peterson Lake within the next 50 years, significantly reducing its value as an aquatic resource. Therefore, if sedimentation is not controlled, accomplishment of other habitat objectives becomes somewhat moot. It was recognized that total control of sedimentation would be impossible. Reduction of sedimentation as much as practicable within planning and fiscal constraints is considered a reasonable objective.

Objective A is considered critical to meeting all three of the project goals.

B. Maintain the 40 acres of islands in the barrier chain separating Peterson Lake from the Upper Mississippi River.

The barrier islands at Peterson Lake are what define the lake as a backwater lake and contribute to the unique habitat it provides. The islands in and of themselves provide habitat for wildlife and add to habitat diversity in the project area. Mature trees on these islands are used by bald eagles for roosting. The land-water interface provided by these islands is high quality habitat for aquatic furbearers, wading birds, and other wildlife. On the lake side, the shallow waters adjacent to the islands provide spawning, feeding, and nursery habitat for fish. On the channel side they provide structure for fish using flowing channel habitat. In addition, erosion of the barrier islands separating Peterson Lake from the Upper Mississippi River has opened the lake up to the river, allowing increased flow through the lake. This has contributed to sand sedimentation in the lake. Further erosion of the barrier island chain in the future will only aggravate these problems. For these reasons, it was determined that it is important to prevent further barrier island loss and associated reduction in habitat diversity and quality. It needs to be further noted that the value of the islands to some degree is tied to their present location and configuration. Thus, losing portion of the barrier island chain to erosion while gaining island mass to accretion within Peterson Lake would not meet this objective.

Objective B is considered critical to meeting all three of the project goals.

C. Maintain submergent aquatic plant growth as it generally existed in 1991, recognizing the annual variations that will occur in any natural system. The parameters defining the 1991 condition are:

(1) Submergent aquatic plant growth extending to water depths of 5 feet.

(2) Mean summer (Jun-Sep) turbidity levels of less than 15 NTU.

Submergent aquatic plant growth in Peterson Lake as it existed in 1991 was excellent for Upper Mississippi River backwater lakes in this reach of the river. This objective was established to insure the maintenance of existing submergent aquatic plant growth in the lake.

Objective C is very important to meet project goals #2 and #3.

D. Create a winter fish refuge in the upper portions of Peterson Lake. The following conditions should be achieved in as large an area as practicable:

1) Winter dissolved oxygen levels of $\geq$ 5 mg/l.

2) Winter current velocities $\leq$ 1 cm/sec (0.03 ft/sec).

3) Winter water temperatures > 1° Centigrade.

Winter habitat conditions in Peterson Lake for Centrarchids (the main component of the fishery) are severe because of high current velocities and low water temperatures. Reducing winter current velocities and increasing winter water temperatures throughout Peterson Lake was not considered feasible without risking adverse effects on summer water quality. Therefore, it was determined that providing a winter refuge within the upper reaches of Peterson Lake was a more practical and achievable goal. Winter is primarily a time of survival for Centrarchids and other warmwater fish species with the basic habitat needs being adequate dissolved oxygen, protection from excessive current velocity, and water temperatures greater than 1° Centigrade.

The numerical criteria $\geq$ 5 mg/l for dissolved oxygen was selected because this is the State water quality standard, although studies have shown that during the winter Centrarchids can survive at dissolved oxygen levels below this. It was deemed inappropriate to establish a project objective that would lower water quality below State water quality standards. The current velocity and water temperature criteria were established based on the findings of recent studies that looked specifically at winter Centrarchid habitat use, such as the pre-project Finger Lake biological monitoring studies (Barko, et. al., 1993) and recent radio telemetry work done by the Wisconsin DNR in pool 10 (Welke, 1993).

Objective D is very important to meeting project goal #3.

E. Increase emergent aquatic plant growth in the lake by approximately 10 acres.

Emergent aquatic plant growth has declined in Peterson Lake significantly since the formation of the lake in the 1930's. Restoration of emergent aquatic plant growth in the lake would provide improved habitat conditions for a variety of fish and wildlife. While increasing emergent plant growth by more than 10 acres would be desirable, the ability to accomplish this in Peterson Lake is questionable given the current state of knowledge concerning factors limiting emergent plant growth in the lake. Increasing emergent aquatic plant growth by 10 acres was selected as a modest objective lying within the realm of what may be achievable.

Objective E would contribute to meeting project goals #2 and #3.

ALTERNATIVES

PLANNING OPPORTUNITIES

The major planning opportunity present is Peterson Lake. The lake has the physical characteristics to provide excellent backwater fish and wildlife habitat. The lake supports excellent submergent aquatic plant growth, important for both migratory waterfowl and fish. The lake has excellent bathymetric diversity and water depths of up to 13.5 feet. The lake also contains ample area shallow enough to support emergent aquatic vegetation, important for both fish and wildlife.

PLANNING CONSTRAINTS

INSTITUTIONAL

Peterson Lake lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge. Barrier islands IV through XIV along the east side of the lake are administered by the Corps of Engineers and managed as part of the Refuge under a cooperative agreement between the Corps and the U.S. Fish and Wildlife Service. Islands I through III are owned by the Fish and Wildlife Service.

The lock and dam 4 dike forms the southern boundary of the lake. Any plan developed for Peterson Lake cannot adversely affect this dike or its function.

HYDRAULIC

Any proposal for habitat restoration at Peterson Lake has to consider floodplain impacts, especially if a major closure of Peterson Lake were proposed.

Aside from inflow from and outflow to the Mississippi River, Peterson Lake is essentially a closed system. Any project at Peterson Lake should have little or no impact on other parts of the river system, except for the potential floodplain effects.

ENVIRONMENTAL

Peterson Lake has water clarity that is better than average for a backwater lake, and it supports excellent submergent aquatic vegetation. One concern identified is that if summer flows entering Peterson Lake are diminished and hydraulic resident time is increased, algae growth may increase, subsequently reducing light penetration and decreasing submergent aquatic plant growth. An analysis based on a review of the literature concerning phosphorus loading, residence time, and chlorophyll-A production, indicates that maintaining a residence time of $\leq$ 5 days should be sufficient to prevent a buildup of algae growth in the lake (Cooke, et. al., 1986). Maintaining a flow of 220 cfs through the lake would provide a 5-day residence time. Currently, about 800 cfs is entering the lake during low flow conditions on the river.

Because of the high flows through Peterson Lake, winter dissolved oxygen levels remain high. The 800 cfs figure given above is applicable to existing winter conditions, also, although it could be reduced by ice on the channel surfaces. In efforts to reduce flows to diminish winter current velocities and decrease the effect of cold river water, care must be taken not to reduce winter dissolved oxygen levels below 5 mg/l. Analysis (see attachment 7) indicates that a winter flow of 70 cfs should be sufficient to maintain adequate dissolved oxygen levels in Peterson Lake.

Peterson Lake water is used to alleviate dissolved oxygen problems in Lower Peterson and Schmokers Lakes. It will also be used for this same purpose in Clear and Third Lakes of the Finger Lakes complex. Any project proposed for Peterson Lake must insure that Peterson Lake waters maintain sufficient dissolved oxygen to satisfy the Finger Lakes requirements.

CULTURAL

Although island stabilizations and channel closures would have the ultimate effect of reducing further erosion of the island remnants (and thus destruction of possible cultural resources), project-related work on the island shores could damage any in situ cultural resources. A cultural resource survey of the island shorelines was completed. No archaeological or historic materials were found.

SOCIOECONOMIC/RECREATIONAL

The Minnesota shoreline of Peterson Lake is developed with residential units. These residents must traverse Peterson Lake for boat access to the Upper Mississippi River. Recreational boat access to the river must be maintained. Also, a project developed for Peterson Lake must take into account the potential impact on the aesthetics of Peterson Lake for these residents.

ALTERNATIVES IDENTIFIED

The following are the alternatives that were identified during the planning process to satisfy project objectives. As with any planning process, there are various iterations of alternatives as additional data becomes available and analyses are completed. The descriptions provide the basic concept associated with each alternative.

NO ACTION

The no action alternative is defined as no implementation of a project to modify habitat conditions at Peterson Lake.

ACTION ALTERNATIVES

Maintain Existing Islands (MEI)

Under this alternative, the existing islands would be stabilized using bank protection and/or other methods to prevent further island loss.

Flow Control Alternatives

A Alternatives

The "A" alternatives involve controlling flow into the upper portion of the lake (openings 1 through 7). The basic purpose is reduce sediment inputs to the lake through these opening and to provide a quiet part of the lake where fish can find refuge from current, especially during the winter.

Alternative A1 - All of the upper openings would be completely closed off, allowing no flow into the upper portion of the lake except during those high water events that would overtop the barrier islands.

Alternative A2 - All openings but one would be closed off. A gated control structure would be placed in one opening (likely opening 5) to regulate flow into the upper portion of the lake.

Alternative A3 - A passive control structure would be used to limit flow into the upper portion of the lake. Openings would be closed off as needed for the structure to function.

B Alternatives

The "B" alternatives involve the center openings in the island chain. The basic purpose of these alternatives would be to reduce or eliminate flows, thereby reducing sediment entering through these openings.

Alternative B1 - Total closure of the openings 8-11.

Alternative B2 - Closure of openings 10 and 11, and possibly either opening 8 or opening 9. This alternative would allow some flow to continue to enter the lake through these openings via a passive control structure.

C Alternatives

"C" alternatives involve the lower portion of the island chain. The purpose would be to control flows entering these lower cuts. Alternative C1 would involve total closure of openings 12-13. Because of their shallow nature, partial closures would not be practical in these openings.

Emergent Vegetation Alternatives

Alternative EV1

Under this alternative all of Peterson Lake would be separated from the Mississippi River with closures, except for opening 14 (essentially the A1B1C1 flow control alternative). Then water levels in the lake would be drawn down through manipulation of lock and dam 4 discharges. The draw down would be used to promote the growth of emergent vegetation on the exposed mud flats.

Alternative EV2

With this alternative, planting of seeds, tubers, and/or sprigs would be conducted to stimulate return of emergent aquatic plants to the lake.

ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION

INITIAL SCREENING

An initial screening of alternatives was conducted to eliminate those that would not satisfy project objectives, were irrational (provide less benefits at a greater cost), or were otherwise considered unacceptable.

Flow Control Alternatives

<u>A2</u>

Any gated structure placed at the upper openings to Peterson Lake would be difficult to operate and maintain because of the lack of land access. The U.S. Fish and Wildlife Service, who would be responsible for operation and maintenance of such a structure, indicated they did not want a gated structure in this location because of the access problems. Because of this, the A2 alternative was eliminated from detailed evaluation.

<u>B1 and B2</u>

The B1 and B2 alternatives were eliminated from consideration as stand alone alternatives. It was determined after initial evaluation, that in and of themselves, these alternatives would do little to meet project objectives.

<u>C1</u>

It was determined after initial evaluation that closing openings 12 and 13 would provide no appreciable habitat benefits. Therefore, the C1 alternative was eliminated from further consideration.

<u>A1B1</u>

Because of the need to allow some flow into the lake for water quality purposes, this combination alternative of total closure of the upper and center openings was eliminated from further consideration.

<u>Summary</u>

Following the initial screening of flow control alternatives, five basic flow control plans remained. They were: A1, A3, A1B2, A3B1, and A3B2.

Emergent Vegetation Alternatives

EV1

Drawing down Peterson Lake would require drawing down all of lower pool 4, which would not be feasible for a number of reasons, e.g. impacts on navigation, impacts on riparian landowners, and environmental impacts. Therefore, this alternative was eliminated from further consideration.

SECONDARY SCREENING

As the planning process proceeded additional alternatives were eliminated as additional information became available.

Flow Control Alternatives

A1

The A1 and A3 alternatives were similar in that they involve controlling of flows through the upper openings to the lake (1-7). A1 would totally cut off flows during most periods while A3 would allow some flow into the upper portion of the lake. Initial cost estimates showed the A1 alternative would cost $125,000 to $360,000 more than the A3 alternative, depending on the type of closures used. Total closure under alternative A1 has the potential for creating adverse water quality impacts in the upper portion of the lake. Because of the greater cost and the potential for creating undesirable water quality impacts, alternative A1 was eliminated in favor of alternative A3.

A1B2 and A3B1

Initial evaluations compared these two alternatives to alternative A3B2, as these were the three alternatives that affected both the upper and central opening to the lake.

A1B2 - This alternative entails total closure of the upper openings, which generated the same water quality concerns as discussed above for alternative A1. Initial cost estimates showed the A1B2 alternative would cost $130,000 to $280,000 more than the A3B2 alternative, depending on the type of closures used. Because of the higher cost and the potential for creating adverse water quality impacts in the upper portion of the lake, alternative A1B2 was eliminated in favor of alternative A3B2.

A3B1 - This alternative entails total closure of the central openings, which forces flow entering the lake to enter through the upper openings. This would make it impossible to meet the objective of creating a winter flow refuge for fish in the upper portion of the lake. Initial cost estimates showed the A3B1 alternative would cost $90,000 to $220,000 more than the A3B2 alternative, depending on the type of closures used. Because of the higher cost and because it would not allow the winter fish refuge objective to be met, alternative A1B2 was eliminated in favor of alternative A3B2.

A3B2

As evaluation of the flow control alternatives proceeded it appeared that the "B2" increment of this alternative could result in sufficient reduction of flow to Peterson Lake. This raised concern with the potential for causing undesirable water quality impacts during the summer and potentially adversely impacting the relatively good summer habitat conditions present in the lake. For this reason, the A3B2 alternative was eliminated from final detailed evaluation.

Emergent Vegetation Alternatives

EV2

Discussions with resource managers knowledgable about emergent vegetation revealed a general concensus that if conditions were suitable for emergent plant growth in Peterson Lake, emergent plants would presently be growing in the lake. Planting of the plants would be ineffective if the conditions limiting their growth were not corrected. Therefore, the planting alternative was dropped from further consideration.

ALTERNATIVES CONSIDERED IN DETAIL

The alternatives that were carried through the final evaluation included the "no action" alternative, two separable action alternatives, and a combination alternative.

NO ACTION

By definition no action would entail no expenditure of Federal funds under the UMRS-EMP HREP program to address habitat concerns at Peterson Lake. The no action alternative is synonymous with the future without project condition.

ACTION ALTERNATIVES

Maintain Existing Islands (MEI)

Under this alternative, the existing barrier islands would be stabilized using bank protection to prevent further island loss. Analysis of the rate and pattern of island loss during the period 1964-73 and 1973-89 indicates that erosion of the upper islands has nearly ceased. In fact, some of these islands are growing slightly due to sediment accretion on the lake side of these islands. Therefore, development of the MEI alternative focused on stabilizing the lower islands (I thru VII) of the barrier chain.

Figure 18 shows the MEI alternative. The design for maintaining the existing islands entails using rock protection on the channel side of the islands. Islands I through VI would be protected by a rock mound design as shown in Figure 19. Protection on Island VII would be standard riprap design of 18 inches of rock on a sloped bank.

The MEI alternative would cost approximately $349,000. A breakdown of the costs for this alternative is shown in table DPR-14. A detailed cost estimate is contained in attachment 2.

Table DPR-14
Cost Estimate for MEI Alternative[1]

Feature	Cost
Construction	
Mobilization/Demobilization	$ 34,000
Island Riprap	225,000
Planning, Engineering, and Design	66,000
Construction Management	24,000
Total	$349,000

[1] to nearest $1,000

Flow Control Alternative A3

Under the A3 alternative, closure structures would be constructed across openings 1 through 7. Figure 20 shows the A3 alternative. A partial closure structure to reduce flows into the upper portion of Peterson Lake would be placed in opening 5. This is the one opening large enough to accomodate this type of structure. Figure 21 shows the design of this structure. Openings 1 through 4 and 6 and 7 would be totally closed. The closures for openings 1 and 7 would be constructed of rock (figure 22), while the closures for openings 2, 3, 4, and 6 would be sand closures (figure 22). The use of sand closures is for the sole purpose of providing an economical method of disposing of the sand from a construction access channel. A construction access channel will be required as shown on figure 20. The sand from this access channel would be used for the core of the partial closure structure and for the sand closures.

During the later stages of planning, it was determined that the A3 alternative would meet the planning constraint of insuring that a hydraulic residence time of 5 days or less be maintained. The A3 alternative would provide for a residence time of about 3.6 days during low flow conditions. In addition, on-site visits and aerial photographs taken after the summer flood of 1993 indicated substantial amounts of sand entering Peterson Lake through opening #8 and #9, more than had been earlier believed.

As a result, it was decided to expand the A3 alternative to include measures to control sand inputs through openings #8 and

#9 while still meeting the < 5-day residence time constraint. This would be accomplished through the placement of weirs in these two openings that would divert bed load sands that would normally enter these openings. The weirs would have crest lengths of 200 feet, with a crest elevation of 663.0, 4 feet below project pool (figure 22). This would provide sufficient flow to continue to enter Peterson Lake to meet the < 5-day residence time criteria.

During the public review of the draft Definite Project Report, the Minnesota and Wisconsin Departments of Natural Resources voiced a concern that deep water areas below closures #1 and #7 would be isolated from the main lake and unusable by fish during the winter if the intervening shallow waters become frozen to the bottom or anoxic. Therefore, two fish access channels were added to the A3 plan to address the concerns of these agencies.

The A3 alternative would cost approximately $633,000. A breakdown of the costs for this alternative is shown in table DPR-15. A detailed cost estimate is contained in attachment 2.

Table DPR-15
Cost Estimate for A3 Alternative[1]

Feature	Cost
Construction	
Mobilization/Demobilization	$ 34,000
Access Dredging/Sand Closures	66,000
Rock Closures/Wiers	301,000
Fish Channels	58,000
Fines	7,000
Seeding	5,000
Planning, Engineering, and Design	119,000
Construction Management	43,000
Total	$633,000

[1] to nearest $1,000

Combination Alternative A3-MEI

This alternative would be a combination of the A3 and MEI alternatives. This alternative would cost approximately $986,000. A breakdown of the costs for this alternative is shown in table DPR-16. A detailed cost estimate is contained in attachment 2.

Under this alternative, the cost for the rock closures/weirs increases over the cost for the same feature under the A3 alternative by about $50,000. This is because under this plan, additional rock is required to tie the A3 and MEI features together where they merge in the area of Islands V and VI.

Table DPR-16
Cost Estimate for A3-MEI Alternative[1]

Feature	Cost
Construction	
Mobilization/Demobilization	$ 34,000
Island Riprap	225,000
Access Dredging/Sand Closures	66,000
Rock Closures/Weirs	351,000
Fish Channels	58,000
Fines	7,000
Seeding	5,000
Planning, Engineering, and Design	171,000
Construction Management	69,000
Total	$986,000

[1] to nearest $1,000

EVALUATION OF ALTERNATIVES

NO ACTION

By definition no action would entail no expenditure of Federal funds under the UMRS-EMP HREP program to address habitat concerns at Peterson Lake. If the habitat concerns were not addressed under the UMRS-EMP HREP program, it is unlikely that any rehabilitation and/or enhancement measures would be taken by the U.S. Fish and Wildlife Service or the Minnesota Department of Natural Resources because of fiscal constraints.

The no action alternative would not satisfy any of the project objectives. Habitat conditions would change as described under "ESTIMATED FUTURE HABITAT CONDITIONS."

ACTION ALTERNATIVES

In order to quantify habitat benefits of the A3 alternative, the U.S. Fish and Wildlife Services' Habitat Evaluation Procedures (HEP) was used. HEP 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, habitat benefits can be quantified.

A fish model was used to evaluate the potential habitat gains for the Peterson Lake project from the A3 features of the project. The model used was the bluegill (Lepomis machrochirus) habitat suitability index model published by the U.S. Fish and Wildlife Service (Stuber, et. al., 1982). A modification of this model for winter habitat parameters developed by the St. Paul District (Palesh and Anderson, 1990) was also used. This model was selected because the bluegill is an important component of the backwater fish community, and is representative of other backwater species. The model is also useful because it can be used to evaluate winter habitat. The model utilizes a series of habitat variables that represent the life requirements of the species for food, cover, water quality, and reproduction.

The stabilization of the islands at Peterson Lake (MEI feature) would provide more holistic benefits to a wide variety of fish and wildlife species. It was not possible to identify an existing habitat model that would adequately evaluate the benefits of island stabilization. The scope of the island stabilization feature was not considered sufficient to warrant the time and cost associated with the development of a community model specifically for this project. Therefore, the potential benefits of island stabization were evaluated from the approach of identifying what would be the minimum habitat benefits likely to achieved by this feature (see attachment 4, HEP appendix). Then these benefits were used to determine if the MEI feature was justified.

MAINTAIN EXISTING ISLANDS

Meeting Project Goals and Objectives

Under the MEI alternative, an estimated island loss of 13.5 acres from islands I, III, IV, V, VI and VII would be prevented. This would contribute significantly to meeting all three project goals. (See earlier discussion under "PROJECT GOALS AND OBJECTIVES").

The MEI alternative would meet project objective B for maintaining 40 acres of barrier islands. This alternative would contribute to meeting objective A. Maintaining the islands will prevent the increase in flows into the lake that would occur with loss of the islands. This in turn would prevent any increase in the rate of sedimentation caused by increased flows into the lake.

Maintaining the existing islands would contribute to objective E as the only areas in the lake where emergent vegetation is surviving is on the lake side of the islands.

Benefits

The importance of maintaining the barrier islands at Peterson Lake has been discussed earlier (see discussion under "PROJECT GOALS AND OBJECTIVES"). This is also discussed in attachment 4 (HEP appendix). Maintaining these islands are considered significant in maintaining Peterson Lake as a productive backwater resource. In addition, islands are important in general in maintaining a diversity of habitats on the Upper Mississippi River, especially in the lower portions of the navigation pools where they are less common and the rate of island loss is the greatest.

Figure 23 shows the estimated zone of benefit in Peterson Lake for the MEI alternative. This alternative would provide an estimated 17 average annual habitat units (AAHU) of benefits (see attachment 4, HEP appendix for details). The cost/AAHU of this alternative would be $1,788.

ALTERNATIVE A3

Meeting Project Objectives

One of the primary effects of alternative A3 would be in significantly reducing sediment inputs to Peterson Lake. This would make a significant contribution to meeting all three project goals and project objective A. (See discussion under "PROJECT GOALS AND OBJECTIVES").

Another effect of alternative A3 would be to create a winter fish refuge in the upper portion of Peterson Lake, meeting project objective D. This alternative would provide a minor contribution to project objective B in that the construction of the closure structures will help stabilize the channel sides of the upper islands and prevent the openings from eroding larger.

Reducing of much of the flow through the upper cuts may contribute to project objective E by creating more protected areas within the lake. This may improve the physical conditions for emergent aquatic plant growth.

Benefits

The A3 alternative would result in a significant reduction in the rate and cumulative effect of sedimentation in Peterson Lake. Using the same methods used to estimate current and future without project sedimentation, estimates have also been developed of the effect of the closures on sedimentation. It is projected that the initial reduction in sedimentation rate will be from the current rate of 43 acre-feet per year to 21 acre-feet per year. Table DPR-17 shows projections for the future without and future with project lake volumes. As can be seen, construction of the closures will have a significant beneficial effect on maintaining Peterson Lake as a backwater lake.

ALTERNATIVE A3-MEI

The A3-MEI combination alternative would meet project objectives and provide habitat benefits in Peterson Lake as discussed above for the two individual alternatives.

This alternative would provide an estimated 197 average annual habitat units of benefits. The cost/AAHU of this alternative woud be $425.

INCREMENTAL ANALYSIS

The MEI and A3 alternatives are distinctly separate increments. When combined as part of the A3-MEI alternative, the A3 increment is considered first-in-place because is the more cost effective of the two. The cost of the MEI increment under the A3-MEI alternative is $353,000 (ave. annual cost = $30,104). The incremental cost/AAHU is $1,771. Table DPR-18 contains the incremental analysis while it is displayed graphically in table DPR-19.

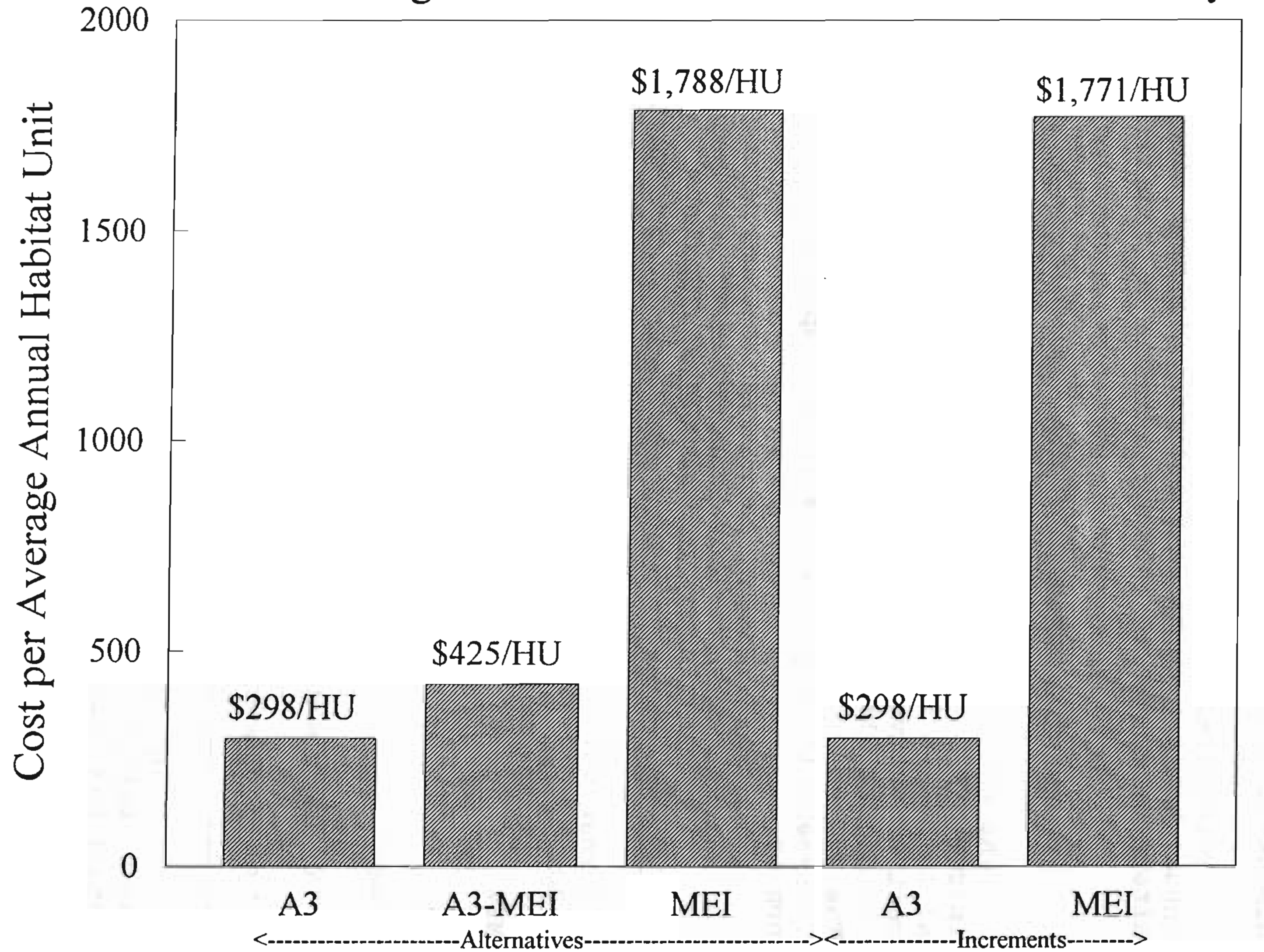
Table DPR-18
Incremental Analsysis

Alternative/ Increment	AAHU Gain	Total Cost	Ave An Cost*	Cost/AAHU
MEI	17	$349,000	$30,402	$1,788
A3	180	$633,000	$53,616	$298
A3-MEI	197	$986,000	$83,721	$425
"A3 Increment"	180	$633,000	$53,616	$298
"MEI Increment"	17	$353,000	$30,104	$1,771

* at current discount rate of 8 percent; also includes $1,875 annual O&M costs for the MEI, A3, and "A3 Increment", $3,125 annual O&M costs for the A3-MEI alternative, and $1,250 for the "MEI Increment"

Table DPR-19

Cost Per Average Annual Habitat Unit and Incremental Analysis



SUMMARY COMPARISON OF ALTERNATIVES

MEETING PROJECT OBJECTIVES

Table DPR-20 summarizes how the various alternatives would contribute to the project objectives. A plus 3 indicates that the alternative would fully meet the project objective. A plus 2 indicates a substantial contribution while a plus 1 indicates a minor contribution. A zero (0) indicates no appreciable effect. A perfect score would be 15.

Alternative A3 would significantly reduce sedimentation in Peterson Lake and would provide for a winter fish refuge, meeting objectives A and D. The MEI alternative contributes somewhat less to project objectives because its primary focus is on satisfying objective B. The combination alternative A3-MEI contributes the most towards meeting project objectives.

As can be seen in the table, none of the alternatives were given a positive score for objective C. This is because objective C is to maintain existing summer water clarity. All of the alternatives are expected to meet this objective. A positive score would have been given if any of the alternatives would be expected to improve water clarity, and a negative score would have been given had any of the alternatives been expected to have a negative impact on water clarity.

Table DPR-20
Contribution of Alternatives to Project Objectives

	Alternative			
	No Action	MEI	A3	A3-MEI
Objective A	0	+1	+3	+3
Objective B	0	+3	+1	+3
Objective C	0	0	0	0
Objective D	0	0	+3	+3
Objective E	0	+1	+1	+1
Total	0	+5	+8	+10

COSTS AND QUANTIFIABLE BENEFITS

Table DPR-21 compares the costs and benefits of the three alternatives. The A3 alternative is the most cost effective followed closely by the combination alternative A3-MEI.

Table DPR-21
Alternatives Comparison

Alternative	AAHU Gain	Total Cost	Ave Annual Cost	Cost/ AAHU
MEI	17	$349,000	$30,402	$1,788
A3	180	$633,000	$53,616	$ 298
A3-MEI	197	$986,000	$83,721	$ 425

PLAN SELECTION AND JUSTIFICATION

Because there are two distinct alternatives and a combination alternative, plan selection proceeded in a step-wise fashion starting first with the most cost effective plan.

A3 Alternative

Because the A3 alternative is more cost effective than the MEI alternative relative to quantifiable benefits, it was considered first. The A3 plan is considered justifiable because it provides quantifiable habitat benefits at a reasonable cost. It is projected that this plan will reduced sedimentation rates in Peterson Lake by approximately 50 percent. In essence this should nearly double the remaining life of Peterson Lake as a backwater lake. It has been well documented in other studies that sedimentation is resulting in the loss of aquatic habitat in the navigation pools of the Upper Mississippi River. The A3 plan will contribute significantly in delaying the decline of Peterson Lake.

The A3 alternative will provide an approximately 100-acre winter refuge for Centrarchids and other fish in the upper portion of Peterson Lake. Centrarchids such as largemouth bass, bluegill, and black crappie are not migratory species per se, though they will move as necessary to find suitable habitat for various life requisites, e.g., spawning, feeding, cover, dissolved oxygen, etc. Being forced to leave Peterson Lake because of marginal winter habitat conditions or having to stay and endure those conditions (if possible) undoubtedly causes physiological stress and consumption of energy resources, which in turn would be expected to have negative effects on the Centrarchid population, both in terms of numbers and the condition of the individual fish. Providing a refuge within the lake from winter currents and cold water temperatures will benefit Centrarchids and other fish by reducing the need to either move from the lake in search of suitable winter habiatat or having to endure marginal winter survival conditions.

It is estimated that the A3 alternative will provide approximately 180 AAHU of benefits at a cost of $298/AAHU. This is a reasonable and prudent cost for the benfits to be achieved.

MEI Alternative

Next, the MEI alternative was considered as an additional increment. Stabilization of the lower islands in the Peterson

Lake chain is considered very important in maintaining Peterson Lake as a productive backwater resource. In addition, the islands have intrinsic habitat value and contribute to the value of habitat in surrounding areas. This study focused on the value of these islands to Peterson Lake. However, from a larger perspective, maintaining these islands is important to overall habitat diversity and quality in this portion of lower pool 4.

At Peterson Lake the opportunity exists to preserve islands before they are lost. In many other areas of the Upper Mississippi River islands have eroded away and the habitat benefits associated with them have been lost. A number of island reconstruction or rehabitation projects are in various stages of implementation to recapture these lost habitat values. It would be more prudent and cost effective to preserve islands before they erode away, than to recreate them after they are lost.

As shown earlier, the incremental cost of the MEI feature is $1,771/AAHU (see table DPR-18). This is a reasonable and prudent cost for the benfits to be achieved by stabilizing the lower barrier islands at Peterson Lake.

Plan Selection

The A3-MEI alternative was selected because both the A3 plan and the MEI increment were considered justified based on their costs and expected habitat benefits.

SELECTED PLAN WITH DETAILED DESCRIPTION/ DESIGN AND CONSTRUCTION CONSIDERATIONS

The selected plan is alternative A3-MEI. This plan is shown on figure 24 and includes the following features:

a. Rock closure of openings #1 and #7.

b. Sand closure of openings #2, #3, #4, and #6.

c. Rock and sand partial closure of opening #5.

d. Rock weirs in openings #8 and #9.

e. Rock bank protection for islands I, III, IV, V, VI, and VII.

The closure structures for openings #1 through #7 were designed with the dual objectives of providing at least 50 cfs of flow into the upper reaches of the lake during the summer for water quality purposes, while restricting winter flows as much as possible to meet the winter fish refuge objective. Three design options were evaluated that are discussed in detail in the Hydraulics Appendix (attachment 5). A critical consideration in this evaluation was the ability to control flows with a rock closure structure. The design option that was determined to offer the best control was to entirely close off flow through all of the openings except for opening #5.

This option would have less maintenance requirements than the other options evaluated. The selected opening size is 20 feet which offer the best combination of meeting the desired summer flows and the winter fish objective as much as possible.

The design elevations of the sand closures are set at elevation 670.0 to insure that during high flow events, the natural islands are overtopped before these closures, reducing the potential for erosion loses. This is not a concern with the rock closures. The elevations of the rock closures are set at a height sufficient to insure that they function as total closures during normal flow conditions.

The rock weirs for openings #8 and #9 will be placed on the boundary between the shallower parts of the openings and the deep side channel and will be tied into the rock mounds providing protection to Islands V and VI, which will also be situated as close to the edge of the sand shelf along the side channel as possible. This will provide adequate construction access and a continous barrier to high sediment concentrations and bedloads near the bottom of the adjacent side channel.

The weirs were designed with a 200-foot crest length and a low enough crest elevation to insure that flows through these openings were not appreciably reduced.

Two separate rock bank protection designs were developed. For most areas, a rock mound design would be used (figure 19). On the tip of Island VII a more traditional riprap design would be used with an 18-inch layer placed on a 1.5H:1V slope. The rock mound design would be used to reduce or eliminate the costs and environmental impacts associated with access dredging to get floating plant and barges close in to the islands for construction. In addition, this design eliminates the need for bank shaping, further reducing costs and construction related environmental effects.

Two channels would be excavated in Peterson Lake to enhance access for fish between the deep water in the main body of the lake and the deeper water pockets that would exist below closures #1 and #7. These channels would have a 40 foot bottom width and would be a minimum of 5 feet deep. The width and depth are more than adequate for fish access. These dimensions were selected as the minimum requirements for dredging equipment access.

An estimated 7,000 cubic yards would be excavated from these channels. The material would be primarily sand with some fines likely present. The excavated material would be placed at Island V to restore some of the island mass that has been lost to erosion. The project cost estimate is based on this method of disposal.

Three alternative methods of dredged material diposal have been identified that would reduce costs. Implementation of one or more of these alternative methods of disposal can not be committed to until borings are taken during the plans and specifications phase to determine the exact nature of the material to be dredged. If the material proves to be uncontaminated sand, the Minnesota Department of Natural Resources is interested in exploring in-lake disposal to create very shallow water in selected areas in an attempt to promote reestablishment of emergent vegetation. Testing for sediment particle size and possibly contaminants would be required as part of the evaluation of this disposal method.

If borings show that the dredged material would have sufficient fine material present, the U.S. Fish and Wildlife Service would be interested in having the material placed on the penninsula at the lower end of Peterson Lake to promote revegetation of old sand dredged material deposits.

The third disposal alternative is to take the material to the U.S. Fish and Wildlife Service boat landing if a beneficial use for the material can be identified. The space at the boat landing is small, so any material placed at the landing for off-site beneficial use would have to be immediately removed.

Table DPR-22 lists the material quantities for the various features.

Table DPR-22
Quantities for Selected Plan Features

Feature	Rock (cy)	Sand (cy)	Fines (cy)
Closure #1	1,200	n.a.	n.a.
Closure #2	n.a.	970	120
Closure #3	n.a.	2,000	120
Closure #4	n.a.	480	75
Closure #5	2,400	3,900	n.a.
Closure #6	n.a.	650	110
Closure #7	800	n.a.	n.a.
Weir #8	700	n.a.	n.a.
Weir #9	200	n.a.	n.a.
Island VII Riprap	150	n.a.	n.a.
Island VI Rock Mound	1,950	n.a.	n.a.
Island V Rock Mound	2,100	n.a.	n.a.
Island IV Rock Mound	1,100	n.a.	n.a.
Island I-III Rock Mound	1,800	n.a.	n.a.
Total	**12,410**	**8,000**	**425**

It is expected that the project would be constructed using marine equipment such as derrick barges and material barges. Access to the project area is good for construction equipment, except at the upper end of the lake. In this area a sand bar blocks access to the project area. A channel with a 70 foot bottom width would have to be dredged through this sand bar for access. The sand excavated from this channel would be used to construct closures #2, #3, #4, and #6, as well as for core material for the partial closure structure at opening #5. The access channel would have to be dredged before the construction equipment could reach the areas where the sand could be used in the closures. Therefore, material dredged from the channel would have to be temporarily stockpiled in the water next to the channel. Contract specifications would require the sand closure be constructed as soon as access is achieved to minimize the length of time the dredged material would need to be stockpile in the water.

Rock will come from commercial sources. It is expected that the rock would be barged from the Wabasha, Minnesota, or Alma, Wisconsin, areas, depending on the location of the quarry used.

ENVIRONMENTAL EFFECTS

An environmental assessment has been conducted for the proposed action, and a discussion of the impacts follows. As specified by Section 122 of 1970 Rivers and Harbors Act, the catergories of impacts listed in the Environmental Impacts Matrix (table DPR-23) were reviewed and considered as part of the environmental assessment. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation was prepared and is included as attachment 2. State of Minnesota water quality certification under Section 401 of the Clean Water Act has been received (attachment 10).

RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

The proposed project complies fully with applicable environmental statutes and Executive Orders for the current stage of planning. Among the more pertinent are the National Environmental Policy Act of 1969, as amended; the Fish and Wildlife Coordination Act of 1958, as amended; the Clean Water Act of 1977; the Clean Air Act, as amended; the National Historic Preservation Act of 1966, as amended; the National Wildlife Refuge System Administration Act; the Endangered Species Act of 1973, as amended; the Land and Water Conservation Fund Act of 1965, as amended; Executive Order 11990- Protection of Wetlands; Executive Order 11988-Floodplain Management; and USACE ER 1105-2-100.

NATURAL RESOURCE EFFECTS

WATER QUALITY

The effects of the placement of the sand dredged material and rock bank protection on water quality are described in detail in the attached Section 404(b)(1) Evaluation (attachment 2). Some short-term negative effects are possible due to construction activities. Localized turbidity plumes and increased suspended solids levels would be expected during access dredging and placement of material for closure structure construction. However, the use of clean sand and rock for closure structure construction and rock riprap for island protection should minimize the impacts on water quality. Releases of contaminants should be minimal due to the use of clean material. Maintaining the integrity of islands would prevent sedimentation from increased main channel flows and island erosion.

Table DPR-23

ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

MAGNITUDE OF PROBABLE IMPACT

NAME OF PARAMETER	<----- INCREASING BENEFICIAL IMPACT			NO APPRECIABLE EFFECT	INCREASING ADVERSE IMPACT ----->		
	SIGNIFICANT	SUBSTANTIAL	MINOR		MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
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 (Temporary)		
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			

The proposed project would result in a change in the hydraulic residence time in Peterson Lake. The hydraulic residence time is the time it takes for the entire lake volume to be discharged (volume/discharge) and is expressed as a unit of time. Phytoplankton production is dependent on phosphorus concentration when residence times are high. This would be the case in a natural lake where residence times are typically expressed in weeks or months. When the residence time is short, it is the determining factor in phytoplankton production. Peterson Lake, with a current residence time of approximately 1.5 days at an inflow of 750 cfs, is not known to have excess phytoplankton production, even though phosphorus concentrations are quite high.

Cooke et. al. (1986) found that if flushing rates were less than the phytoplankton growth rate, then excess growth would not occur. Flushing rates of 10 to 15 percent of lake volume per day (residence times of 10 to 6.7 days) were found to be sufficient to prevent excess phytoplankton growth. Post-project residence times will be 3 to 4 days, which would be short enough to provide a flushing rate greater than phytoplankton production rates. This should preclude an increase in phytoplankton production to the point where they would adversely impact water quality.

Summer water temperature and dissolved oxygen levels would remain unchanged in most of the lake. Areas near the closures would have near zero velocities and might experience a slight increase in temperature (2 to 3 degrees C) and an increase in diel variation in dissolved oxygen. Fish would be able to move to areas of preferred temperature and dissolved oxygen and would be unaffected by conditions in these small areas.

During winter, ambient water temperatures are near 0 degrees C. Due to closure construction, temperatures are expected to be greater than 1 degree C in areas of lowered velocity. Throughout most of the lake, dissolved oxygen levels would remain above 5 mg/l. Areas of zero velocity and minimum depth may experience dissolved oxygen levels below 3 mg/l. This would not be expected to have an adverse effect on water quality or the fishery because of the minimal area involved.

The proposed project will not have any impact on the Finger Lakes project relative to First and Second Lakes because the source water for these lakes is the main channel of the Mississippi River. The structures for Third, Lower Peterson, and Clear Lakes have a cumulative design capacity of 180 cfs. However, studies on the Finger Lakes indicate that the winter flow requirements to alleviate dissolved oxygen depletion problems in these lakes are likely to be less than 10 cfs per lake, or less than 30 cfs cumulative.

The proposed project will reduce flows entering the upper reaches of Peterson Lake. However, it is estimated that under winter low flow conditions 250 to 300 cfs of highly oxygenated water will continue to flow into Peterson Lake through openings 8-9, in addition to whatever flow enters through opening 5. Because of the lack of flow through the upper openings, these flows will distribute themselves throughout the lower half of Peterson Lake. The Finger Lakes culverts may even facilitate this mixing to some degree by drawing water toward the dike at the lower end of the lake. Winter conditions in this lower portion of Peterson Lake will continue to be characterized by high dissolved oxygen levels, cold water temperatures, and current velocities similar to or slightly less than what presently occurs. This will insure that the requirements of the Finger Lakes project for Third, Lower Peterson, and Clear Lakes will be met.

AQUATIC HABITAT

Some benthic habitat would be lost through dredging for access, borrow, and fish habitat. The sand bottom does not provide substantial habitat. It would recover its former value quickly after excavation. In addition, rock fill would provide increased diversity of stable benthic habitat.

The project would provide substantial aquatic habitat benefits. Sediment inputs to the lake would be reduced by 50 percent, extending the longevity of the lake as aquatic habitat. In the upper portion of Peterson Lake a winter fish refuge would be created, greatly increasing the overall fish habitat value of the lake.

Protection of the islands in the lower portions of the lake would benefit aquatic habitat by preventing the adverse effects of increased flow and sedimentation that would occur if the islands were allowed to continue to erode. An estimated 175 acres of the lake would be directly benefitted by this action.

FISH AND WILDLIFE

The project would improve winter fish habitat through closure of most of the upper side channel openings into the lake. The closures are expected to result in a decrease in current velocities from over 0.5 feet per second to approximately 0.02 feet per second while maintaining dissolved oxygen levels above 5 mg/l. At the same time, water temperatures would increase from near zero degrees C. to above 1.0 degrees C. Winter habitat conditions for Centrarchids would be closer to optimum in approximately 100 acres of the upper portion of the lake.

The stabilization of the islands would maintain the existing quality of important off-channel habitat. This area not only provides seasonal habitat for fish, but supports aquatic vegetation beds that are utilized by migrating waterfowl.

WETLANDS

The proposed project would take place in a lacustrine setting. No wetlands would be affected.

THREATENED AND ENDANGERED SPECIES

A biological assessment of the proposed project was completed to determine the potential effect on Federally- and State of Minnesota-listed threatened and endangered species, including the following Federally-listed species; Higgins' eye pearly mussel (<u>Lampsilis higginsi</u>), peregrine falcon (<u>Falco peregrinus</u>), and bald eagle (<u>Haliaeetus leucocephalus</u>).

The bald eagle uses mature trees on the barrier islands at Peterson Lake for roosting during migration and during at least the open water portion of the winter.

No nesting sites for the peregrine falcon are known to exist in the immediate vicinity of Peterson Lake.

Higgins' eye pearly mussels are not known to occur in Peterson Lake. During a mussel survey conducted on 1 September 1992, no shells or living specimens of Higgins' eye pearly mussels or any other threatened or endangered species were collected.

The Minnesota Department of Natural Resources Heritage database search identified four locations records for three species of special concern in Wabasha County: the pugnose minnow (<u>Opsopoedus</u> <u>emilae</u>), Walter's barnyard grass (<u>Echinochla</u> <u>walteri</u>), and sea-beach needlegrass (<u>Aristida</u> <u>tuberculosa</u>). The potential for adverse effects on these species was evaluated and determined to be low.

The pugnose minnow prefers quiet, clear, vegetated waters which the proposed project is designed to promote. Therefore, if anything, there will be a gain in habitat for this species.

Sea-beach needlegrass is a sand dune species that prefers somewhat dry conditions which are not found at Peterson Lake. It is not expected that this species would be located in the areas to be affected by the project.

Walter's barnyard grass prefers moist soil habitat that would be present along the shoreline of Peterson Lake. The shorelines to be affected by the project are island shorelines that are relatively steep and, in many instances, eroding. It is unlikely that this species is present in the areas that will be affected by construction of the proposed project.

Surveys by the Minnesota Department of Natural Resources for these and similar species are expected to take place prior to project construction. If the surveys identify the presence of the plant species, then measures will be taken to avoid or minimize impacts to these species.

It has been determined that the proposed project would not affect any threatened or endangered species. The proposed project has been coordinated with the U.S. Fish and Wildlife Service.

AIR QUALITY

The proposed project would have temporary minor effects on air quality. Construction equipment exhaust may degrade the air quality slightly for short periods. The overall effect on people, wildlife, and vegetation would be negligible.

CULTURAL RESOURCE EFFECTS

A Corps of Engineers archaeologist researched records and completed a cultural resource field survey of the Peterson Lake islands. No archaeological or historic material was found by the survey. The survey report was reviewed by the National Park Service, the Minnesota State Historic Preservation Office, and the U.S. Fish and Wildlife Service cultural resource manager. These offices concurred that no significant cultural resources will be affected by the Peterson Lake project.

SOCIOECONOMIC EFFECTS

Maintaining the channel islands and improving waterfowl and aquatic habitats of Peterson Lake would have a positive impact upon the visual aesthetics of the area for nearby residents and recreational boaters on the river. Habitat restoration of Lake Peterson could also have a minor positive impact upon property values for homeowners or cabinowners in the area. There would be no impact upon the population, industry, employment, and commercial navigation of the area as a result of habitat improvements.

RECREATIONAL RESOURCES

The proposed project will have a positive impact upon the recreational opportunities around Peterson Lake. Restoring the waterfowl and fish habitats will improve recreational fishing in Peterson Lake and possibly commercial fishing along the Mississippi River. Other recreational activities such as swimming may increase in Peterson Lake. Boating access at Peterson's Landing for nearby residents would be maintained and possibly improved as a result of the habitat restoration project. However, construction to restore wildlife habitats around Peterson Lake may temporarily disrupt recreation activities and boating access to the main channel of the river.

SUMMARY OF PLAN ACCOMPLISHMENTS

The habitat benefits of the selected plan have been discussed at length in earlier sections of this report. In capsulized form they are as follows. The side channel closures in the upper reaches of the lake would reduce the rate of sedimentation in Peterson Lake by approximately 50 percent. In essence, this will significantly extend the ecologic life of Peterson Lake as a backwater lake. In the upper portion of Peterson Lake, side channel closures will create a winter fish refuge, substantially increasing the value of Centrarchid and other fish habitat in the lake. Quantifiable habitat benefits are estimated at 180 AAHU.

In the lower portion of the lake, stabilization of existing islands will produce an estimated 17 AAHU of quantifiable benefits. This work will prevent the lost of about 13.5 acres or 30 percent of barrier islands at Peterson Lake. In addition to the quantifiable benefits, preservation of these islands will have additional unquantifiable benefit by avoiding the adverse effects increase flows and sedimentation would have on the lake if the islands were lost.

OPERATION, MAINTENANCE, AND REHABILITATION

GENERAL

Upon completion of construction, the U.S. Fish and Wildlife Service would accept responsibility for operation and maintenance (O&M) of the Peterson Lake project in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-692, and subsequent Annual Addendums. Specific operation and maintenance features would be defined in a project operation and maintenance manual whcih would be prepared by the Corps of Engineers and coordinated with the U.S. Fish and Wildlife Service.

OPERATION

No operation is anticipated with the proposed project.

MAINTENANCE AND REPAIR

The proposed project is expected to require little or no maintenance. Nearly all of the project features are constructed of rock. Maintenance would consist of annual inspections and repairing minor rock displacements. Because the project is located in the lower portion of the pool away from the main river flows, rock displacement associated with flood events on the river should not be a problem. An operation and maintenance manual detailing maintenance requirements would be prepared during the plans and specifications phase. Development of the manual would be coordinated with the U.S. Fish and Wildlife Service. Over the 50-year project life, the average annual operation and maintenance costs of the project are estimated to be $3,125. A breakdown of projected costs is contained in table DPR-24.

Table DPR-24
Estimated Operation and Maintenance Costs

Item	Amount
a. Inspection and Reporting	$ 625
b. Rock replacement	2,500
Total annual amount	$3,125

Note: (1) Total project operation and maintenance costs over the 50-year project life are estimated to be $156,250.

(2) Following are the calculations used to arrive at the costs shown in the table (rounded off to the nearest $25 in the table).

a. <u>Inspection</u>: (1 man-day/job x 8 hr/man-day x $30/hour) + (50 miles/job x $0.25/mile) = $252.50/job, $252.50/job x 2 jobs/year = $505

b. <u>Reporting</u>: (1/2 man-day/job x 8 hr/man-day x $30/hour) x (1 job/year) = $120

c. <u>Rock Replacment</u>: Over the 50-year period, an average of 50 cy of rock would be replaced per year, (50 cy/year x $50/cy) = $2,500

PROJECT PERFORMANCE EVALUATION

A monitoring plan for project evaluation was designed to directly measure the degree of attainment of the selected project objectives. The plan is presented in tables DPR-25 thru DPR-27. Monitoring activities would be coordinated with similar efforts by the Long-Term Resource Monitoring program.

Though not included as a part of the performance evaluation plan, the opportunity will exist to gather additional information concerning the effects of the Peterson Lake project. Lower pool 4 is a key pool being monitored by the LTRM out of the Lake City Field Station. Peterson Lake contains permanent water quality and fish monitoring stations. Data collected as part of the LTRM monitoring efforts will be evaluated along with the performance evaluation data. In addition, it may be possible to occasion to supplement the LTRM monitoring efforts to collect data specific to the Peterson Lake project.

In additional to the normal project performance monitoring, it is proposed to conduct additional detailed monitoring at Peterson Lake to evaluate the effects of side channel closures on sedimentation rates and patterns. Peterson Lake offers an ideal situation to conduct a backwater sedimentation study. The lake is a relatively simple system without a lot of complicating influences such as large size, large wind fetches, tributary streams, or navigation traffic. The information collected will be valuable in the planning and design of future projects involving side channel closures for sediment control. A preliminary scope of work for this proposed effort is contained in attachment 9.

TABLE DPR–25
PROJECT OBJECTIVES AND ENHANCEMENT FEATURES

Objective	Project Accomplishment	Potential Enhancement Feature	Units	Enhancement Potential		
				Existing	Future Without	Future With
Maintain 40 acres of islands	Maintain 40 acres of islands	Bank protection Breakwaters	acres	40 acres	27.5 acres	40 acres
Maintain submergent aquatic plant growth	Maintain or reduce sediment inputs	Side channel closures Bank protection	depth plant growth turbidity (NTU)	5 feet < 15 NTU	<5 feet > 15 NTU	5 feet < 15 NTU
Create winter fish refuge	100–acre refuge created in upper portion of lake	Side channel closures	mg/l DO cm/sec vel degree Cent	> 5 mg/l 1.5 – 4.0 cm/sec < 1 degree C	> 5 mg/l 1.5 – 4.0 cm/sec < 1 degree C	> 5 mg/l < 1.0 cm/sec > 1 degree C
Increase emergent plant growth by 10 acres	Maintain/increase shallow protected habitat	Side channel closures Bank protection	acres	< 1 acre	< 1 acre	> 1 acre
Reduce sediment inputs to lake	Side channels closed and islands stabilized	Side channel closures Bank protection	acre–feet of lake volume	2,200 acre–feet	< 500 acre–feet	1,150 acre–feet

TABLE DPR-26
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.	USFWS	USFWS (EMTC)	LTRM	Lead into pre-project monitoring; define desired 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 Cooperative Agreements, or Corps.*	LTRM ***	Should be over several years to reconcile pertubations.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	After fact sheet. Data may 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.*	LTRM ***	After construction.
Analysis of Biological Responses to Projects	1. Determine critical impact levels, cause-effect relationships, and long-term losses of significant habitat.	USFWS	USFWS (EMTC)	LTRM	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.
	2. Demonstrate success or response of biota.	Corps	Corps/USFWS (EMTC)/Others	LTRM ***	

*Choice depends on logistics. When done by the States under a Cooperative Agreement, the role of the EMTC 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 EMTC 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.

***Requires a transfer of allocations from the Habitat Project account to the LTRM account.

TABLE DPR-27
PRE – AND POST-CONSTRUCTION MEASUREMENTS

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
Enhance the value of Peterson Lake for migratory waterfowl	Maintain 40 acres of existing islands	Bank stabilization Breakwaters	Acres	Measurements from aerial photographs	1989 photographs for pre-construction 5 and 10 years post-construction	$1,000
	Maintain sub-mergent aquatic plant growth a. growth to 5 feet of water b. < 15 NTU	Bank stabilization Side channel closures	a. Depth of plant growth b. NTU	Measurements of depth of plant growth and turbidty	1991-94 for pre-construction 3, 6, and 10 years post-construction	$4,000
Enhance the value of Peterson Lake for backwater	Create winter fish refuge with a. > 5 mg/l DO b. < 1 cm/sec vel. c. > 1 degree C	Side channel closures	a. mg/l b. cm/sec c. degrees C	Measure dissolved oxygen, current velocity, and water temperature during the winter	1992 and 1993 for pre-construction 3 of first 5 years post-construction	$3,750
	Create 10 acres of emergent aquatic plant growth	Side channel closure structures Bank stabilization	Acres	Measurements from aerial photographs	1989 photographs for pre-construction 5 and 10 years post-construction	*
	Reduce sediment inputs to lake	Bank stabilization Side channel closures	Acre-feet	Bathymetric surveys	5 and 10 years post-construction	$7,000

* Included in the cost of monitoring of the maintaining the existing islands objective

COST ESTIMATE

The total project cost for the selected plan is estimated to be $986,000 at the fully funded level. This cost does not include prior allocaions of $245,000 for general design (planning). A detailed cost estimate is contained in attachment 2. A summary of costs is shown in table DPR-28.

Table DPR-28
Summary of Total Project Costs

Feature	Cost
Construction	
Mobilization/Demobilization	$ 34,000
Island Riprap	225,000
Access Dredging/Sand Closures	66,000
Rock Closures/Weirs	351,000
Fish Channels	58,000
Fines	7,000
Seeding	5,000
Planning, Engineering, and Design	171,000[1]
Construction Management	69,000
Total	$986,000

[1] This does not include prior allocations of $245,000 for general design (planning).

REAL ESTATE REQUIREMENTS

This habitat rehabilitation and enhancement project is located at the lower end of pool 4 in a backwater lake of the Mississippi River in Wabasha County, Minnesota. The project will be constructed entirely upon lands owned and operated by the United States of America and managed by the U.S. Department of the Interior's Fish and Wildlife Service as the Upper Mississippi River National Wildlife and Fish Refuge.

SCHEDULE FOR DESIGN AND CONSTRUCTION

A schedule for review and approval, major work tasks, and project construction follow:

Requirement	Scheduled Date
Submit final Definite Project Report to North Central Division, U.S. Army Corps of Engineers	Mar 1994
Obtain construction approval by North Central Division, U.S. Army Corps of Engineers	Jun 1994
Complete Plans and Specifications	Feb 1995
Advertise for bids	Mar 1995
Award Contract	May 1995
Complete Construction	Nov 1995

IMPLEMENTATION RESPONSIBILITIES

The responsibilities 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 islands as outlined in OPERATION, MAINTENANCE, AND REPAIR section of this report. These actions would be the responsibility of the U.S. Fish and Wildlife Service.

Should rehabilitation of the Peterson Lake project which exceeds the annual maintenance requirements be needed (as a result of a specific storm or flood), 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 responsibility. Attachment 8 contains a draft copy 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 proposed Peterson Lake project.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

The proposed project has been cordinated with the U.S. Fish and Wildlife Service, the Minnesota and Wisconsin Departments of Natural Resources, the Minnesota State Historic Preservation Office, and the Minnesota State Archaeologist. Correspondence is contained in attachment 10.

A public information meeting was held on June 18, 1992, to obtain public input concerning resource problems and opportunities in the project area. Another public meeting was held on December 8, 1993, during the public review period of the draft Definite Project Report/Environmental Assessment.

The draft Definite Project Report/Environmental Assessment was sent to Congressional interests; appropriate Federal, State, and local agencies; special interest groups; interested citizens; and others listed in attachment 10.

CONCLUSIONS

The Peterson Lake habitat rehabilitation and enhancement project provides the opportunity to maintain and improve habitat for fish, migratory birds, and other forms of fish and wildlife indigenous to the Upper Mississippi River. Sedimentation is filling in Peterson Lake, and if unchecked, will significantly diminish the lake as a backwater lake over the next 50 years. Peterson Lake provides marginal winter fishery habitat, which in turn reduces the overall value of the lake as fish habitat. The barrier islands bordering the lake protect the lake from river flows and sedimentation and provide valuable wildlife habitat in and of themselves. These islands are eroding away, especially along the lower reaches of the lake.

A number of measures are aimed at correcting existing habitat problems and preventing future habitat losses. Closure of the upper openings in the lake will reduce sedimentation in the lake by an estimated 50 percent, significantly extending the life of Peterson Lake as a backwater lake. The closures will also reduce current velocities in the upper portion of the lake and maintain higher winter water temperatures, providing suitable winter fish habitat in this portion of the lake. Stabilization of the barrier islands in the lower portion of the lake will retain the intrisic habitat value provided by these islands, and would prevent the further habitat degradation that would occur if these islands were allowed to erode away.

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

RECOMMENDATION

I have weighed the accomplishments to be obtained from the Peterson Lake habitat project against its cost and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the cost of the project is a justified expenditure of Federal funds. I recommend that higher authority approve construction of the habitat rehabilitation and enhancement features of the Peterson Lake, Minnesota, project at a total estimated cost of $986,000, which would be a 100-percent Federal cost according to Section 906(e)(3) of the 1986 Water Resource Development Act.

for [signature] MAJ, EN
James T. Scott
Colonel, Corps of Engineers
District Engineer

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

REPLY TO
ATTENTION OF
Planning Division
Environmental Resources

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 environmental impacts of the following project:

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 4, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

The purpose of the proposed project is to maintain and enhance the habitat of Peterson Lake, a backwater lake of approximately 500 acres located immediately above Lock and Dam 4 on the Upper Mississippi River. The proposed project would include construction of closures between islands along the upper half of the lake and the stabilization of islands along the riverward edge of the lower half of the lake. The purpose of the closure structures would be to decrease the amount of sediment being transported into the lake. In addition, the uppermost closure structures would decrease current velocity and increase water temperatures during winter to provide improved winter habitat conditions for fish. Channels would be excavated within the lake, at two locations, to improve the passage of fish through shallow areas under ice cover conditions. Stabilization of the existing islands would preserve existing habitat values for fish and wildlife in the middle and lower portions of the lake.

This Finding of No Significant Impact is based on the following factors: the proposed project would have only minor and short-term adverse impacts on fish and wildlife resources; the project would have beneficial impacts on both fish and wildlife resources; the project would have no impact on the cultural environment; and continued coordination would be maintained with appropriate State and Federal agencies.

The environmental review process indicated 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.

16 Mar 94
Date

for [signature] MAJ, EN
James T. Scott
Colonel, Corps of Engineers
District Engineer

Table DPR-17
Projected Changes in Lake Volume with Alternative A3

Year	Approximate* Future Without Lake Volume	Approximate* Future With Lake Volume
Present	2,200 acre-feet	2,200 acre-feet
Present +10	1,750 acre-feet	2,000 acre-feet
Present +20	1,350 acre-feet	1,775 acre-feet
Present +30	900 acre-feet	1,575 acre-feet
Present +40	500 acre-feet	1,350 acre-feet
Present +50	< 500 acre-feet	1,150 acre-feet

* rounded to nearest 25 acre-feet

Alternative A3 would provide approximately 100 acres in the upper portion of Peterson Lake that will serve as a winter fish refuge. Figure 23 shows the approximate area that would function as the refuge. The actual size and configuration of the area would vary from year to year depending on river flow conditions. In addition, there would be portions of this area that would not meet the desired flow and temperature criteria because of inflows through opening #5. It is believed however, that within this 100-acre zone, there will be sufficient areas that will meet the criteria to significantly contribute to fish survival and productivity.

This alternative may benefit the growth of emergent aquatic vegetation in the upper portions of the lake. The construction of the closures will create some small additional areas of shallow water protected from flows. On a localized basis, this should improve conditions for emergents.

Alternative A3 would provide an estimated 180 average annual habitat units of benefits (see attachment 4, HEP appendix for details). The cost/AAHU of these quantifiable benefits would be $298.

BIBLIOGRAPHY

Barko, J.W., R.F. Gaugush, W.F. James, B.J. Johnson, T.J Naimo, J.T. Rogala, S.J. Rogers, and D.M. Soballe. 1993. Hydrologic modification for habitat improvement in the Finger Lakes: Pre-project Report Number 2, 1993. U.S. Fish and Wildlife Service Environmental Mangement Technical Center, Onalaska, Wisconsin; U.S. Fish and Wildlife Service National Fisheries Research Center, La Crosse, Wisconsin; and U.S. Army Corps of Engineers, Waterways Experiment Station, Eau Galle Limnological Laboratory, Spring Valley, Wisconsin. EMTC 93-T002 57 pp.

Cooke, G.D., E.B. Welch, S.A. Peterson, and P.R. Newroth. 1986. Lake and Reservoir Restoration. Butterworth Publ., Boston.

Lewis, Henry. 1967 (1854). The Valley of the Mississippi Illustrated. Minnesota Historical Society, St. Paul.

Minnesota DNR. 1987. Mississippi River Survey, Peterson Lake - River Mile 754.0 Pool 4 - Wabasha County, Minnesota. 19 pp.

Olson, Kurt N., and Merle P. Meyer. 1976. Vegetation, Land and Water Surface changes in the Upper Navigation Portion of the Mississippi River Basin over the Period 1929-1973. Remote Sensing Laboratory, College of Forestry, University of Minnesota, St. Paul, for U.S. Army Corps of Engineers, St. Paul District.

Palesh, Gary and Dennis Anderson. 1990. Modification of the Habitat Suitability Index Model for the Bluegill (<u>Lepomis macrochirus</u>) for Winter Conditions for Upper Mississippi River Backwater Habitats. U.S. Army Engineer District. St. Paul. 8 pp.

Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982. Habitat suitability index models: Bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8. 26 pp.

Welke, Kurt I. 1993. Winter Centrarchid Habitat Use (Draft). Wisconsin Department of Natural Resources. 18 pp.

ATTACHMENT 1

FIGURES

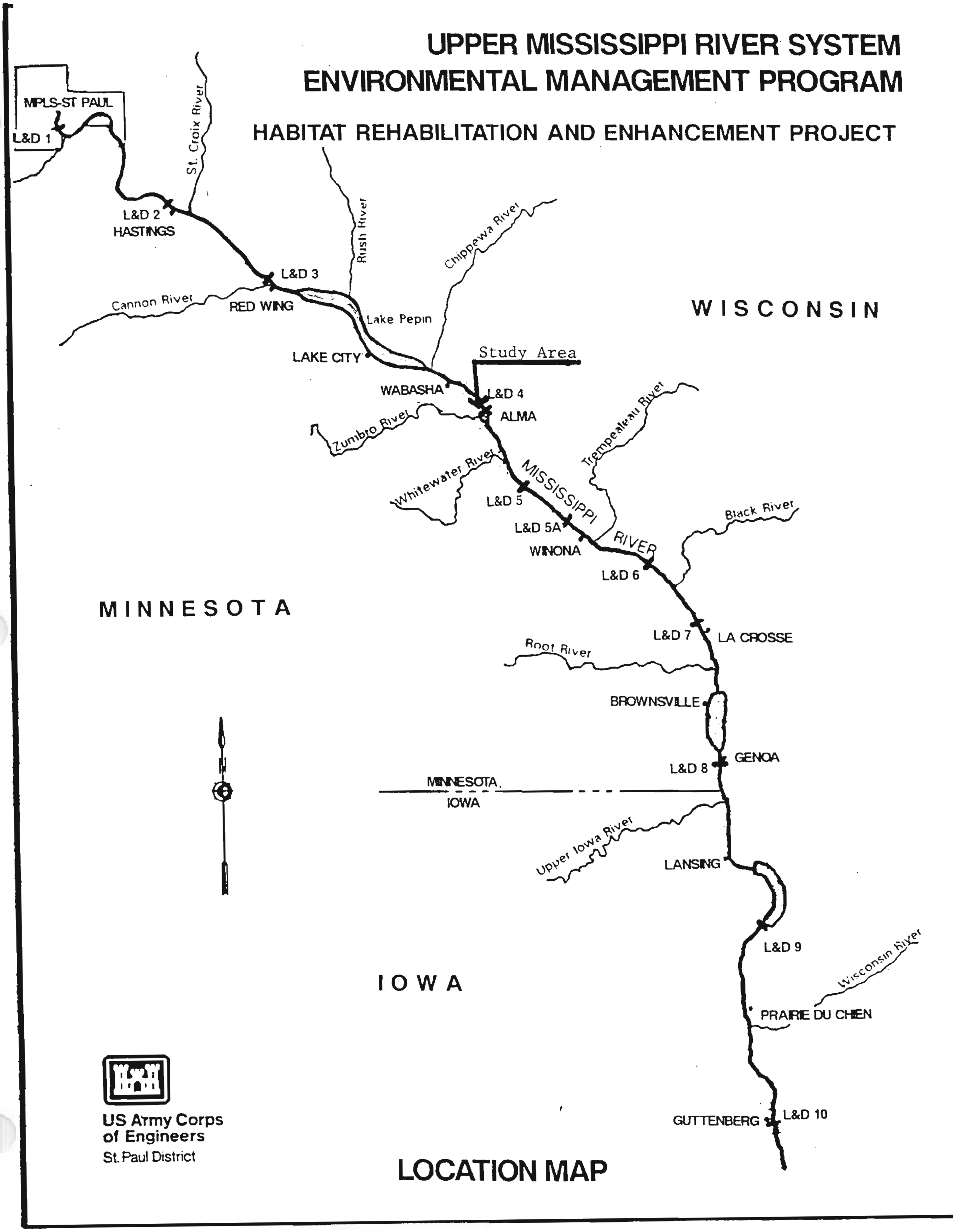


Figure 1. General Location Map

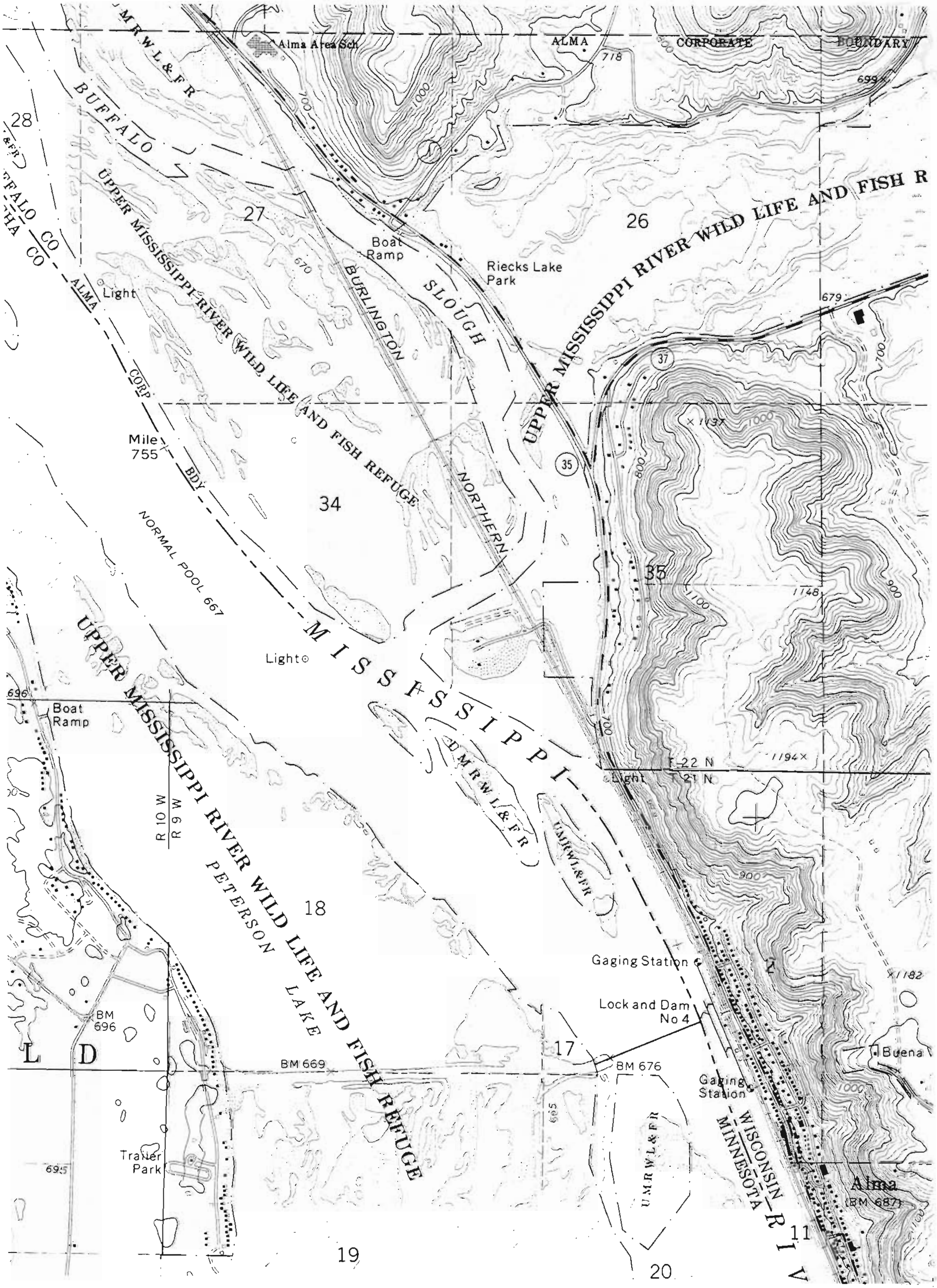


Figure 2. Peterson Lake Study Area

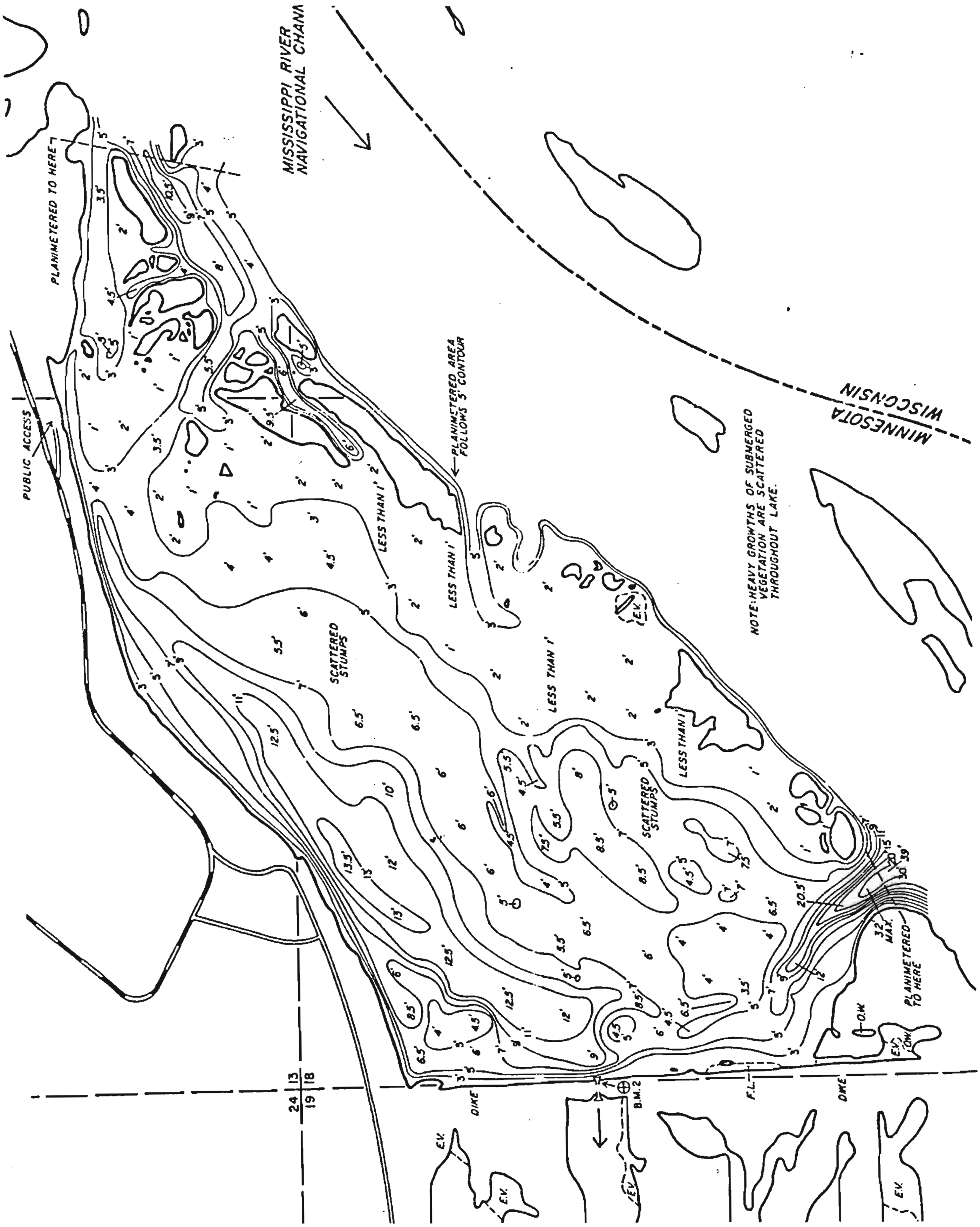


Figure 3. 1986 Minnesota DNR Bathymetric Map

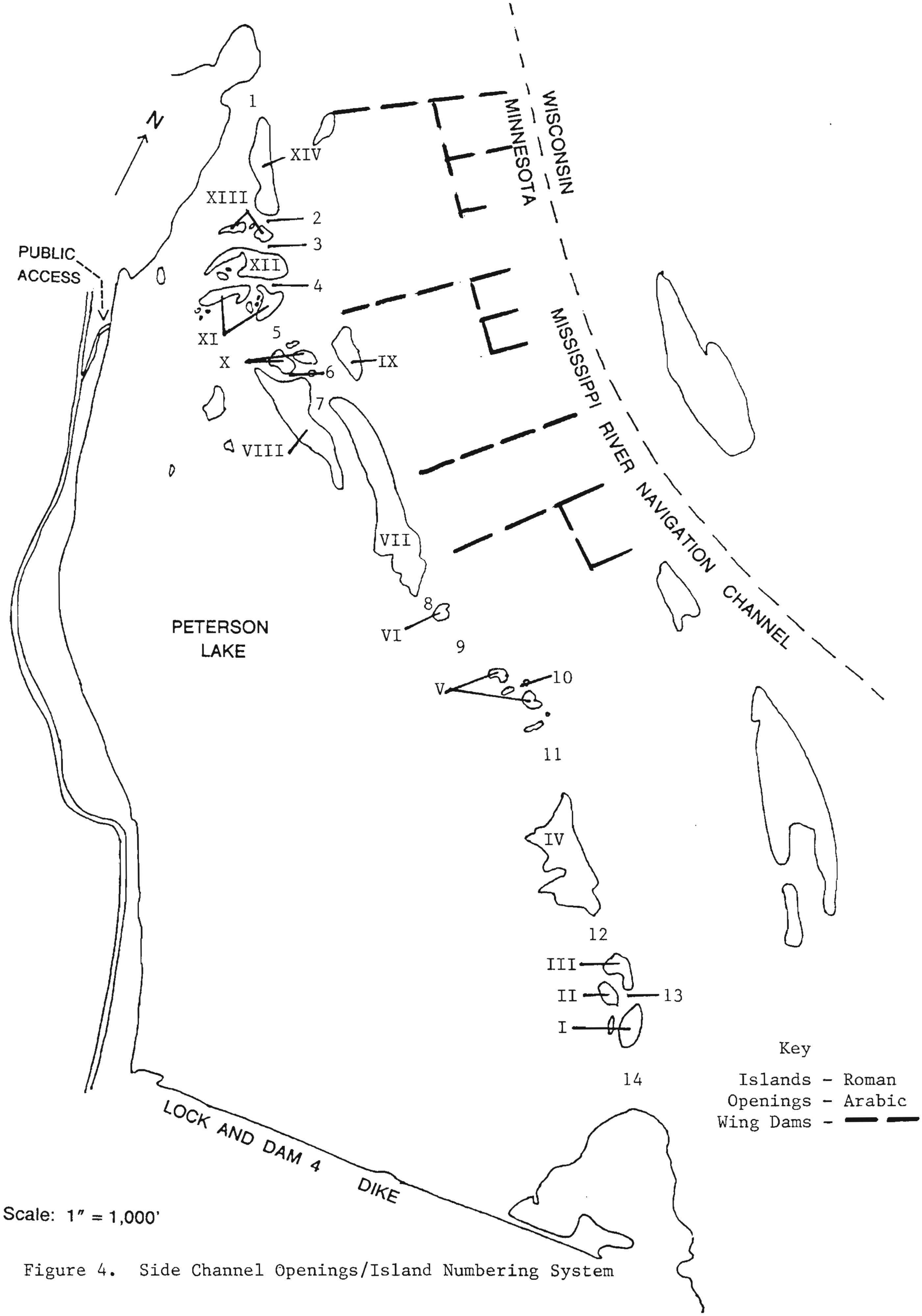


Figure 4. Side Channel Openings/Island Numbering System

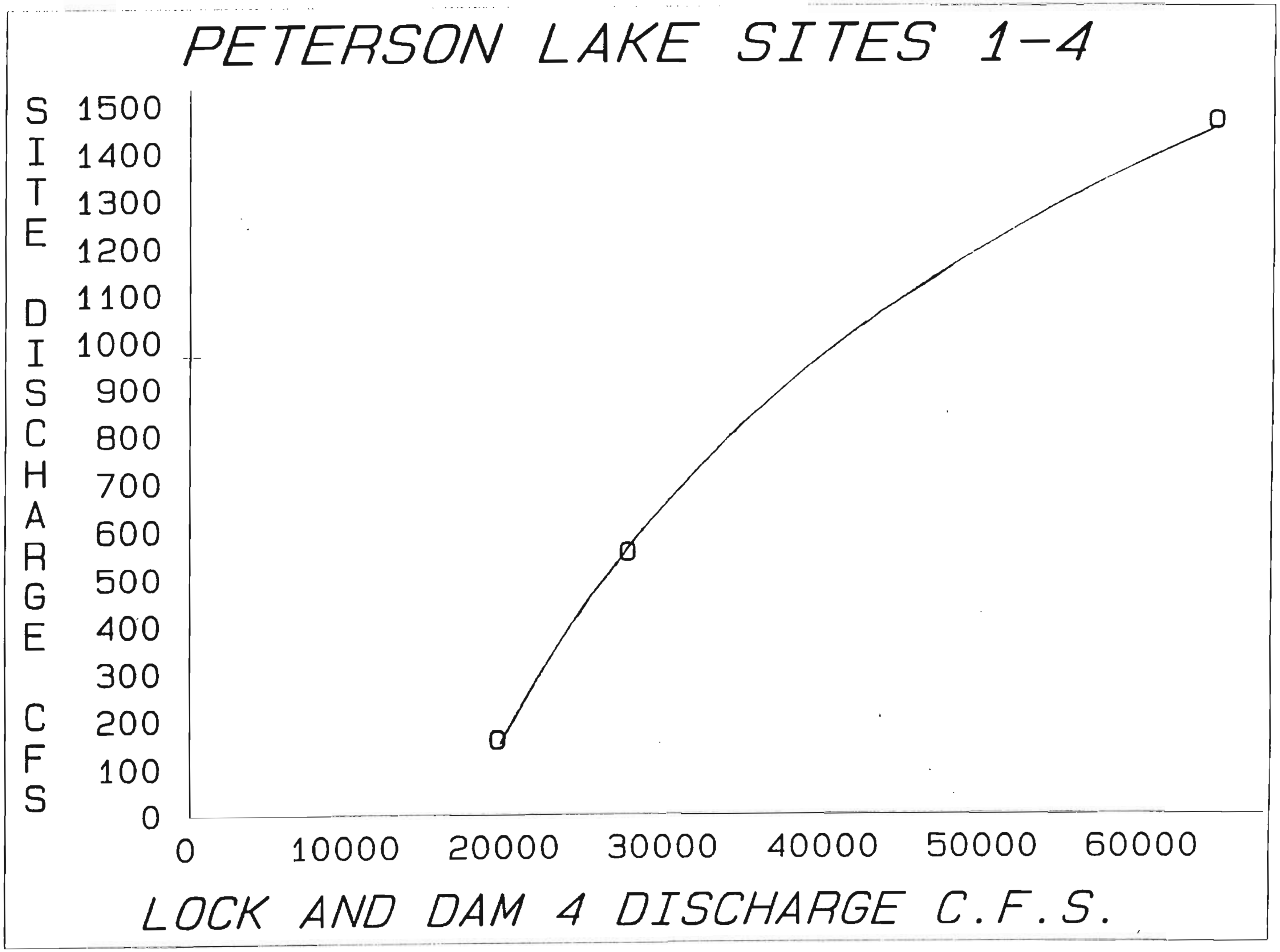


Figure 5. Discharge Relationships - Sites 1-4

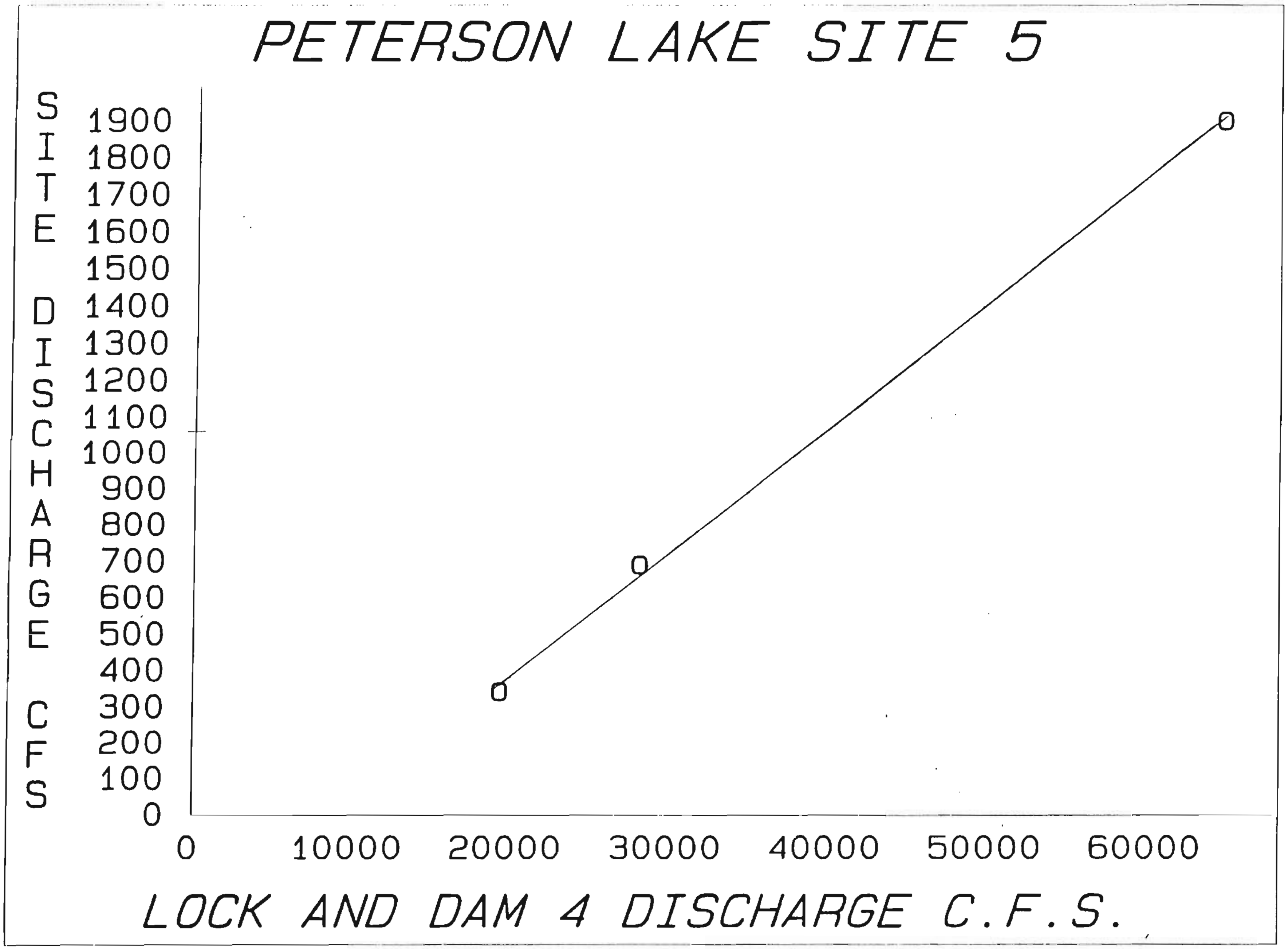


Figure 6. Discharge Relationships - Site 5

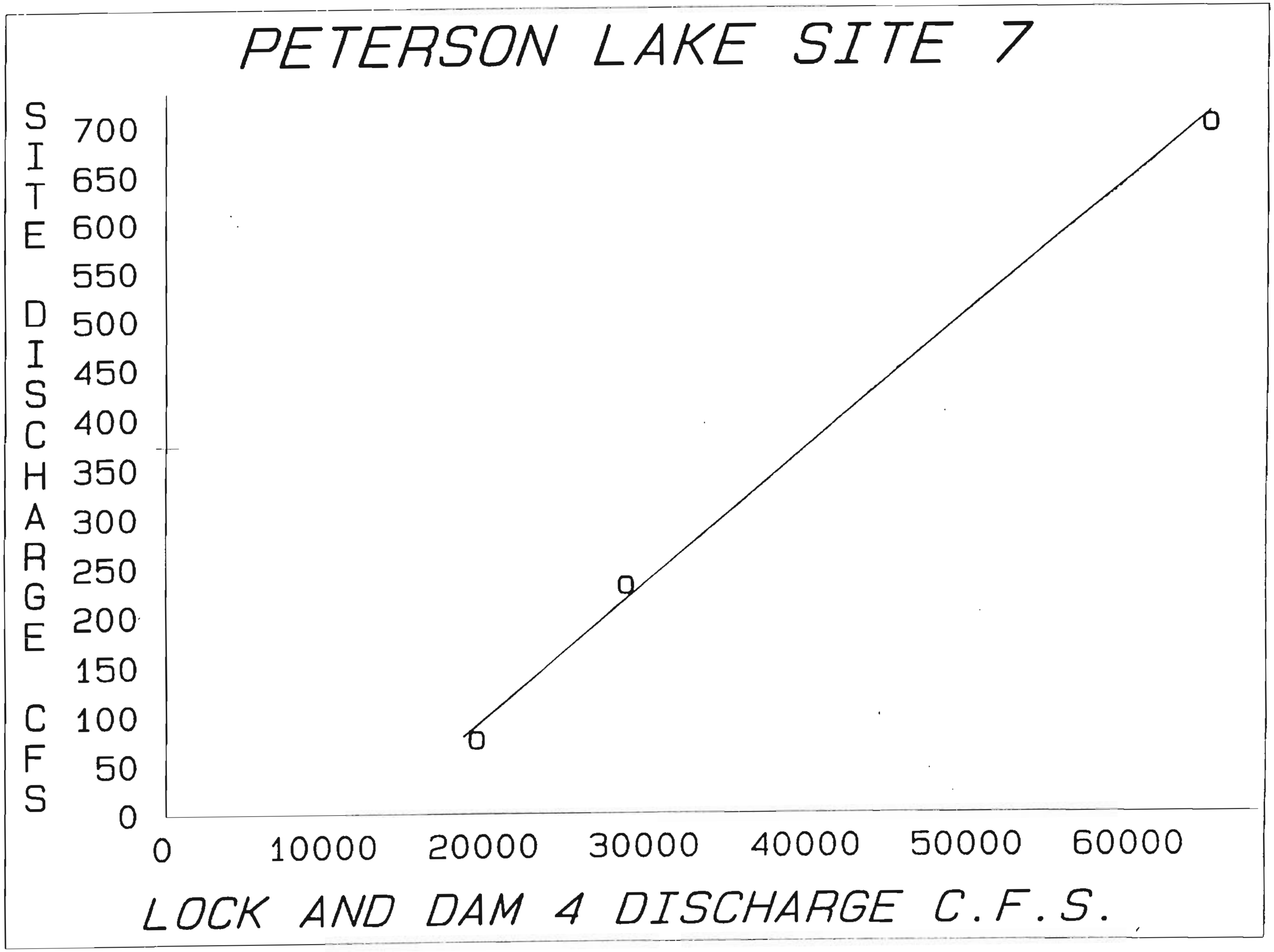


Figure 7. Discharge Relationships - Site 7

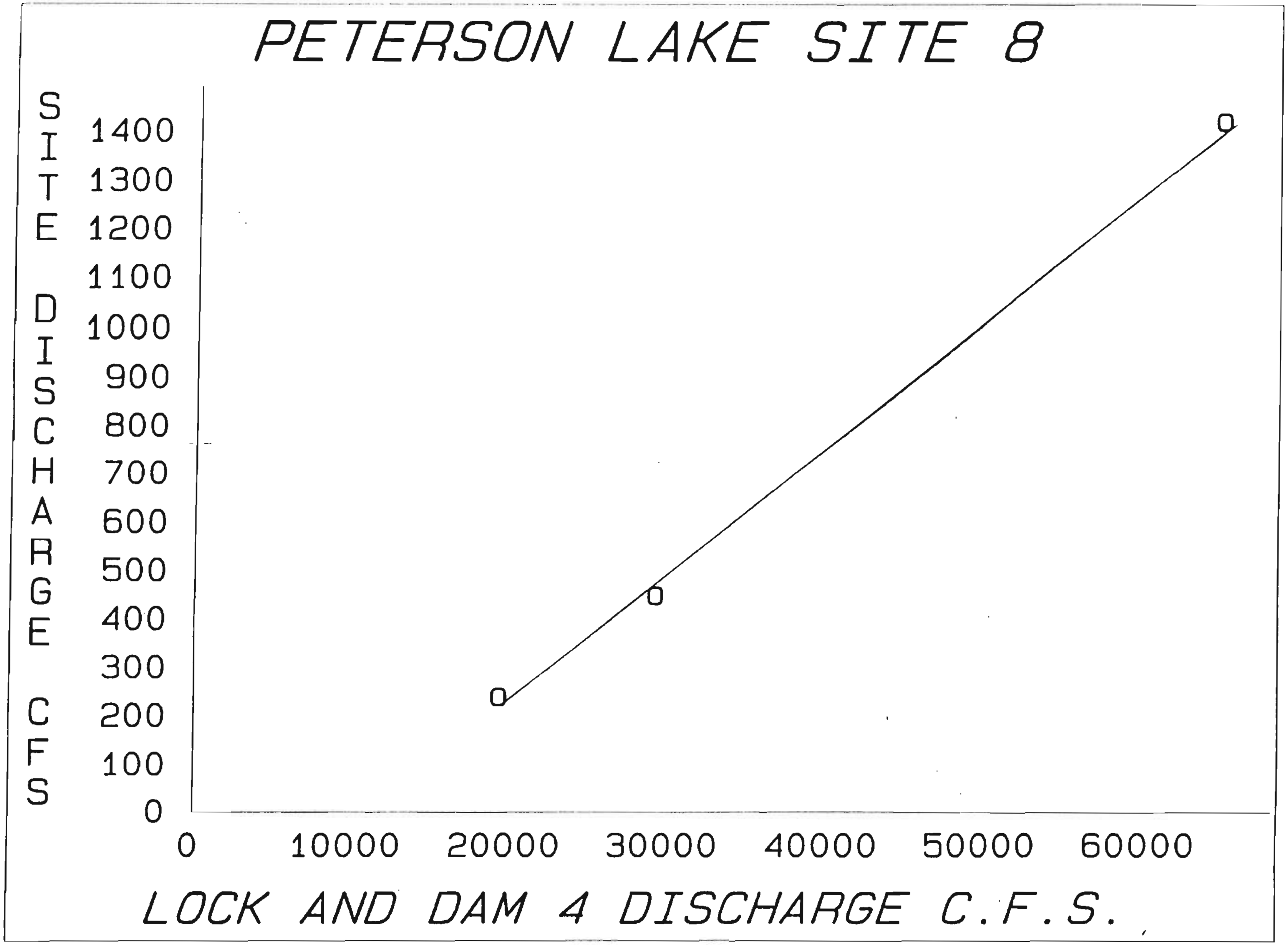


Figure 8. Discharge Relationships - Site 8

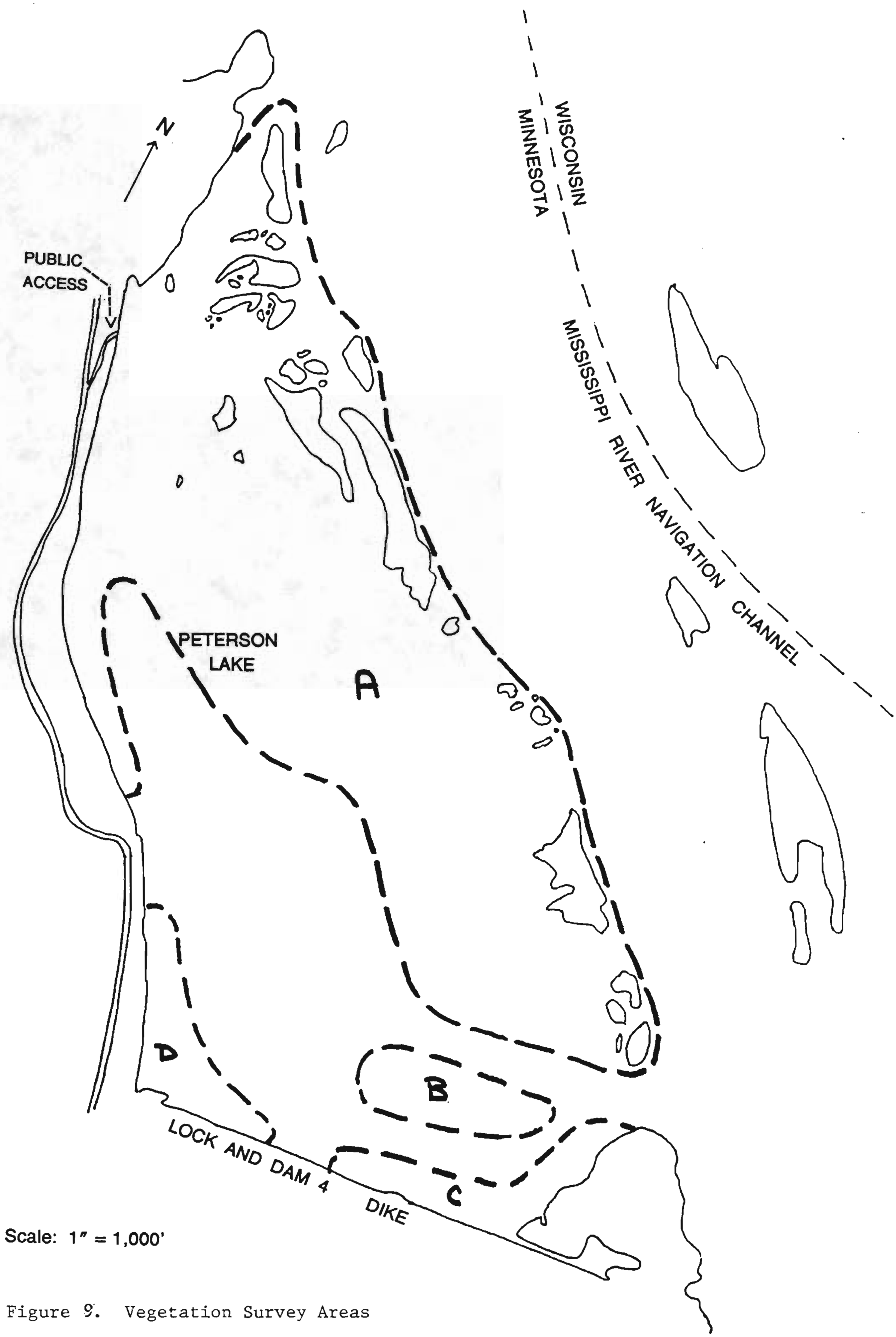


Figure 9. Vegetation Survey Areas

Figure 10. Peterson Lake - 1938

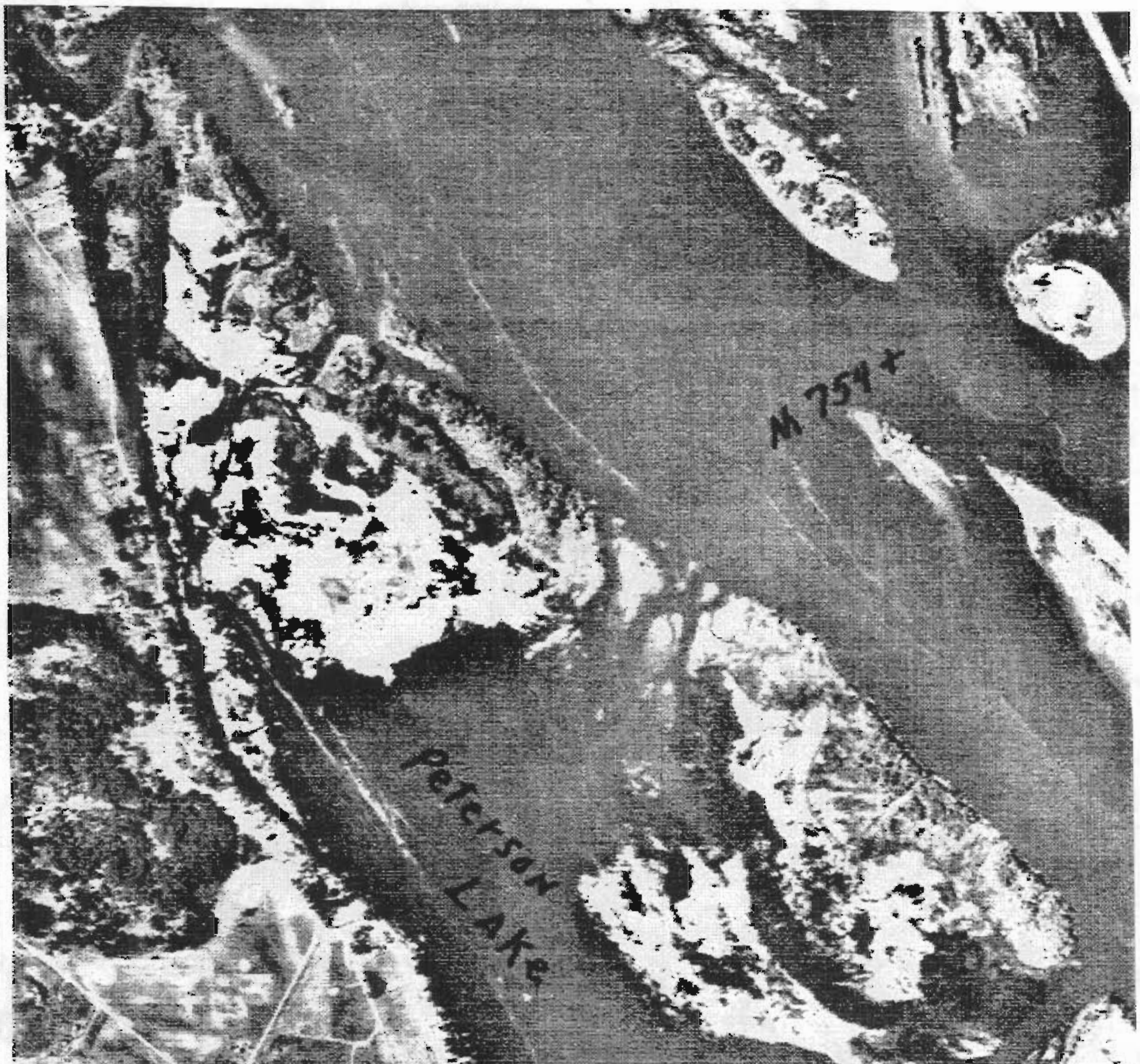


Figure 11. Peterson Lake - 1958

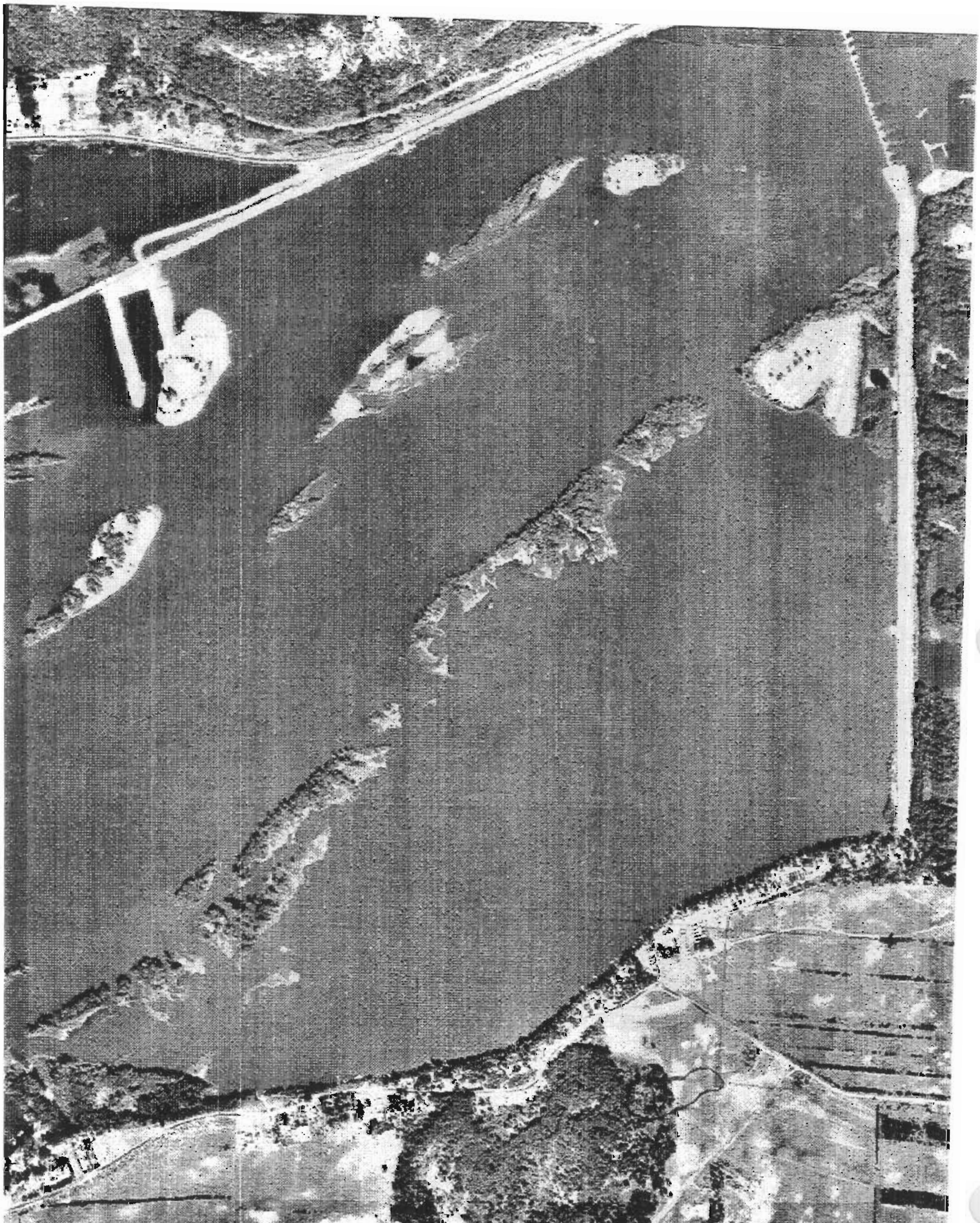


Figure 12. Peterson Lake - 1964

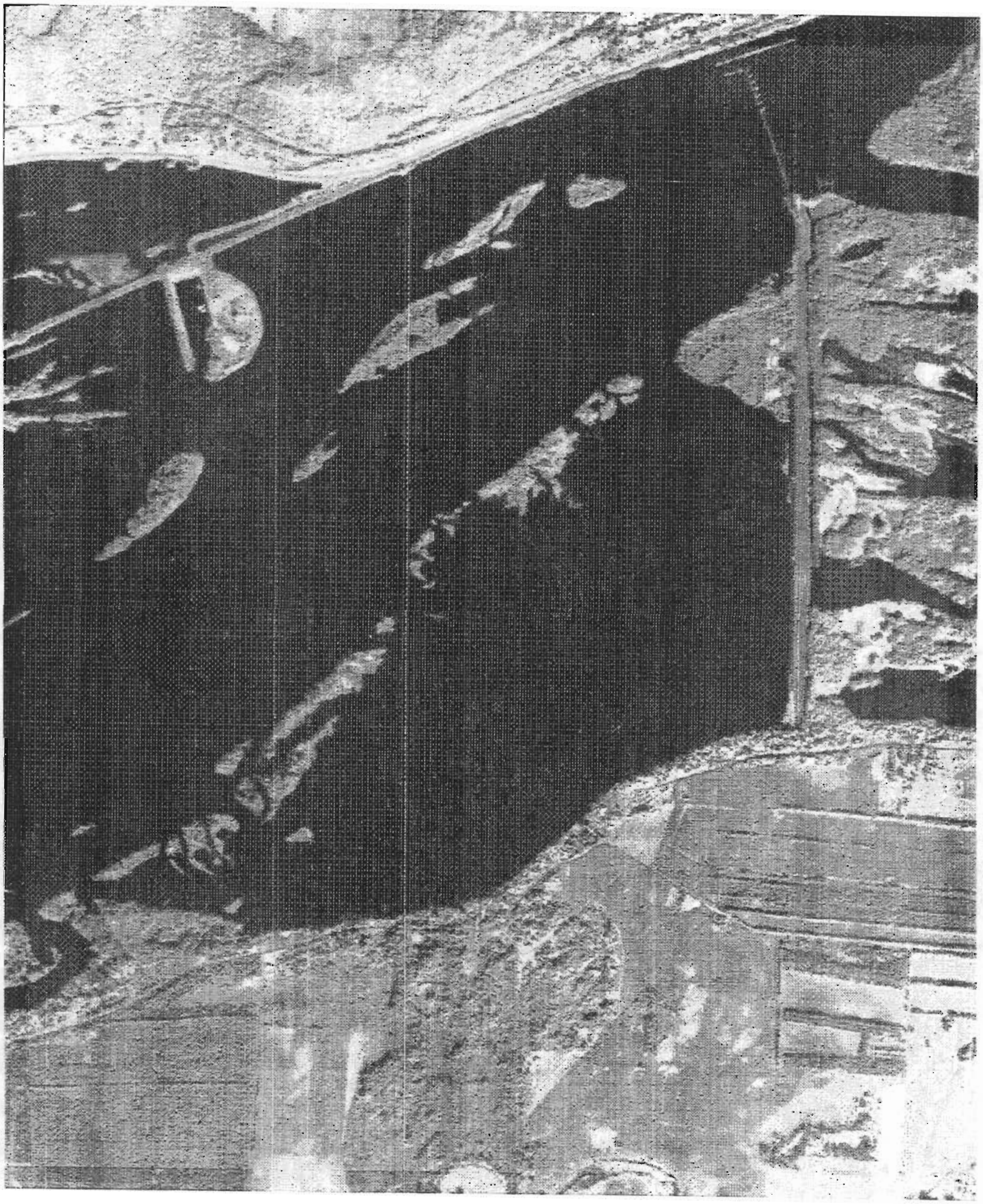


Figure 13. Peterson Lake - 1973

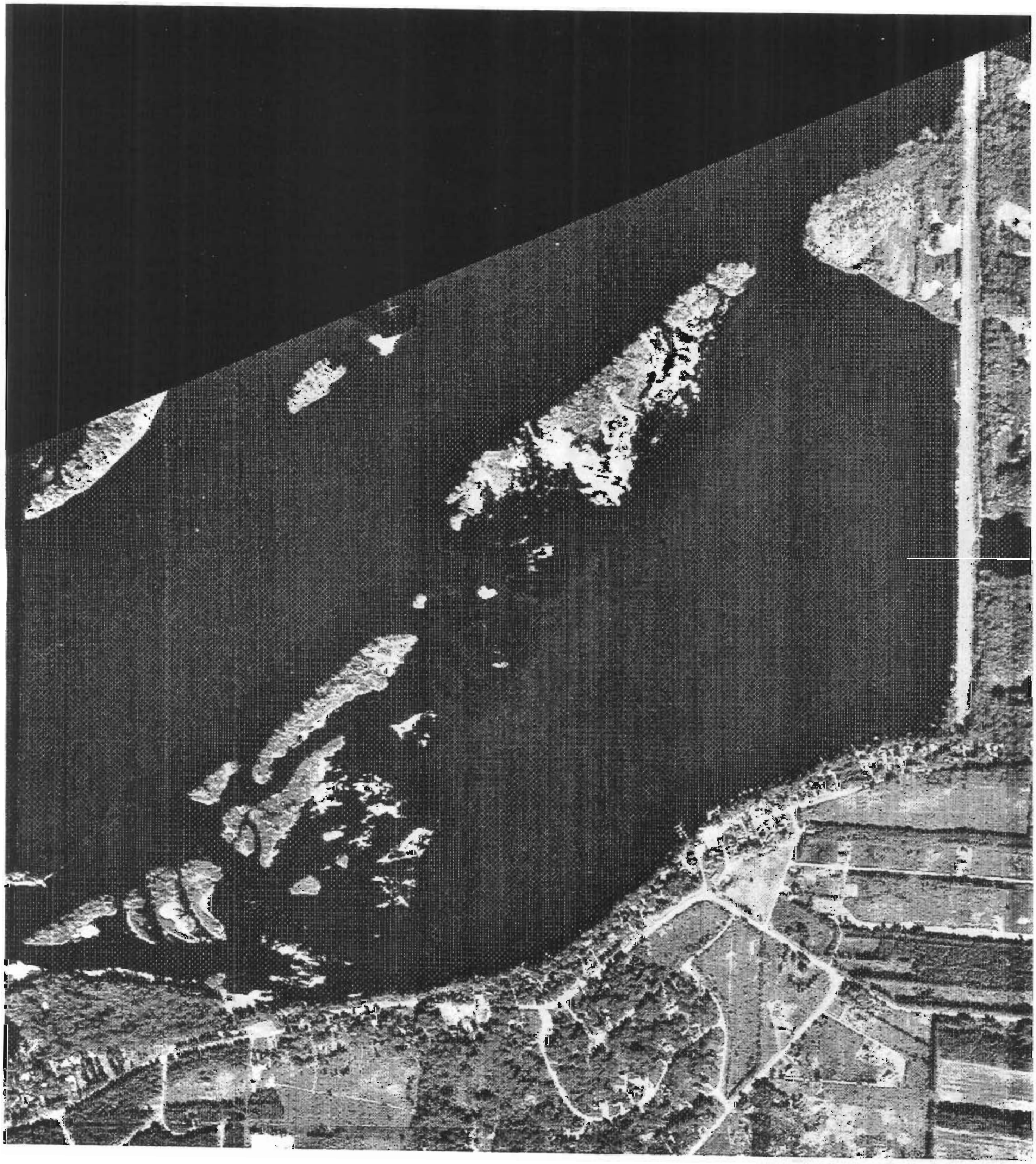


Figure 14a. Peterson Lake - 1989

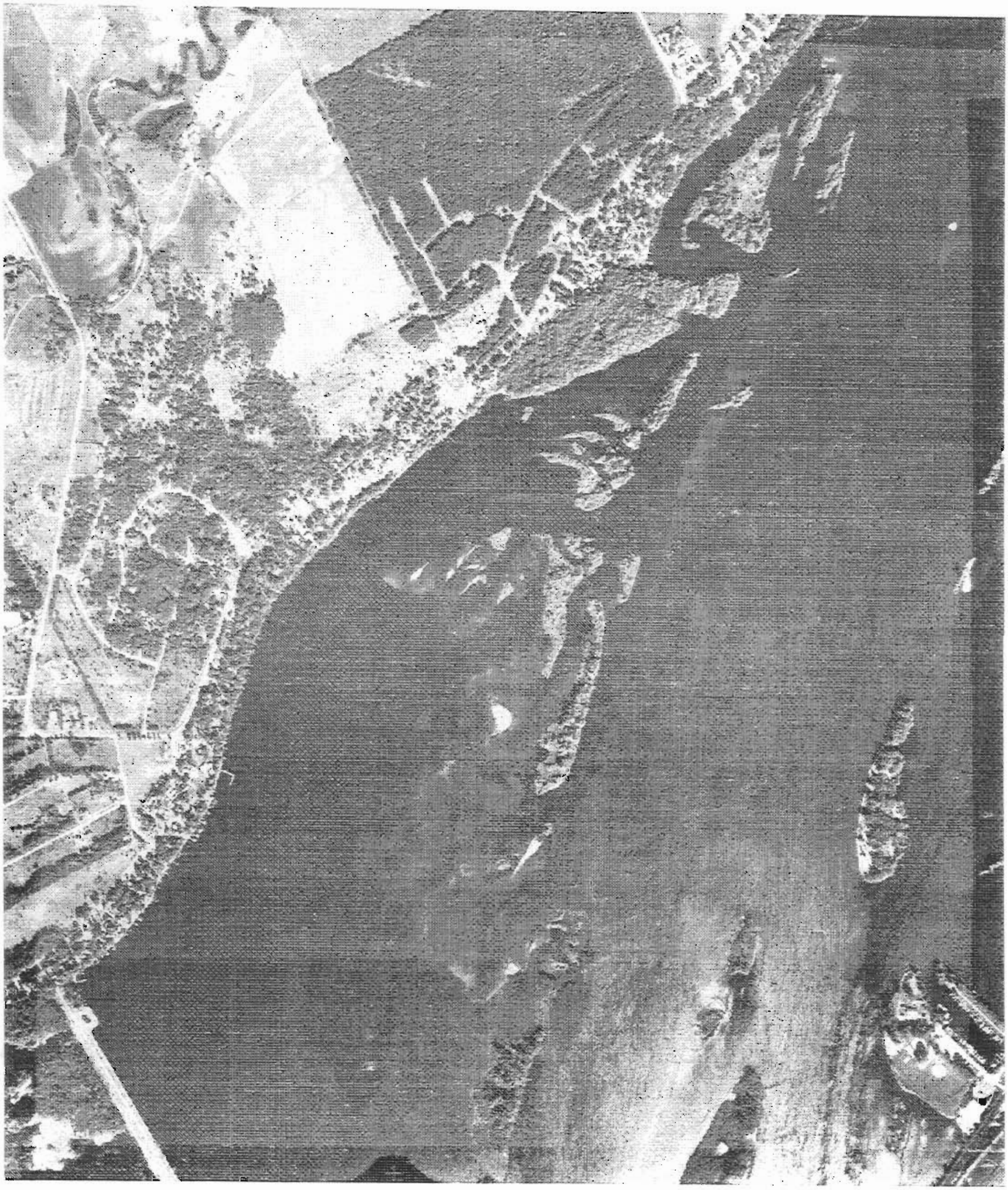


Figure 14b. Peterson Lake - 1993

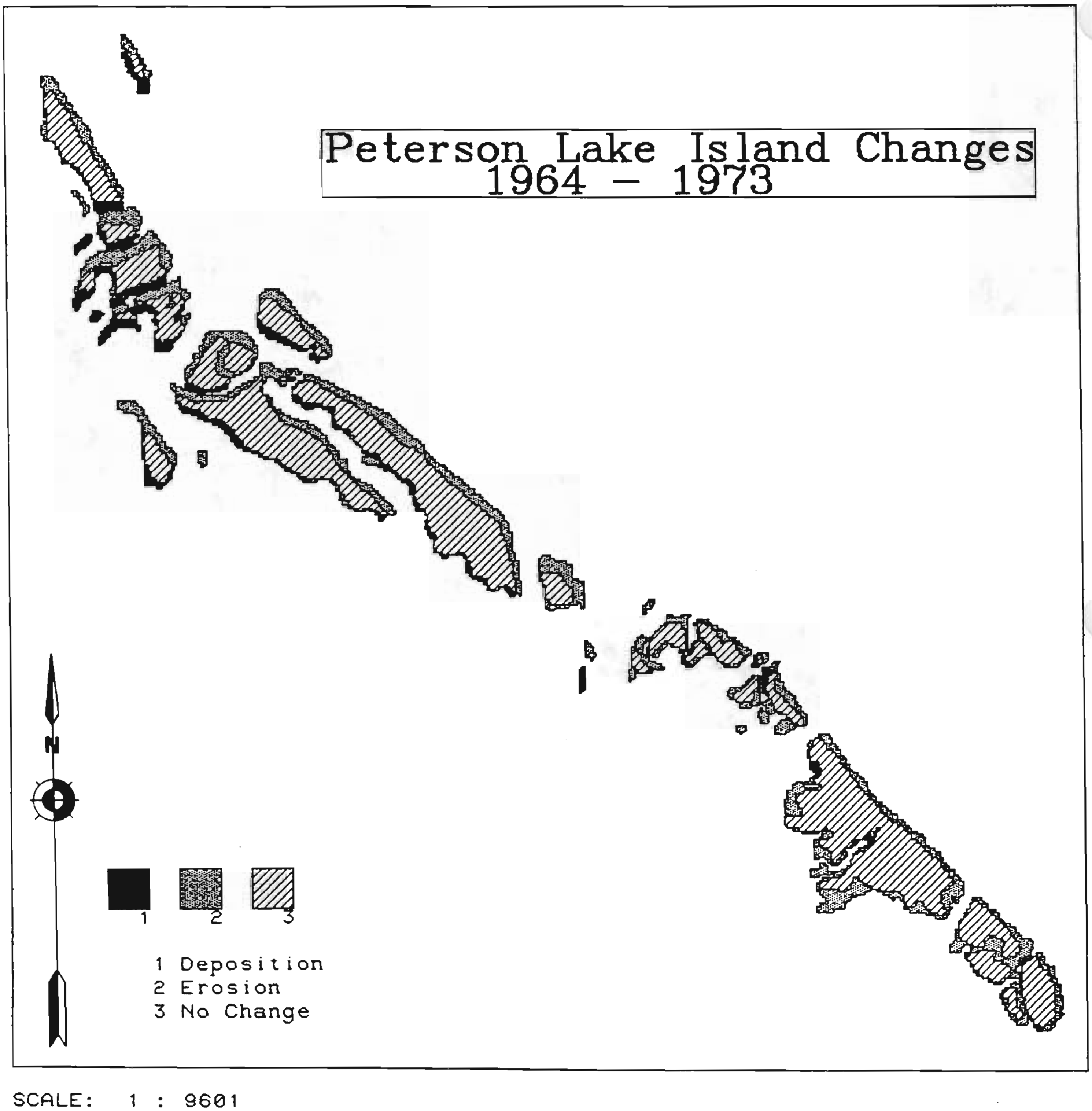


Figure 15. Peterson Lake Island Changes 1964 - 1973

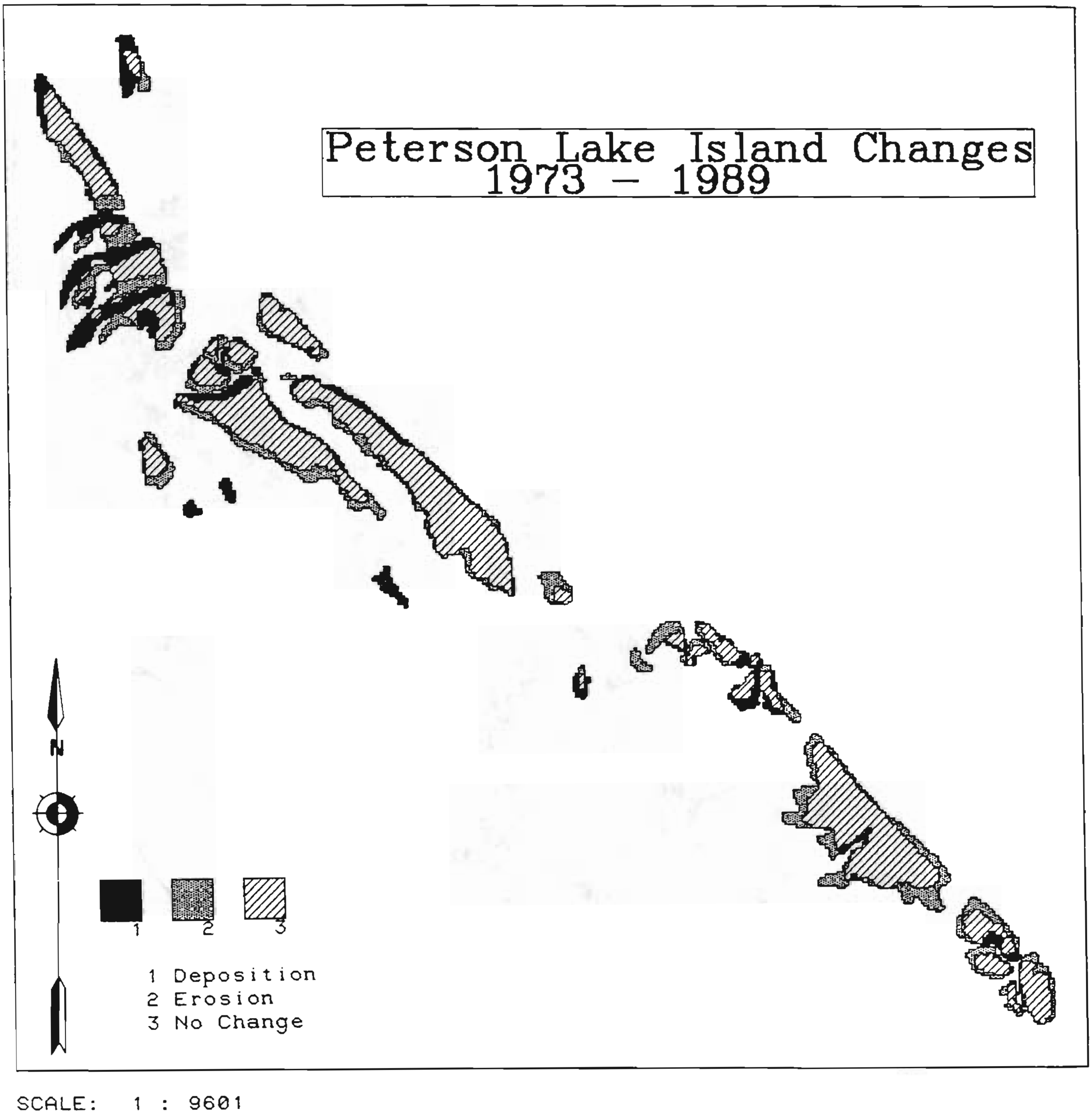


Figure 16. Peterson Lake Island Changes 1973 - 1989

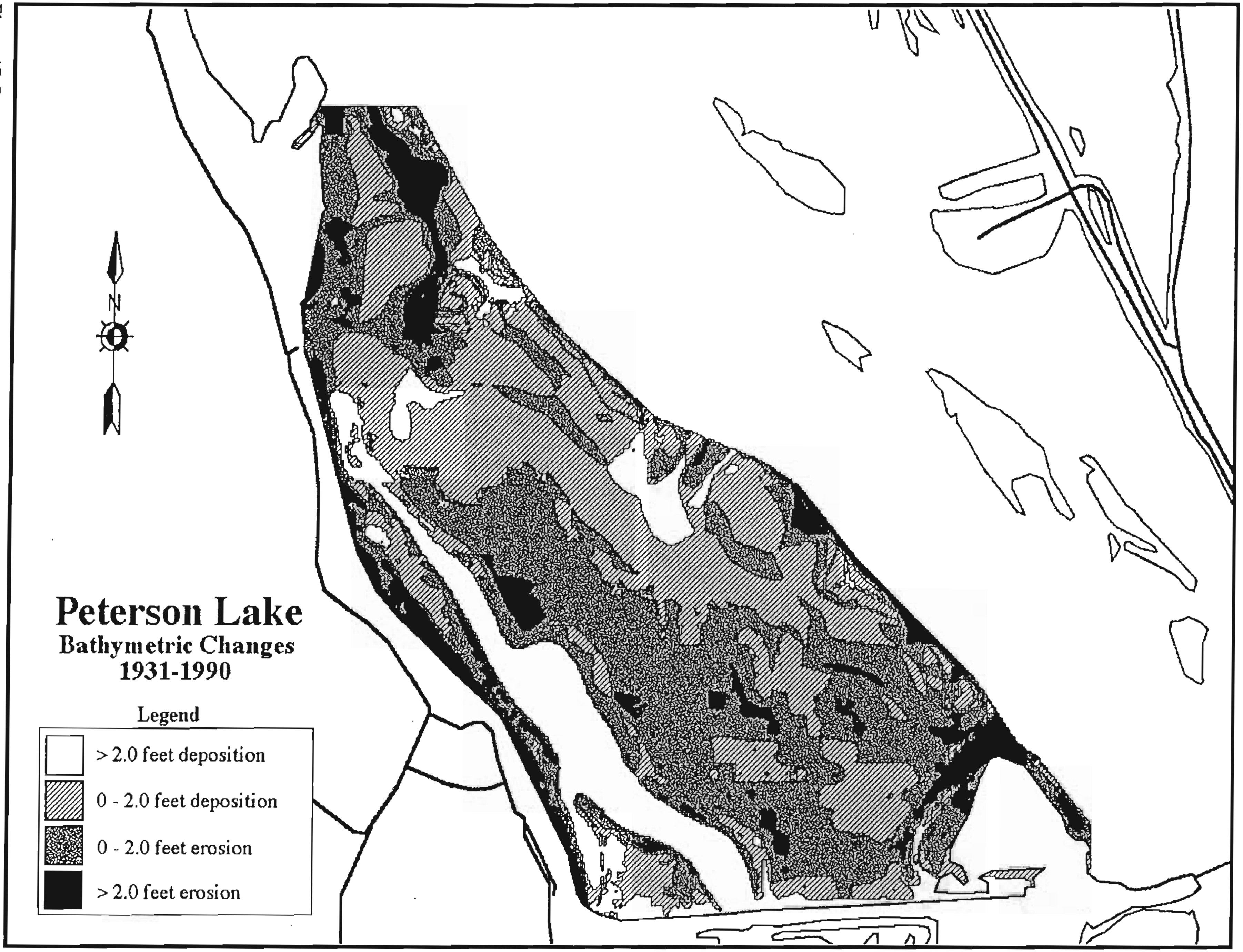
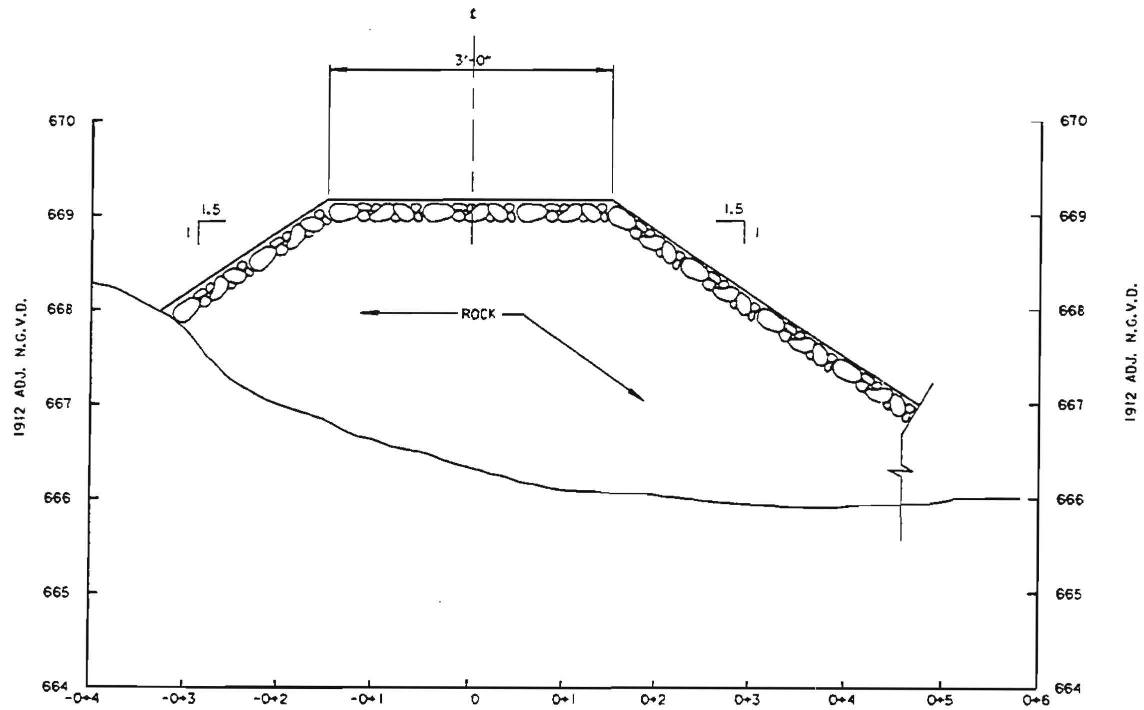


Figure 17. Peterson Lake Bathymetric Changes 1931 - 1990



SECTION
BANK PROTECTION

GEN ENG
HYD
HYDR
GEOTECH
STR ENG
MEA

Figure 19

SYMBOL	DESCRIPTION	DATE	APPROVAL

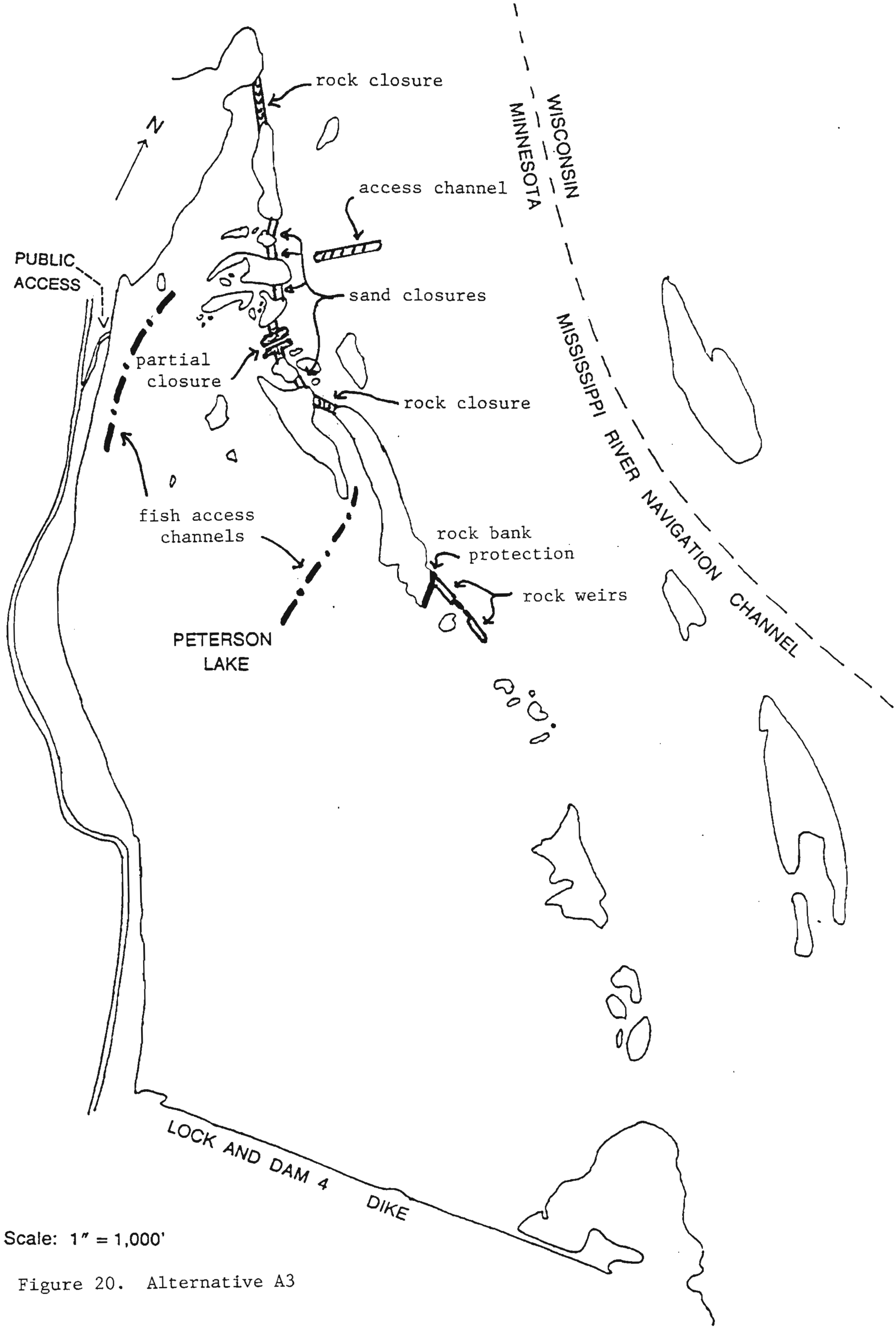
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

REPORT
PETERSON LAKE
ENVIROMENTAL PROGRAM - UPPER MISSISSIPPI RIVER
PETERSON LAKE POOL 4 WABASHA CO., MN
TYPICAL SECTION
FOR
BANK PROTECTION

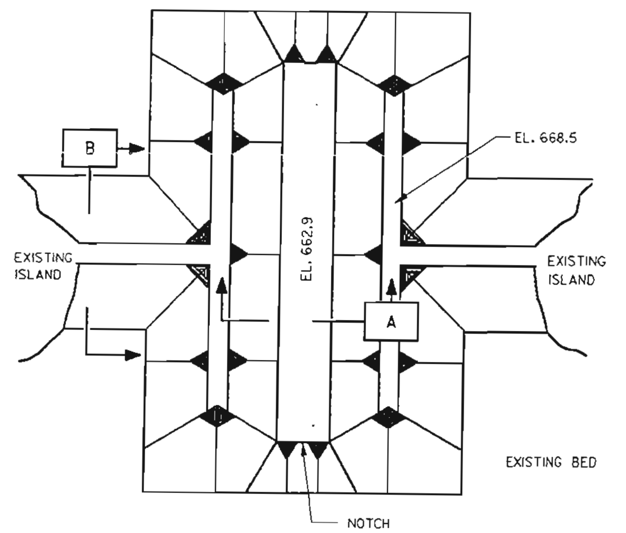
ED-D DESIGNED: WPR
CHECKED: XXX/XXX
DRAWN: SKM
ED-GH DESIGNED: XXX/XXX
CHECKED: XXX/XXX
DATE: 09-22-93

CAD FILE NAME: PETER1.DGN
SPEC NO: DACW37-90-B-0000
DRAWING NUMBER: BASIN-T-CC/FNO.1
SHT 999 OF 999

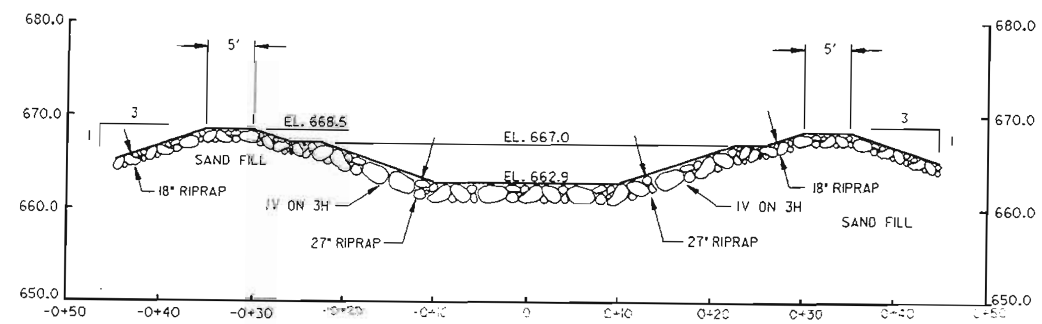


Scale: 1″ = 1,000′

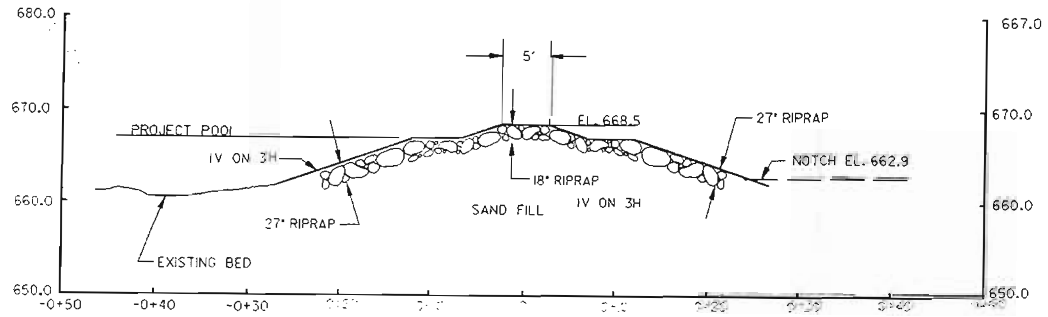
Figure 20. Alternative A3



PLAN VIEW



SECTION
THROUGH NOTCH A



SECTION
ACROSS CLOSURE B

10 0 10 20
SCALE IN FEET

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

AE APPROVING OFFICIAL:

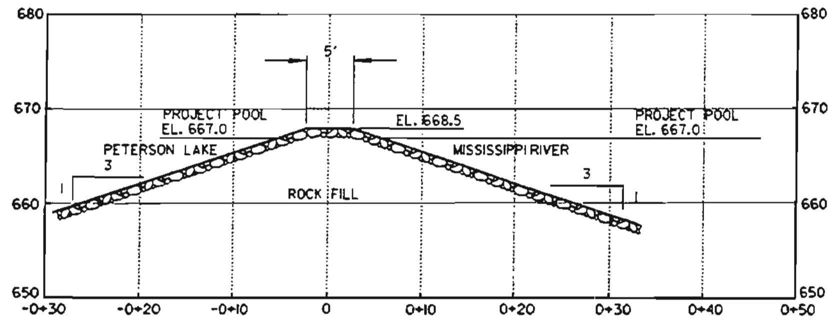
DEFINITE PROJECT REPORT
PETERSON LAKE
ENVIROMENTAL PROGRAM - UPPER MISSISSIPPI RIVER
PETERSON LAKE POOL 4 WABASHA CO., MN

PARTAL CLOSURE STRUCTURE
PLAN AND SECTIONS

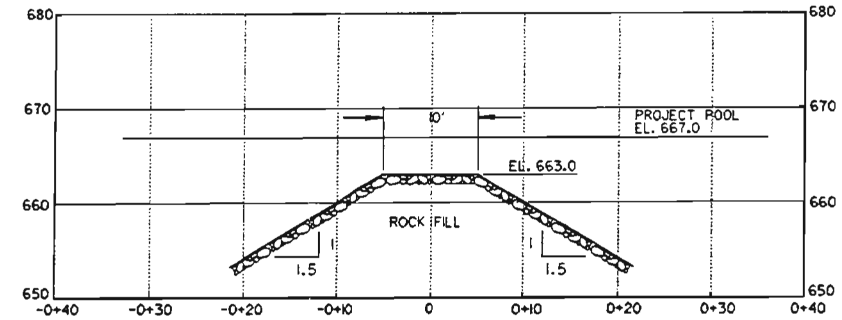
ED-D	DESIGNED:	WPR
	CHECKED:	
	DRAWN:	SKM
ED-GH	DESIGNED:	
	CHECKED:	
	DATE:	06-14-93

CAD FILE NAME: PETER2.DGN
SPEC NO: DACW37-93-B-0000
DRAWING NUMBER: BASIN-T-CC/FNO.1
SHT X OF X

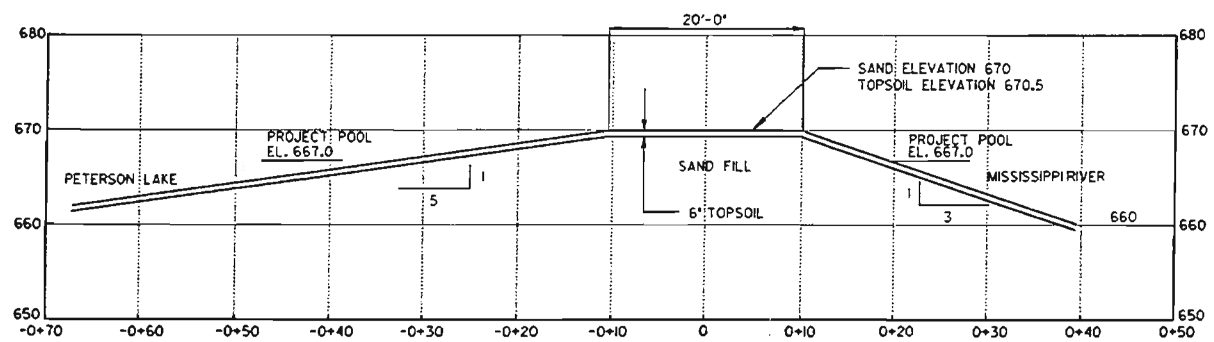
Figure 21



SECTION
ROCK CLOSURE (OPENING 1,7)



SECTION
ROCK WEIR (OPENING 8,9)



SECTION
SAND CLOSURE (OPENING 2,3,4,6)

GEN ENG
HYD
HYDR
GEOTECH
STR ENG
MEA

Figure 22

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

DEFINITE PROJECT REPORT
PETERSON LAKE
ENVIROMENTAL MANAGEMENT PROGRAM - UPPER MISSISSIPPI RIVER
PETERSON LAKE POOL #4 WABASHA CO., MN
PETERSON LAKE (E.M.P.)
TYPICAL SECTIONS
ROCK AND SAND CLOSURES

ED-D: DESIGNED: WPR; CHECKED: WPR; DRAWN: SKM
ED-GH: DESIGNED:; CHECKED:
DATE: 06-14-93

CAD FILE NAME: peter3.dgn
SPEC NO: DACW37-94-B-0000
DRAWING NUMBER: M-R4-5/3
SHT 3 OF 3

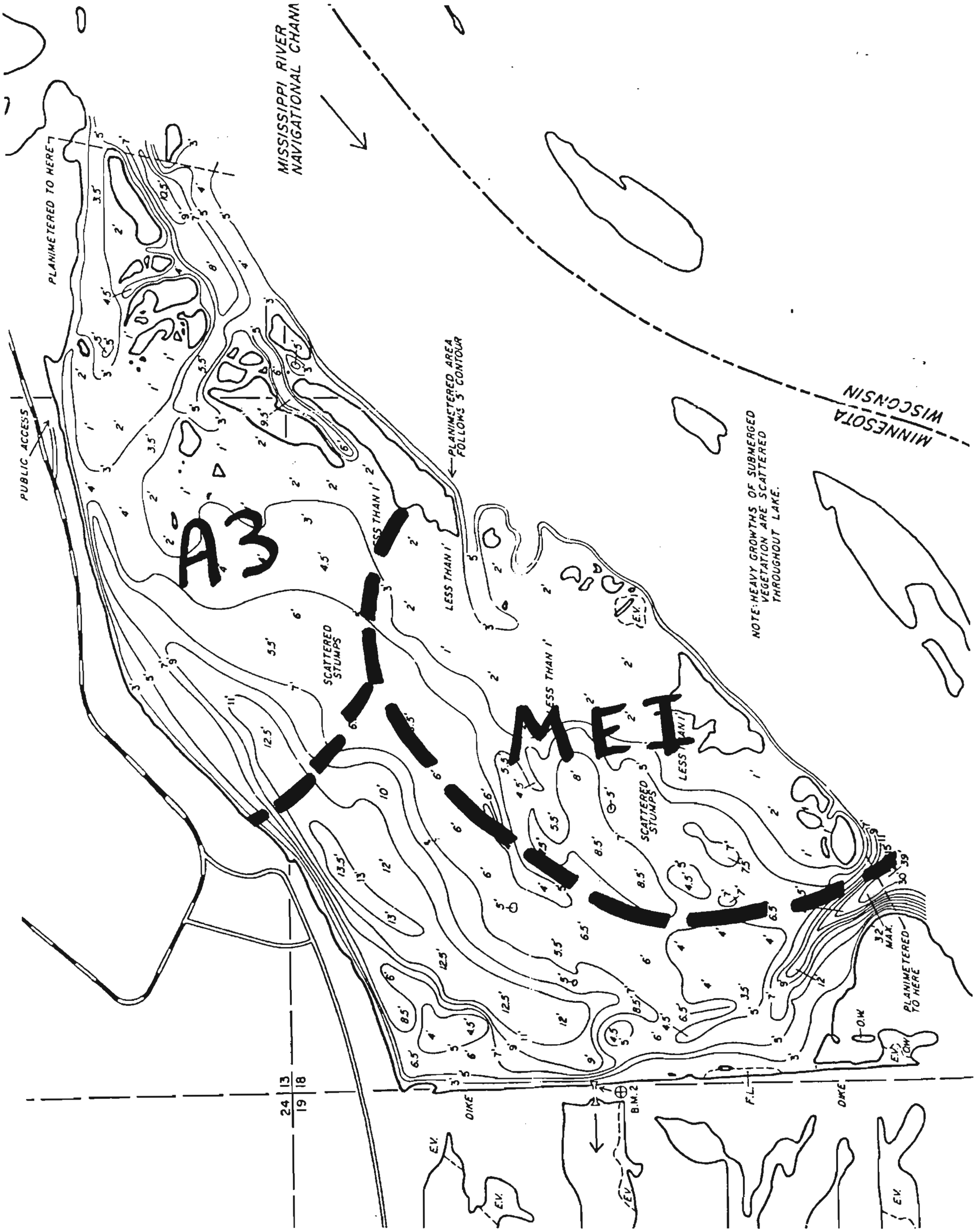
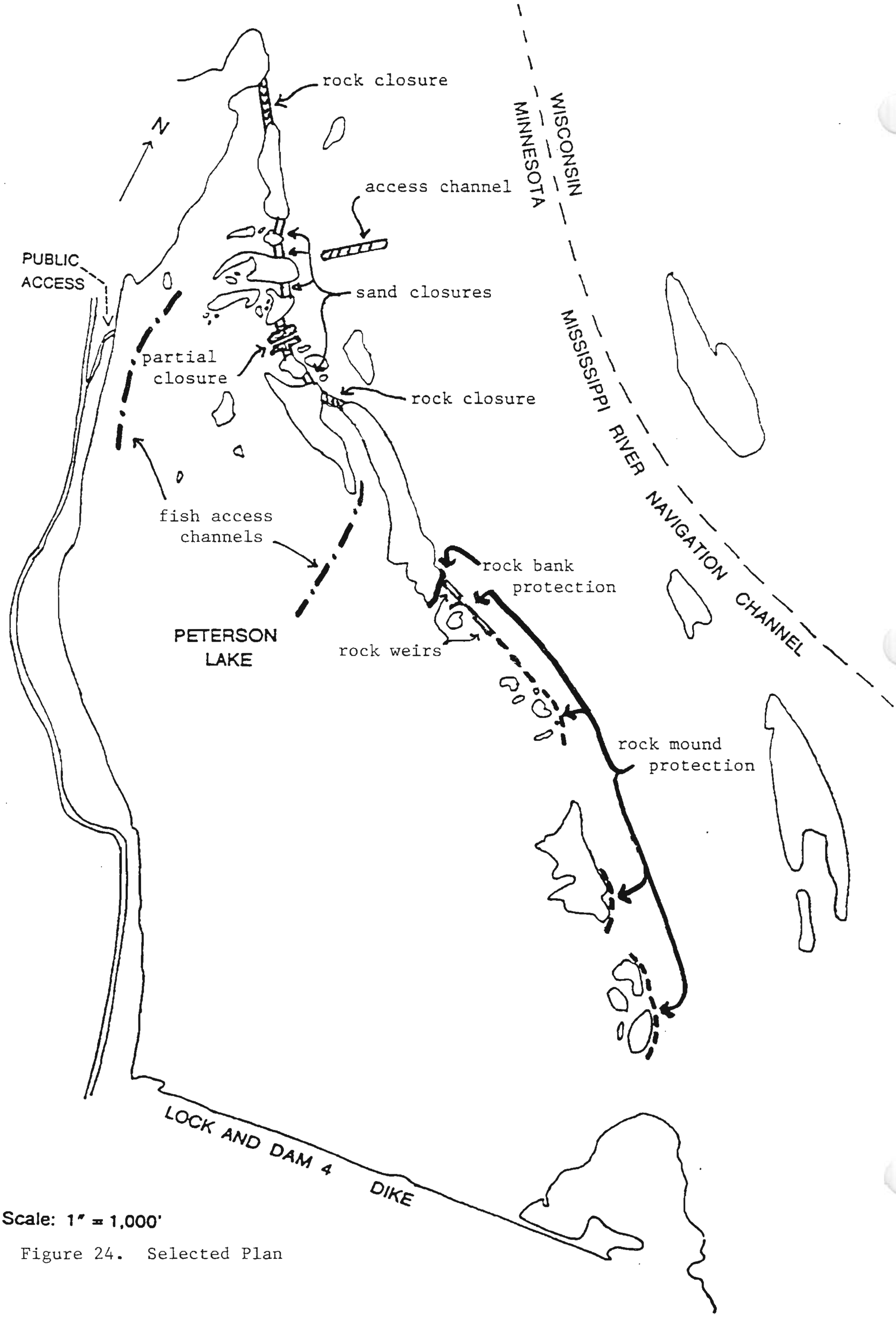


Figure 23. Estimated Fish Refuge (Winter) with A3 Alternative and Area of Benefit for MEI Alternative



Scale: 1" = 1,000'

Figure 24. Selected Plan

ATTACHMENT 2

COST ESTIMATE

PETERSON LAKE H.R.E.P. - DEFINITE PROJECT REPORT

NARRATIVE REPORT ON ESTIMATE

1. DESCRIPTION OF PROJECT. The purpose of this project is to improve fish and wildlife habitat in Peterson Lake through the protection of islands separating the lake from the main river channel and the construction of a series of closures between the islands. There are three alternatives being considered and estimates for all of the alternatives have been prepared. The work consists of placing rockfill closures, rockfill shore protection and dredging.

2. CONSTRUCTION METHODS. Since the work site is not accessible from land, marine plant has been used for all features of the work. The estimates have been prepared assuming that a mechanical dredging crew will do the work since the quantity of dredging is relatively small and the same crew can be used to place rockfill. The mechanical dredging crew has been modified somewhat since the majority of the work involves rock placement and that the dredged material can be disposed of in the immediate project area. Ten hour work days are assumed for all dredging and rock placement activities. A small amount of access dredging has been included in the estimate to allow access to an area of work where there is not enough depth to accommodate the floating plant.

3. COST ANALYSIS. Costs are based on the crew that has been developed and unit pricing is generated by assigning appropriate productivity to the crew for the feature of work being considered. Labor and equipment rates are estimated based on regional information.

4. PED AND CONSTRUCTION MANAGEMENT COSTS. For alternative A3-MEI, PED costs were developed by the functional sections and provided to the study manager to be included in the estimate. A percentage of construction costs was then calculated and this percentage used to estimate the PED costs for alternative A3 and MEI. Construction management costs were estimated as a percentage of construction costs based on historical information.

5. CONTINGENCY ANALYSIS. The contingencies used in these estimates generally consist of uncertainties in quantities and unit prices along with uncertainties in design. Quantity and design uncertainties were assigned by the designers while Cost Engineering Branch assigned unit price uncertainties. Contingencies for PED and construction Management are based on uncertainties in workhours required. A separate contingency calculation was prepared for each line item and is shown in the estimate summary.

PETERSON LAKE H.R.E.P. - ALTERNATIVE MEI **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: PETERSON LAKE H.R.E.P. - ALTERNATIVE MEI
LOCATION: MISSISSIPPI RIVER AT LOCK AND DAM NUMBER 4
DATE PREPARED: 11 FEBRUARY 1994

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-C
REVIEWED AND APPROVED BY: W. MICHAEL OSTERBY, ACTING CHIEF, PE-C

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/93 %	OMB INFLATION TO 10/93 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	179,000	68,000	38%	247,000	1.80%	251,000	JULY 95	2.900%	188,000	71,000	259,000
	TOTAL CONSTRUCTION COSTS =====>	179,000	68,000	38%	247,000		251,000			188,000	71,000	259,000
30---	PLANNING, ENGINEERING AND DESIGN	50,000	12,000	24%	62,000	2.90%	64,000	MARCH 95	2.300%	53,000	13,000	66,000
31---	CONSTRUCTION MANAGEMENT	18,000	5,000	28%	23,000	2.90%	24,000	JULY 95	3.900%	19,000	5,000	24,000
	TOTAL PROJECT COSTS ======>	247,000	85,000		332,000		339,000			260,000	89,000	349,000

NOTES:
1. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	PERCENT	REASON
ALTERNATIVE MEI								
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.-.-	WILDLIFE FACILITIES/SANCTUARIES							
06.3.A.-	MOB., DEMOB. AND PREP. WORK							
06.3.A.-	MOB/DEMOB	JOB	1	25589.00	25,600	6,400	25.0%	2,3
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	RIPRAP	CY	4,850	31.68	153,600	61,400	40.0%	2,3

SUBTOTAL CONSTRUCTION COSTS		$179,000	
SUBTOTAL CONTINGENCIES	38.0%		$68,000
TOTAL 06. FISH AND WILDLIFE FACILITIES			$247,000

REASONS FOR CONTINGENCIES:

1. NOT APPLICABLE
2. UNKNOWN QUANTITIES
3. UNKNOWN UNIT PRICES

NOTES:

A. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
30.-.-.-	PLANNING, ENGINEERING AND DESIGN							
30.H.-.-	PLANS AND SPECIFICATIONS	JOB	1	38,538.70	38,500	9,600	25.0%	2
30.J.-.-	ENGINEERING DURING CONSTRUCTION	JOB	1	11,205.40	11,200	2,800	25.0%	2
	SUBTOTAL P.E.D COSTS				$49,700			
	SUBTOTAL CONTINGENCIES		24.9%			$12,400		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$62,100		

REASONS FOR CONTINGENCIES

1. NOT APPLICABLE
2. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN COMPUTED AS SAME % OF CONSTRUCTION COSTS AS A3-MEI.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
31.-.-.-	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	17900.00	17,900	4,500	25.0%	1

SUBTOTAL S&I COSTS		$17,900	
SUBTOTAL CONTINGENCIES	25.1%		$4,500
TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)			$22,400

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 10% OF CONSTRUCTION COSTS

PETERSON LAKE H.R.E.P. - ALTERNATIVE A3 **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: PETERSON LAKE H.R.E.P. - ALTERNATIVE A3 PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-C
LOCATION: MISSISSIPPI RIVER AT LOCK AND DAM NUMBER 4
DATE PREPARED: 14 FEBRUARY 1994 REVIEWED AND APPROVED BY: W. MICHAEL OSTERBY, ACTING CHIEF, PE-C

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/94 %	OMB INFLATION TO 10/94 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	324,000	126,000	39%	450,000	1.80%	458,000	JULY 95	2.900%	339,000	132,000	471,000
	TOTAL CONSTRUCTION COSTS =====>	324,000	126,000	39%	450,000		458,000			339,000	132,000	471,000
30---	PLANNING, ENGINEERING AND DESIGN	90,000	23,000	26%	113,000	2.90%	116,000	MARCH 95	2.300%	95,000	24,000	119,000
31---	CONSTRUCTION MANAGEMENT	32,000	8,000	25%	40,000	2.90%	41,000	JULY 95	3.900%	34,000	9,000	43,000
	TOTAL PROJECT COSTS ======>	446,000	157,000		603,000		615,000			468,000	165,000	633,000

NOTES:
1. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
ALTERNATIVE A3								
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.-.-	WILDLIFE FACILITIES/SANCTUARIES							
06.3.A.-	MOB., DEMOB. AND PREP. WORK							
06.3.A.1	MOB/DEMOB	JOB	1	25589.00	25,600	6,400	25.0%	2,3
06.3.A.2	ACCESS DREDGING	CY	8,000	5.63	45,000	18,000	40.0%	2,3
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	RIPRAP	CY	6,500	31.68	205,900	82,400	40.0%	2,3
06.3.3.B	CHANNEL EXCAVATION	CY	7,000	5.63	39,400	15,800	40.0%	2,3
06.3.3.B	FINES	CY	425	11.26	4,800	1,900	40.0%	2,3
06.3.3.B	SEEDING	SF	58,760	0.06	3,500	1,400	40.0%	2,3

SUBTOTAL CONSTRUCTION COSTS		$324,000	
SUBTOTAL CONTINGENCIES	38.9%		$126,000
TOTAL 06. FISH AND WILDLIFE FACILITIES			$450,000

REASONS FOR CONTINGENCIES:

1. NOT APPLICABLE
2. UNKNOWN QUANTITIES
3. UNKNOWN UNIT PRICES

NOTES:

A. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
30.-.-.-	PLANNING, ENGINEERING AND DESIGN							
30.H.-.-	PLANS AND SPECIFICATIONS	JOB	1	69,757.20	69,800	17,500	25.0%	2
30.J.-.-	ENGINEERING DURING CONSTRUCTION	JOB	1	20,282.40	20,300	5,100	25.0%	2
	SUBTOTAL P.E.D COSTS				$90,100			
	SUBTOTAL CONTINGENCIES		25.1%			$22,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$112,700		

REASONS FOR CONTINGENCIES

1. NOT APPLICABLE
2. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN COMPUTED AS SAME % OF CONSTRUCTION COSTS AS A3-MEI.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
31.-.-.-	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	32400.00	32,400	8,100	25.0%	1
	SUBTOTAL S&I COSTS				$32,400			
	SUBTOTAL CONTINGENCIES		25.0%			$8,100		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$40,500		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 10% OF CONSTRUCTION COSTS

PETERSON LAKE H.R.E.P. - ALTERNATIVE A3-MEI **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: PETERSON LAKE H.R.E.P. - ALTERNATIVE A3-MEI PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-C

LOCATION: MISSISSIPPI RIVER AT LOCK AND DAM NUMBER 4

DATE PREPARED: 14 FEBRUARY 1994 REVIEWED AND APPROVED BY: W. MICHAEL OSTERBY, ACTING CHIEF, PE-C

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/94 %	OMB INFLATION TO 10/94 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	511,000	201,000	39%	712,000	1.80%	725,000	JULY 95	2.900%	535,000	211,000	746,000
	TOTAL CONSTRUCTION COSTS =====>	511,000	201,000	39%	712,000		725,000			535,000	211,000	746,000
30---	PLANNING, ENGINEERING AND DESIGN	142,000	21,000	15%	163,000	2.90%	168,000	MARCH 95	2.300%	149,000	22,000	171,000
31---	CONSTRUCTION MANAGEMENT	51,000	13,000	25%	64,000	2.90%	66,000	JULY 95	3.900%	55,000	14,000	69,000
	TOTAL PROJECT COSTS ======>	704,000	235,000		939,000		959,000			739,000	247,000	986,000

NOTES:

1. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	PERCENT	REASON
ALTERNATIVE A3-MEI								
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.-.-	WILDLIFE FACILITIES/SANCTUARIES							
06.3.A.-	MOB., DEMOB. AND PREP. WORK							
06.3.A.1	MOB/DEMOB	JOB	1	25589.00	25,600	6,400	25.0%	2,3
06.3.A.2	ACCESS DREDGING	CY	8,000	5.63	45,000	18,000	40.0%	2,3
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	RIPRAP	CY	12,400	31.67	392,700	157,100	40.0%	2,3
06.3.3.B	CHANNEL EXCAVATION	CY	7,000	5.63	39,400	15,800	40.0%	2,3
06.3.3.B	FINES	CY	425	11.26	4,800	1,900	40.0%	2,3
06.3.3.B	SEEDING	SF	58,760	0.06	3,500	1,400	40.0%	2,3
	SUBTOTAL CONSTRUCTION COSTS				$511,000			
	SUBTOTAL CONTINGENCIES		39.3%			$201,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$712,000		

REASONS FOR CONTINGENCIES:

1. NOT APPLICABLE
2. UNKNOWN QUANTITIES
3. UNKNOWN UNIT PRICES

NOTES:

A. UNIT PRICES ARE AT FEBRUARY 1994 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
30.-.-.-	PLANNING, ENGINEERING AND DESIGN							
30.H.-.-	PLANS AND SPECIFICATIONS	JOB	1	110,000	110,000	16,500	15.0%	2
30.J.-.-	ENGINEERING DURING CONSTRUCTION	JOB	1	32,000	32,000	4,800	15.0%	2
	SUBTOTAL P.E.D COSTS				$142,000			
	SUBTOTAL CONTINGENCIES		15.0%			$21,300		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$163,300		

REASONS FOR CONTINGENCIES

1. NOT APPLICABLE
2. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED BY FUNCTIONAL SECTIONS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
31.-.-.-	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	51,100	51,100	12,800	25.0%	1
	SUBTOTAL S&I COSTS				$51,100			
	SUBTOTAL CONTINGENCIES		25.0%			$12,800		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$63,900		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 10% OF CONSTRUCTION COSTS

ATTACHMENT 3

SECTION 404 (B) (1) EVALUATION

SECTION 404(b)(1) EVALUATION
DESIGN MODIFICATIONS FOR THE PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 4, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

I. PROJECT DESCRIPTION

A. LOCATION

The proposed project is located in Pool 4 of the Upper Mississippi River between river mile 753.0 and river mile 754.8. It is adjacent to the main channel of the river on the Minnesota or right descending side.

B. GENERAL DESCRIPTION

A large number of alternatives were evaluated. A combination of them was selected as the proposed plan. The project includes the construction of a winter fish refuge through the full, or partial closure, of nine openings between the islands. Some access dredging would be required for this alternative. Channels would be excavated within the lake, at two locations, to improve the passage of fish through shallow areas under ice cover conditions(A3). Six islands would be stabilized with riprap to prevent their erosion and to keep sediment laden flows out of the lake(MEI).

C. AUTHORITY AND PURPOSE

The authority for the project is Section 1103 of the Water Resources Development Act of 1986.

The purpose of the project is provide winter habitat for fish and to preserve the habitat provided by 40 acres of islands along the edge of the lake. This in turn would improve habitat conditions for the variety of fish and waterfowl species that inhabit or migrate through this portion of the Upper Mississippi River.

D. GENERAL DESCRIPTION OF DREDGED/FILL MATERIAL

1. General Characteristics of the Material - The partial and total closures would be constructed of rock, over a sand core. Island protection would be riprap over geotextile fabric. Two islands (5 and 6)would be restored with sand from the excavation of fisheries channels within the lake.

2. Quantity of Material - Construction of the partial and total closures, and the riprap protection would require 12,410 cubic yards (c.y.) of rock. Approximately 8,000 cubic yards of material would be dredged for construction access and

placement of closure structures. Approximately 7000 yards of sand would be excavated from the fish channels. Approximately 425 cubic yards of fine material would be placed atop some of the closures for revegetation purposes.

3. Source of the Material - The rock for island construction will come from a local operating quarry. The sand would come from the dredging of a construction access channel, from the fish channels, and from miscellaneous excavation required for rock placement. The fine material would be dredged from Peterson Lake.

E. DESCRIPTION OF THE PROPOSED DISCHARGE SITE

1. Location - The proposed discharge site is a 500 acre backwater of the Upper Mississippi River, between river miles 753.0 to 754.8, immediately upstream of the dike of Lock and Dam Number 4. The partial and total closures would block the passage of flow from the main channel into the lake through nine openings between islands. Eroding islands would be protected from further degradation by riprap on the river side and by restoration with sand excavated within Peterson Lake.

2. Size - The closure structures would cover approximately 1.70 acres. The riprap protection would cover approximately 1.75 acres of river bottom.

3. Type of Site - The proposed discharge sites are shallow areas between islands with water depths in the range of 1 to 5 feet, the shores of islands, and shallow open water with a depth of 1-3 feet.

4. Types of Habitat - The habitat at the project site includes shallow sand-bottomed channels between islands, the shores of eroding islands, and shallow open water. The project area currently provides moderate value habitat for fish and waterfowl. The habitat value of the area is in decline because of sedimentation from the main channel. Also, the area provides no winter fish habitat because of high winter flows and low temperatures.

5. Timing and Duration - The construction contract would be awarded in April 1995 and construction would be completed by November 1995.

F. DESCRIPTION OF DISPOSAL METHOD

The rock obtained from quarries would be transported by barges, and placed at the island site by mechanical equipment. Dredging of fine material for construction access would be done mechanically, placed into barges, hauled to the placement site, and unloaded mechanically. Use of hydraulic dredging equipment is unlikely due to the small volume of material required.

II. FACTUAL DETERMINATIONS

A. PHYSICAL SUBSTRATE DETERMINATIONS

The substrate at the proposed discharge site is sand or silty sand. Construction of the closure structures and dikes will cover 3.45 acres of this substrate.

B. WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS

1. Water

a. Salinity - Not applicable.

b. Water Chemistry - The proposed discharge activities should have no impact on water chemistry.

c. Clarity - During construction there may be localized short term reductions in water clarity due to turbidity. Over the long term water clarity in the area protected by the structures should show some improvement.

d. Color - The proposed discharge activities should have no impact on water color.

e. Odor - The proposed discharge activities should have no impact on water odor.

f. Taste - The proposed discharge activities should have no impact on water taste.

g. Dissolved Gas Levels - The proposed discharge activities should have no impact on dissolved gas levels.

h. Nutrients - The proposed discharge activities should have no impact on nutrient levels.

i. Eutrophication -The proposed discharge activities should have no impact on eutrophication.

j. Temperature - The proposed discharge activities should raise winter water temperatures in the upper end of the lake to provide a winter refuge for fish.

2. Current Patterns and Circulation

a. Current Patterns and Flow - The proposed project will alter current patterns and reduce water flows though the project area. This is one of the purposes of the project and is expected to have a beneficial effect on the project area. No adverse effects on adjacent areas is expected because of the large dispersal area for the deflected flows.

b. Velocity - Current velocities over much of the protected area should be reduced. No adverse effects on adjacent areas is expected because of the large dispersal area for the deflected flows.

c. Stratification - The proposed discharge activities are intended to raise winter water temperatures in the upper end of the lake to 3-4 degrees Centigrade.

d. Hydrologic Regime - The proposed discharge activities should have no impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed discharge activities should have no impact on normal water level fluctuations.

4. Salinity Gradients - Not applicable.

C. SUSPENDED PARTICULATE/TURBIDITY DETERMINATION

The placement of the rock for the closures, riprap, and dikes would result in negligible increases in turbidity during construction.

D. CONTAMINANT DETERMINATION

No appreciable release of chemical contaminants is expected from the proposed action. The substrate is primarily sand. Excavation would be minimal and the material would be used in the immediate area to construct the core of closure structures or rebuild islands.

The rock for the islands will come from a quarry and should be free of contaminants. There would be no contaminant effects associated with the placement of the rock to construct the closure structures, erosion protection, and dikes.

E. AQUATIC ECOSYSTEM AND ORGANISM DETERMINATION

The would be an absolute loss of about 3.45 acres of aquatic habitat due to conversion to closures structures and dikes. The benthos in these areas would be covered and lost but the sandy substrate provides only minimal benthic habitat. Rock would provide solid substrate and increase benthic habitat diversity.

While the project will result in a quantitative loss of aquatic habitat, the overall purpose is improve the habitat quality of the remaining aquatic habitat in the project area. The project should result in a substantial improvement in aquatic habitat quality.

F. PROPOSED DISPOSAL SITE DETERMINATION

1. Mixing Zone Determination - Because the area of impact is expected to be very small and limited to the immediate area of construction, no mixing zone was calculated.

2. Determination of Compliance with Applicable Water Quality Standards -It is expected that the proposed action will comply with state water quality standards. Water quality certification will be obtained from the state of Minnesota and any conditions imposed to minimize adverse effects will be complied with.

3. Potential Effects on Human Use Characteristics - The proposed action is not expected to have any adverse effect on human use of the project area. There will be beneficial effects in terms of increased use of the area for recreational fishing.

G. DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

The proposed project would result in the conversion of approximately 3.45 acres of aquatic habitat to improve the habitat quality of approximately 460 acres of fish and wildlife habitat and provide a winter fish refuge. The net effects of this project would be positive and would not contribute to cumulative effects on the aquatic ecosystem.

H. DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

The proposed project is not expected to have any adverse secondary effects on the aquatic ecosystem.

III. FINDINGS OF COMPLIANCE

The proposed discharge of dredged material would comply with the Section 404(b)(1) guidelines of the Clean Water Act. There are no alternatives to the proposed project that would accomplish the project purpose without involving the discharge of dredged and fill material. The project has been designed to minimize any adverse effects of the placement of dredged and fill material while maximizing aquatic habitat benefits.

The proposed discharge of dredged material would comply with all State of Minnesota water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. A Section 401 Water Quality Certificate has been received from the State of Minnesota for this project. The proposed action would have no adverse impacts on human health or welfare. On the basis of this evaluation, therefore, I specify that the proposed action complies with the requirements of the guidelines for discharge of dredged material.

16 Mar 94
Date

for C.B.W. Rogers MAJ, EN
James T. Scott
Colonel, Corps of Engineers
District Engineer

ATTACHMENT 4

HABITAT EVALUATION PROCEDURES APPENDIX

HABITAT EVALUATION APPENDIX

INTRODUCTION

The purpose of this analysis is to determine the existing habitat values of Peterson Lake and to predict how they will change in the future with the construction of the proposed project.

GENERAL HABITAT GOALS FOR PETERSON LAKE

* Maintain Peterson Lake as a productive backwater resource.

* Optimize habitat conditions for migratory waterfowl, especially migration, feeding, and resting habitat.

* Optimize habitat conditions for fish species typical of Upper Mississippi River backwater habitats; e.g. largemouth bass, northern pike, bluegill, crappie, and associated species.

SPECIFIC OBJECTIVES OF THE PETERSON LAKE PROJECT

A. Reduce sedimentation in Peterson Lake as much as practicable.

B. Maintain the 40 acres of existing islands in the barrier chain separating Peterson Lake from the Mississippi River.

C. Maintain submergent aquatic plant growth as it generally existed in 1991, recognizing the annual variations that will occur in any natural system. The parameters defining the 1991 conditions are:

1) Submergent aquatic plant growth extending to water depths of 5 feet.
2) Mean summer (Jun-Sept) turbidity levels of less than 15 NTU.

D. Create a winter fish refuge in the upper portion of Peterson Lake. The following conditions should be achieved in this portion of the lake.

1) Winter dissolved oxygen levels of $\geq$ 5 mg/l/

2) Winter current velocities to $\leq$ 1 cm/sec (0.03 ft/sec)

3) Winter water temperatures $\geq 1^0$ Centigrade

E. Increase emergent plant growth in the lake by approximately 10 acres.

EXISTING CONDITIONS

Peterson Lake is a triangular shaped 500 acre backwater of the Mississippi River (Figure 24 of the main report). It is located at the lower end of Pool 4 on the Minnesota side. Peterson Lake is bounded by islands which separate it from the main channel on the east, by the dike of Lock and Dam 4 which forms the south boundary of the lake, and by the Minnesota shore on the west.

The lake has good substrate and water quality, satisfactory temperature (summer), minimal water level fluctuation, and low sedimentation rates. The lake has limited amounts of emergent vegetation but contains 12 species of submerged aquatic vegetation including plants with high value to waterfowl such as wild celery and sago pondweed, other pondweeds, Eurasian watermilfoil, coontail and Canada waterweed.

The barrier island chain defines Peterson Lake and is important in maintaining aquatic vegetation by providing some protection from wind and wave action and by controlling flow and associated sand sediment inputs to Peterson Lake. The islands also provide high quality habitat for aquatic furbearers, wading birds, and other wildlife. Mature trees on the islands are utilized by bald eagles during migration and the open water portion of winter.

Peterson Lake provides good open water season habitat for a diverse mix of backwater fish species. Thirty-three species of fish have been found in Peterson Lake. Major game fish species which utilize Peterson Lake for spawning, rearing, and dwelling include: bluegill, largemouth and smallmouth bass, channel and flathead catfish, black and white crappie, yellow perch, northern pike, walleye and sauger. Forage species present in the lake include shiners, and "rough" species like gar, bowfin, carp, and suckers. The islands also provide structure for fish using the side channel adjacent to the lake.

Peterson Lake is accessible to all fish species present in the Mississippi River. There is excellent spawning habitat for northern pike in flooded riparian vegetation in the spring. Excellent spawning habitat for bluegill, channel and flathead catfish and largemouth bass is provided by scattered submerged stumps on the eastern side of the lake. The aquatic vegetation that is present provides good nursery and rearing habitat for juvenile fishes.

Peterson Lake has minimal winter habitat for many fish species because of the large volume of water flowing through the lake. Winter current velocities are high and water temperatures approach $0^{o}C$. Fish require water temperatures greater than $1^{o}C$. Fish metabolic rates are low when water temperatures are low, and the fish are not able to maintain position in strong currents.

PROPOSED PLAN

An array of alternatives were evaluated in the course of study for this project. During the study process, some alternatives were eliminated as unsuitable for engineering, environmental, or economic reasons. The remaining alternatives were evaluated in detail to determine how they would contribute to project and program objectives.

The alternatives that were studied in detail were designated A3, MEI and the combination, A3-MEI. A3 is an alternative to reduce sedimentation and to provide a winter fish refuge through the construction of total and partial closures in channel openings at the upstream end of the lake, and construction of rock weirs in two central openings. MEI (maintain existing islands) is an alternative to preserve the existing islands that separate Peterson Lake from the main channel by armoring them with riprap on the river side. A3-MEI is a combination of the two (Figure 24 of the main report).

ANALYSIS

The U.S. Fish and Wildlife Service Habitat Suitability Index (HSI) Model for Bluegill was used to evaluate the partial closure alternatives proposed for Peterson Lake. It was selected because a modification for winter conditions for Upper Mississippi River backwater habitats was available. This modification was prepared by Gary Palesh and Dennis Anderson of the St. Paul District, Corps of Engineers in cooperation with Federal and State fishery biologists.

The HSI model consists of a set of variables (Table 1). Since the model may be used in lacustrine or riverine settings, not all of the variables may apply. Values are assigned to these variables and calculations are done with a set of equations (Table 2) to determine the contribution of these variables to several categories (Food, Cover, Water Quality, Reproduction, Other) that determine the habitat suitability of the area. Several assumptions were made to assign values to the variables of the bluegill model. Summer fish habitat in Peterson Lake is very good, so most of the model variables are already at, or near, optimum.

Only two summer habitat variable were at less than optimum. V20, spawning habitat, would not be affected by the project and would remain at 0.7. The V3 variable, percent vegetative cover, was assigned a value which would be expected to diminish over time. With the A3 alternative, it was expected that there would be a definite, but not substantial, improvement in vegetative cover.

The habitat variables that would be affected by the proposed project would include those that predict winter values. At present, there is minimal winter fish habitat in Peterson Lake because areas of satisfactory depth have low temperatures and substantial flows. Because of flows and low temperatures, dissolved oxygen is not, nor would become, limiting. Therefore the variables VA, for depth, and VB, for dissolved oxygen, were set at optimum for with or without project conditions. Variables VC, temperature, and VD, current velocity, were set at 0.2 and 0.1, respectively for without project conditions. The partial closure of openings in the upper end of the lake would provide a reduction in current flow and an elevation in temperature. This would provide near-optimum winter fish habitat in that part of the upper lake which is deeper than the maximum ice thickness. Therefore, for with project conditions, the values for VC and VD were set at optimum (1.0). It was estimated that this would affect about 100 acres. The model showed that, with alternative A3, there would be a gain of about five habitat units in summer and 58 overall. The MEI alternative would not provide any winter fish habitat improvement.

The values for variables and outputs of the bluegill model are shown in Table 3.

Table 1-HSI MODEL VARIABLES

SUMMER

V1 Percent Pool Area

V2 Percent Cover(e.g. logs, brush, and debris) within pools or littoral areas during summer.

V3 Percent Cover (aquatic vegetation, submersed dense strands, finely divided leaves)

V4 Percent littoral area during summer stratification

V5 Average TDS level during the growing season

V6 Maximum monthly average turbidity during average summer flow or summer stratification

V7 pH range during the growing season

V8 Minimum dissolved oxygen level during the summer

V9 Maximum monthly average salinity during the growing season

V10 Maximum midsummer temperature within pools or littoral areas (adult)

V11 Average of mean weekly water temperature within pools or littoral areas (embryo)

V12 Maximum early summer temperature within pools or littoral areas (fry)

V13 Maximum midsummer temperature within pools or littoral areas (juveniles)

V14 Average current velocity in pools and backwater areas during the growing season (adult)

V15 Average current velocity in spawning areas (embryo)

V16 Average current velocities in pools and backwater areas during early summer (fry)

V17 Average current velocities in pools and backwater areas during early summer (juvenile)

V18 Stream gradient within the representative reach

V19 Reservoir drawdown during spawning

V20 Substrate composition within pools or littoral areas during spawning

WINTER

Va Backwater water depths

Vb Winter Dissolved oxygen

Vc Winter Water Temperature

Vd Current Velocity

Table 2. Equations

RIVERINE MODEL

Food $C_F=(V_1 x V_2 x V_3)^{1/3}$

Cover $C_C=\frac{V_2+V_3}{2}$

Water Quality $C_{WQ}=\frac{V_6+V_7+2V_8+V_9+2[(V_{10}xV_{12}xV_{13})^{1/3}]}{7}$

If V_8 or $(V_{10}xV_{12}xV_{13})^{1/3} \leq 0.4$, C_{WQ} equals the lowest of the following: V_8, $V_{10}xV_{12}xV_{13})^{1/3}$, or the above equation. Note: V_9 may be dropped and the denominator changed to 6 if salinity is not considered to be a problem or potential problem in the study area.

Reproduction $C_R=(V_{11}xV_{15}xV_{20})^{1/3}$

Other $C_{OT}=\frac{\frac{V_{14}+V_{16}+V_{17}}{3}+V_{18}}{2}$

HSI Determination If all component ratings > 0.4,

$$HSI=(C_F x C_C x C_{WQ}^2 x C_R x C_{OT})^{1/6}$$

LACUSTRINE MODEL

Food $C_F=(V_2 x V_3 x V_5 x V_7)^{1/4}$

Cover $C_C=(V_2 x V_3 x V_4^2)^{1/4}$

Water Quality $C_{WQ}=\frac{V_6+V_7+2V_8+V_9+2[(V_{10}xV_{12}xV_{13})^{1/3}]}{7}$

If V_8 or $(V_{10}xV_{12}xV_{13})^{1/3} \leq 0.4$, C_{WQ} equals the lowest of the following: V_8, $V_{10}xV_{12}xV_{13})^{1/3}$, or the above equation. Note: V_9 may be dropped and the denominator changed to 6 if salinity is not considered to be a problem or potential problem in the study area.

Reproduction $C_R=(V_{11}xV_{19}xV_{20})^{1/3}$

Note: If the lacustrine environment is a natural lake or pond, V_{19} will not be applicable. Thus,

$C_R=(V_{11}xV_{20})^{1/2}$ in a natural lake or pond

HSI Determination If all component ratings > 0.4,

$$HSI=(C_F x C_C x C_{WQ}^2 x C_R)^{1/5}$$

If C_{WQ} or $C_R \leq 0.4$, use lowest component ratings as the species HSI.

WINTER MODEL

Winter Cover

$C_{W-C}=V_a$

Winter Water Quality

$$C_{W-WQ}=\frac{(2V_b+V_c)}{3}$$

If V_b or $V_c \leq 0.4$, C_{W-WQ} equals the lowest of these variables.

Winter Other

$C_{W-OT}=V_d$

HSI Determination

Winter HSI=$(C_{W-C} x C_{W-WQ}^2 x C_{W-OT})^{1/4}$

Note: if C_{W-WQ} is ≤ 0.4, use this value as the winter HSI.

OVERALL HSI

1. In isolated areas the lowest quality habitat would be the limiting factor. Thus,

Overall HSI=the lowest of the summer or winter HSI

2. Backwater habitat is well connected to other suitable habitat and does not have to provide both summer and winter habitat. Thus,

Composite HSI=(summer HSI x winter HSI)$^{1/2}$

TABLE 3

PETERSON LAKE EMP-PLACEMENT OF CHANNEL CLOSURE STRUCTURES

ALTERNATIVE EVALUATION (460 Acres)

	FUTURE WITHOUT PROJECT			FUTURE WITH PROJECT		
Variable	YR 1	YR 25	YR 50	YR 1	YR 25	YR 50
V3%Cover	1.00	0.60	0.30	1.00	0.80	0.60
V4Depth	1.00	0.60	0.10	1.00	0.90	0.60
V5TDS	1.00	1.00	1.00	1.00	1.00	1.00
V6Turbidity	1.00	1.00	1.00	1.00	1.00	1.00
V7 pH	1.00	1.00	1.00	1.00	1.00	1.00
V8 DO	1.00	1.00	1.00	1.00	1.00	1.00
V10TempA	1.00	1.00	1.00	1.00	1.00	1.00
V11TempS	1.00	1.00	1.00	1.00	1.00	1.00
V12TempF	1.00	1.00	1.00	1.00	1.00	1.00
V13TempJ	1.00	1.00	1.00	1.00	1.00	1.00
V14CurVelA	1.00	1.00	1.00	1.00	1.00	1.00
V15CurVelS	1.00	1.00	1.00	1.00	1.00	1.00
V16CurVelF	1.00	1.00	1.00	1.00	1.00	1.00
V17CurVelJ	1.00	1.00	1.00	1.00	1.00	1.00
V18Gradient	1.00	1.00	1.00	1.00	1.00	1.00
V20SpawSubs	1.00	1.00	1.00	1.00	1.00	1.00
(TEMP CALC)	1.00	1.00	1.00	1.00	1.00	1.00
(WQ CALC)	1.00	1.00	1.00	1.00	1.00	1.00
(MIN VAL)	1.00	1.00	1.00	1.00	1.00	1.00
C-F	1.00	0.84	0.67	1.00	0.93	0.84
C-C	1.00	0.60	0.14	1.00	0.87	0.60
C-WQ	1.00	1.00	1.00	1.00	1.00	1.00
C-R	1.00	1.00	1.00	1.00	1.00	1.00
C-OT	1.00	1.00	1.00	1.00	1.00	1.00
S-HSI	1.00	0.89	0.68	1.00	0.96	0.89
VA Depth	1.00	0.40	0.40	0.70	0.70	0.70
VB DO	1.00	1.00	1.00	1.00	1.00	1.00
VC Temp	0.25	0.25	0.25	0.50	0.50	0.50
VD CurVel	0.10	0.10	0.10	0.70	0.70	0.70
(WQ CALC)	0.75	0.75	0.75	0.83	0.83	0.83
(MIN VAL)	0.25	0.25	0.25	0.50	0.50	0.50
W-C	1.00	0.40	0.40	0.70	0.70	0.70
W-WQ	0.25	0.25	0.25	0.83	0.83	0.83
W-OT	0.10	0.10	0.10	0.70	0.70	0.70
W-HSI	0.25	0.25	0.25	0.76	0.76	0.76
HSI	0.50	0.47	0.41	0.87	0.86	0.83
HU		5591	5082		9959	9682
TOTAL HU			10674			19641
(AAHU CALC)			213.48			392.83
AAHU			213			393
AAHU GAIN						180

The barrier islands of Peterson Lake define the lake, directly provide fish and wildlife habitat, limit the deposition of sediment carried by the river and contribute to the habitat diversity in lower Pool 4.

It was not possible to quantify the benefits of the Maintaining Existing Islands (MEI) alternative with the bluegill model that was used to evaluate the closure structure alternatives. Most of the variables which describe conditions in Peterson Lake are near optimum for summer conditions and are not sensitive enough to register the changes caused by the protection of islands and reduction of sedimentation. In any case, no individual species model would adequately describe conditions for all the species affected by protection of the barrier islands.

It would be most appropriate to evaluate the effects of island stabilization with a community-based model since no individual species model would adequately evaluate the all the effects of the loss of islands. However, there were no suitable community-based models available during the period of this analysis. The scope of this feature was not considered sufficient to warrant expenditure of the time and cost that the development of such a model would require.

In order to determine the habitat benefits resulting from implementation of the MEI alternative, the study team biologists conducted an analysis based on professional experience and education. For the area influenced by the islands (175 acres), the team developed a consensus that the habitat suitability index at the present time would be approximately 0.7. This conclusion was based on several factors. One was that there were considerable islands within close proximity in a part of the pool where islands are otherwise scarce. Also, several of the islands are large enough to support mature trees and underbrush. As such, they provide habitat for a wide variety of species including deer, owls, bald eagles, furbearers, and wading birds among others. The islands limit sediment-laden flows entering the lake from the main channel and help to protect the substantial mussel beds along the upstream side of the Lock and Dam 4 dike. The islands provide protection from wind and wave action, which encourages the growth of aquatic vegetation. The vegetation beds provide spawning, incubation, and rearing habitat for fish and feeding and brood habitat for waterfowl. The islands provide areas of refuge from high current velocity for fish during periods of high flow in the river.

As the islands erode, greater volumes of river water enter the lake and deposit their sediment loads. Without the project, the professional consensus was that there would be a fairly substantial degree of degradation of habitat that would result from the continual sedimentation from eroding islands and main channel sediment loading. The loss of the islands would also result in reduced habitat diversity in lower Pool 4. Based on these factors, the study team estimated that the future condition of Peterson Lake with no project would be, at most, a habitat suitability index of 0.4 by the end of a 50-year planning period.

The geotechnical analysis indicated that the rate of sedimentation with the project in place would be decreased by about 50 percent. Therefore, it was estimated that, over the fifty year life of the project, the reduction in sedimentation would result in a fifty percent decrease in the rate of aquatic habitat degradation in the lower Peterson Lake, when compared to the without project condition. In addition, stabilization of the islands would ensure the continued presence of the existing terrestrial habitat, thus maintaining the habitat diversity that currently exists in lower Pool 4. Based on these factors, the study team estimated that the habitat quality in the evaluation area with the project would decrease to an HSI of 0.6. Applying this to the area influenced by the island protection (175 acres) would result in a value for average annual habitat units of 105. The difference between the future with no project and the future with the project in place would be 17 AAHU's. The habitat unit gain with the MEI feature is summarized in Table 4.

Table 4. Habitat Unit Calculation for the MEI Feature.

	TARGET YEARS (ACRES=175)			AVERAGE ANNUAL HABITAT UNITS (AAHU'S)
	TY 0	TY 1	TY 50	
Future Without Project	0.7	0.7	0.4	97
Future With Project	0.7	0.7	0.6	114
			AAHU GAIN	17

BIBLIOGRAPHY

Minnesota DNR. 1987. Mississippi River Survey, Peterson Lake-River Mile 754.0 Pool 4 - Wabasha County, Minnesota. 19 pp.

Palesh, Gary and Dennis Anderson. 1990. Modification of the Habitat Suitability Model for the Bluegill (*Lepomis machrochirus*) for Winter conditions for Upper Mississippi River Backwater Habitats. U.S. Army Engineer District, St. Paul.

Stuber, R.J., and G. Gebhart, and O.E. Maughan. 1982. Habitat Suitability index models: Bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8. 26 pp.

ATTACHMENT 5

HYDRAULICS APPENDIX

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-3)

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 4, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

HYDRAULIC DESIGN APPENDIX

September 28, 1993

Mark W. Rodney, P.E.
St. Paul District Corps of Engineers
190 East Fifth Street
St. Paul, Minnesota 55101

HYDRAULIC DESIGN/SEDIMENT TRANSPORT ANALYSIS

GENERAL

1. A general description of the Pool 4 region, including Peterson Lake and the surrounding area, is given in the main report. Also given in the main report is a detailed discussion of all alternatives considered, and the criteria used to eliminate alternatives from further consideration. Of all the alternatives considered, these have been retained: No Action; Maintain Existing Islands (MEI) using rock protection; Alternative A3B2 - closures of the upper and central openings into Peterson Lake (designated as openings 8 through 11 and 1 through 7, respectively, in Figure 4 of the main report) with flow control structures to provide passive control of flow into Peterson Lake; and Alternative A3 - closure of only the upper openings into Peterson Lake with a flow control structure to provide passive control of flow into Peterson Lake. In addition, the MEI Alternative was considered in conjuction with each of the structural alternatives; these combinations were designated as A3B2-MEI and A3-MEI. This Appendix deals mainly with the hydraulic analysis of the two structural alternatives, A3B2 and A3, which have been retained, and with the rock protection for the existing islands in conjunction with these alternatives. Plan views of Alternatives A3B2-MEI and A3-MEI are given in Plates 5-1 and 5-2, respectively. Discussions of these alternatives and related subjects are given in the following paragraphs.

DISCUSSION OF STRUCTURAL ALTERNATIVES

2. Alternative A3B2 - For this alternative, 3 design options were considered. These are:

Option 1 - Long, shallow sill for summer flow (about .1-.2 foot depth) through upper and central openings, with culvert through sill embankment through upper openings only for winter flow. This is essentially the design given in the Problem Appraisal Report (PAR) for the Peterson Lake HREP (Reference 1), changed to account for a re-evaluation of hydraulic conditions in Peterson Lake and changes in the desired management practices of the U.S. Fish and Wildlife Service (FWS). The sills are sized to allow for an average flow of about 50 cfs through the upper openings, including the culvert, in summer, and about 200 cfs through the central openings in summer, and about 5 and 45 cfs average flow through the upper and central openings, respectively, in winter, assuming at least a partial winter freezeover. Design details for this and all options relating to Alternative A3B2 are given in Table 5-1. Flows for all designs and options were calculated by Manning's Equation, using the "n" values given in Tables 5-1 and 5-2. Manning's "n" was selected using criteria given by Chow (Reference 2). Water surface slopes are based on the head differential across the structures and the length of the structures. Option 1 has significant maintenance and constructability problems. The shallow sills can be expected to accumulate debris. This will generally need to be removed manually. Some might be flushed out during high water events, but the site is close to Lock and Dam 4 and water surface fluctuations will be minimized, reducing debris flushing potential. More basically, in order to function as designed, the construction of the sills would need to be very precise - more precise than is possible with rock. Post-project settling of the rock might also change characteristics. And even if the sill could be constructed with sufficient precision, there is no certainty that ice of sufficient thickness will form in winter. There are also potentially serious maintenance problems with culverts. Debris could partially or totally block a culvert, and removal would be difficult due to limited access to the culverts. There is also the possibility of partial blockage of culverts should there be a serious zebra mussel infestation in Pool 4. The combination of these potential maintenance and constructability problems make this the least desirable of the three options being considered here.

Option 2 - Long, shallow sill for summer flow (about .1-.2 foot depth) through upper and central openings, with shallow notch (less than 1 foot depth) through sills for winter flow. Design details are given in Table 5-1. This option replaces the submerged culvert of Option 1 with an open notch through the upper sill and a similar open notch through the central sill. The design flows for this option are the same as for Option 1. This concept presumes that the sills will at least partially freeze over in winter, as for Option 1, but that flow through the notches will be fast enough to keep them open. Except that the potential adverse impact of zebra mussels is reduced because of the replacement of submerged culverts by open notches, this option presents the same maintenance and constructability problems as Option 1.

Option 3 - Single large notch through otherwise complete closure of both upper and central openings. Design details are given in Table 5-1. This option would go a long way toward solving the maintenance and constructability concerns of Options 1 and 2. Since design does not rely on shallow flow during low flow conditions, clearing away debris is not a concern unless a very large amount of debris were to block the notch. A large notch would require less construction precision, and there would be a further reduction in debris problems with increasing notch size; 30-foot wide notches at similar projects are known to have virtually no debris problems. Zebra mussels would take up a much smaller percentage of the opening area if there were a serious infestation. However, using this option as part of Alternative A3B2 would limit the effectiveness of this alternative in achieving fish and waterfowl management goals for several reasons. There would be much less flow control, particularly when compared to Option 1 and with respect to winter vs. summer. There is, in all cases, the good chance that significant ice formation will not occur across the openings, as is the the case with similar openings into Weaver Bottoms, approximately 9 miles downriver. Even with ice formation, there would be much more winter flow than desired because of the larger openings and because the head across the openings would be governed by the difference in river elevation between the openings and the Peterson Lake outlet just above Lock and Dam 4. This elevation difference will typically generate a head across the upper opening of .07-.18 foot in winter and .1-.3 foot in summer, with only slightly smaller values across the central opening, assuming that Peterson Lake is essentially flat between the openings and the downstream outlet. This casts doubt on the desirability of this option as part of Alternative A3B2, and, along with the problems with the other options, on the desirability of Alternative A3B2 itself.

3. Alternative A3 - Three design options, analogous to those considered for Alternative A3B2, were considered, the difference being that no closures for the central openings were considered. Option 1 consists of a long, shallow sill for summer flow and a culvert for winter flow. Option 2 consists of a long, shallow sill for summer flow with a notch through the sill for winter flow. These features would have the same design criteria and dimensions as for their counterparts in Alternative A3B2. They would also have the same problems with respect to maintenance, constructability, and possibly zebra mussels. Option 3 consists of a single large opening through an otherwise complete closure of the upper openings. Design details for this option are given in Table 5-2. All flows were calcuated by Manning's Equation as for Alternative A3B2. This option comes closest to achieving the specific FWS fishery management goals for the upper part of Peterson Lake while still providing a reasonably constructable structure with minimal maintenanace that will be minimally impacted by zebra mussels. There are several reasons why this is so. With this alternative, the central openings will be open, so that the head across the upper opening will be governed more by the difference in river elevation between the upper and central openings, rather than that between the upper opening and the outlet, resulting in lower flows through the upper opening. This should reduce winter flows at the upstream end to levels approaching those desired, particularly if ice forms across the opening, while leaving an opening large enough to provide the desired summer flows. By comparison with flow measurements taken in the field through the upper openings for selected low flow conditions (Table 5-3), it would appear that even the largest notch sizes being considered can be expected to generate significant flow reductions through the upstream end. As with Option 3 in Alternative A3B2, debris problems will be reduced. Also, there would appear to be relatively little water management advantage to be gained by partial closures at the central openings because of the large range of flows predicted through the various sizes of openings listed in Table 5-1, and also because these flow ranges are not much different than those measured in the field at

the central openings for selected low flow conditions (Table 5-3). In February, 1993, a dye study was performed to estimate flow patterns between the central openings and the outlet. This study showed that flow through the central openings generally is directed straight toward the outlet, rather than out into the lake. This indicates that, even with no closure of the central openings, there will be significant flow velocity reductions over the larger part of Peterson lake, with accompanying fish habitat enhancement. For these reasons, Option 3 of Alternative A3 is considered the best structural alternative from a hydraulics standpoint.

OTHER CONSIDERATIONS

4. Sedimentation - One of the stated Specific Project Objectives is to "reduce sediment inputs to Peterson Lake" (page 26 of the Main Report). Deposition patterns in Peterson Lake could be explained as follows. Sediment input through secondary channels is creating the large deposition zone (delta) along the islands bordering the east side of the lake (Figure 17, main report). This deposition zone extends down to site 9, with two of the largest deltas existing at sites 8 and 9. In addition, sediment entering sites 1 through 5 (which convey 65-percent of the water entering the lake) is transported to the deep part of the lake. This explanation is based on flow patterns (flow conveyed at sites 7,8,9... is deflected toward the outlet and never reaches the deep part of the lake) and deposition patterns (there is a large region of erosion between the two primary deposition zones. Deposition in the deltas is sand. Deposition in the deep part of lake certainly consists of finer material, but there could be some coarse material here also especially closer to the upstream end of the lake.

5. Due to limitations in the bathymetric data and in sediment transport data it is difficult to quantify the sediment transport regime in Peterson Lake, however it is possible to partially quantify the relative effects of the project on future sedimentation conditions. An analysis has been done of existing and proposed conditions in Peterson Lake. This analysis was based on criteria given in Corps of Engineers EM 1110-2-4000 and USGS Water Resources Investigations Report 85-4312 (References 3 and 4). The analysis for existing conditions used an estimated relationship between Mississippi River discharge and flow into Peterson Lake based on the field measurements summarized in Tables DPR-3 and 5-3, extrapolated for high flows, for both upper and central openings. For proposed conditions, the analysis assumed no change in flow conditions at the central openings. For the upper openings, an estimated relationship based on a computed rating curve for the proposed partial closure was used for Mississippi River discharge below 110,000 cfs which corresponds to an elevation of 668.5, the elevation at which the rock closures will overtop. For river discharges greater than 110,000 cfs, the Peterson Lake inflow calculated at river discharge 110,000 cfs (i.e elevation 668.5) was

subtracted from the estimated inflow at river discharge 110,000 cfs for existing conditions, and this value was subtracted from the existing conditions curve above 110,000 cfs to obtain an estimate for expected with-project conditions at higher discharges. The resulting curves are shown in Plates 5-1 and 5-2. The analysis then proceeded per References 3 and 4. The results of the analysis are shown in Tables 5-4 for existing conditions and in Table 5-5 for proposed conditions. These results predict that, with the project in place, sediment loading into Peterson Lake will decrease by about a factor of 7 through the upper openings, and by a factor of 2 overall. This is consistent with the goals of the project, particularly in the north end of the lake, where, except for the higher flood peaks, sediment loading will be virtually eliminated.

6. In Table 5-4, the suspended sediment load deposition was based on a sediment trap efficiency of 38-percent which was calibrating to the 1986 to 1990 volume changes (Table DPR-11). Bed load, in Table 5-4, was assumed to equal 25-percent of suspended load, and a trap efficiency of 100-percent was used for bed load deposition. In Table 5-5 for proposed conditions, the same trap efficiencies were used. Two potential sources of error exist in this methodology. First is that 38-percent is a fairly high trap efficiency for suspended sediment and is probably a result of errors in estimating the volume change between 1986 and 1990. Second, the trap efficiency for proposed conditions will increase due to the increased residence time in Peterson Lake. Classical trap efficiency methods such as Brune's or Churchill's methods don't usually work well on Mississippi River backwaters, but are worth considering since they offer a way to consider the change in trap efficiency for postproject conditions. The change in total load deposition for existing to proposed conditions given by Tables 5-4 and 5-5 is from 43 ac-ft/year to 21 ac-ft/year. The change in total load using Brunes method is 16 ac-ft/year to 11 ac-ft/year, and using Churchill's method it is 47 ac-ft/yr to 27 ac-ft/yr. The bottom line is that no matter which trap efficiency method is used the project reduces net sediment deposition.

7. Further information on the change in the sediment transport regime can be gained by comparing critical depositional and erosional shear stresses for fine sediments to bottom shear stresses for existing and proposed flow conditions. Point velocities over the deep portion of the lake used to calculate bottom shear stresses are based on field data for existing conditions. For proposed conditions point velocities were obtained by reducing the existing conditions field data by the amount that inflows to the lake are reduced. This comparison is presented in Table 5-6. For existing conditions, deposition of fine sediment occurs during low flow conditions with erosion at high flow conditions. For proposed conditions, deposition occurs at low flows, with a reduced amount of erosion during high flows. The particle size range of greatest concern are the coarser silts (0.028 - 0.074 mm). However, particle size data of suspended

sediment samples on the Chippewa River at Pepin, Wisconsin, and of bed material samples at the downstream end of Lake Pepin indicates that silt accounts for 30 to 40-percent of the suspended sediment load (or 24 to 32-percent of the total load assuming that bed load is 25-percent of suspended sediment). Since all of the sand entering Lake Pepin deposits at its upstream end, it is probably true that some of the coarse silts deposit there also. Therefore it is likely that coarse silts in lower pool 4 represent a small fraction of the total sediment load. And since the coarse silt load will be reduced by the project, the reduced erosion of this class of sediments may not be a large concern.

8. Deposition in the deltas and in deep part of lake are serious long term problems (especially if considering the relatively small size of Peterson Lake) and justify construction of this project. Classical trap efficiency methods show that the project will reduce the sediment load although these methods aren't necessarily applicable to a backwater lake like Peterson Lake. The shear stress analysis indicates that there may be less potential for erosion of coarse silts during a flood. But this is compensated for by the fact that the overall sediment load is reduced. In fact, bed load is probably reduced even more than what is predicted in the tables since the rock structures reduce conveyance in the lower part of the water column where coarse material transport is highest. While alternative A3 is recommended over A3B2, the bathymetry analysis showing the large amount of sediment deposition at the middle openings, sites 8 and 9, demands that something be done at these sites to reduce coarse material transport. This shouldn't be the extensive closures proposed in alternative A3B2, but rather a structure that interupts bed load movement.

9. Flow Velocities - A summary of estimated average flow velocity conditions now occurring at selected locations in Peterson Lake, and of expected average flow velocity conditions in the lake with the project in place, is given in Table 5-6. The summary for existing conditions is based on actual field measurements of flows into Peterson Lake through all openings. The summary for proposed conditions is based on actual field measurements through the central openings and calculated lake inflow vs. river discharge relations through the notch at the proposed upper closures. In both cases, average velocity through the "upper lake" was estimated by dividing the flow through the upper openings by the crossectional area (based on MDNR bathymetric surveys) through a transect from the lowermost tip of Island VII to a point on the landward side where the transect is perpendicular to the shore. In the same way, average velocity through the "lower lake" was estimated by dividing the total inflow into Peterson Lake by the crossectional area through a transect from the middle of Island IV to the shoreline. For the winter estimates, both transect crossectional areas were reduced by an amount representing an 18-inch ice layer on the lake. The significant result of the summer average velocity estimates is that, for all three

Mississippi River conditions considered, the estimated residence time in Peterson Lake for proposed conditions would have remained below 5 days. This is consistent with the requirement that summer residence time be kept below 5 days to limit algal growth. The significant result of the winter average velocity estimates is that, for the two Mississippi River conditions considered, the project would have reduced average velocity to below 0.01 foot/second through the upper lake transect. This is consistent with the requirement that velocities be kept below 0.03 foot/second in order to enhance the winter fishery. It is also noteworthy that the estimated average with-project velocity through the lower lake transect compares favorably with this criterion, indicating that, even with the central openings left as is, the project can be expected to provide some improvement with respect to fisheries over the entire lake.

10. Water Quality Considerations - Project objectives for water quality in Peterson Lake involve maintaining adequate dissolved oxygen and creating a fish sanctuary in the upper portion of the lake with lower flow velocities and slightly higher winter water temperatures. In addition, an adequate supply of well oxygenated water is required to supply much needed oxygen into the Finger Lakes Chain directly below the Lock and Dam 4 dike. Anoxic conditions in Peterson Lake could result in the entrainment of reduced chemical species into the Finger Lakes chain, resulting in an increased oxygen demand. Alternative A3B2 provides a fish sanctuary in the upper portion of the lake, however chances of experiencing dissolved oxygen deficits at the culvert intakes to Finger Lakes are greater than with Alternative A3. Alternative A3 offers the greatest potential for successfully meeting project goals by providing a fish sanctuary in the upper portion of Peterson Lake and maintaining the dissolved oxygen supply in the lower portion of the lake. For these reasons Alternative A3 is considered the best structural alternative from a water quality standpoint. A detailed discussion of these and other water quality issues is given in the Water Quality Appendix (Attachment 7).

11. Rock Protection - Rock protection is recommended for the barrier islands as a safeguard against erosion from wind-driven waves and high river currents. This is equivalent to the MEI alternative, and leads to the designation of the structural alternatives as A3B2-MEI and A3-MEI when they are considered along with rock protection. Plates 5-3 and 5-4 show the general nature of the protection. Islands I, III, IV, V, and VI (as designated in Figure 4 of the main report) have been determined to need protection, as discussed in the main report protection for the other islands is not required. These conclusions were further borne out by a geographic information system study of the islands, the results of which are shown in Figures 15 and 16 of the main report. Protection will be in the form of a rock fill mound on the riverward side of the designated islands. A sketch of a typical cross section for the recommended protection is shown in Plate 5-5,

along with the rock fill gradation which would be used. In addition, a 250-foot long reach at the lowermost end of Island VII will be protected with an 18-inch layer of riprap (27-inch below the water line) to offset the possible channeling effects of the rock mound protecting Island VI. The gradation of this layer will be that given in Plate 5-5. A layout for the rock protection based on available bathymetric information is shown in Plate 5-6. Minimum criteria for this protection were found by procedures given in Reference 5. The design elevation of 669 was chosen based on typical flood elevations observed in lower Pool 4 with freeboard to the design elevation to allow for wave runup and setup. Additional rock protection design details are given in the Geotechnical Appendix (Attachment 6).

RECOMMENDED ALTERNATIVE

12. Based on the above discussions, Alternative A3-MEI is recommended over Alternative A3B2-MEI as a structural solution for the Peterson Lake EMP. Alternative A3-MEI is also recommended over the "No Action" alternative and "MEI" as a stand-alone alternative as the alternative which comes closest to achieving the project objectives given in the main report. A single large notch (Option 3) is recommended as the means to control flow into the upper portion of Peterson Lake. Although the amount of flow reduction desired would be the basic criterion for selecting a notch size, it is noted that debris blockage does not occur for a notch of 30 foot bottom width, based on field experiences at other locations. A notch bottom width of 20 feet has been selected for the opening as a compromise to account for these conflicting criteria; while, on the one hand, fishery objectives would dictate a small notch size to reduce flow, maintenance considerations would call for a larger notch size. The significant deltas forming at sites 8 and 9 should also be addressed by this project. Sills should be constructed across sites 8 and 9 to minimize conveyance in the lower part of the water column where coarse material transport is highest. These sills differ from alternative A3B2 in that they will be constructed so that the conveyance area over the top of them is large, resulting in minimal impact on inflows to the lake. Essentially what the sills do is reduce the amount of water drawn from the lower part of the water column where higher coarse sediment concentrations are found. Plate 5-7 shows the design for the sand-core rock closure traversed by a notch at opening 5. The design is for a 20 foot wide notch of invert elevation 662.9. The crest elevation of 668.5 was selected so that it would overtop before the sand closure structures at the other openings and before most of the islands, while keeping the top of the sand core no lower than project pool. Riprap thickness is based on criteria given in Reference 5. The gradation given in Plate 5-7 exceeds the minimum criteria given in Reference 5, and in EM 1110-2-1601 (Reference 6); it is a gradation in common use at EMP projects because it is readily available in large quantities at reasonable

prices.

13. Plate 5-8 shows the design for the closures at the other sites between 1 and 7. Openings 2, 3, 4, and 6 will have sand closures. The crest elevation of 670 for these structures was chosen to provide superior elevation with respect to the existing islands so that the sand structures will be overtopped last; this is also the approximate elevation of the 20-percent chance flood on the Mississippi River at the upper end of Peterson Lake. Openings 1 and 7 will have rock closures. These openings are larger and deeper than the others, which suggests stronger hydrodynamic forces at work at these openings. The crest elevation of 668.5 for these closures was chosen so that they will be overtopped first, thereby relieving head pressure on the other structures. These criteria, along with those for the island protection design to account for wave runup and setup, constitute the general design philosophy for island and bank protection which has been in use for other projects of this kind, and which will be applied to future projects.

14. Plate 5-9 shows the design for the rock sills at sites 8 and 9. The sills will have a crest length of 200 feet, crest width of 10 feet, and a crest elevation of 663.0 (4 feet below low pool). The island protection will be adjusted and extended to tie into the rock sills. The rock gradation will be the same as that given above.

15. The above discussed combinations of structures proposed as the recommended alternative is based in part on current information as to the availability of construction material, particularly of sand. It is subject to change as more detailed information becomes available. Changes that could occur would include the elimination of the sand core at Opening 5, and possibly the replacement of sand with rock at other openings, if there were to be less sand available than is currently expected. The probable source of sand is material dredged from the river for construction barge access, whose quality and quantity has not yet been fully determined.

16. Plates 5-10 through 5-13 show computed discharge-duration curves through the proposed notch for three selected notch sizes for Alternative A3-MEI for the months of January, February, July, and August, respectively. These four months represent the critical period of operation for fisheries in winter and summer. The curves represent conditions without obstructions which would be caused by debris or ice. They were used in the selection of the 20-foot notch size, which was made in part based on the qualitative expectation that some obstruction can be expected at the notch inlet in winter, most likely by ice, which would be removed naturally in spring and be largely absent in summer.

REFERENCES

1. Problem Appraisal Report for Peterson Lake Habitat Rehabilitation and Enhancement Project, U. S. Army Corps of Engineers, St. Paul District, September 1992.

2. Chow, V. T., Open Channel Hydraulics, McGraw-Hill, Inc. 1959.

3. EM 1110-2-4000, Sedimentation Investigations of Rivers and Reservoirs, U. S. Army Corps of Engineers, Washington, D. C., December, 1989.

4. Suspended Sediment in Minnesota Streams, U. S. Geologic Survey Water Resources Investigations Report 85-4312, St. Paul, Minnesota, 1986.

5. Slope Protection for Dams and Lakeshores, Minnesota Technical Release 2, Soil Conservation Service, St. Paul, Minnesota, April 1988.

6. EM-1110-2-1601, Hydraulic Design of Flood Control Channels, U. S. Army Corps of Engineers, Washington, D. C., July 1991.

TABLE 5-1

DATA FOR DESIGN OPTIONS - ALTERNATIVE A3B2

		<----Sill----				<----Winter Flow Structure----								
											(2)	(3,4) winter flow range		
Openings	Option	invert elevation 1912 adj.	(1) bottom width feet	length feet	(2) flow range cfs	structure	invert elevation 1912 adj.	length feet	Manning's "n"	other dimensions	summer flow range cfs	no ice cfs	6" ice cfs	12" ice cfs
UPPER	1	666.8	350	40	0-120	culvert	663	40	0.014	24" dia. RCP	2-10	2-7	no freezeover	
										30" dia. RCP	3-17	4-12	no freezeover	
	2	666.8	350	40	0-120	notch	666.1	40	0.04	5' BW 1V:3H SS	7-20	1-10	no freezeover	
	3	N/A	N/A	N/A	N/A	notch	663.9	200	0.04	5' BW 1V:3H SS	18-106	19-69	10-40	6-25
		N/A	N/A	N/A	N/A	notch	662.9	200	summer	10' BW 1V:3H SS	46-156	54-183	34-118	24-86
		N/A	N/A	N/A	N/A	notch	662.9	200	0.03	20' BW 1V:3H SS	72-427	87-288	56-190	41-143
		N/A	N/A	N/A	N/A	notch	662.9	200	winter	30' BW 1V:3H SS	99-586	121-397	78-264	57-200
CENTRAL	1	666.7	850	40	20-250	----no winter low flow structure----						10-110	no freezeover	
	2	666.7	850	40	20-250	notch	666.1	40	0.04	5'BW 1V:3H SS	48-118	9-72	no freezeover	
	3	N/A	N/A	N/A	N/A	notch	663.9	200	0.04	5' BW 1V:3H SS	14-86	15-57	8-33	5-20
		N/A	N/A	N/A	N/A	notch	662.9	200	summer	10' BW 1V:3H SS	35-224	44-152	27-98	19-71
		N/A	N/A	N/A	N/A	notch	662.9	200	0.03	20' BW 1V:3H SS	56-354	70-240	45-158	33-118
		N/A	N/A	N/A	N/A	notch	662.9	200	winter	30' BW 1V:3H SS	77-486	98-331	63-219	46-166

Notes:

(1) Assume tie-in with existing islands - no designed side slopes.

(2) Based on discharges estimated using range of mean seasonal water surface elevations for summer (July-August) from 1970-1992.
Total summer flow is sill flow + notch/culvert flow.

(3) Based on discharges estimated using range of mean seasonal water surface elevations for winter (January-February) from 1970-1992.

(4) Neglect flows over summer sill in winter for upper openings, Options 1 and 2. Sills are sized above mean winter pool at openings.

TABLE 5-2

DATA FOR DESIGN OPTIONS - ALTERNATIVE A3

Option	invert elevation 1912 adj.	Manning's "n"	length feet	bottom width feet	side slope	(2) summer flow range cfs	(2) winter flow range no ice cfs	6" ice cfs	12" ice cfs
1,2	Similar to Alternative A3B2								
(1) 3	663.9	0.04	200	5	1V:3H	9-56	9-38	5-22	3-14
	662.9	summer	200	10	1V:3H	22-144	27-99	17-64	12-47
	662.9	0.03	200	20	1V:3H	35-226	44-157	28-103	20-77
	662.9	winter	200	30	1V:3H	48-311	61-216	39-143	29-109

Notes:

(1) All design data are for a single large opening.

(2) Based on discharges estimated using range of mean seasonal water surface elevations for winter (January-February) and summer (July-August) from 1970-1992.

TABLE 5-3

FIELD MEASUREMENTS OF FLOW INTO PETERSON LAKE

Date	L/D 4 discharge cfs	upper openings inflow cfs	(1) estimated stage 1912 adj	central openings inflow cfs	(1) estimated stage 1912 adj	total inflow cfs	Comments
(2) 5/30/91	64500	4066	667.37	1420	667.24	5486	
(2) 10/16/91	19300	578	666.48	242	666.46	820	
(2) 5/27/92	28300	1478	666.66	492	666.63	1970	
(3) 1/8/93	18450	949	666.77	536	666.75	1513	Some ice - 6" max thickness
(3) 2/19/93	15600	576	666.68	226	666.66	802	6" ice at upper openings 12" ice at central openings

Notes:

(1) - Based on linear interpolation between Lock and Dam 4 Pool and Wabasha, MN.

(2) - Measurements taken by Corps of Engineers.

(3) - Measurements taken by Minnesota Department of Natural Resources.

TABLE 5-4

SUSPENDED SEDIMENT LOADING INTO PETERSON LAKE - EXISTING CONDITIONS
BASED ON 1991-1992 FIELD DATA FOR FLOW INTO PETERSON LAKE

LOADING FROM MISSISSIPPI RIVER

FLOW DURATION IN PCT--- EXCEEDANCE	MID-ORDINATE	INCREMENT	Qw AT LOCK AND DAM 4 (CFS)	Qw INTO UPPER OPENINGS (CFS)	AV. Qw UPPER OPENINGS (CFS)	Qw INTO CENTRAL OPENINGS (CFS)	AV. Qw CENTRAL OPENINGS (CFS)	(1) Qs AT LOCK AND DAM 4 TONS/DAY	(2) CONCENTRATION AT L/D 4 (mg/l)	(3) Qs INTO UPPER OPENINGS TONS/DAY	AVG. Qs UPPER OPENINGS TONS/DAY	(3) Qs INTO CENTRAL OPENINGS TONS/DAY	AVG. Qs CENTRAL OPENINGS TONS/DAY
0													
	0.05	0.1	240000	33500	34	23000	23	67590	104.3	9434	9.4	6477	6.5
0.1													
	0.3	0.4	165000	21000	84	14500	58	36836	82.7	4688	18.8	3237	12.9
0.5													
	1	1	120000	13500	135	9300	93	21990	67.9	2474	24.7	1704	17.0
1.5													
	3.25	3.5	87500	7300	256	5600	196	13182	55.8	1100	38.5	844	29.5
5													
	10	10	61000	3950	395	2600	260	7348	44.6	476	47.6	313	31.3
15													
	20	10	44500	2400	240	1330	133	4408	36.7	238	23.8	132	13.2
25													
	30	10	33000	1550	155	700	70	2716	30.5	128	12.8	58	5.8
35													
	40	10	26640	1180	118	450	45	1920	26.7	85	8.5	32	3.2
45													
	50	10	21900	900	90	300	30	1398	23.6	57	5.7	19	1.9
55													
	60	10	18300	730	73	230	23	1045	21.1	42	4.2	13	1.3
65													
	70	10	15000	600	60	170	17	757	18.7	30	3.0	9	0.9
75													
	80	10	12500	500	50	110	11	564	16.7	23	2.3	5	0.5
85													
	90	10	10000	400	40	80	8	393	14.5	16	1.6	3	0.3
95													
	96.75	3.5	6700	250	9	40	1	205	11.3	8	0.3	1	0.0
98.5													
	99	1	5500	210	2	30	0	149	10.0	6	0.1	1	0.0
99.5													
	99.7	0.4	5100	180	1	20	0	132	9.6	5	0.0	1	0.0
99.9													
	99.95	0.1	4900	160	0	10	0	124	9.3	4	0.0	0	0.0
100													
			DAILY AVERAGE FLOW		1741		969						

	UPPER OPENINGS		CENTRAL OPENINGS
DAILY AVERAGE SUSPENDED LOAD	201.2		124.4
DAILY AVERAGE BED LOAD (4)	50.3		31.1
BED LOAD + SUSPENDED LOAD	251.4		155.6
(5)SUSPENDED LOAD DEPOSITION		1.50	IN/YR
(6)BED LOAD DEPOSITION		0.73	IN/YR
VOLUME CHANGE - >5' DEEP WATER		29	AC-FT/YR
VOLUME CHANGE - <5' DEEP WATER		14	AC-FT/YR

NOTES
(1) GIVEN BY Qs=.00013*Qw^1.62 (REFERENCE 4)
(2) GIVEN BY C=370.37*Qs/Qw
(3) GIVEN BY Qs=.0027*Qw*C
(4) TAKEN TO BE 25 PERCENT OF SUSPENDED LOAD
(5) ASSUME DEPOSITION IN >5' DEPTHS AND 38% TRAP EFFICIENCY
(6) ASSUME DEPOSITION IN <5' DEPTHS AND 100% TRAP EFFICIENCY

TABLE 5-5

SUSPENDED SEDIMENT LOADING INTO PETERSON LAKE - PROPOSED CONDITIONS
BASED ON 1991-1992 FIELD DATA FOR FLOW INTO PETERSON LAKE

LOADING FROM MISSISSIPPI RIVER

FLOW DURATION IN PCT--- EXCEED-ANCE	MID-ORDINATE	INCRE-MENT	Qw AT LOCK AND DAM 4 (CFS)	Qw INTO UPPER OPENINGS (CFS)	AV. Qw UPPER OPENINGS (CFS)	Qw INTO CENTRAL OPENINGS (CFS)	AV. Qw CENTRAL OPENINGS (CFS)	(1) Qs AT LOCK AND DAM 4 TONS/DAY	(2) CONCEN-TRATION AT L/D 4 (mg/l)	(3) Qs INTO UPPER OPENINGS TONS/DAY	AVG. Qs UPPER OPENINGS TONS/DAY	(3) Qs INTO CENTRAL OPENINGS TONS/DAY	AVG. Qs CENTRAL OPENINGS TONS/DA
0													
	0.05	0.1	240000	22400	22	23000	23	67590	104.3	6308	6.3	6477	6.5
0.1													
	0.3	0.4	165000	10000	40	14500	58	36836	82.7	2232	8.9	3237	12.9
0.5													
	1	1	120000	2500	25	9300	93	21990	67.9	458	4.6	1704	17.0
1.5													
	3.25	3.5	87500	380	13	5600	196	13182	55.8	57	2.0	844	29.5
5													
	10	10	61000	280	28	2600	260	7348	44.6	34	3.4	313	31.3
15													
	20	10	44500	160	16	1330	133	4408	36.7	16	1.6	132	13.2
25													
	30	10	33000	105	11	700	70	2716	30.5	9	0.9	58	5.8
35													
	40	10	26640	90	9	450	45	1920	26.7	6	0.6	32	3.2
45													
	50	10	21900	81	8	300	30	1398	23.6	5	0.5	19	1.9
55													
	60	10	18300	75	8	230	23	1045	21.1	4	0.4	13	1.3
65													
	70	10	15000	71	7	170	17	757	18.7	4	0.4	9	0.9
75													
	80	10	12500	68	7	110	11	564	16.7	3	0.3	5	0.5
85													
	90	10	10000	65	7	80	8	393	14.5	3	0.3	3	0.3
95													
	96.75	3.5	6700	60	2	40	1	205	11.3	2	0.1	1	0.0
98.5													
	99	1	5500	50	1	30	0	149	10.0	1	0.0	1	0.0
99.5													
	99.7	0.4	5100	48	0	20	0	132	9.6	1	0.0	1	0.0
99.9													
	99.95	0.1	4900	47	0	10	0	124	9.3	1	0.0	0	0.0
100													
			DAILY AVERAGE FLOW		203		969						

	UPPER	CENTRAL
DAILY AVERAGE SUSPENDED LOAD	30.2	124.4
DAILY AVERAGE BED LOAD (4)	7.6	31.1
BED LOAD + SUSPENDED LOAD	37.8	155.6

(5)SUSPENDED LOAD DEPOSITION	0.71	IN/YR
(6)BED LOAD DEPOSITION	0.35	IN/YR
VOLUME CHANGE - >5' DEEP WATER	14	AC-FT/YR
VOLUME CHANGE - <5' DEEP WATER	7	AC-FT/YR

NOTES
(1) GIVEN BY Qs=.00013*Qw^1.62 (REFERENCE 6)
(2) GIVEN BY C=370.37*Qs/Qw (REFERENCE 5)
(3) GIVEN BY Qs=.0027*Qw*C (REFERENCE 5)
(4) TAKEN TO BE 25 PERCENT OF SUSPENDED LOAD
(5) ASSUME DEPOSITION IN >5' DEPTHS AND 38% TRAP EFFICIENCY
(6) ASSUME DEPOSITION IN <5' DEPTHS AND 100% TRAP EFFICIENCY

TABLE 5-6

COMPARISON OF BOTTOM SHEAR STRESS TO CRITICAL SHEAR STRESS FOR EROSION OR DEPOSITION

Silt Size Range (mm)	.074 - .028	.028 - .014	< .014
Critical Shear Stress (psf)	Tce = .0125 Tcd = .0088	Tce = .0079 Tcd = .0069	Tce = .0012 Tcd = .0009
Existing Cond., Low Flow	Tb = .0038 Deposition	Tb = .0038 Deposition	Tb = .0038 Erosion
Existing Cond., High Flow	Tb = .0322 Erosion	Tb = .0322 Erosion	Tb = .0322 Erosion
Proposed Cond., Low Flow	Tb = .00044 Deposition	Tb = .00044 Deposition	Tb = .00044 Deposition
Proposed Cond., High Flow	Tb = .0089 Dep/Transport	Tb = .0089 Erosion	Tb = .0089 Erosion

Note:

1. Tce = critical shear stress for erosion
   Tcd = critical shear stress for deposition
   Tb = bottom shear stress based on measured velocities

2. If Tb < Tcd, Deposition
   If Tb > Tce, Erosion
   If Tcd<Tb<Tce, Transport

3. Values of critical shear stress given above are from:
   Teeter, A.M. (1993). Size Dependence in Fine-Grained Sediment Transport. Waterways Experiment Station, Dredging Research Technical Notes, DRP-1-11.

4. Values from other references may vary.

TABLE 5-7

VELOCITY ESTIMATES IN PETERSON LAKE
Based on Field Conditions Observed on Given Dates

		Warm Season			Cold Season (1)	
Date		5/30/91	10/16/91	5/27/92	1/7/93	2/19/93
Lake Volume		2200 acre-ft			1450 acre-ft (2)	
Mississippi River Flow (cfs)		64500	19300	28000	18450	15600
Peterson Lake Quantities - Existing Conditions						
Upper Lake						
(3)	Discharge (cfs)	4066	578	1518	718	576
	Velocity (ft/sec)	0.32	0.05	0.12	0.08	0.04
Lower Lake						
(3)	Discharge (cfs)	5486	818	1968	1212	802
	Velocity (ft/sec)	0.32	0.05	0.10	0.08	0.05
(4)	Residence Time (days)	0.2	1.4	0.6	0.6	0.9
Peterson Lake Quantities - Proposed Conditions						
Upper Lake						
(5)	Discharge (cfs)	300	70	60	60	50
	Velocity (ft/sec)	0.02	0.004	0.004	0.007	0.005
Lower Lake						
(6)	Discharge (cfs)	1720	310	510	554	276
	Velocity (ft/sec)	0.08	0.02	0.03	0.04	0.02
(4)	Residence Time (days)	0.6	3.6	2.2	1.3	2.6

Notes:

(1) Assume 18" ice thickness, no ice in openings, lake flow vs. river flow relations for winter are the same as for summer.

(2) Based on 500 acre surface area and 1.5 foot ice thickness.

(3) Based on Table DPR-3.

(4) Calculated as discharge divided by volume, with appropriate unit conversions, for entire lake (minus ice volume based on 18" ice thickness for cold season

(5) Based on Plate 5-2.

(6) Based on Plate 5-2 for upper openings (1-7), and on Table DPR-3 for lower openings (8-10).

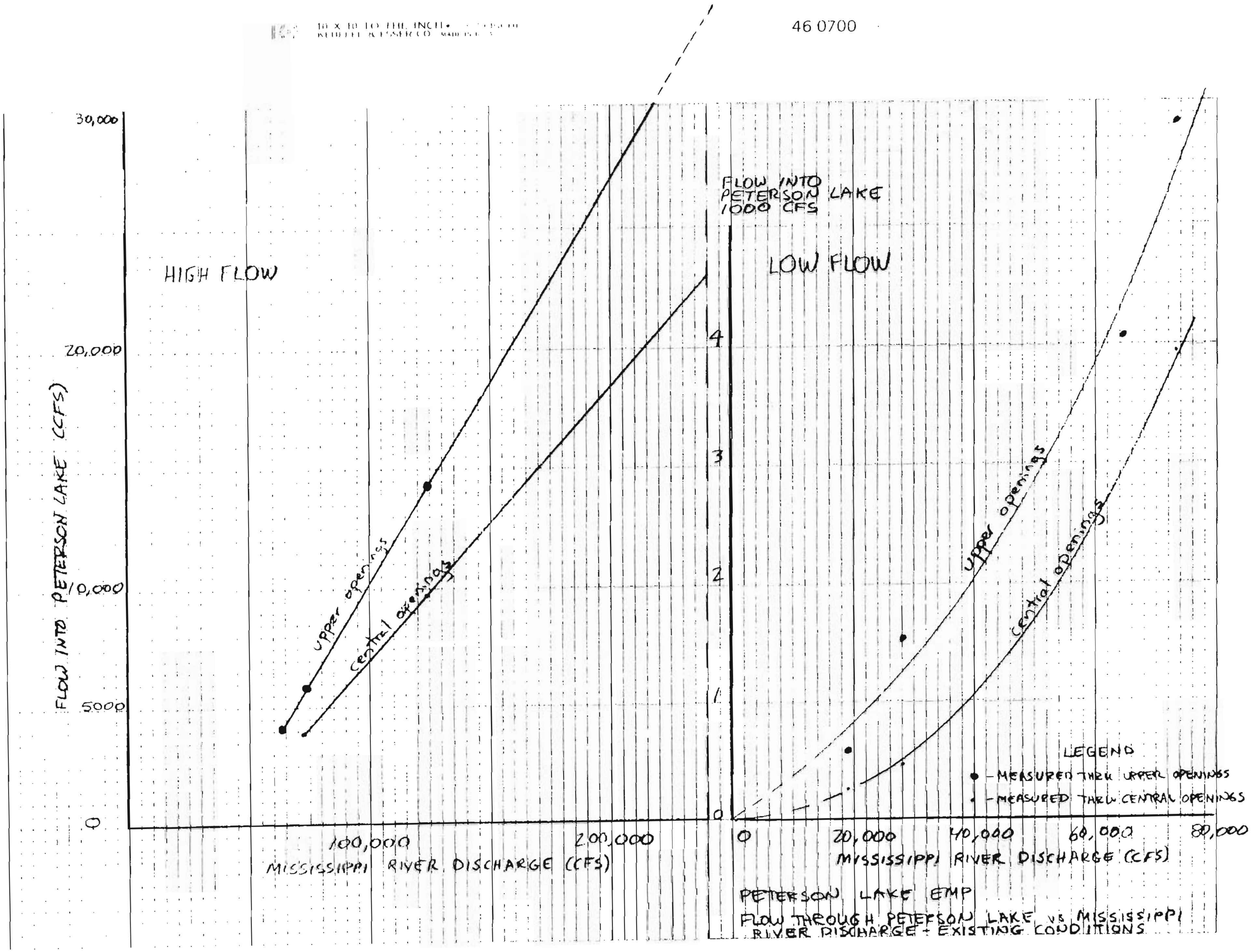

HIGH FLOW
LOW FLOW
FLOW INTO PETERSON LAKE (CFS)
30,000
20,000
10,000
5000
0
100,000
200,000
MISSISSIPPI RIVER DISCHARGE (CFS)
upper openings
central openings
FLOW INTO PETERSON LAKE 1000 CFS
4
3
2
1
0
20,000
40,000
60,000
80,000
LEGEND
• - MEASURED THRU UPPER OPENINGS
• - MEASURED THRU CENTRAL OPENINGS
PETERSON LAKE EMP
FLOW THROUGH PETERSON LAKE vs MISSISSIPPI RIVER DISCHARGE - EXISTING CONDITIONS

PLATE 5-1

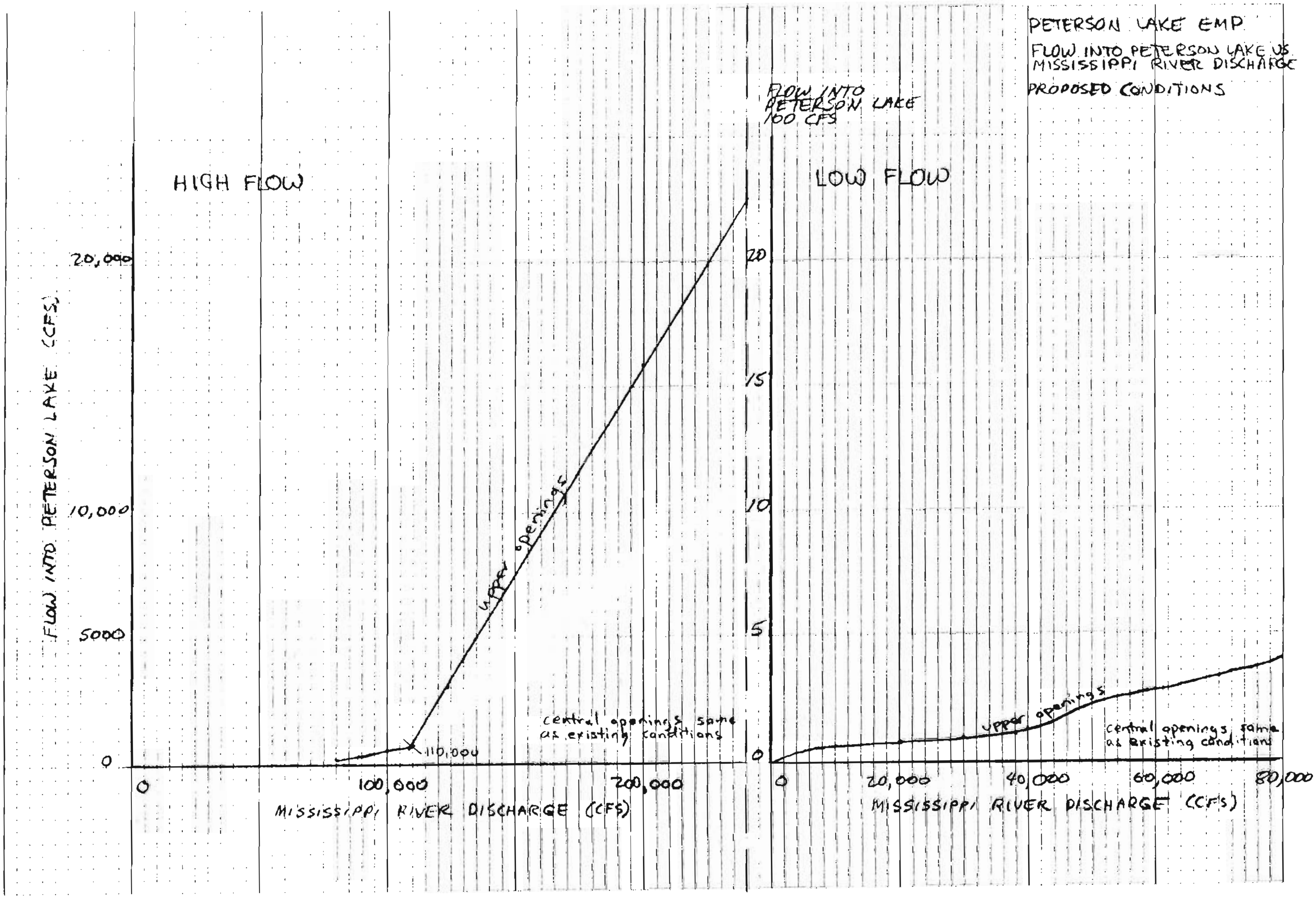

PETERSON LAKE EMP
FLOW INTO PETERSON LAKE VS MISSISSIPPI RIVER DISCHARGE
PROPOSED CONDITIONS
HIGH FLOW
LOW FLOW
FLOW INTO PETERSON LAKE (CFS)
FLOW INTO PETERSON LAKE 100 CFS
20,000
10,000
5000
0
20
15
10
5
0
upper openings
central openings same as existing conditions
110,000
0
100,000
200,000
MISSISSIPPI RIVER DISCHARGE (CFS)
0
20,000
40,000
60,000
80,000
upper openings
central openings same as existing conditions
MISSISSIPPI RIVER DISCHARGE (CFS)

PLATE 5-2

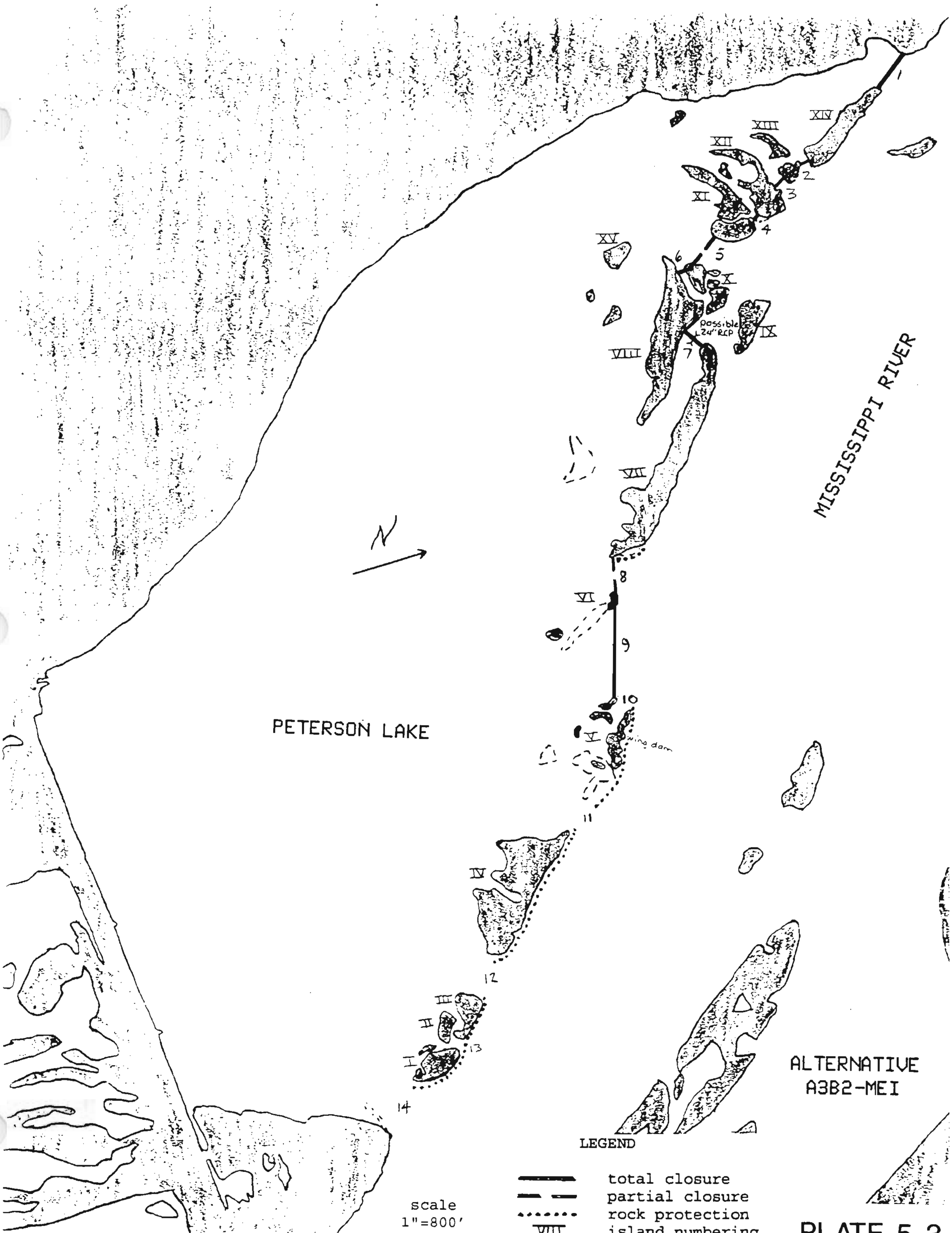

MISSISSIPPI RIVER
PETERSON LAKE
N
Possible 24" RCP
wing dam
ALTERNATIVE
A3B2-MEI
LEGEND
total closure
partial closure
rock protection
island numbering
scale
1"=800'

PLATE 5-3

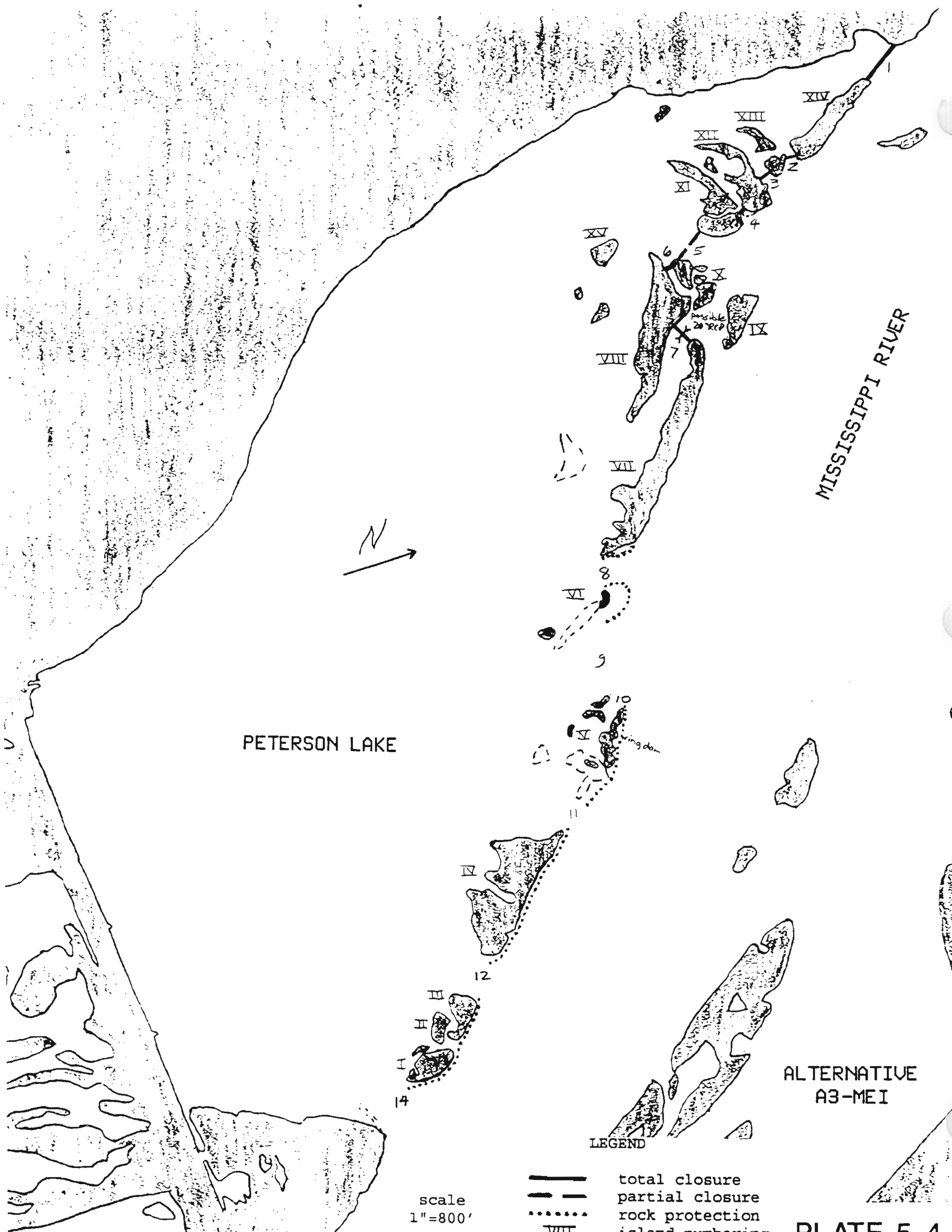
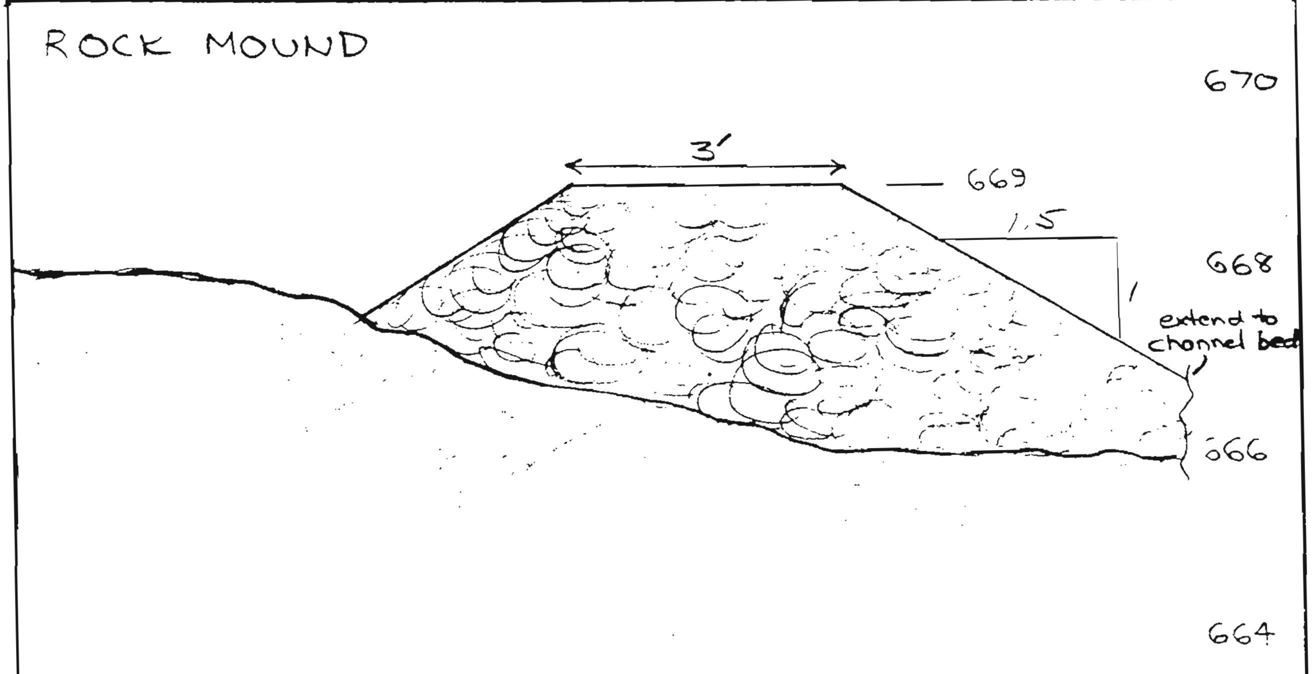

MISSISSIPPI RIVER
N
PETERSON LAKE
ALTERNATIVE
A3-MEI
LEGEND
total closure
partial closure
rock protection
island numbering
scale
1"=800'

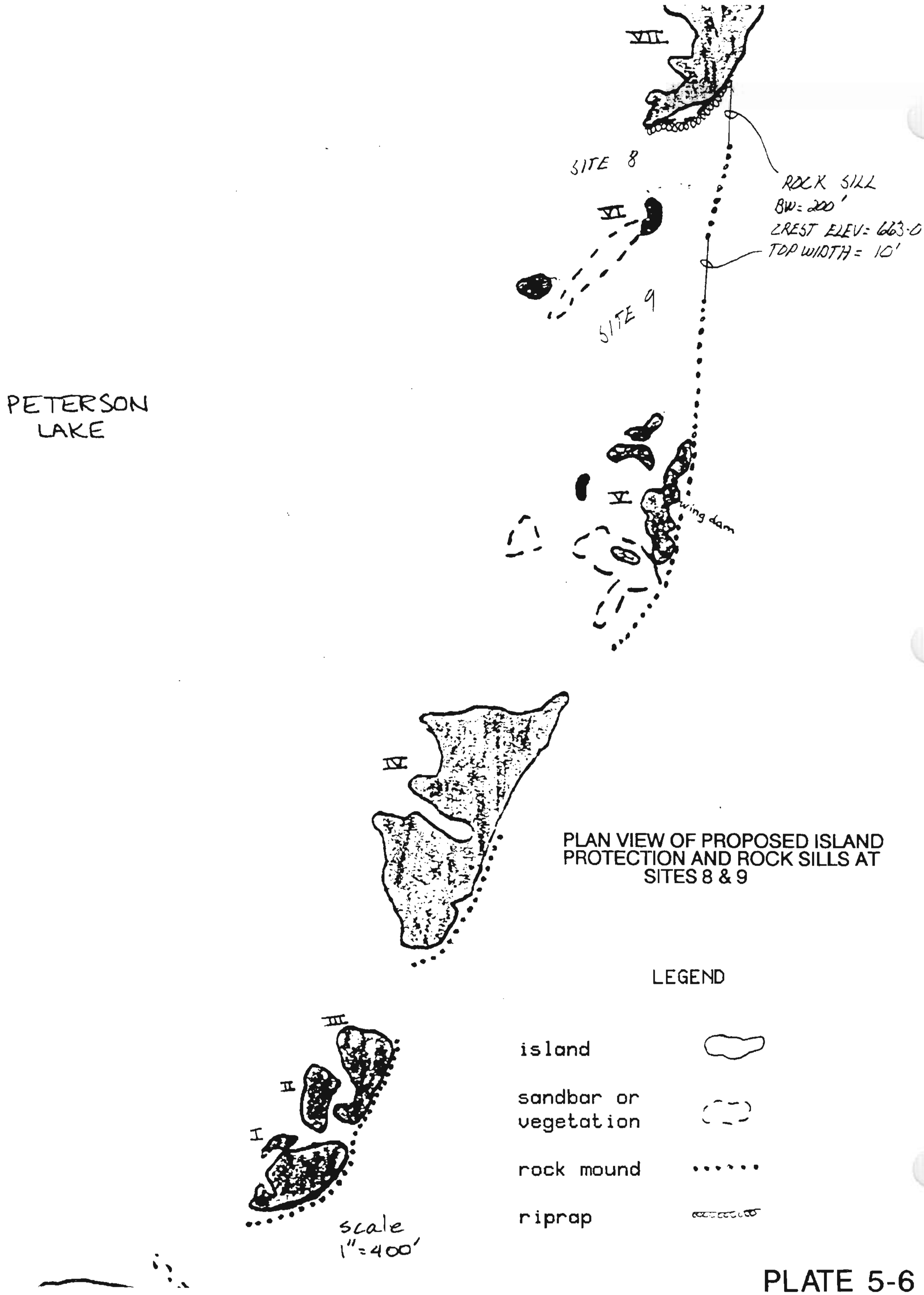
PLATE 5-4

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: PETERSON LAKE EMP	COMPUTED BY:	DATE:	SHEET:
	SUBJECT TITLE: ROCK PROTECTION FOR EXISTING ISLANDS	CHECKED BY:	DATE:	CONTRACT NO.:



rock gradation:

% lighter by wt.	wt. limits lb
100	300-100
50	120-40
15	25-8

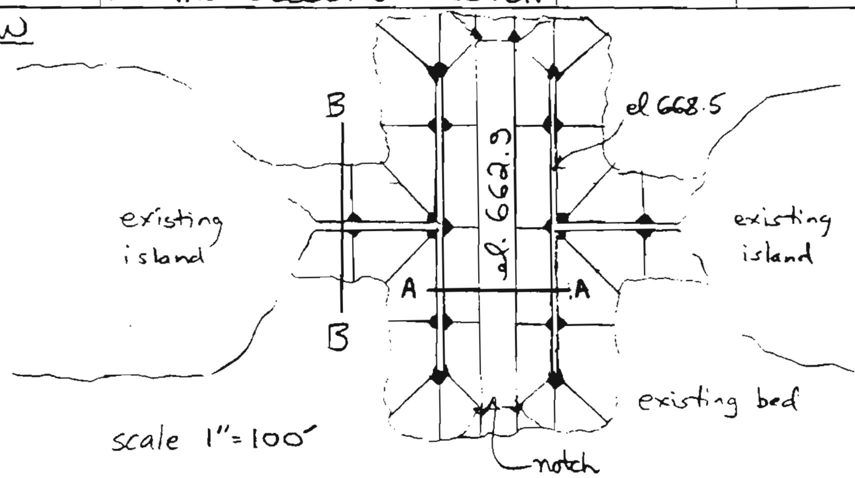


PLAN VIEW OF PROPOSED ISLAND PROTECTION AND ROCK SILLS AT SITES 8 & 9

PLATE 5-6

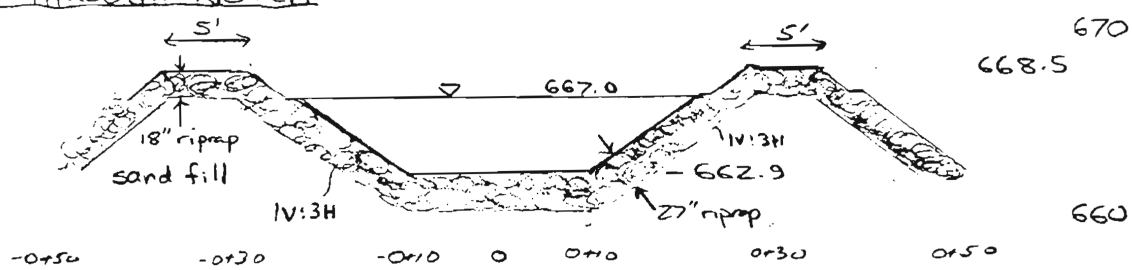
US Army Corps of Engineers Saint Paul District	PROJECT TITLE: PETERSON LAKE EMP	COMPUTED BY:	DATE:	SHEET:
	SUBJECT TITLE: OPENING 5 PARTIAL CLOSURE + NOTCH	CHECKED BY:	DATE:	CONTRACT NO.:

PLAN VIEW



SECTION THROUGH NOTCH

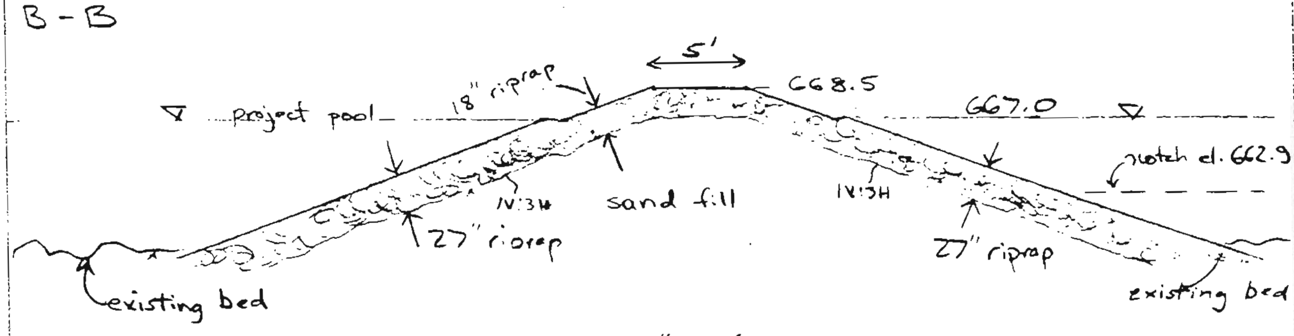
A - A



scale as shown

SECTION ACROSS CLOSURE

B - B



scale 1" = 10'

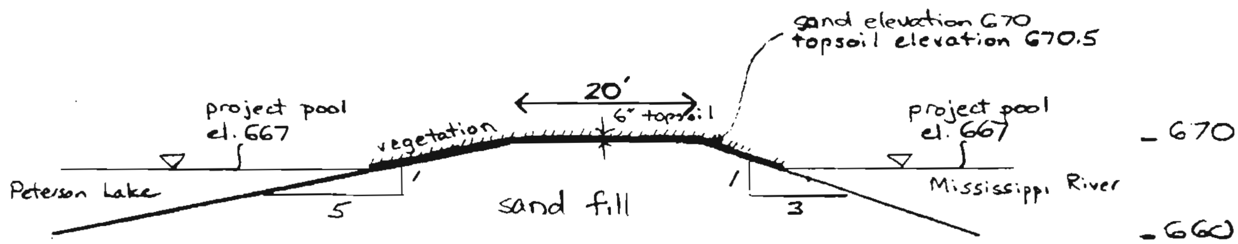
RIPRAP GRADATION

(same as for Finger Lakes EMP)

% lighter by weight	Wt. limits in pounds
100	300-100
50	120-40
15	25-8

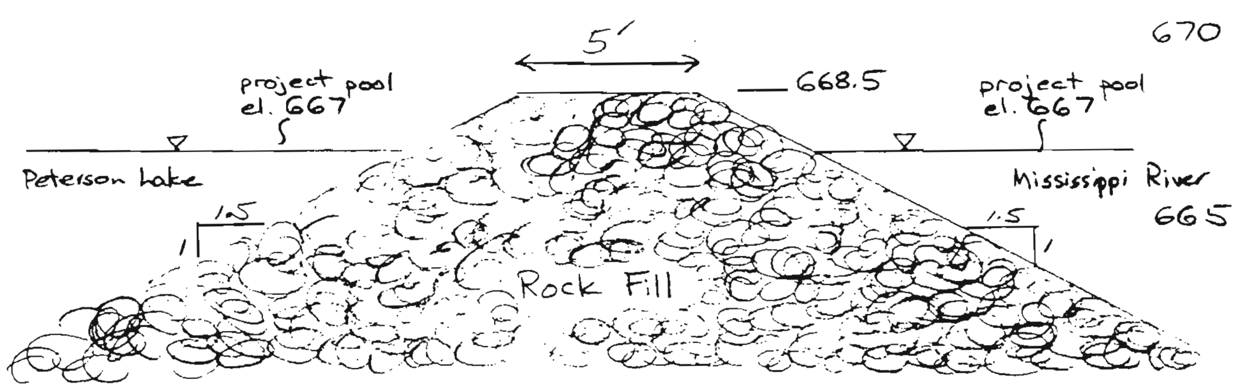
US Army Corps of Engineers Saint Paul District	PROJECT TITLE:	COMPUTED BY:	DATE:	SHEET:
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:

Sand Closure (Openings 2,3,4,6)



Scale: 1" = 20'

Rock Closure (Openings 1, 7)



Scale: 1" = 5'

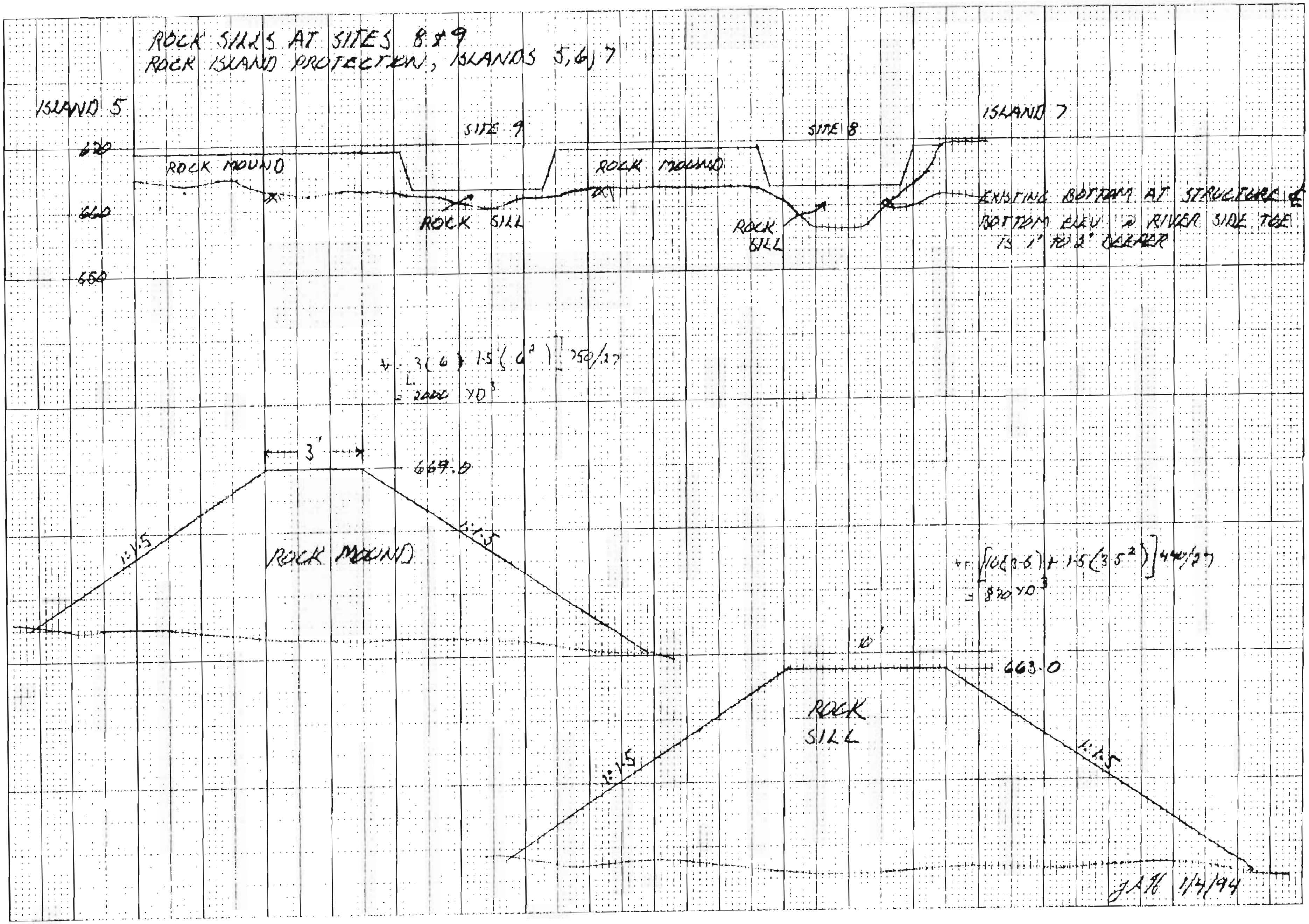

ROCK SILLS AT SITES 8 & 9
ROCK ISLAND PROTECTION, ISLANDS 5, 6, 7
ISLAND 5
SITE 9
SITE 8
ISLAND 7
ROCK MOUND
ROCK MOUND
ROCK SILL
ROCK SILL
EXISTING BOTTOM AT STRUCTURE ℄
BOTTOM ELEV @ RIVER SIDE TOE IS 1' TO 2' DEEPER
3'
669.0
1:1.5
1:1.5
ROCK MOUND
= 2400 YD³
10'
663.0
ROCK SILL
1:1.5
1:1.5
= 870 YD³
JAH 1/4/94

PLATE 5-9

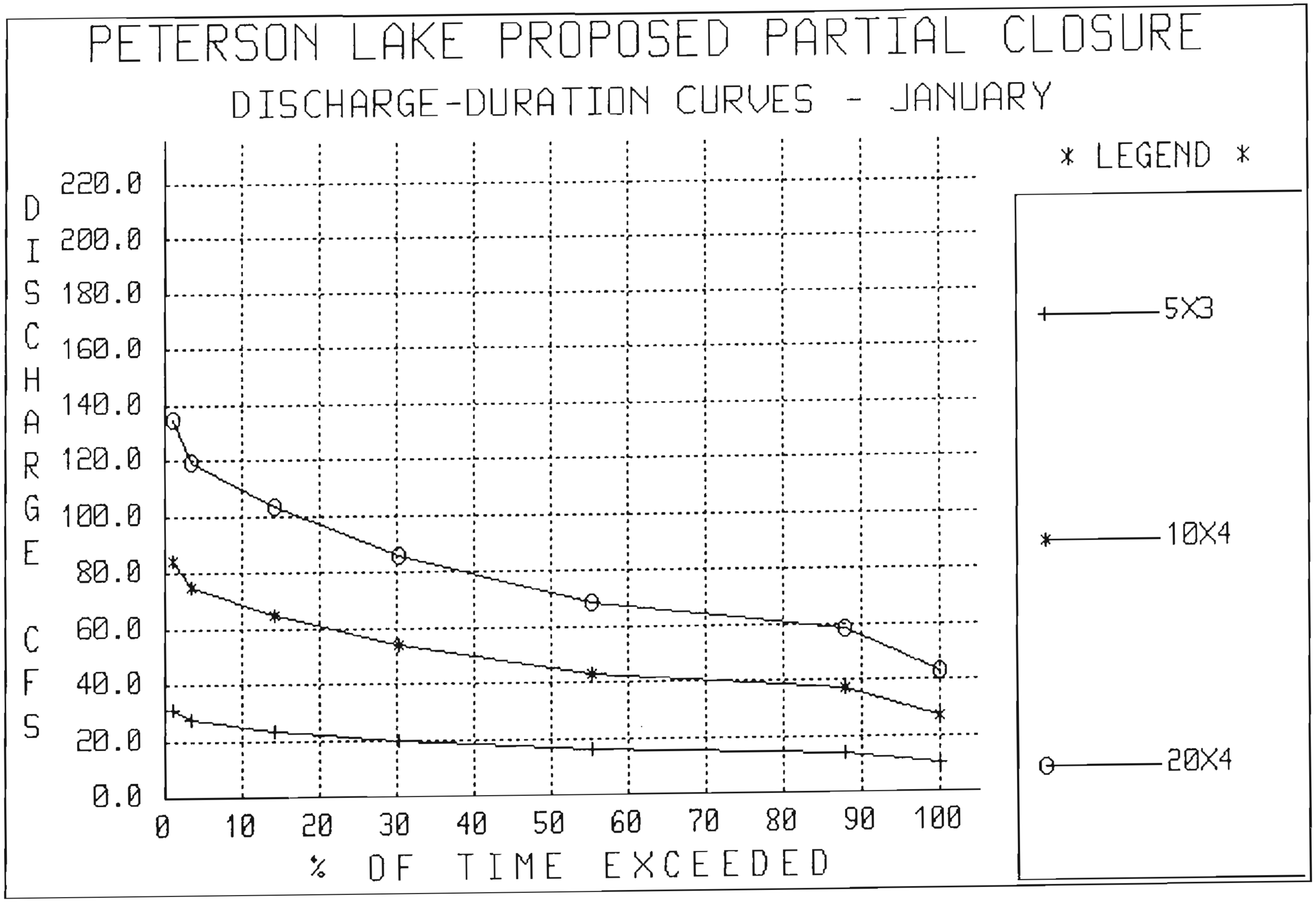

PETERSON LAKE PROPOSED PARTIAL CLOSURE
DISCHARGE-DURATION CURVES - JANUARY
* LEGEND *
5X3
10X4
20X4
DISCHARGE CFS
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
10
20
30
40
50
60
70
80
90
100
% OF TIME EXCEEDED

PLATE 5-10

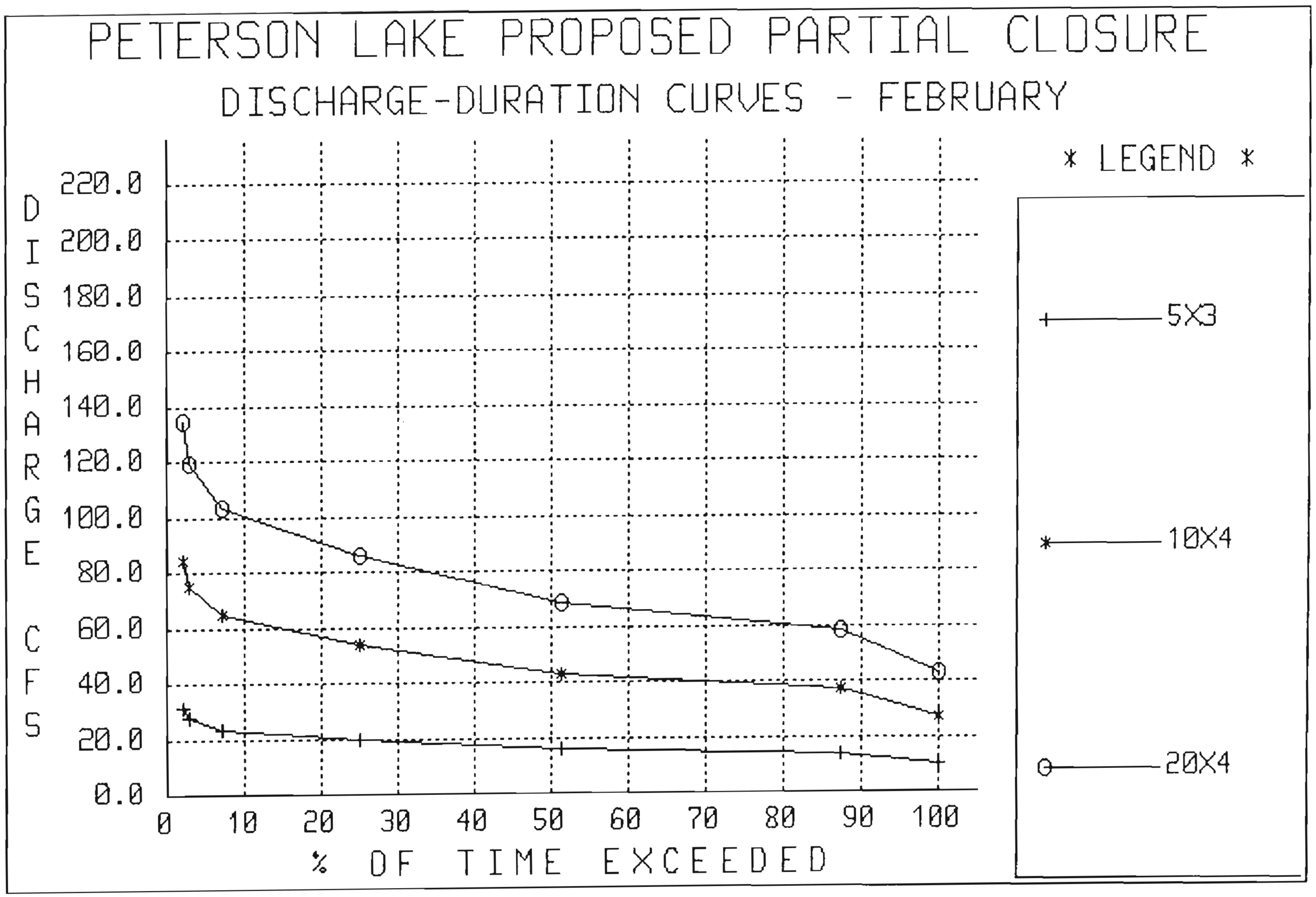
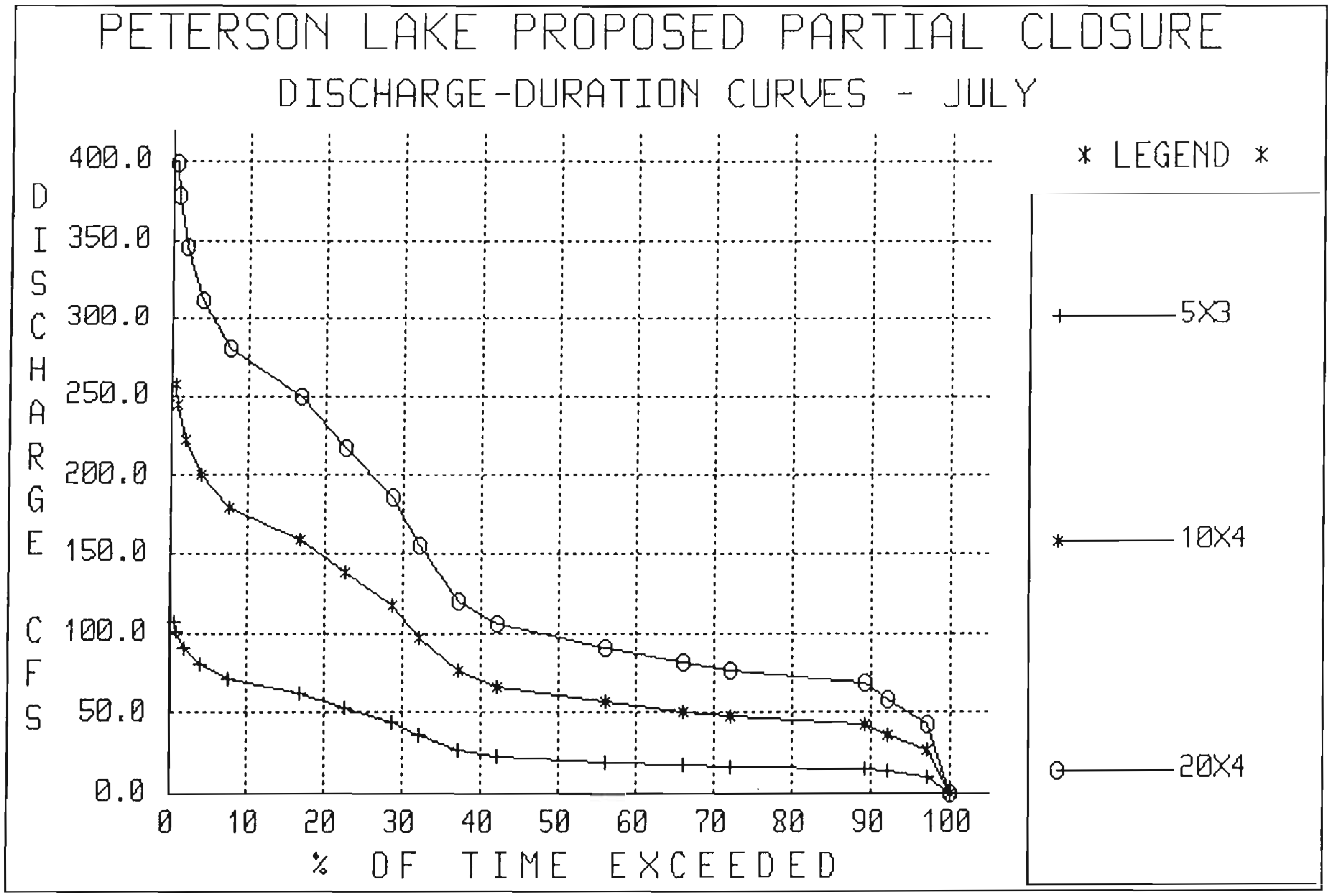

PETERSON LAKE PROPOSED PARTIAL CLOSURE
DISCHARGE-DURATION CURVES - FEBRUARY
DISCHARGE CFS
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
10
20
30
40
50
60
70
80
90
100
% OF TIME EXCEEDED
* LEGEND *
5X3
10X4
20X4

PLATE 5-11



PETERSON LAKE PROPOSED PARTIAL CLOSURE
DISCHARGE-DURATION CURVES - JULY
DISCHARGE CFS
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
10
20
30
40
50
60
70
80
90
100
% OF TIME EXCEEDED
* LEGEND *
5X3
10X4
20X4

PLATE 5-12

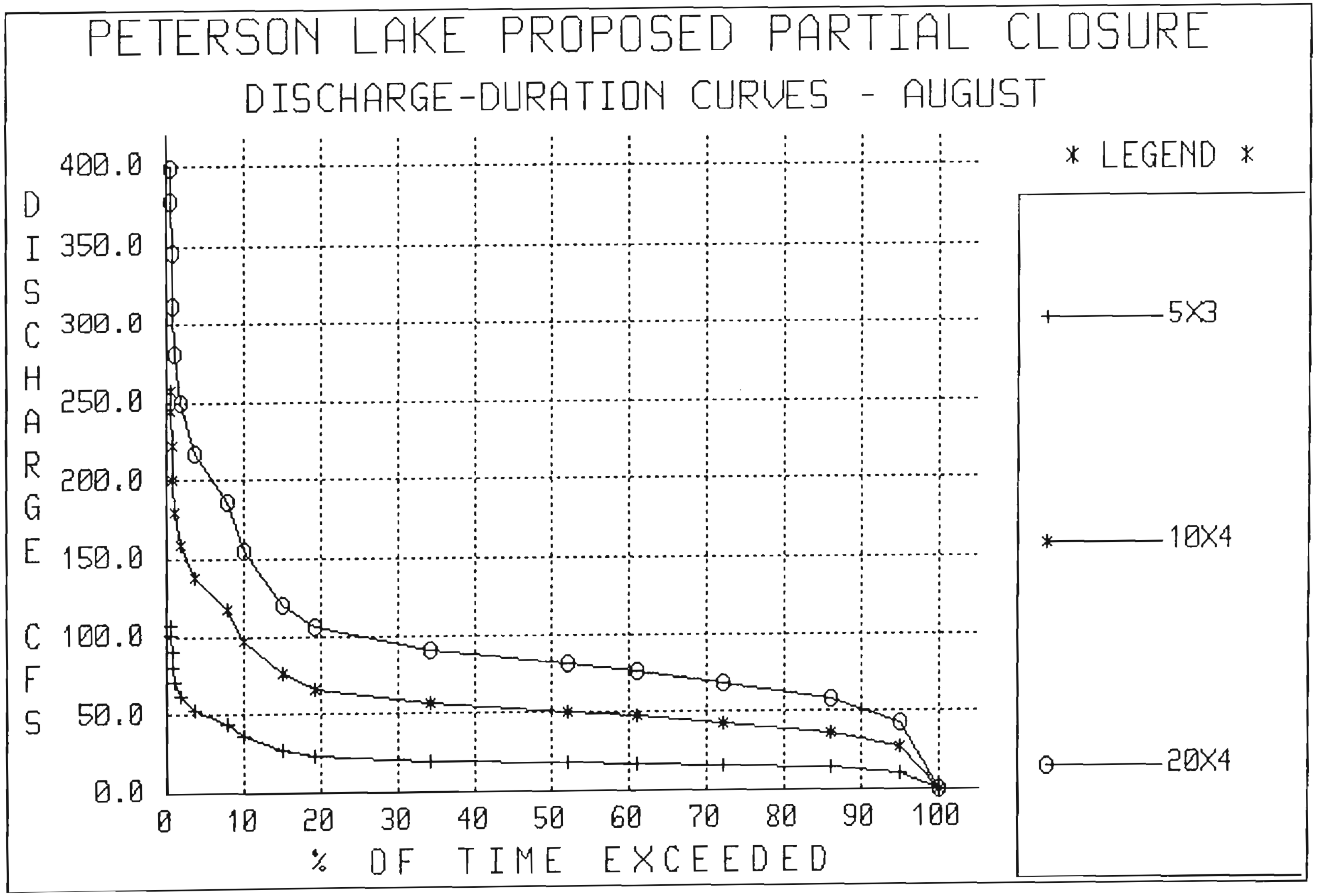

PETERSON LAKE PROPOSED PARTIAL CLOSURE
DISCHARGE-DURATION CURVES - AUGUST
DISCHARGE CFS
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
10
20
30
40
50
60
70
80
90
100
% OF TIME EXCEEDED
* LEGEND *
5X3
10X4
20X4

PLATE 5-13

ATTACHMENT 6

GEOTECHNICAL APPENDIX

TABLE OF CONTENTS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-15)
PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

APPENDIX NO. 6
GEOTECHNICAL DESIGN

1. **GENERAL:** This Appendix presents the geologic and geotechnical data and analysis for the Peterson Lake EMP project. The geologic information was taken from the USGS Hydrologic Investigations Atlas HA-543 (1975); The Geology and Underground Waters of Southern Minnesota (Thiel, 1944, pp 433-438, University of Minn. Press); the Wisconsin Geologic and Natural History Bulletin No. XXXVI; and from Corps of Engineers borings taken in the project vicinity. The geotechnical data includes borings taken in the project area to locate possible borrow sites, judgements on borrow sites, and rockfill gradation. Finally, future Geotechnical Design work will be discussed.

2. **PHYSIOGRAPHY:** Peterson Lake is located in Pool No. 4 of the Mississippi River, between Lock and Dam No. 4 and the Buffalo River. The lake is adjacent to the present navigation channel. A discontinuous line of islands separates Peterson Lake from disturbances in the river channel.

3. In the vicinity of Peterson Lake, the river flows on top of a thick deposit of fluvial sediments covering a large, flat-bottomed gorge carved by Glacial River Warren. The Mississippi River Valley near Peterson Lake is approximately six miles wide. The river itself, however, occupies only a small portion of the valley.

4. On the Minnesota side of the river valley, a conspicuous, well-developed gravel terrace rises above the flood plain near the town of Kellogg. The terrace extends westward from the river bank and is up to two miles wide. At the western edge of the river valley, the base of the steep bluffs of the uplands region rise more than 500 feet above river level. The uplands region is part of a maturely dissected plateau that has been transformed into a system of steep ridges and broad, alluvial valleys.

5. Gravel terraces are absent on the Wisconsin side of the river in the project vicinity. The river valley extends to the base of the steep bluffs which are lithologically similar to those on the Minnesota side of the river. However, the drainage valleys are young, mainly post-glacial, and the valleys are shallow and steep. The numerous tributary rivers and streams that dissect the uplands on both sides of the river continue to contribute relatively large

amounts of sediment to the Mississippi River Basin.

6. **GEOLOGY:** Over most of the upland areas there is only a thin veneer of glacial drift with scattered pebbles and boulders. Wind-blown silt or loess locally extends down the slopes of the main valleys nearly to the streams. Loess deposits on the uplands and on the valley slopes can reach thicknesses of up to 15 feet.

7. Bedrock formations crop out along the bluffs bordering both sides of the Mississippi River valley. Ordovician-period dolomites and limestones of the Prairie du Chien Formation cap the bluffs and ridges along the river valley. The hillsides are composed of Cambrian-period clastic and carbonate formations. These include, in descending order, the Jordan Sandstone, the St. Lawrence Formation dolomites, sandstones, and siltstones, the Franconia Formation sand-stones, and the Dresbach Formation sandstones, which extend down to river level.

8. Springs emerge at numerous points along the base of the cliffs bordering the river both from the limestones and the sandstones. Most are thought to issue from the limestone of the uplands, and their volumes are generally small.

9. The Mississippi Valley gorge is entrenched into the lowermost Cambrian-period rock, the Dresbach Formation. The unit is composed of marine-deposited quartz sandstones. The sandstones are relatively easy to erode which accounts for the wide, U-shaped geometry of the bedrock gorge. Older Precambrian sedimentary and crystalline rocks lie below the Dresbach Formation and are assumed to be thousands of feet thick.

10. Peterson Lake is situated on top of alluvial deposits in the valley gorge which are locally as much as 200 feet thick. Textural analyses of soil samples and drill cuttings from borings at Lock and Dam No. 4 and from the Finger Lakes project indicate that there is little if any drift in the gorge. All the material above the bedrock surface is typical fluvial silts, sands, and gravels.

11. Three 30-foot borings taken in 1991 along the earth dam at Lock and Dam No. 4 confirmed that an abundance of poorly sorted loose sands with minor amounts of organic-rich sandy clays and silts underlie the project vicinity. Four shallow borings taken during 1992 in Peterson Lake indicated that soft clay layers exist between one and five feet below the lake bottom. Thicknesses of the clay layers varied from one boring location to another. The cohesive sediments discovered in the top thirty feet of these borings were similar in composition, and are possibly a remnant of the floodplain that existed prior to the construction of the Lock and Dam system in the 1930's.

12. **SUBSURFACE EXPLORATION:** The four borings mentioned above taken in 1992 were drilled to locate possible borrow sites for the clean sand (SP) required to construct the proposed structures. Several areas within Peterson Lake were found to have significant layers of sand. However, the decision was made to use rockfill rather than sand core for structures 1 and 7 and to use sand dredged for access to the site from the main-channel side for the other structures. The locations of these openings are shown on Figure 4 of the main report and the cross sections of the proposed structures are shown on Plates 5-5 and 5-6 in the Hydraulics Appendix (Appendix No. 5). The boring locations are shown on Plate 6-2 with actual logs shown on Plate 6-3.

13. **SETTLEMENT AND STABILITY OF THE PROPOSED STRUCTURES:** As stated above, the cross sections of the structures are shown on Plates 5-5 and 5-6 in appendix no. 5. The slopes of the proposed structures will be 1V:3H with a five foot top width. Settlement and stability are not expected to be a problem for two reasons. The Flowage Survey maps, drawn before Lock and Dam No. 4 was built, show the land in the area of the structures to be a meadow with an elevation of about 665 at that time. So it is believed that the area has been preconsolidated. Also, the height of the structures is 8.5 feet with 7 feet under the water making the amount of added stress relatively low. The settlement and stability of the proposed structures will be verified for plans and specifications with data from future borings.

14. **ROCK SOURCES:** Both rockfill and riprap are available locally. Numerous limestone and dolomite quarries have been developed in the bluffs adjacent to the Mississippi River valley. Acceptable quality rock for this project is available within a 10 to 20 mile radius of Peterson Lake.

15. **ROCK GRADATION:** The sizing of the rockfill is explained in the Appendix No. 5. The gradation as shown on Plate 6-1 and in the table below was established by making sure the gradation would be easy to produce by widening the acceptable band of the 50 percent size stone.

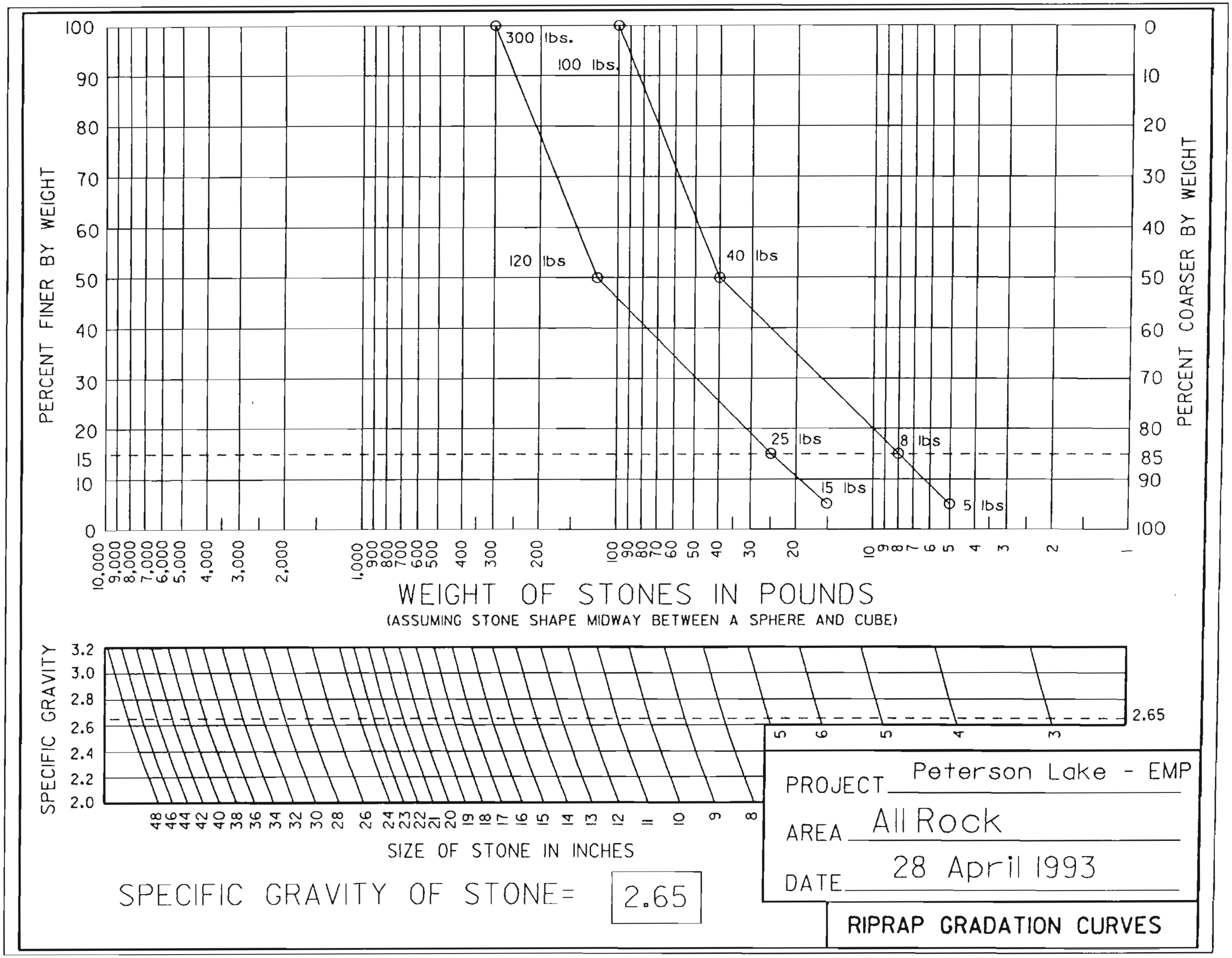
Table: Rock Gradation

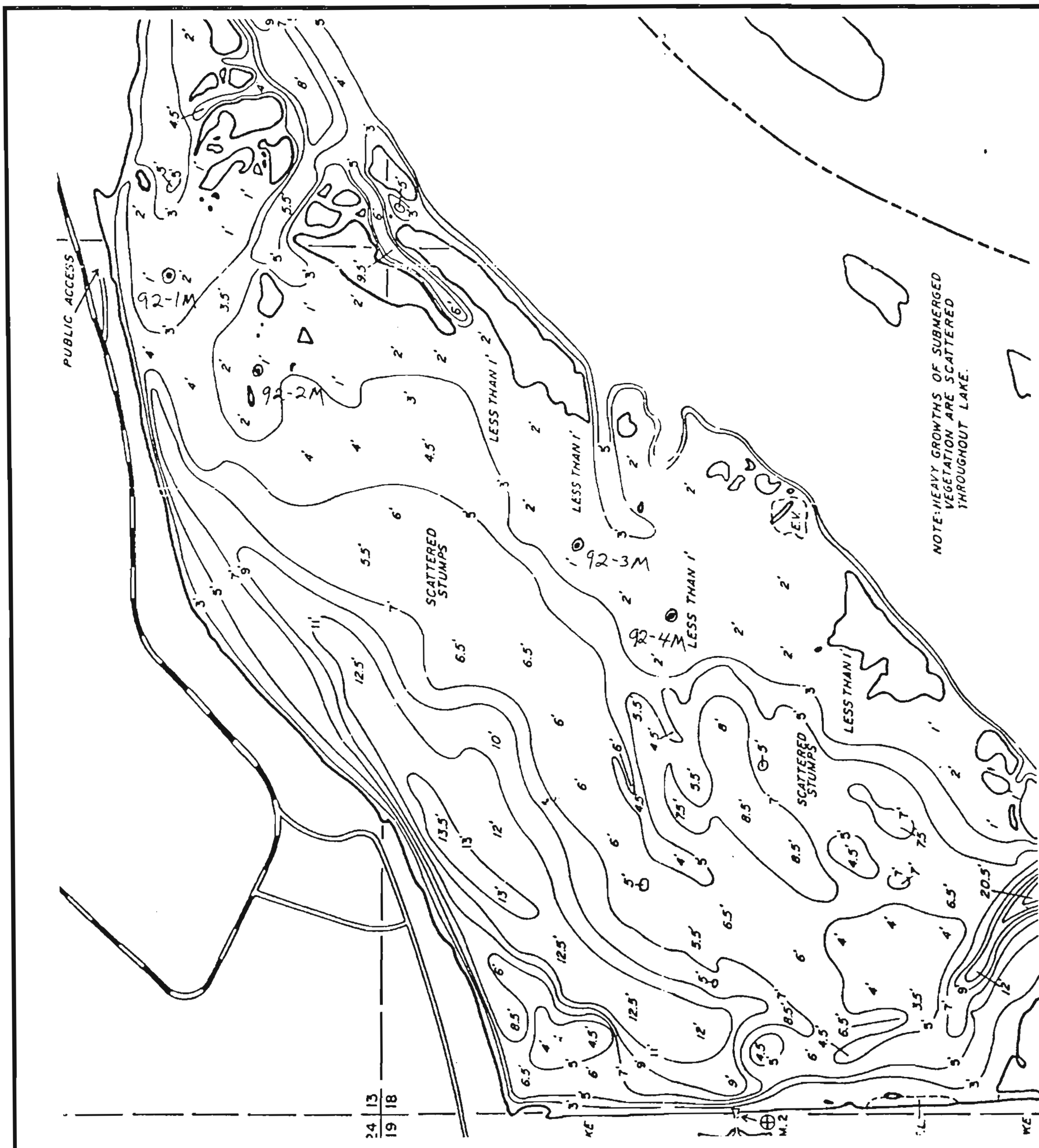
Percent Less then by Weight	Maximum	Minimum
100	300	100
50	120	40
15	25	8
5	15	5

16. **FUTURE WORK:** Borings should be taken in the areas of the proposed structures and the area of the proposed access dredging. These borings will be done in summer 1993. The data will be used to complete a stability and settlement analysis of structures and

to estimate the volume of sand that will be dredged to access the site.

PLATE 6-1


300 lbs.
100 lbs.
120 lbs
40 lbs
25 lbs
8 lbs
15 lbs
5 lbs
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
WEIGHT OF STONES IN POUNDS
(ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE)
SPECIFIC GRAVITY
2.65
SIZE OF STONE IN INCHES
SPECIFIC GRAVITY OF STONE= 2.65
PROJECT Peterson Lake - EMP
AREA All Rock
DATE 28 April 1993
RIPRAP GRADATION CURVES

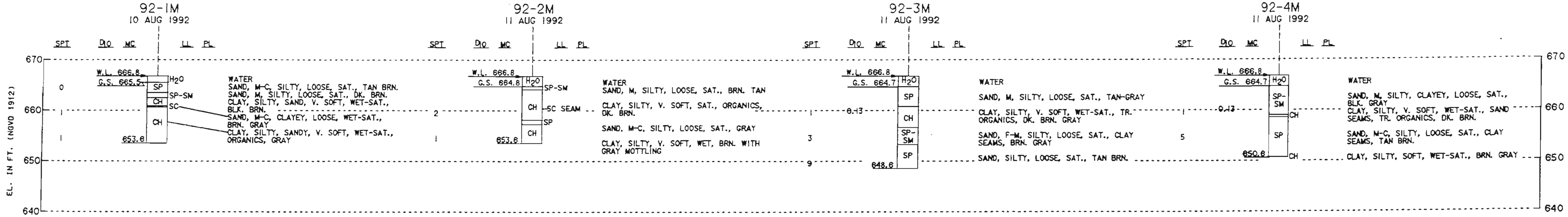


Peterson Lake EMP

Boring Location Map

HREP/EMP

Plate 6-2



NOTES (92-1M)
1. SET 4" CASING TO EL. 658.6.
2. ELEVATIONS DETERMINED FROM POOL 4 WATER SURFACE. (EL. 666.78)
3. PULLED CASING AND ALLOWED HOLE TO CAVE.

NOTES (92-2M)
1. SET 4" CASING TO EL. 658.6.
2. ELEVATIONS DETERMINED FROM POOL 4 WATER SURFACE. (EL. 666.78)
3. PULLED CASING AND ALLOWED HOLE TO CAVE.

NOTES (92-3M)
1. SET 4" CASING TO EL. 658.6.
2. ELEVATIONS DETERMINED FROM POOL 4 WATER SURFACE. (EL. 666.78)
3. PULLED CASING AND ALLOWED HOLE TO CAVE.

NOTES (92-4M)
1. SET 4" CASING TO EL. 653.6.
2. ELEVATIONS DETERMINED FROM POOL 4 WATER SURFACE. (EL. 666.78.)
3. PULLED CASING AND ALLOWED HOLE TO CAVE.

GENERAL BORING LEGEND

84-1M	YEAR OF BORING-BORING NUMBER, BORING TYPE (EG: M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER).
1 MAY 1984	DATE OF BORING
G.S. 1020.2	GROUND SURFACE ELEVATION AT BORING
GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURE, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS, LIQUID LIMIT LESS THAN 50
MH	INORGANIC SILTS, LIQUID LIMIT GREATER THAN 50
CL	INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY, LIQUID LIMIT LESS THAN 50
CH	INORGANIC CLAYS, HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
OL	ORGANIC SILTS OR CLAYS, LOW PLASTICITY, LIQUID LIMIT LESS THAN 50
OH	ORGANIC SILTS OR CLAYS, MEDIUM TO HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
PT	PEAT
SP-SM	BORDERLINE MATERIAL
SP& SM	STRATIFIED MATERIAL
1	LOCATION AND SAMPLE NUMBER FOR UNDISTURBED SAMPLE
☒	NO RECOVERY
W.L. 726.7	WATER LEVEL ON DATE OF BORING
700.0	ELEVATION AT BOTTOM OF BORING

GENERAL BORING NOTES

1. GENERAL : THE UNIFIED SOIL CLASSIFICATION SYSTEM IS USED TO IDENTIFY BASIC SOIL TYPE. THE LEGEND REPRESENTS ONLY THE BASIC SOILS. TO COMPLETE THE CLASSIFICATION, PERTINENT INFORMATION IS ADDED TO THE RIGHT OF THE BORING STAFF. NOTES PERTAINING TO A SPECIFIC BORING ARE SHOWN BELOW THE BORING STAFF.

2. MOISTURE CONTENT: THE NATURAL MOISTURE CONTENT IN PERCENT OF DRY WEIGHT (MC) IS SHOWN TO THE LEFT OF THE BORING STAFF.

3. BLOW COUNT (SPT): BLOW COUNTS ARE SHOWN TO THE LEFT OF THE BORING STAFF AND, EXCEPT AS NOTED, ARE THE NUMBER OF BLOWS NECESSARY TO DRIVE THE SAMPLER USED A DISTANCE OF 12". STANDARD BLOW COUNTS ARE FOR A STANDARD PENETRATION TEST (SPT) USING A 1-3/8" X 2" SAMPLER, 140 LB. HAMMER AND A 30" DROP. FOR NON-STANDARD BLOW COUNTS, SAMPLER SIZE, HAMMER WEIGHT AND HEIGHT OF DROP ARE AS SHOWN.

4. ATTERBERG LIMITS: LIQUID LIMIT (LL) AND PLASTIC LIMIT (PL) ARE SHOWN TO THE RIGHT OF THE BORING STAFF.

5. D_{10} SIZE: THE GRAIN SIZE IN MILLIMETERS OF WHICH 10% OF THE SAMPLE IS FINER IS SHOWN TO THE LEFT OF THE BORING STAFF.

6. THE BORINGS SHOW SUMMARIES OF INFORMATION RECORDED ON THE ORIGINAL FIELD LOGS. THESE LOGS ARE AVAILABLE FOR INSPECTION AT THE ST. PAUL DISTRICT OFFICE. ARRANGEMENTS TO INSPECT LOGS CAN BE MADE BY CALLING (612) 220-0599.

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

APPROVING OFFICIAL:

DEFINITE PROJECT REPORT
PETERSON LAKE, MINNESOTA
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL #4 WASHINGTON COUNTY, MN

GEOLOGICAL DATA
BORING LOGS
92-1M THRU 92-4M

DESIGNED:
CHECKED:
DRAWN:
DESIGNED: JJF/PAW
CHECKED: JJF
DATE: MAY 1993
CAD FILE NAME: peters01.dgn
SPEC NO: DACW37-93-B-0000
DRAWING NUMBER: 1
SHT 1 OF 1

Plate 6-3

ATTACHMENT 7

WATER QUALITY APPENDIX

This appendix presents the water quality data and analysis for the Peterson Lake HREP project. Section one lists the raw water quality data collected by the Minnesota Department of Natural Resources (MDNR) and Minnesota Field Station for the Long Term Resource Monitoring Program. Winter in situ data including dissolved oxygen, water temperature, and current velocity were collected at several stations throughout Peterson Lake. Chemical data were collected at two permanent Peterson Lake stations and at a nearby permanent Mississippi River station. Sample collection and analysis was conducted according to standard limnological techniques and instrumentation as specified in the USFWS EMTC procedures manual. Monitoring objectives were determined in early coordination meetings involving the various agencies. Objectives included documenting current winter habitat conditions involving dissolved oxygen, temperature, and current velocity. These objectives were met for Peterson Lake.

The St. Paul District has characterized the water quality of Peterson Lake using the above water quality data (section two). Dissolved oxygen data were incorporated into a mass balance dissolved oxygen model to determine the flow required through Peterson Lake to maintain adequate dissolved oxygen for fisheries habitat during ice cover. Modeling assumptions and procedures are described in the Dissolved Oxygen Mass Balance Section.

In February 1983, District personnel conducted a dye study to observe existing mixing and flow patterns in Peterson Lake (section three). The study indicated the extent of mixing that occurs under existing conditions for flows entering through cut 8, the major avenue of flow for the central cuts. Under the selected plan, A3-MEI, flows into the upper portion of the lake will be reduced. As part of the Finger Lakes project, additional culverts will be installed to supply flow from Peterson Lake to some of the Finger Lakes. These changes will allow flows entering through cut 8 to mix with a greater portion of Peterson Lake than currently occurs. The extent of this mixing may be largely dependent on flow through the culverts into the Finger Lakes.

With the proposed plan, dissolved oxygen will continue to be introduced into the upper portion of the lake through cut 5, and the portion of the lake through cuts 8 and 9. Additional flow may be contributed through the lower cuts (10-13). The locations of the inlets should provide a corridor of adequate DO with lower current velocities than currently exists.

Section One

1992 and 1993 Winter Water Quality Monitoring Data

PETERSON LAKE WINTER 1992 WATER QUALITY MONITORING

SITE	DATE	TIME	ICE (cm)	SNOW (cm)	SNOW (%)	WATER DEPTH (cm)	SAMPLE DEPTH (cm)	D.O (mg/l)	TEMP (C)	VEL (m/s)	VEL (dir)
1S	1-31-92	1300	12	0	20	86	20	12.6	.3	---	---
1B							66	12.6	.3	0.12	10 deg
14S	1-31-92	1340	10	0	70	120	20	12.6	.3	0.13	360 deg
14B							100	12.6	.3	0.35	360 deg
12S	1-31-92	1410	19	0	90	343	20	12.0	.1	0.22	330 deg
12B							323	12.1	.1	0.33	330 deg
6S	1-31-92	1430	20	0	80	185	20	12.4	.5	0.32	340 deg
6B							165	12.5	.5	0.30	340 deg
7S	1-31-92	1445	25	0	80	181	20	12.8	.8	0.14	350 deg
7B							161	12.8	.8	0.27	350 deg
12S	2-6-92	1330	12	0	5	345	20	13.2	.7	0.05	330 deg
12B							325	13.2	.7	0.03	330 deg
2S	2-6-92	1413	0	0	0	85	20	13.9	.9	0.27	5 deg
2B							65	14.0	.9	0.18	5 deg
3S	2-6-92	1420	0	0	0	225	20	13.6	.9	0.38	30 deg
3B							205	13.7	.9	0.30	30 deg
4AS	2-6-92	1440	10	0	0	158	20	14.5	.9	0.26	320 deg
4AB							138	14.4	1.0	0.22	320 deg
5BS	2-6-92	1450	8	0	0	130	20	13.8	.9	0.18	10 deg
5BB							110	13.8	1.0	0.18	10 deg
7S	2-6-92	1500	14	0	0	110	20	13.5	.9	0.19	352 deg
7B							90	13.6	.9	0.18	352 deg
8S	2-6-92	1520	0	0	0	355	20	13.9	.9	0.42	260 deg
8B							335	14.0	.9	0.23	260 deg
9S	2-6-92	1530	6	0	0	135	20	13.7	.2	0.16	325 deg
9B							115	13.7	.4	0.16	325 deg

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

PHONE NO. (612) 345-3331 FILE NO.

Section of Ecological Services
1801 South Oak St.
Lake City, MN 55041
March 29, 1993

Mr. Daniel Wilcox
Environmental Resources Branch
St. Paul District, U.S Army Corps of Engineers
1421 U.S. Post Office and Customs House
St. Paul, MN 55101

Dear Mr. Wilcox:

Field staff at Lake City have completed winter dissolved oxygen (DO), temperature, current velocity, and discharge measurements in the Peterson Lake HREP area of Mississippi River Navigation Pool 4 as outlined in the Scope Of Work. A description of methods, summaries of data, and discharge calculations follow:

WINTER DO, TEMPERATURE, AND CURRENT VELOCITY MEASUREMENTS

METHODS

Dissolved oxygen and temperature were measured with a YSI meter, model 57 equipped with a 5739 oxygen probe and thermistor, air calibrated prior to each days efforts and periodically throughout the day. Current velocity was measured using a Marsh-McBirney electromagnetic velocity meter and probe, and current direction was determined with a compass. Ice thickness, snow thickness, and water column depth were measured with a wood or fiberglass staff demarcated in centimeters and tenths of feet. All data were recorded on standard forms provided by the Corps of Engineers.

Sites were located using the map provided and GPS coordinates were recorded for all locations on the first field trip.

DATA SUMMARY

Peterson Lake was visited three times during the winter: January 14, February 11, and March 5, 1993.

January 14, 1993

Fifteen sites were sampled on this date. DO levels ranged from 11.9 to 12.5 mg/L.

Water temperatures were 0.0 degrees centigrade at all sites and depths.

Velocity ranged from 0.0 ft/s at sites 9 and 11, and near bottom at site 10 (all next to the dike), to 0.32 ft/s near bottom at site 3 (inlet channel). No unusual current directions were measured.

Snow cover was 100% at all sites while snow depth ranged from 18 to 28 cm. Ice thickness ranged from 13 to 28 cm. Cloud cover varied from 30 to 100% during the day.

February 11, 1993

Fourteen sites were monitored on this date. DO ranged from 9.5 to 12.0 mg/L. However, the DO meter was recalibrated near midday to adjust for an apparent drift toward lower readings. Thus DO probably did not actually decrease from early morning to noon.

Water temperatures were 0.0 degrees Centigrade at all sites.

Velocity ranged from 0.0 at sites 5 and 9 to 0.30 ft/s at site 3.

Snow cover was 100% at all sites. Snow depth ranged from 1 to 4 cm. Ice thickness ranged from 17 to 45 cm.

March 5, 1993

Twelve sites were sampled on this date, as two sites were not accessible due to poor ice conditions. DO ranged from 13.0 to 13.8 mg/L.

Water temperatures were 0.0 degrees Centigrade at all sites.

Velocity ranged from 0.02 ft/s at site 9 to 0.31 at site 14.

Snow cover was at or near 100% at all sites. Snow depth ranged from 2 to 15 cm. Ice thickness ranged from 6 to 58 cm.

WINTER DISCHARGE MEASUREMENTS

Winter discharge measurements of flows into Peterson Lake inlets have been completed by the Minnesota Department of Natural Resources in accordance with the Corps of Engineers Scopes of Work dated December 30, 1992. Data summaries, discharge calculations, cross-sections and a transect location map are attached.

METHODS

Transects were flagged in the field as identified in the Scopes of Work. Holes were chipped in the ice at evenly spaced intervals from the upstream shore (in reference to the main channel flow direction) perpendicular to the inlet shoreline. Transects were terminated when land was encountered or the ice reached the inlet bottom. Depending on the total width of the individual inlet, between 10 and 20 discharge measurements were taken. Transects thought to contribute non-significant flow to Peterson Lake were investigated with fewer discharge measurement holes. A graduated 12 foot wooden pole was used to measure total depths and ice thickness. Effective depth was calculated by subtracting the ice thickness from the total depth. Discharge measurements were made at 6/10s effective depth by sliding the Marsh-McBirney 201D flow meter transducer to the appropriate location on the graduated pole. All information was recorded on field data sheets. The flow meter calibration was checked before, during and after each day in the field.

Discharge measurements for all transects were made on January 7 and 8, 1993. Inlets 6, 10, 11, 12, and 13 contributed less than 10 cfs each in January and were not remeasured on February 19, 1993.

Field data was entered into a Lotus 123 spreadsheet to present the information and complete the necessary calculations. The following USGS general equation was used to calculate discharge values for each partial section.

$$q_x = v_x[b_{(x-1)} - b_{(x+1)}/2]d_x$$

Discharge within each partial section (q_x) was calculated by multiplying the partial section width ($b_{(x+1)}-b_{(x-1)}/2$) x effective depth (d_x) x flow velocity (v_x) x .92 (USGS coefficient for under ice velocity measurements). Discharge for all partial sections within each inlet were then summed to determine total discharge through the individual inlet. The effective depths and flow velocities were estimated for border partial sections greater than 5 feet in width.

Flow directions in Inlet 9 on February 19, 1993 changed from zero flow, to flow into the lake, to flow parallel to the transect, to flow out of the lake as discharge was measured across the transect (upstream to downstream). This would suggest that the inlet was partially blocked due to the thick ice conditions and that flows were hooking around within the inlet. Therefore, the total discharge calculated for Inlet 9 on February 19, 1993 may not accurately reflect the amount of water entering Peterson Lake at that location. All other discharge measurements are believed to accurately reflect the flow conditions on the days measured.

It is our understanding that this report fulfills our obligation to the U.S. Army Corps of Engineers.

Sincerely,

Walt Popp

Walt Popp
Team Leader,
Pool 4 LTRM Field Station

WP/sj-md

enclosures

cc. Scot Johnson, Mississippi River Hydrologist w/o enclosures
Mike Davis, Ecological Services w/o enclosures

WATER QUALITY DATA FORM

WINTER HREP MONITORING

PROJECT AREA	PETERSON LAKE
DATE	1/14/93
FIELD CREW	DAVIS/DIETERMAN
% CLOUD COVER	100-60% AM, 30-50% PM

LOCATION	TIME	ICE (cm)	SNOW (cm)	SNOW (%)	WATER DEPTH (cm)	SAMPLE DEPTH (cm)	D.O. (mg/l)	TEMP. (C)	VELOCITY (FT/S)	VELOCITY (DIR °)
1	0915	20	24	100	90	40	12.5	0	.28	335
						70	12.5	0		
2	0930	21	25	100	125	41	12.4	0	.24	10
						100	12.4	0		
3	0945	13	18	100	182	33	12.5	0	.30	14
						162	12.4	0	.32	
4A	1015	20	20	100	208	40	12.4	0	.24	310
						95	12.4	0	.25	310
						188	12.4	0	.25	310
4B	1045	28	25	100	138	45	12.4	0	.02	60
						118	12.2	0		
5	1120	23	23	100	170	43	12.4	0	.02	35
						150	12.5	0		
6	1210	27	24	100	215	47	12.2	0	.04	325
						105	12.2	0	.04	325
						195	12.2	0	.04	325
7	1230	27	23	100	140	47	12.2	0	.03	345
						120	12.2	0		
8	1250	27	22	100	720	47	12.2	0	.12	280
						350	12.2	0	.13	290
						700	12.2	0		
9	1310	27	22	100	158	47	12.2	0	0	
						138	12.2	0	0	
10	1335	27	28	100	247	47	12.2	0	.02	320
						227	12.2	0	0	
11	1355	21	27	100	137	41	12.2	0	0	
						117	12.1	0	0	
12	1410	25	24	100	330	45	12.2	0	.03	10
						165	12.2	0		
						310	12.2	0		
13	1430	27	22	100	255	47	12.0	0	.11	340
						120	11.9	0	.13	340
						235	11.9	0	.07	340
14	1450	22	26	100	140	42	12.0	0		
						120	12.0	0	.28	340

WATER QUALITY DATA FORM

WINTER HREP MONITORING

PROJECT AREA	PETERSON LAKE
DATE	2/11/93
FIELD CREW	DAVIS/STOPYRO
% CLOUD COVER	100%

LOCATION	TIME	ICE (cm)	SNOW (cm)	SNOW (%)	WATER DEPTH (cm)	SAMPLE DEPTH (cm)	D.O. (mg/l)	TEMP. (C)	VELOCITY (FT/S)	VELOCITY (DIR °)
1	0950	22	4	100	80	42	12.0	0	.23	0
2	1010	22	3	100	112	42	11.5	0	.22	0
						92	11.3	0	.13	0
3	1020	17	4	100	140	37	11.8	0	.30	35
						120	11.4	0	.28	35
4~~B~~A	1035	45	3	100	125	65	11.3	0	.05	45
						105	11.2	0	.03	45
5	1045	38	3	100	146	58	11.2	0	0	
						126	11.2	0	0	
6	1100	31	4	100	190	51	11.3	0	.06	295
						170	11.2	0	.03	295
7										
8	1130	38	1	100	590	58	9.5	0	.03	280
						300	9.5	0	.02	280
						570	9.5	0		
9	1145	45	3	100	205	65	9.8	0	0	
						185	9.8	0	0	
10	1210	44	4	100	287	64	11.9	0	.05	330
						267	11.9	0		
11	1240	37	4	100	140	57	11.8	0	.03	300
						120	11.8	0		
12										
13	1335	39	2	100	301	59	11.3	0	.20	320
						281	11.1	0		
14	1350	25	4	100	140	45	12.0	0	.20	315
						120	11.9	0		

WATER QUALITY DATA FORM

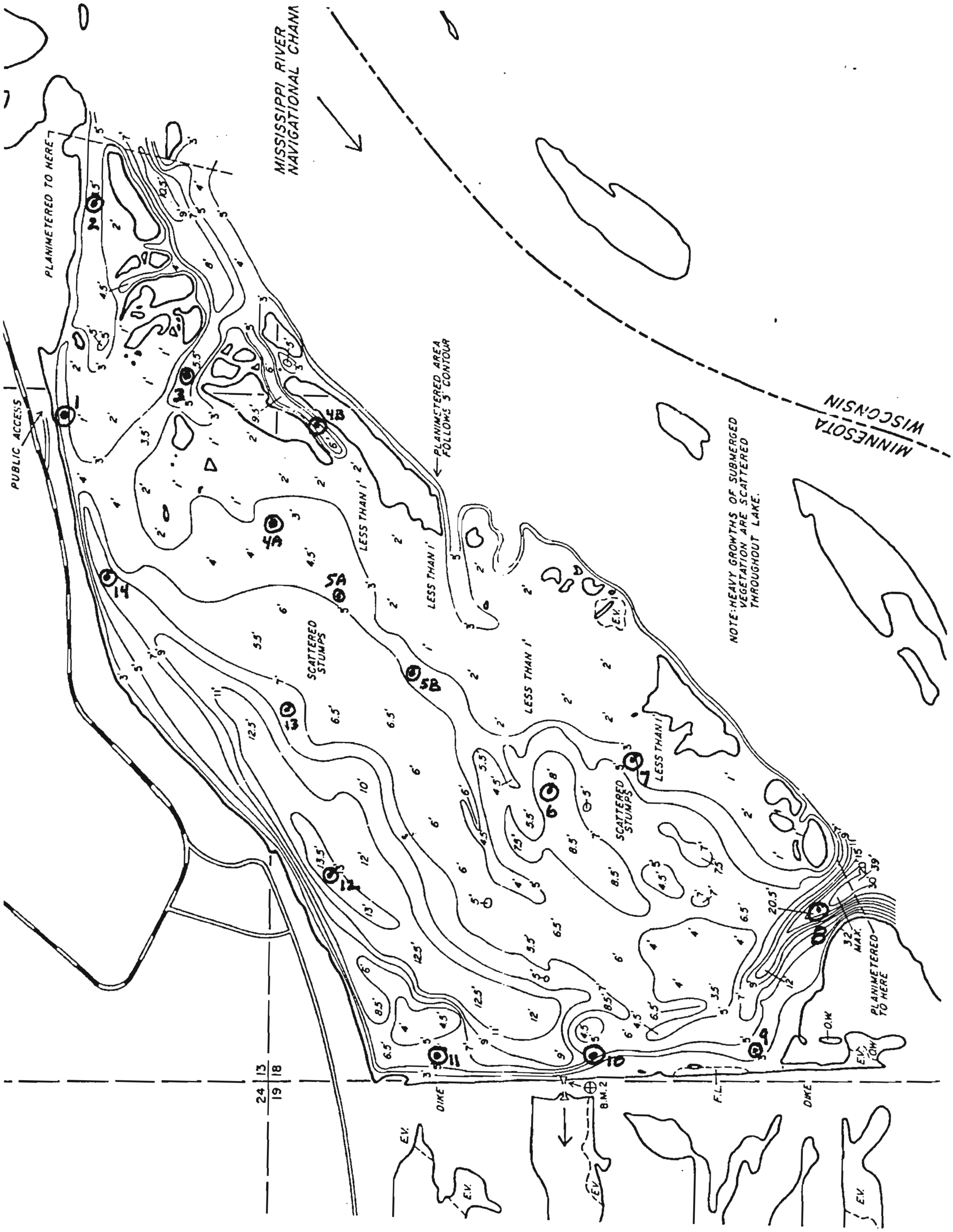
WINTER HREP MONITORING

PROJECT AREA	PETERSON LAKE
DATE	3/05/93
FIELD CREW	DIETERMAN/SOGLA
% CLOUD COVER	0%

LOCATION	TIME	ICE (cm)	SNOW (cm)	SNOW (%)	WATER DEPTH (cm)	SAMPLE DEPTH (cm)	D.O. (mg/l)	TEMP. (C)	VELOCITY (FT/S)	VELOCITY (DIR °)
1	0820	30	9	100	85	80	13.6	0	.21	345
2	0835	9	2	100	92	80	13.5			
3	poor ice									
4A	0930	58	6	100	131	110	13.6	0		
4A						50	13.6	0	.08	42
4B	poor ice									
5A	0945	52	15	100	165	150	13.4	0		
5A						70	13.4	0	.02	200
5B	1000	46	15	100	143	100	13.8	0	.11	10
6	1015	43	9	100	183	160	13.6	0		
6						80	13.4	0	.09	325
8	1040	46	6	100	1000	702	13.5	0	(velocity	measured at
8						458	13.5	0	214 cm)	
8						100	13.5	0	.14	270
9	1050	58	9	100	230	220	13.0	0		
9						130	13.1	0		
9						70	13.1	0	.02	270
10	1100	55	9	100	310	240	13.2	0		
10						100	13.2	0	.03	340
11	1115	52	6	100	159	140	13.2	0		
11						70	13.5	0	.04	280
13	0915	58	3	100	220	210	13.3	0		
						110	13.2	0	.10	317
14	0845	6	2	95	159	80	13.6	0	.31	10

UMT Coordinates - Peterson Lake
Waters Quality Sites

1	5-83-350 E 15 49-09-563 N
2	5-83-368 E 15 49-09-905 N
3	5-83-630 E 15 49-09-747 N
4A	5-83-935 E 15 49-09-622 N
4B	5-83-778 E 15 49-09-259 N
5	5-84-016 E 15 49-08-998 N
6	5-84-511 E 15 49-08-726 N
7	
8	5-85-115 E 15 49-08-456 N
9	5-85-038 E 15 49-08-219 N
10	5-84-545 E 15 49-08-146 N
11	5-84-175 E 15 49-08-198 N
12	
13	5-83-519 E 15 49-09-293 N
14	5-83-429 E 15 49-09-398 N



Winter Water Quality Monitoring Stations

Section Two

Mass Balance of Dissolved Oxygen Analysis

PETERSON LAKE
MASS BALANCE OF DISSOLVED OXYGEN

OVERVIEW

Peterson Lake is a backwater lake which receives substantial flows from the Mississippi River. These flows introduce suspended sediments into the lake and create current velocities in excess of those desirable for target fish habitat. Several closure alternatives are being considered which would reduce suspended sediment loading to the lake and maximize the winter fishery habitat. The Water Quality Unit has been asked to determine the quantity of flow required from the Mississippi River into Peterson Lake to maintain adequate dissolved oxygen for fish habitat during winter ice cover.

To determine the required inflow of Mississippi River water to aerate Peterson Lake the Water Quality Unit developed a mass balance Lotus spreadsheet dissolved oxygen (DO) model. The model predicts dissolved oxygen concentrations at the outlet of Peterson Lake given an inflow rate and initial dissolved oxygen concentration. Inflows are routed through the lake while undergoing oxygen depletion. The model allows different inflows, winter oxygen depletion rates (WODR), and initial dissolved oxygen situations to be modeled. The following assumptions were adopted for the modeling:

1. Lake volume is 2711 acre ft.

2. inflow will effectively disperse within Peterson Lake.

3. inflow DO is 10 mg/l.

4. winter oxygen depletion rate (WODR) is .24 mg/l day. WODR includes sediment and water column oxygen demand.

5. Over time Peterson Lake will resemble a shallow midwestern winterkill lake (if no inflow allowed).

6. photosynthesis is non-existent during ice cover.

RIVER DISSOLVED OXYGEN

LTRM data for the Mississippi River and Peterson Lake was used to characterize inflow DO during the winter. Dissolved oxygen at four stations was reviewed. Two stations were upstream of Peterson Lake (LTRM stations M761.5E and M760.7) and two stations were in Peterson Lake (LTRM stations M753.2S and M753.2V). Winter dissolved oxygen levels were above 10 mg/l on all sampling dates at every station. As a check, dissolved oxygen levels in Peterson Lake during the winters of 1991 and 1992 were reviewed. Both Peterson Lake stations exhibited dissolved oxygen above 10 mg/l on all sampling dates.

WINTER OXYGEN DEPLETION RATE

Calculation of a winter oxygen depletion rate (WODR) was accomplished using methods from "Oxygen Demand in Ice Covered Lakes as it Pertains to Winter Aeration", by Christopher Ellis and Heinz Stephan. It was assumed that flow would disperse and not disrupt the sediment-water interface. The resulting WODR using this method was found to be 0.24 gr/m^2 day.

OTHER CONSIDERATIONS

Below Peterson Lake is the Finger Lakes Chain of Lakes. Peterson Lake and the Finger Lakes are separated by the Lock and Dam 4 dike. Several gated culverts are planned to be installed through the dike connecting Peterson Lake to the Finger Lakes Chain. The culverts are intended to introduce oxygen laden water from Peterson lake into the Finger Lakes Chain. The actual flow rate required into Finger Lakes has not been determined at this time, but will depend on the inflow dissolved oxygen from Peterson Lake. It has been assumed that turbulence at the culvert outlets will produce open water areas where aeration of the inflow will occur. In any case the inflow to Peterson Lake must be at least as great as the required inflow to the Finger Lakes.

RESULTS

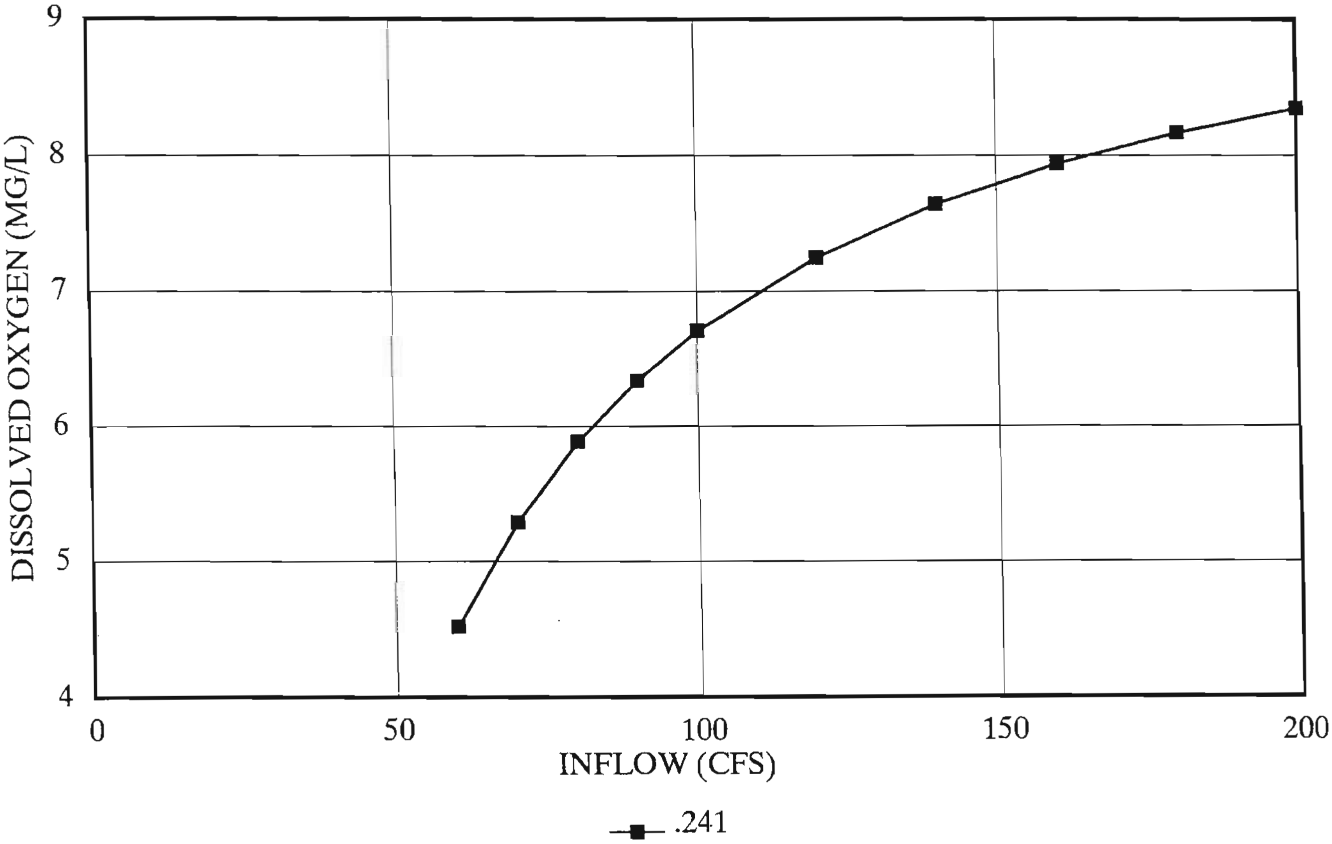
Based on field observations, literature values, and the assumptions of this analysis, it is estimated that approximately 70 cfs will be required to provide suitable dissolved oxygen levels in Peterson Lake. It should be noted that this value is approximate and may vary from year to year. This value does not ensure that low dissolved oxygen will not occur in Peterson Lake. It should however ensure that some areas of Peterson Lake will have adequate dissolved oxygen to support resident fisheries.

RECOMMENDATIONS

It is recommended that post project monitoring of Peterson Lake be accomplished. Post project monitoring should include insitu measurements of dissolved oxygen, pH, conductivity, and temperature, as well as nutrient and Chlorophyll A samples. Monitoring should also include flow measurements and tracking to document actual mixing conditions in the lake. The same monitoring should also be accomplished in the Finger Lakes with special attention given to the inflow dissolved oxygen concentrations and oxygen depletion through the lake chain.

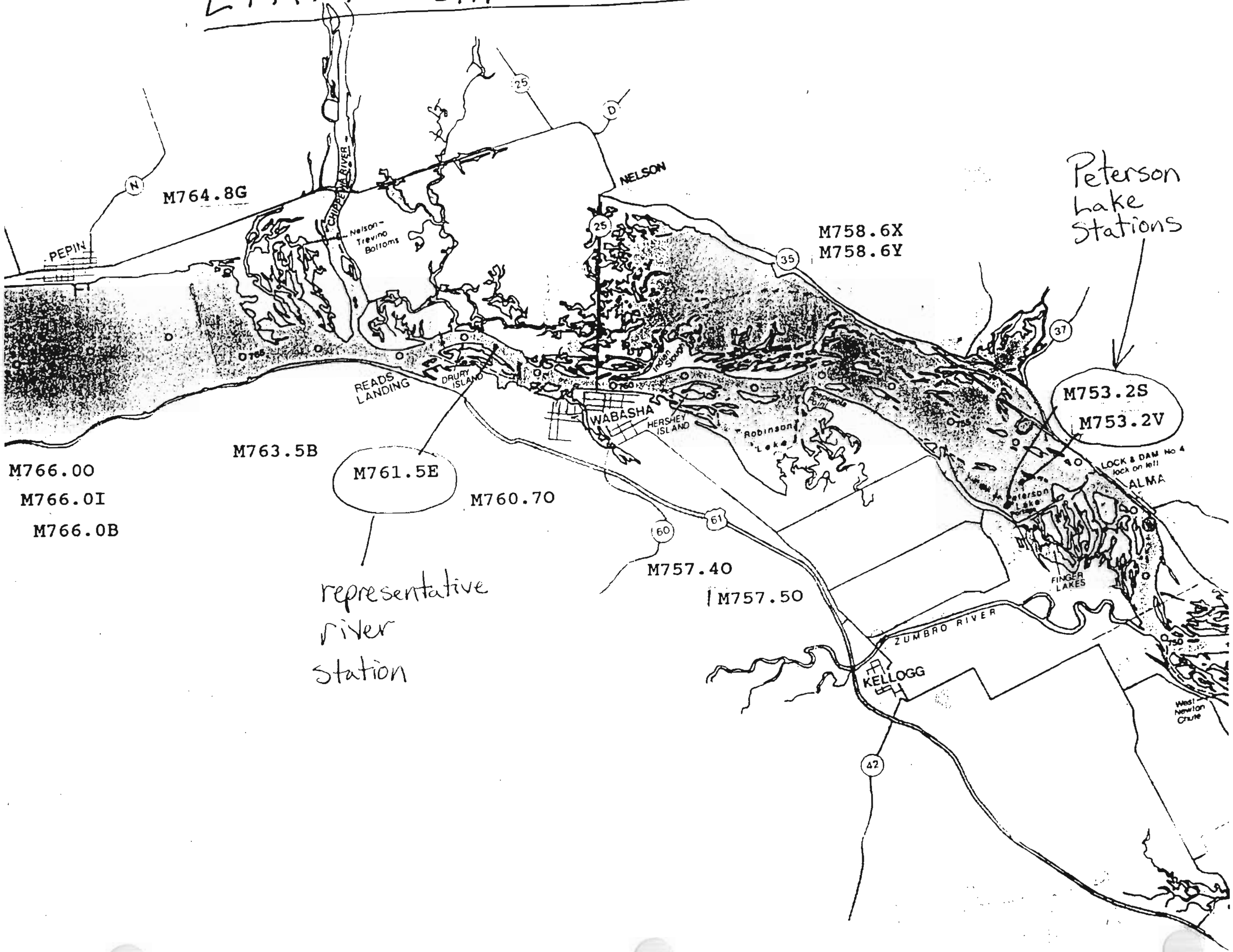
PETERSON LAKE HREP

ENTIRE LAKE VOLUME DO PREDICTION



WINTER OXYGEN DEPLETION RATE (WODR) IS 0.241 GR/M ^ 2 DAY

LTRM - STATION LOCATIONS



Section Three

Peterson Lake Dye Study

CENCS-ED-GH

MEMORANDUM FOR RECORD

SUBJECT: PETERSON LAKE HREP DYE STUDY

1. On 18 and 19 February, 1993 Dennis Holme, Jim Sentz, Mark Rodney, and Farley Haase of the U. S. Corps of Engineers conducted a dye tracking study of Peterson Lake, directly above the Lock and Dam 4 dike. The purpose of the study was to observe mixing and flow patterns of water entering Peterson Lake through cut 8.

2. On 18 February, 1993 stationing for the study was established. Five cross sections, spaced 500 feet apart and parallel to the Lock and Dam 4 dike, were laid out as shown on enclosure 1 and labeled as A, B, C, D, and E. Stationing on the cross sections was measured from a tree on the shoreline of cross section E. Sampling holes were drilled every 250 ft across each cross section and labeled as shown on enclosure 1.

3. At 0900 on 19 February 2 liters of rhodamine dye was injected into cut 8 (see enclosure 2). The injection was made into the deeper section of the cut through four holes spaced approximately 24 feet apart. Equal amounts of dye were injected into each hole. Purging of the holes was done to minimize the amount of dye remaining in the holes.

4. A monitoring tent was set up on cross section A station 6. Cross sections were sampled at various intervals during the day utilizing a four wheeled ATV and trailer. Samples were immediately returned to the monitoring tent and analyzed using a calibrated Turner Design Field Fluorometer, Model 10-AU-005. Results were recorded on a laptop computer for further analysis.

5. Existing conditions - Discharge through Lock and Dam 4 on February 19 was 16600 cfs. Flow entering Peterson lake through cut 8 was measured by the Minnesota Department of Natural Resources on February 19. Results of their monitoring were not available at this time.

6. Observations - The dye reached station 7 on cross section A in less than 1 hour. The dye then slowed considerably, not appearing at cross section C until 1600 or 7 hours after the initial injection. Generally the dye cloud remained concentrated over a narrow width. A very sharply defined leading edge was detected at cross sections A, B, and C. The trailing edge of the cloud appeared to mix somewhat more with the surrounding waters.

At cross section C the dye turned sharply toward the outlet channel (see enclosure 3). The dye plume appeared to be following a channel of deeper water toward the outlet. Sampling was discontinued due to darkness at 1730. Enclosure 3 is a plan view of the dye path and maximum recorded concentrations during the day. It is not known if the peak concentration had reached cross section C when sampling was discontinued.

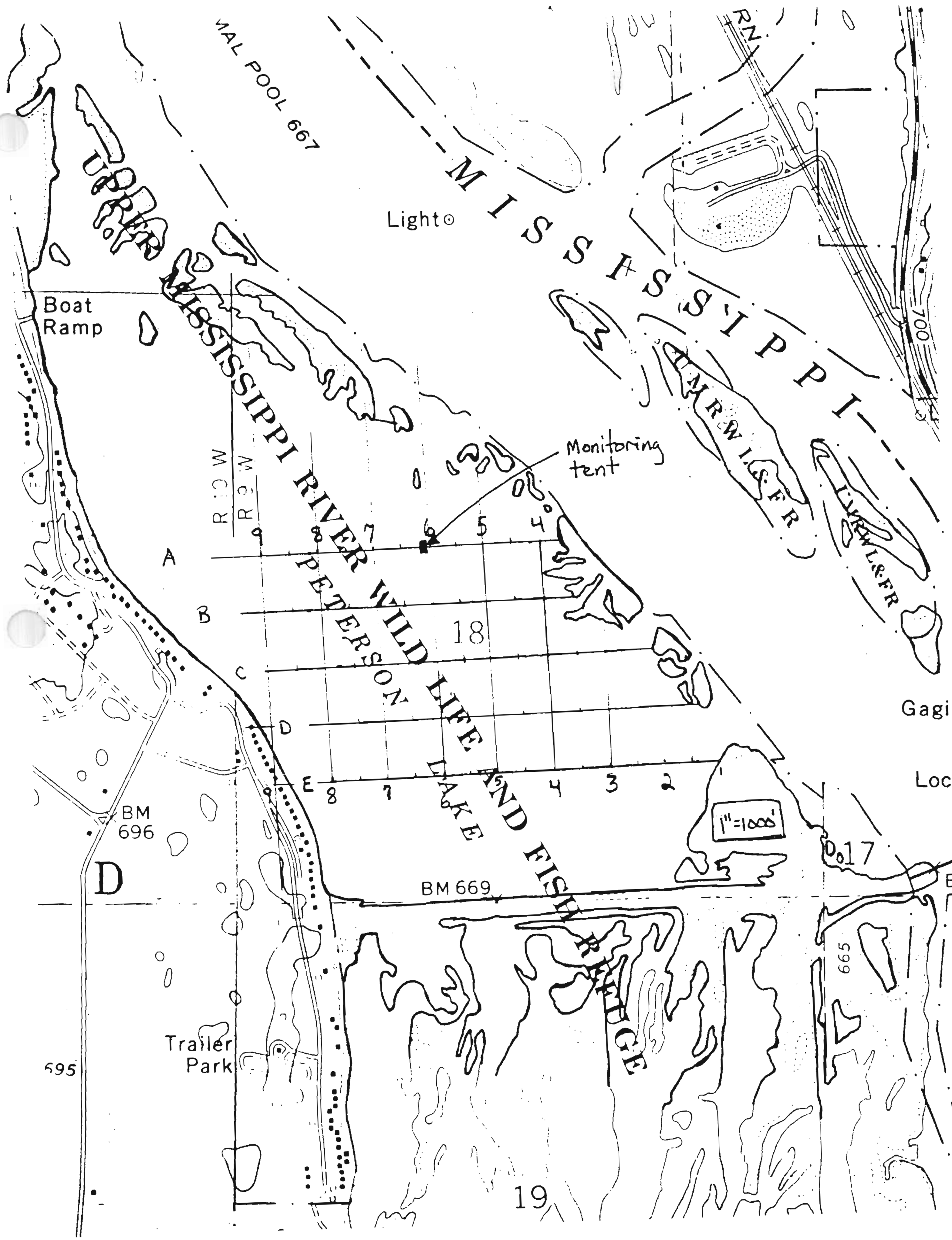
7. Conclusion - The dye appeared to follow a well defined path through Peterson Lake. Flows entering above and below the cut seemed to confine and limit lateral mixing of the flow. Flow entering through cut 8 followed a straight path across a shallow water area. Upon reaching deeper water the flow appeared to redirect towards the outlet.

Encl.

Jim Sentz
Env. Eng.
ED-GH Branch

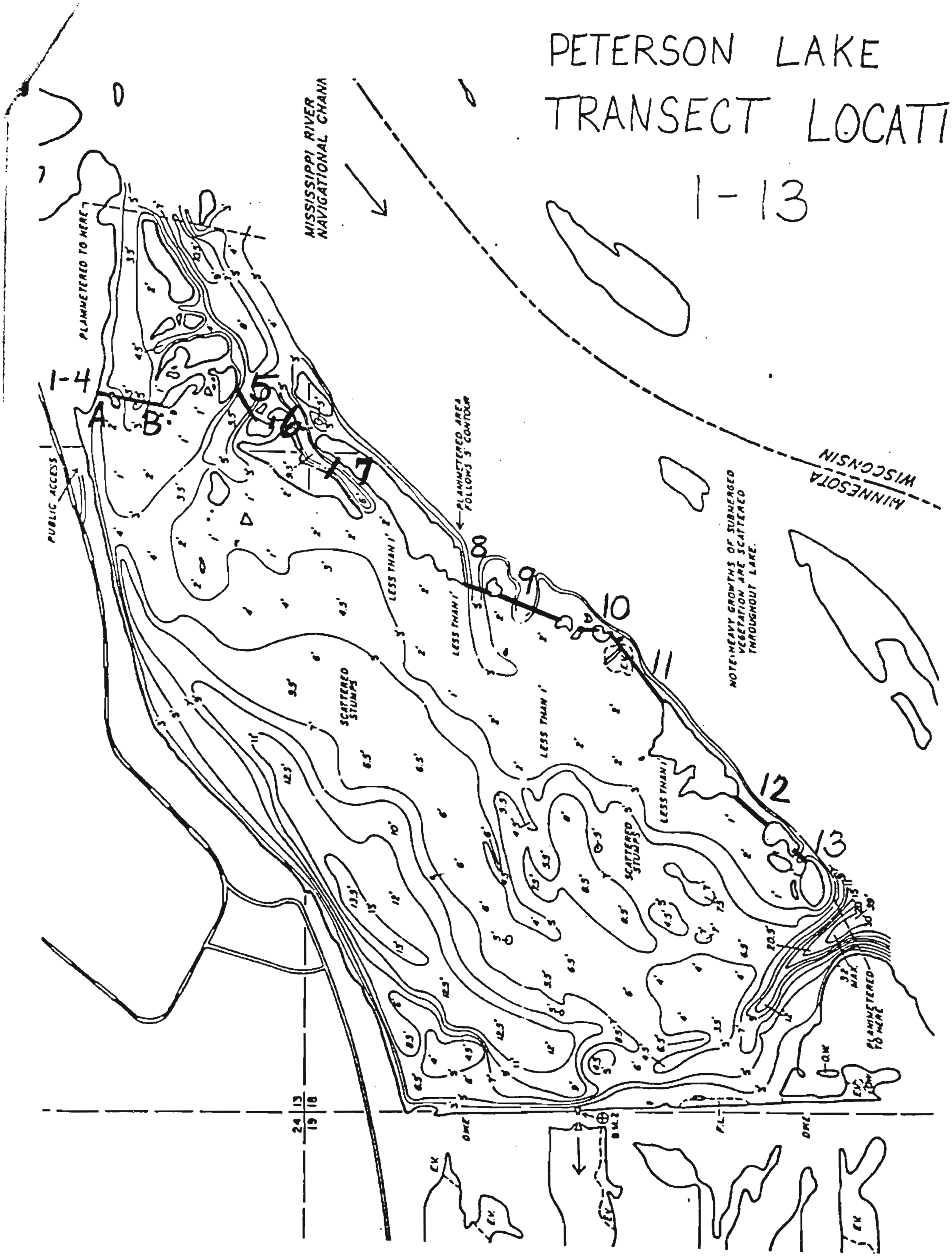
Distribution:

Gary Palesh, PD-WR
Mark Rodney, ED-GH
Joel Face, ED-GH
John Shyne, PD-ER
Sissel Johannessen, PD-ER
Jon Hendrickson, ED-GH



NAL POOL 667
MISSISSIPPI
UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE
Light
Boat Ramp
Monitoring tent
R10W
R9W
A
B
C
D
E
9 8 7 6 5 4
18
PETERSON LAKE
8 7 6 5 4 3 2 1
1"=1000'
BM 696
D
BM 669
17
Gagi
Loc
700
665
Trailer Park
695
19

PETERSON LAKE TRANSECT LOCATIONS 1-13

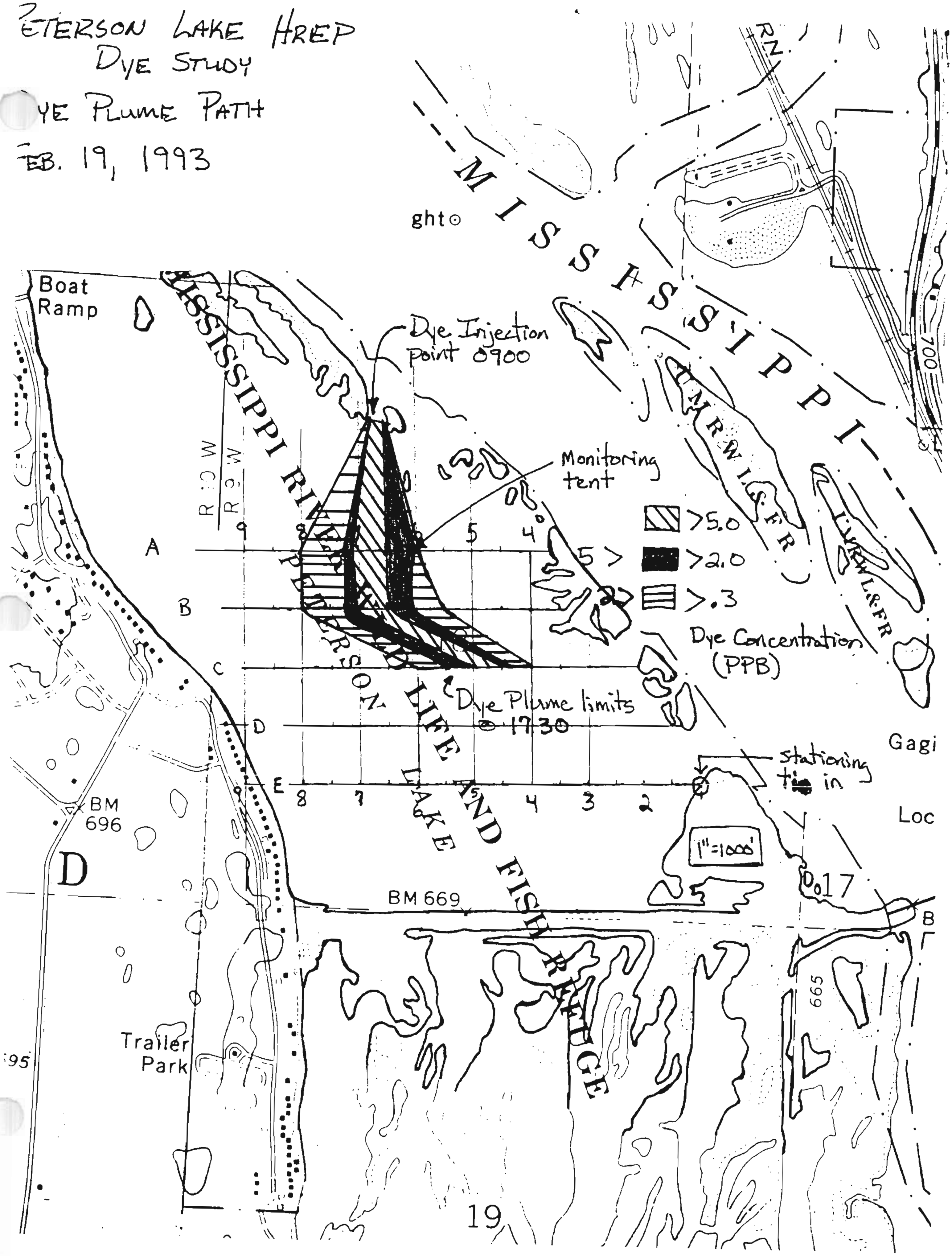


1986 Minnesota DNR Bathymetric Map

Peterson Lake HREP
Dye Study

Dye Plume Path

Feb. 19, 1993



ATTACHMENT 8

MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT
BETWEEN
THE UNITED STATES FISH AND WILDLIFE SERVICE
AND
THE DEPARTMENT OF THE ARMY
FOR
ENHANCING FISH AND WILDLIFE RESOURCES
OF THE
UPPER MISSISSIPPI RIVER SYSTEM
AT
PETERSON LAKE
WABASHA COUNTY, MINNESOTA

I. PURPOSE

The purpose of this memorandum of agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (USFWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Peterson Lake separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. The project area is managed by the USFWS and is on land managed as a national wildlife refuge. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, 100% of the construction costs of those fish and wildlife features for the Peterson Lake project are the responsibility of DOA, and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, 100% of the costs of operation and maintenance for the Peterson Lake project are the responsibility of USFWS.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of rehabilitating and improving the fish and wildlife habitat at Peterson Lake. This would involve the construction of bank stabilization on six islands, two rock side channel closures, four sand side channel closures, two rock weirs, and one rock partial side channel closure. The project would stabilize existing islands at Peterson Lake and reduce flows into the upper portion of the lake for the benefit of fish and wildlife.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction. Construction of the project consists of placement of approximately 3,500 feet of rock bank protection, and nine side channel structures of rock and/or sand.

2. Major Rehabilitation. The Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the definite project report and that is needed as a result of specific storm or flood events.

3. Construction Management. Subject to and using funds appropriated by the Congress of the United States, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, DOA will construct the Peterson Lake project as described in the Definite Project Report/ Environmental Assessment, Peterson Lake Habitat Rehabilitation and Enhancement Project, dated March 1994, applying those

procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the project, DOA will promptly notify USFWS of such delays.

4. Maintenance of Records. The DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the project to the extent and in such detail as will properly reflect total costs. The DOA shall maintain such books, records, documents, and other evidence for a minimum of three years after completion of construction of the project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the USFWS.

B. USFWS is responsible for operation, maintenance, and repair: Upon completion of construction, as determined by the District Engineer, St. Paul, the USFWS shall accept the project and shall operate, maintain, and repair the project as defined in the Definite Project Report/Environmental Assessment entitled "Peterson Lake Habitat Rehabilitation and Enhancement Project," dated March 1994, in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties.

USFWS: Regional Director
U.S. Fish and Wildlife Service
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, Minnesota 55111-4056

DOA: District Engineer
U.S. Army Corps of Engineers, St. Paul District
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

BY: ______________________
(signature)

JAMES T. SCOTT
Colonel, Corps of Engineers
St. Paul District

DATE: ______________________

THE U.S. FISH AND WILDLIFE SERVICE

BY: ______________________
(signature)

SAM MARLER
Regional Director
U.S. Fish and Wildlife Service

DATE: ______________________

ATTACHMENT 9

PERFORMANCE EVALUATION PLAN

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
PROJECT PERFORMANCE EVALUATION PLAN

INTRODUCTION

Description of the Project Area

Peterson Lake is a 500 acre backwater lake located on the Minnesota side of the Mississippi River just upstream of Lock and Dam 4.

Existing Habitat Conditions

The islands which separate Peterson Lake from the Mississippi River have been eroding since the installation of the locks and dams of the nine-foot channel project. This has allowed increased sedimentation and a decrease in habitat quality within the lake. In addition, the high current velocity and low winter water temperature do not provide any refuge for fish during winter.

Project Objectives for Habitat Improvement

The proposed plan of improvement is to prevent further deterioration of the islands by armoring them with rock. In addition a winter fish refuge by closing several of the openings into the upstream end of the lake and maintaining 5 mg/l or greater of dissolved oxygen, water temperature greater than 3 degrees C, and less than 1 cm/sec current velocity.

MONITORING PLAN

Parameters to be Measured

The effectiveness of the protection of the islands would be measured by measuring the acreage of the islands and by determining the depth of plant growth and the turbidity of the water.

The effectiveness of the creation of a winter fish refuge would be analyzed by measuring dissolved oxygen, current velocity, and water temperature during winter.

The creation of new areas of emergent aquatic plant growth would be measured by review of aerial photographs.

Measurement Methodology

Aerial photographs would be compared to previous photographs. The preservation of vegetative beds would be measured by determining the depth of plant growth with a marked staff or weighted line and the turbidity with a portable meter. Winter conditions would be measured using portable metering equipment including: dissolved oxygen meter, current meter, and thermometer.

Spatial Monitoring Design

The spatial monitoring design will follow sampling stations and vegetative transects currently used in the HREP monitoring program. Aerial photographs will be measured against existing photographs representing pre-project conditions.

Temporal Monitoring Design

Winter The monitoring of winter fish refuge conditions would be dependent on the formation of ice of sufficient thickness to be safely traversed. Measurements taken during January and February would be indicative of conditions within the fish refuge.

Summer Aerial photographs would be taken during the period of peak emergent plant growth so that the photographs would show the extent of plant beds as well as island size. Submerged plant growth would be measured during the peak growth period of July-early August. Turbidity would be measured at the same time.

Products to be Used for Project Evaluation

The winter measurements would be used to evaluate how effective the establishment of the winter fish refuge. If water temperatures are above 3 degrees C, current velocities below 1 cm/sec, and dissolved oxygen above 5 mg/l then the winter fish refuge would be considered a success.

Summer measurements that showed that island acreage was not decreasing and that emergent vegetative beds were stable or increasing, would demonstrate that the islands had been stabilized. Further evidence of protection of the vegetative beds would be obtained by measurement of plant growth and turbidity. If plant growth equaled or exceeded present values, while turbidity values were stable or decreasing, then the maintenance of aquatic plant growth would be demonstrated.

MONITORING SCHEDULE

This schedule assumes that construction will take place during the summer of 1994.

Winter Sampling Schedule

The monitoring would occur during the winters of 1992 and 1993 for preconstruction and 3 of the winters between 1994 and 1999 for post-construction.

Summer Sampling Schedule

The measurements of depth of plant growth and turbidity would take place during the summers of 1991-1994 for pre-construction and 3, 6, and 10 years after construction.

Aerial photographs from 1989 would be used for pre-construction measurements of island size and vegetation bed size. Additional photographs would be taken 5 and 10 years after construction for evaluation of plant bed size and island size.

SCHEDULE OF PROJECT EVALUATION REPORTS

Interim reports would be prepared for the Annual Addendums in 1997 and 1999. A final evaluation report would be completed in December 2004.

COST ESTIMATE

ACTIVITY	ESTIMATED COST
SUMMER MONITORING(One Year)	
Pre-sampling Preparation	$1,000
Field Work	$2,000
Mileage, Per diem, Supplies,	$500
Photo Interpretation	$1,000
Equipment Charges	$500
Total	$5,000
WINTER MONITORING(One Year)	
Pre-sampling Preparation	$1,000
Field Work	$2,000
Mileage, Per diem, Supplies	$500
Equipment Charges	$250
Total	$3,750
SUMMARY	
Summer Monitoring(Three times)	$15,000
Winter Monitoring(Three times)	$11,250
Interim Report	$1,200
Interim Report	$1,200
Final Report	$2,500
TOTAL MONITORING COST	$31,150

COMMITMENTS FOR CONDUCT OF MONITORING

The St. Paul District is responsible for insuring that the monitoring takes place and the reports are prepared. The field monitoring is likely to be contracted or conducted by other agency personnel under an interagency agreement.

PETERSON LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
PROJECT PERFORMANCE EVALUATION PLAN
SEDIMENT TRANSPORT

INTRODUCTION

Description of the Project Area

Peterson Lake is 500 acres in area, 7000 feet long, and has an average depth of 4.9 feet. Having relatively small dimensions, and having distinct boundaries of floodplain forest, islands, terrace, and dams, wind is not as significant a factor as on other backwater areas. And with short hydraulic residence times of 1.1 days for low flow conditions of 20,000 cfs, and 0.1 days for high flow conditions of 80,000 cfs, Peterson Lake is a "flow dominated" system.

Existing Sediment Transport Regime

Peterson Lakes's location just 11 miles downstream of Lake Pepin and 9 miles downstream of the mouth of the Chippewa River results in a unique sediment transport environment. The coarse fraction and some of the fine fraction of the Mississippi River sediment load is removed by Lake Pepin which acts as a sediment trap. Sediment from the Chippewa River is mainly sand - 80-percent of its total sediment load consists of coarse grained sediment (Rose, 1992). This combination of sediment sources results in a sediment transport regime in lower Pool 4 that is skewed towards coarse grained sediment. Apparently this is responsible for the lower suspended sediment concentrations and turbidity found in Peterson Lake as compared to other backwater lakes. However, the transport of sand into the lake and subsequent delta formation at inflow points appear to be a more significant problem than in other backwater areas.

Project Objectives for Sediment Transport

Reduction of sediment deposition in Peterson Lake. This includes both coarse grained and fine grained deposition although the major focus is on coarse grained deposition in the delta areas.

MONITORING PLAN

Goals of Monitoring Plan

1. Quantify existing sediment transport regime.
2. Quantify changes to sediment transport regime due to project.
3. Increase the understanding of Mississippi River sediment transport and develop criteria to be used on other projects.

Parameters to be Measured and Methods of Measurement

1. A suspended sediment budget of Peterson Lake will be done for 1994 and 1996. Daily sediment Loads in and out of Peterson Lake will be determined by collecting daily suspended sediment samples and integrating them with the lake discharge. The suspended sediment samples will consist of a composite of 6 samples each day taken at 4-hour intervals using automatic water samplers. Two samplers will be used, one at the upstream most site (site 1 for preproject, site 5 for postproject) and one at the outlet of Peterson Lake. Periodic measurements will be made at other sites to check if site 5 is representative of all inflow points. The daily lake discharge will be obtained from the discharge rating curve for Peterson Lake using the known discharge at Lock and Dam 4.

2. Total Sediment Load Transport will be quantified in two ways:
- by summing measured suspended sediment load and Helley-Smith bedload.
- by using analytical methods such as the modified Einstein procedure.

Data requirements for the modified Einstein Procedure include water discharge, average water depth, effective channel width, water temperature, suspended sediment particle size, bed material particle size, suspended sediment concentration, average depth of suspended sediment sampling verticals, and depth of unsample zone.

3. Particle size information of suspended sediment and bed material in Peterson Lake will be obtained.

4. Bathymetry will be collected in the lake in 1994 and 1999. Changes in Lake Volume will be quantified. Since the 1993 flood may have introduced significant quantities of sediment to the lake, the 1990 bathymetry shouldn't be relied on to represent preproject conditions.

5. Wind Speed, which may cause sediment resuspension, will be available for the 1994 monitoring period through the Weaver Bottoms Sediment Budget Study. Data at Lock and Dam 4 will also be used.

6. Point velocities (magnitude and direction) will be measured in the lake along 3 or 4 transects to define pre- and postproject flow distributions. Three sets of measurements will be obtained for pre- and postproject conditions. The schedule of measurements will be adjusted to coincide with river discharges of 20,000, 50,000, and 80,000 cfs. Existing Aerial photographs will also be used to define this flow distribution.

8. Discharge measurements will be obtained to better define the discharge rating curve for Peterson Lake (ie. the relationship between lake discharge and total river discharge at Lock and Dam 4). A good relationship exists already and this will be enhanced by additional measurements.

MONITORING SCHEDULE

Monitoring will be done during the 1994 open water season. Dates of certain types of monitoring are a function of river discharge conditions.

SCHEDULE OF PROJECT EVALUATION REPORTS

Interim reports describing preproject and postproject conditions will be prepared after the 1994 and 1996 sediment work is done. The final report will be prepared after the first set of postproject bathymetry is obtained.

COST ESTIMATE

ACTIVITY	ESTIMATED COST
Suspended Sediment Budget	$26,980
Particle Size Data	$ 7,420
Bathymetry	$10,000
Total Sediment Load Point Velocities Discharge Measurements	$10,530
Interim and Final Reports	$20,000
Total	$74,930

COMMITMENTS FOR CONDUCT OF MONITORING

The St. Paul District is responsible for insuring that the monitoring takes place and the reports are prepared. Some of the field monitoring is likely to be contracted or conducted by other agency personnel under an interagency agreement. This work will be coordinated with the LTRM field station in Lake City.

ATTACHMENT 10

COORDINATION/CORRESPONDENCE

The draft Definite Project Report/Environmental Assessment and/or Public Notice was sent to the following agencies, interests, and individuals:

<u>Congressional</u>
Sen. Dave Durenberger (St. Paul)
Sen. Paul Wellstone (St. Paul)
Sen. Herbert Kohl (Madison)
Sen. Russell Feingold (Madison)
Rep. Tim Penny (Rochester)
Rep. Steve Gunderson (Black River Falls)

<u>Federal</u>
Environmental Protection Agency (Chicago)
Department of Transportation (Chicago)
U.S. Coast Guard (St. Louis)
U.S. Geological Survey (St. Paul)
National Park Service (Omaha)
Soil Conservation Service (St. Paul)
Advisory Council on Historic Preservation (Wash DC)
U.S. Fish and Wildlife Service - (Twin Cities - Marler, Gibbons, Lewis, Dobrovolny; Winona - Fisher, Lennartson, Beseke, Drieslein; LaCrosse -Delaney)

<u>State of Minnesota</u>

Department of Natural Resources (St. Paul - Sando, Johnson; Lake City - Davis, Johnson, Schlagenhaft; Winona - Gulden)
Pollution Control Agency
Department of Administration
Department of Transportation
Department of Agriculture
Department of Health and Human Services
State Historic Preservation Office
Department of Energy, Economics, and Development
State Planning Agency
Water and Soil Resources Board

<u>State of Wisconsin</u>

Department of Natural Resources (Madison - Meyer; La Crosse - Moe, Janvrin; Eau Claire - Bourget; Alma - Brecka)
Department of Administration
Department of Transportation

<u>State of Iowa</u>

Department of Natural Resources (Des Moines - Szcodronski)

<u>Local</u>

Wabasha County Commissioners
City of Wabasha
Greenfield Township

Other Interests

Minnesota-Wisconsin Boundary Area Commission (Hudson)
Upper Mississippi River Conservation Committee (Rock Island)
Sierra Club (Minneapolis, Madison)
Izaak Walton League (Minneapolis)
National Audubon Society (Minneapolis)
Upper Mississippi River Basin Association (St. Paul)
Mississippi River Regional Planning Commission (La Crosse)
Ducks Unlimited (La Crosse)
Nature Conservancy
Wabasha Herald
Winona Daily News
La Crosse Tribune
Buffalo County Journal
Cochrane-Fountain City Recorder
Prairie du Chien Courier Press
Wabasha Public Library
Winona Public Library

Individuals

Gary Adams	Bob Arbuckle	Sam Amundson
Kim Amundson	Peg Bauernfeine	Alex Becher
John Brunner	Robert Croshe	John Dee
Duane Dornack	John Dubbels	Al Dubbels
Les Duncanson	John Dunaga	Dorothy Fenton
Dick Gerths	Mrs. Robert Gilbert	Sonja Harft
Dick Hedglin	Harold Hoffman	Dale Hulshizier
Paul Janzen	William Johnson	Allan Kackmann
Donald Krahn	Dewey Kollman	Irvine Larney
Keith Larson	Glenn LeBarrow	Ray Logan
Mike Malloy	Reuben Marzolf	Bernard McNab
Jack Mettler	George Murphy	Randy Mytten
Larry Mytten	Merritt Peterse	Robert Podolske
Mary Rivers	Jim Ryan	Roger Remington
David Saterdalen	Francis Sullivan	Lyndon Taylor
Frank Torrance	Larry Udstrum	Tim Waby
Brian Wolfe	Charles Wornack	

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

TAKE PRIDE IN AMERICA

FWS/ARW-SS

NOV 27 1992

Colonel Richard W. Craig
District Engineer
U. S. Army Engineering District, Saint Paul
1421 U. S. Post Office and Custom House
Saint Paul, Minnesota 55101-1479

Dear Colonel Craig:

Thank you for providing us with a copy of the draft report "A Cultural Resources Investigation of the Peterson Lake Islands, Navigation Pool 4, Wabasha County, Minnesota," by Sissel Johannessen (October 1992: Saint Paul; 12 pages). The investigation covered islands VII, XII, and XIV and identified no archeological sites. In the absence of data in the report, we estimate the investigation covered a total of about 10 acres in Section 18, T.110N., R.9W., and Section 12, T.110N., R.10W.

The land acquisition statement on page 5 is misleading. According to our land ownership records, the Corps of Engineers acquired the islands in Peterson Lake, and the U.S. Fish and Wildlife Service administers the islands under cooperative agreement as part of the Upper Mississippi River National Wildlife and Fish Refuge. The report itself seems to be a complete description of an appropriately executed field survey. Ms. Johannessen found no cultural resources, so curation is not a concern.

In the event this report, as well as the several that have preceded it, is ever prepared in a final version, we would appreciate receiving five copies of the final report for our own distribution requirements.

Sincerely,

Sam Marler

Sam Marler
Regional Director

MINNESOTA HISTORICAL SOCIETY

December 11, 1992

Mr. Robert J. Whiting
Corps of Enigneers, Environmental Resources Branch
180 Kellogg Boulevard East - Room 1421
St. Paul, Minnesota 55101-1479

Dear Mr. Whiting:

Re: Survey of Peterson Lake Islands, Navigation Pool 4
Peterson Lake, Wabasha County
MHS Referral File Number: 92-2752

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to the responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the Advisory Council on Historic Preservation (36CFR800).

We have reviewed the results of your survey of the project area. Based on the results of this survey, we feel that the probability of any unreported properties being located in the area of potential effect is low. Therefore, we conclude that **no properties** eligible for or listed on the National Register of Historic Places are within the area of potential effect for the project.

Please contact Dennis Gimmestad at 612-296-5462 if you have any questions on our review of this project.

Sincerely,

Britta L. Bloomberg
Deputy State Historic Preservation Officer

BLB:dmb

345 KELLOGG BOULEVARD WEST / SAINT PAUL, MINNESOTA 55102-1906 / TELEPHONE: 612-296-6126

UPPER MISSISSIPPI RIVER NATIONAL
WILDLIFE AND FISH REFUGE
Established 1924

Compatibility Study
PETERSON LAKE REHABILITATION AND
ENHANCEMENT PROJECT

Established Authority

Public Law No. 268, 68th Congress, The Upper Mississippi River Wildlife and Fish Refuge Act.

Purpose for Which Established

"The refuge shall be established and maintained (a) as a refuge and breeding place for migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, and (b) to such extent as the Secretary of Agriculture by regulations, prescribe, as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and (c) to such extent as the Secretary of Commerce may, by regulations, prescribe a refuge and breeding place for fish and other aquatic animal life."

Description of Proposed Use

The proposal is a Habitat Rehabilitation and Enhancement project authorized by the Water Resource Development Act of 1986 (Pub. L. 99-662). The proposed project will be constructed in Peterson Lake, a 500-acre lake on the Minnesota side of the Upper Mississippi River. It is located between river miles (RM) 753 and 754.8 approximately 5 miles south of Wabasha, Minnesota.

The project formulation process considered several alternatives for preventing further habitat degradation at Peterson Lake and for rehabilitating and improving habitat conditions. These centered on methods to prevent further island loss and reducing flow and sedimentation entering Peterson Lake.

The project calls for rock bank protection to prevent further erosion of the lower islands in the barrier island chain of Peterson Lake. The purpose is to maintain these islands for their habitat value and to prevent further degradation of habitat conditions in Peterson Lake due to increased flows and sedimentation. Six of the upper seven openings into the lake would be totally closed and the seventh would be partially closed to reduce flows and sediment entering the lake through these openings. This would create an area in the upper portion of the lake that fish could use as a refuge from current velocities and cold water during the winter. Some of the closures would be constructed of rock, while others would be constructed of the sand excavated to provide construction access to the site.

More details of the project, including maps and engineering drawings, are contained in the draft report entitled, "Upper Mississippi River System Environmental Management Program Definite Project Report With Integrated Environmental Assessment (SP-16) Peterson Lake Habitat Rehabilitation and Enhancement, Pool 4, Upper Mississippi River, Wabasha County, Minnesota," prepared by the St. Paul District, Corps of Engineers.

Anticipated Impacts on Refuge Purposes

As a result of the project fish and wildlife populations should increase which will be a direct benefit toward maintaining and accomplishing refuge purposes. The above-mentioned report contains additional information on the project's impacts.

Justification

The proposed project works toward the accomplishment of the stated objectives of the refuge.

Determination

The proposed project is compatible with purposes for which the refuge was established.

Determined by: James R. Kumaitar — Project Leader — Date: 8/5/93

Reviewed by: James R. Fisher — Complex Manager — Date: 8/5/93

Reviewed by: Ed Crozier — WAM-1 — Date: 8/12/93

Concurred by: Larry L. Hood — Regional Director — Date: 08-16-93

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

FWS/ARW-SS

DEC 3 1993

Colonel James T. Scott
District Engineer
Saint Paul District, US Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
Saint Paul, Minnesota 55101-1638

Dear Colonel Scott:

The U.S. Fish and Wildlife Service (Service) has reviewed the "Definite Project Report/Environmental Assessment (SP-16)" dated November 1993 for the Peterson Lake Habitat Rehabilitation and Enhancement Project. This project, located in pool 4, is proposed under the Water Resources Development Act of 1986 (Public Law 99-662) as part of the Upper Mississippi River System Environmental Management Program.

The project has been coordinated with the Service and we approve and support the project as planned and described in the definite project report. The Service agrees with the preferred alternative described in the environmental assessment, that of closing seven openings between islands, rock bank protection for six islands, and installing a water supply pipe through closure #7. On August 5, 1993, the Refuge Manager found the project compatible with the purposes for which the Refuge was established, as required by the National Wildlife Refuge Administration Act.

The Service will assure operation and maintenance requirements of the project will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986. In accordance with the policies stated in the Fourth Annual Addendum, the Service will perform the operation and maintenance requirements for this project as listed on page 66.

This project being located on Refuge lands, enclosed is the signed Finding of No Significant Impact for the Peterson Lake Habitat Rehabilitation and Enhancement Project. Our Finding is based on your Definite Project Report/Environmental Documentation (SP-16) dated November 1993.

The Agreement for Operation, Maintenance, and Rehabilitation will be signed upon receipt of the final version of that document. We look forward to continued progress on this project.

Sincerely,

Sam Marler
Sam Marler
Regional Director

Enclosure: FONSI

FINDING OF NO SIGNIFICANT IMPACT

For the reasons presented below and based on an evaluation of the information contained in the supporting references, I have determined that the Environmental Management Program project, Peterson Lake, Pool 4, Habitat Rehabilitation and Enhancement, is not a major Federal action that would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons

Peterson Lake is one of three major backwater lakes in lower pool 4 and has unique morphologic and hydrologic characteristics. The lake is a valuable fish and wildlife habitat resource that adds to the overall habitat diversity and quality in lower pool 4. The project purpose is to slow the loss through erosion of the barrier islands and to slow the sand sedimentation in the lake. Curtailing the rate of resource degradation would benefit a wide variety of fish and wildlife.

Alternatives considered included no Federal action and three action alternatives. The selected plan includes closing seven openings between islands on the upriver portion, protecting six islands from erosion through rock bank protection, and installing a 24-inch pipe through closure #7 for water supply.

The project will not affect federally-listed endangered or threatened species nor their critical habitat.

An archeological survey located no significant sites. No standing structures would be affected by the project. The Minnesota Historic Preservation Officer made a determination of no effect on significant cultural resources.

Short term negative effects are possible due to construction activities. Localized turbidity plumes and increased suspended solids levels would be expected during access dredging and placement of material.

Supporting References

1. Definite Project Report/Environmental Assessment (SP-16)
2. Compatibility Determination

Sam Marler 6 Nov 93

Regional Director Date

Distribution: AES (Master File)
EHC/BFA--Washington, DC
SS
UMR through WAM 1

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD • ST. PAUL, MINNESOTA • 55155-4010

DNR INFORMATION
(612) 296-6157

December 22, 1993

James T. Scott, Colonel
Department of Army
Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

Re: Peterson Lake Habitat Rehabilitation and Enhancement Project - Wabasha County

Dear Colonel Scott:

The Minnesota Department of Natural Resources has reviewed the draft Definite Project Report/Environmental Assessment of Peterson Lake, Wabasha County and provide the following comments.

The Heritage database search for rare species and natural species in the proposed project area produced four locational records for three species listed as special concern: The pugnose minnow (*Opsopoeodus emilae*) #19 and #66; Walter's barnyard grass (*Echinochla walteri*) #18, and Sea-beach needlegrass (*Aristida tuberculosa*) #26. Page 63 states that "it has been determined that the proposed project would not affect any threatened or endangered species", however it does not include or mention special concern species found in the area.

The Minnesota County Biological Survey is currently underway in Wabasha County. This project area is a designated survey site to be sampled during the next field season (1994). Preliminary aerial photo-interpretation of the area's vegetation and habitat characteristics suggest that rare species and/or natural communities may likely be found. We will be better equipped to assess potential impacts when the rare species and natural features have been surveyed. Based on this time schedule, we suggest postponing specific comments on rare species and natural features until fall of 1994.

We question the statement about the extensive use of Peterson Lake by waterfowl species on page 17. Our understanding was that Peterson Lake had very little waterfowl use and that the lack of use was a factor in nominating this area as a Habitat Rehabilitation and Enhancement Project site.

The DNR is bothered by the decision as stated on page 41 to eliminate the Emergent Vegetation (EV1) alternative from further consideration. Allowing a navigation pool to draw down even one to two feet at an appropriate time would simulate the natural conditions on the river which plant and animal species have adapted to over several thousands and perhaps millions of years.

In order to regain lost marsh vegetation communities, it may become necessary for navigation interests and riparian owners to accomodate the temporary inconvenience of low water levels once every five to ten years as occurred on the river prior to lock and dam construction. Such accomodations would have significant impacts, but the decline in marsh vegetation communities dictates that such concepts need to be discussed. The need for exposure of marsh soils to the air is well established in the scientific literature and is commonly employed by wildlife managers all over the world to rejuvenate marsh habitats which have been artificially impounded.

The DNR requests that the Draft Definite Project Report (DPR) explain in more detail the scope of this alternative, its potential impacts, and why it is no longer being considered. This alternative, although a significant departure from past practice, may be very feasible for increasing emergent aquatic plant growth in shallow areas of Peterson Lake as well as thousands of other acres within the nine foot channel project. Restoring the natural river hydrograph would greatly reduce erosion of the interior side of the barrier islands and would rehabilitate marsh habitat in the entire river ecosystem.

We are concerned that the minor flows (one to two cubic feet per second) through the 24 inch culvert discussed under Alternative A3 on page 44 could be too great, resulting in cold temperatures which would reduce this area's value for fish habitat in winter. It is not clear how the volume of the area to be affected by the culvert compares with the lake volume in Finger Lakes where one to two cubic feet per second was recommended.

The DNR does not agree that the estimated $40-50,000 for dredging access channels to these deep areas (as mentioned in the attachment 10 response to our previous comments) would be cost prohibitive. This amount of money is a small fraction of the total project cost which would be reduced by eliminating the $13,000 culvert.

As stated in the DPR and at the public meeting, Peterson Lake is experiencing net sediment deposition. This small amount of dredging would mimic natural channel scouring which will no longer occur in the lake after its inlets are closed.

The discussion of the Maintain Existing Islands (MEI) alternative which begins on page 47 should mention that covering the littoral zone of these islands with rock will eliminate or reduce its quality as habitat for burrowing mammals, mussels and aquatic plants. The DPR does not include the loss of this habitat in the computation of average annual habitat units. Because of the impact of the alternative on habitat, the DNR cannot support the extent of riprap use that is proposed.

Using rock groins to stabilize the shoreline is not discussed. If use of the groins is effective in reducing erosion of the islands, it would help retain the most important ecological functions of the aquatic terrestrial ecotone. The DNR would support the use of rock groins.

The DNR is concerned that deep areas of the river downstream from the cuts proposed to be closed with sand will be filled inadvertently during construction. This happened at Weaver Bottoms in 1986 when sand was used to close flows through several cuts and was washed downstream filling valuable habitat with sand. We would like to discuss construction techniques with the engineers prior to development of plans and specifications for these closures.

For your information we have noted two minor typographical errors in the Environmental Effects Section (page 59, paragraph 1) of the DPR. We believe the word "catergories" should be "categories" and the Section 404(b)(1) evaluation is included as attachment 3, not attachment 2.

Thank you for the opportunity to comment on this project. If you have any questions or need additional information, please contact Gail Fox of my staff at (612)296-0731.

Sincerely

Thomas W. Balcom

Thomas W. Balcom, Supervisor
Natural Resources Planning & Review Services
DNR Office of Planning

c: Bill Johnson
Steve Colvin
Denny Thompson
Pete Otterson
Brian McCann
Jan Shaw Wolf
Steve Johnson

940090-1

January 26, 1994

Planning Branch
Engineering and Planning Division

Mr. Thomas W. Balcom
Supervisor, Natural Resources Planning &
Review Services
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, Minnesota 55155-4010

Dear Mr. Balcom:

This is in response to your letter of December 22, 1993, concerning the Peterson Lake Habitat Rehabilitation and Enhancement Project.

We have evaluated the potential for the Peterson Lake project to affect the three species of special concern identified in your letter. The pugnose minnow has been collected in Peterson Lake by the Minnesota Long Term Resource Monitoring (LTRM) Lake City field station. Based on the limited information in the literature concerning the pugnose minnow, it appears that it prefers quiet, clear, vegetated waters. This is the type of habitat conditions the proposed Peterson Lake project is designed to promote, especially in the upper portion of the lake. Therefore, if the project has any impact on this species, it is likely to be beneficial.

Sea-beach needlegrass is a sand dune species that prefers somewhat dry conditions. No habitat of this type is located at Peterson Lake. Therefore, we believe it is extremely unlikely that this species would be located in the project area or be affected by the proposed project.

Walter's barnyard grass prefers moist soil habitat that would be present along the shorelines of Peterson Lake. The shorelines we would be affecting with construction, however, are island shorelines that are relatively steep and, in many instances, eroding. Therefore, we believe it is highly unlikely that this species is present in the areas we will affect with construction of the proposed project.

We will add to the report the above information concerning the species of special concern. However, because of the very low potential that we would be adversely affecting any of these species, we will proceed with project planning and design. If your surveys identify the presence of sea-beach needlegrass or Walter's barnyard grass in the areas that would be affected by the project, we will consider at that time what measures can be taken to avoid or minimize impacts to these species.

We concur with your comment concerning waterfowl use of Peterson Lake, and we will revise the discussion in the report accordingly.

We believe the correct decision was made to eliminate the lake drawdown alternative as a viable option for stimulating the regrowth of emergent vegetation at Peterson Lake. Because the lake is located immediately above lock and dam 4, drawing down Peterson Lake a few feet would have an impact felt throughout lower pool 4, an area containing nearly 8,000 acres of aquatic habitat. Aside from the obvious potential impact to commercial navigation traffic, there would be impacts to fish and wildlife resources elsewhere in the pool, impacts to water-based recreation of all types, and impacts to riparian landowners. These are the potential effects that readily come to mind. We are certain that, if more detailed evaluations were conducted, there would be many other areas of concern that would have to be addressed.

At this point, we are not closing our minds to the future consideration of pool drawdowns for fish and wildlife purposes. However, we believe this issue and area of study are more properly addressed as part of the ongoing navigation studies. It is far beyond the scope of the Peterson Lake project, or any other Upper Mississippi River System Environmental Management Program (UMRS-EMP) habitat project for that matter, to consider pool-wide water level manipulations.

On January 13, 1994, we met with representatives of the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources and with representatives from your Department's Lake City office concerning the recommended Peterson Lake project. As a result of that meeting, we have decided to eliminate the 24-inch culvert and to excavate two fish access channels into isolated deepwater areas in the upper portion of the lake. Minnesota Department of Natural Resources representatives at that meeting (Mr. Mike Davis and Mr. Dan Dieterman) concurred with this decision.

Four optional sites were identified for disposal of dredged material from the fish access channels, with general criteria for use of each site also agreed upon. This information will be included in the final Definite Project Report for the project.

At the same meeting, we discussed the extent of bank stabilization being recommended. We explained that the use of groins had been considered and that they would not be effective in this particular situation. Mr. Davis and Mr. Dieterman indicated they understood why groins would not work. We also revisited the extent of bank stabilization being considered. After reviewing the available site data, we mutually agreed to reduce the bank stabilization recommended for Island IV by approximately 600 feet, or about one-half that shown on figure 24 of the draft Definite Project Report. During advanced design, we will obtain more detailed surveys of the shorelines of all the affected islands. At that time, we will make the final determination, in coordination with Mr. Davis, as to the extent and final design of the shoreline protection for Island IV and the other islands involved.

We believe there is little potential for a problem occurring with the placement of sand for the closures at Peterson Lake. The closures where sand will be placed are small and shallow, with little flow passing through them. This contrasts with the situation at Weaver Bottoms where the sand was being placed in a major side channel feeding Weaver Bottoms. In addition, the problem at Weaver Bottoms resulted from the unfortunate happenstance of a small flood event occurring during the middle of construction. At the onset of plans and specifications, we will coordinate with Mr. Davis to identify safeguards we can include in project plans and specifications to minimize the potential for erosion of the sand as the closures are being constructed.

We trust that the concerns expressed in your letter have been addressed. We request that the Minnesota Department of Natural Resources provide a letter supporting the proposed Peterson Lake project.

Sincerely,

/s/
Charles E. Crist
Chief, Planning Branch
Engineering and Planning Division

cf:
Roger Holmes, MDNR (w/incoming letter)
Kent Lokkesmoe, MDNR (w/incoming letter)
Steve Johnson, MDNR
Mike Davis, MDNR
Jeff Janvrin, WDNR
Keith Beseke, USFWS

Bruce Heide, PP-PM

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD • ST. PAUL, MINNESOTA • 55155-40 10

DNR INFORMATION
(612) 296-6157

February 3, 1994

Mr. Charles Christ
Chief, Planning Branch
Engineering and Planning Division
Corps of Engineers
190 East 5th Street
St. Paul, MN 55101-1638

Dear Mr. Christ:

Thank you for your response letter of January 26, 1994 on the Peterson Lake Habitat Rehabilitation and Enhancement Project. The January 13 meeting and your letter serve as adequate responses to our comments and concerns with the Peterson Lake Project. Your response that pool drawdowns for fish and wildlife purpose is more properly addressed as part of the ongoing navigation studies is especially noted and we will pursue this issue with the Rock Island District.

As you requested, please consider this a letter of support for the Peterson Lake Habitat Rehabilitation and Enhancement Project. Thank you for your continued cooperation in this matter.

Sincerely,

Thomas W. Balcom

Thomas W. Balcom
Supervisor, Natural Resources Planning & Review Section

cc: Roger Holmes
Kent Lokkesmoe
Steve Johnson
Mike Davis
Jeff Janvrin, WDNR
Keith Beseke, USFWS

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD • ST. PAUL, MINNESOTA • 55155-40

DNR INFORMATION
(612) 296-6157

March 1, 1994

Mr. Charles Christ
Chief, Planning Branch
Engineering and Planning Division
Corps of Engineers
190 E. 5th St.
St. Paul, MN 55101-1638

Re: Peterson Lake HREP

Dear Mr. Christ:

Thank you for your letter of Feb. 9 concerning modifications to the selected plan for the Peterson Lake Habitat Rehabilitation and Enhancement Project. We support the modifications described in your letter.

As you requested, please consider this a letter of support for the modified project. Thank you for your continued cooperation.

Sincerely,

Thomas W. Balcom

Thomas W. Balcom
Supervisor, Natural Resources Planning and Review Section

cc: Steve Johnson
Mike Davis

Minnesota Pollution Control Agency

January 12, 1994

Colonel James T. Scott
St. Paul District
U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Re: Peterson Lake Habitat Rehabilitation and Enhancement Project
U.S. Army Corps of Engineers, Upper Mississippi River Pool 4
Wabasha County

Dear Colonel Scott:

This letter is submitted by the Minnesota Pollution Control Agency (MPCA) under authority of Section 401 of the Clean Water Act (33 USC 1251 et seq.) and Minn. Stat. chs. 115 and 116. The referenced project involves a proposal for total closure of six side channels and partial closure of a seventh side channel to reduce flow entering Peterson Lake and associated sedimentation. In addition rock will be placed along seven islands in the lower portion of the lake to reduce erosion.

The MPCA certifies the referenced project since the project's individual and cumulative impacts do not appear to be significant as defined by present water quality standards.

The project impacts should be minimized in accordance with the requirements of Section 404(b)(1) guidelines.

Minnesota statutes and state regulations require a State Disposal System (SDS) permit be obtained for any dredge material disposal. Dredged material is defined as a waste material by Minn. Stat. § 115.01, subd. 4. Minn. Rules ch. 7001 requires any dredged material disposal site to have an SDS permit. The permitted disposal of dredged material covers facilities that include confined disposal facilities, dredged spoil settling ponds, stock piles, land spread activities, beneficial reuse or other disposal. The MPCA has determined that an SDS permit may not be required for activities if: they generate a low volume of dredged material (typically less than 5,000 cubic yards); the project activity is a one-time occurrence versus an ongoing maintenance activity; the dredge material is not contaminated; and the material will not require a discharge or be disposed of in wetlands. The description of this project fit this criteria and, therefore, an SDS permit for the disposal of the dredged material will not be required for this project. If the conditions of the project are modified so that these criteria are not met, the MPCA should be contacted for determination of permit requirements.

JAN 19 1994

This action does not exempt the applicant from the responsibility of complying with all applicable local, state and federal requirements, nor does it grant any right to violate personal or property rights.

If you have any questions on this, please call Lawrence S. Zdon at (612) 297-8219.

Sincerely,

Richard G Sandberg

for Duane L. Anderson, Manager
Assessment and Planning Section
Water Quality Division

DLA/LZ:mbo

cc: Ms. Sue Elston, U.S. Environmental Protection Agency, Chicago
Ms. Lynn Lewis, Field Supervisor, U.S. Fish and Wildlife Service
Mr. Kent Lokkesmoe, Director, Division of Waters, MDNR
Mr. Steve Colvin, Ecological Services, Environmental Review, MDNR

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

State Office Building
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

December 29, 1993

Colonel James T. Scott, District Engineer
St. Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, MN 55101-1638

Subject: Peterson Lake Habitat Rehabilitation and Enhancement Project, Wabasha County

Dear Colonel Scott:

The Wisconsin Department of Natural Resources has completed review of the draft Definite Project Report (DPR) for the Peterson Lake Habitat Rehabilitation and Enhancement Project (HREP), Pool 4, Upper Mississippi River, Wabasha County, Minnesota, dated November 1993. We are pleased to see that some changes have been made to the document in response to our July 29, 1993 letter. However, we have some additional comments to make regarding the November 1993 Peterson Lake DPR.

We were unaware of the addition of a 24 inch RCP through closure #7 to provide 1 to 2 cfs of flow into the deep hole behind the closure. The Corps' response (located in attachment 10) to our July 29, 1993, comment 6, regarding reduction of bed load to Peterson Lake, states that the closures "...will deflect all or most of the Mississippi River bed load back into the channel outside of the islands during most conditions." We are concerned that the RCP in closure 7 will soon become inoperable due to sedimentation from sand deflected by the upstream closures. If this does occur, then the purpose of the RCP to provide oxygen to the deep hole will not be met. Therefore, we once again suggest that channels be dredged to connect the deep hole to an area of deep water within Peterson Lake. Furthermore, 1-2 cfs of flow through the culvert may be too much to meet environmental conditions favorable for centrarchid overwintering habitat in the deep hole behind closure 7.

Our other comment is in regards to a typographical error in the first sentence of the second paragraph on page 61 of the DPR. The sentence should state "...rates were <u>greater</u> than..."

We appreciated the opportunity to review the draft DPR for the Peterson Lake HREP. The Wisconsin Department of Natural Resources supports the design of the project as presented in the DPR and looks forward to the construction and completion of the Peterson Lake HREP.

Sincerely,

Terry A. Moe

Terry A. Moe
Western Boundary Rivers Coordinator

c: Jim Fisher, USFWS
Steve Johnson, MN DNR

January 26, 1994

Planning Branch
Engineering and Planning Division

Mr. Terry A. Moe
Western Boundary Rivers Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Dear Mr. Moe:

This is in response to your letter of December 29, 1993, concerning the Peterson Lake Habitat Rehabilitation and Enhancement Project. We appreciate the support for the project provided by the Wisconsin Department of Natural Resources.

On January 13, 1994, we met with representatives of the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources and with representatives from your Department, Mr. Jeff Janvrin and Mr. Brian Brecka. As a result of that meeting, we have decided to eliminate the 24-inch culvert through closure #7 and to excavate two fish access channels into isolated deepwater areas in the upper portion of the lake. Messrs. Janvrin and Brecka supported this decision.

Four optional sites were identified for disposal of dredged material from the fish access channels, with general criteria for use of each site also agreed upon. This information will be included in the final Definite Project Report for the project.

At the same meeting, we discussed the extent of bank stabilization being recommended due to concerns expressed by the Minnesota Department of Natural Resources. After reviewing the available site data, we mutually agreed to reduce the extent of bank stabilization recommended for Island IV by approximately 600 feet, or about one-half that shown on figure 24 of the draft Definite Project Report. During advanced design, we will obtain more detailed surveys of the shorelines of all the affected islands. At that time, we will make the final determination, in coordination with your agency and others, as to the extent and final design of the shoreline protection for Island IV and the other islands involved.

If you have any questions concerning the proposed modifications to the recommended project, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

/s/
Charles E. Crist
Chief, Planning Branch
Engineering and Planning Division

PE-P

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State Office Building
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

February 21, 1994

Colonel James T. Scott, District Engineer
St. Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, MN 55101-1638

Subject: Peterson Lake Habitat Rehabilitation and Enhancement Project, Wabasha County

Dear Colonel Scott:

We have reviewed the proposed modifications to the selected plan for the Peterson Lake Habitat Rehabilitation and Enhancement Project. The Wisconsin Department of Natural Resources was included in the development of these options which include placing 200-foot-long partial closure structures across openings #8 and #9 and the addition of rock mound structures along portions of Peterson Lake. We support the design modifications as presented in a correspondence from the St. Paul District dated February 9, 1994.

Sincerely,

Terry A. Moe

Terry A. Moe
Western Boundary Rivers Coordinator

c: Jim Fisher, USFWS
Steve Johnson, MnDNR
Mike Davis, MnDNR
Keith Beseke, USFWS

MINNESOTA-WISCONSIN BOUNDARY AREA COMMISSION
619 SECOND STREET, HUDSON, WISCONSIN 54016-1576
Serving Our Sponsor States on the St. Croix and Mississippi Rivers since 1965
Office Hours: 8 A.M. - 5 P.M. Monday-Friday
Minnesota Telephone (612) 436-7131
Wisconsin Telephone (715) 386-9444

December 10, 1993

Colonel James T. Scott
District Engineer
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 East Fifth Street
St. Paul, Minnesota 55101-1638

RE: Peterson Lake, Minnesota Habitat Rehabilitation and Enhancement Project

Dear Colonel Scott:

In reviewing the Peterson Lake Project, there are changes which are not in line with the public insights to backwater assistances. During the many years of meetings, the public has continued to urge some major considerations to the backwater improvements.

This project is listed to receive riprap rock for the majority of the island work. The material of sand and the like is projected to come from the main channel area.

Public desires, historically, have stated there should be major removal of materials from the backwaters. The report indicates there are several areas where the material meets the standards of quality. The Corps and the planners have forgotten the importance placed by the public to have major amounts of materials removed from the backwaters.

Realizing there are cost constraints, there are those challenges from the public which indicate their values of a project toward the beneficial basis. The losses of this backwater in the filling of the backwater is at a time when there are few years left to rejuvenate. Utilization of the materials from the backwaters results in a higher benefit ratio from the public than is being applied by the Corps and the other agencies coordinating the Peterson Lake improvements.

Sincerely,

William Howe

William H. Howe, Chair
Mississippi River Regional Committee

cc: Jim Fisher, Upper Miss. Refuge Complex, Winona
Steve Johnson, MN Department of Natural Resources
Terry Moe, WI Department of Natural Resources

January 21, 1994

Water Resources Study Branch
Planning Division

Mr. William H. Howe
Chairman, Mississippi River Regional Committee
Minnesota-Wisconsin Boundary Area Commission
619 Second Street
Hudson, Wisconsin 54016-1576

Dear Mr. Howe:

Thank you for your letter of comment on the Peterson Lake Habitat Rehabilitation and Enhancement Project. The project consists of two basic features, side channel closures and island bank stabilization.

We are proposing the use of rock for bank stabilization because we believe it is the only effective method of stabilizing the island shorelines in this particular situation.

We are proposing to use rock for some of the side channel closures because this is the most cost effective material to use. The only reason sand will be used for the remaining side channel closures is to dispose of material that will have to be dredged for equipment access. If we are able to access the site without dredging, these closures will also be constructed of rock.

During project planning, the lack of deepwater habitat was not identified as a critical habitat problem at Peterson Lake. More than 50 percent of the lake is greater than 4 feet deep, and approximately 20 percent is greater than 7 feet deep. It was recognized that sedimentation, especially sand sedimentation, is becoming a problem in the lake. If left unchecked, this will result in substantially reduced habitat values in the lake. Eventually, Peterson Lake will fill in to some point where an equilibrium is reached. We predict that, if nothing is done, this will occur sometime within the next 50 to 100 years.

Our planning efforts have focused on reducing sedimentation in Peterson Lake to maintain its habitat values for as long as practicable. We recognize that it is not possible to stop all sedimentation in the lake. Our recent experience has been that it costs $7 to $10 per cubic yard to remove material from backwater lakes. Much of this cost is associated with the development of disposal sites for the material. We estimate that the proposed Peterson Lake project will reduce sedimentation in Peterson Lake at a cost of less than $1 per cubic yard. It is much more cost effective to keep the sediment out of the lake than to remove it once it is there.

In summary, we believe that general removal of sediments from Peterson Lake is not warranted at this time because (1) the lack of deepwater habitat is not a critical habitat problem in the lake, and (2) it is much more cost effective to keep sediment from the lake than to remove it.

Based on comments received from the Minnesota and Wisconsin Departments of Natural Resources during the public review process, we will be including two fish access channels in the lake as part of the recommended project. Excavation of these channels will result in the removal of about 7,000 cubic yards of sediment from the lake.

We appreciate your interest in this project and will keep you informed of its progress. If you have any questions, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

/s/
James T. Scott
Colonel, Corps of Engineers
District Engineer

cf:
James Fisher, USFWS
Steve Johnson, MDNR
Terry Moe, WDNR