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US Army Corps
of Engineers
St. Paul District

DREDGED MATERIAL PLACEMENT RECONNAISSANCE REPORT LOWER POOL 2

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DREDGED MATERIAL PLACEMENT RECONNAISSANCE REPORT
LOWER POOL 2

Table of Contents

Section		Page
1.	INTRODUCTION	1
2.	PROJECT DESCRIPTION	2
	General Project Area	2
	Lower Pool 2 Dredging	3
3.	OTHER PLANNING EFFORTS	4
	GREAT I	4
	Lower Pool 2 Reconnaissance Report (July 1984)	4
	Spring Lake	4
	Mississippi National River and Recreation Area	6
4.	ALTERNATIVES NOT INCLUDED IN THE ALTERNATIVE ASSESSMENT	7
	Placement Sites	8
	Alternative Placement Plans	9
5.	ALTERNATIVE PLACEMENT PLANS AND EVALUATIONS	10
	Alternative Placement Sites	10
	Alternative Placement Plans for Dredge Cuts 2 and 3	12
	Alternative A1	13
	Alternative B1	16
	Alternative F1	19
	Alternative G1	23
	Alternative H1	25
	Alternative I1	28
	Alternative Placement Plans for Dredge Cuts 4 and 5	31
	Alternative A2	31
	Alternative B2	34
	Alternative F2	37
	Alternative G2	40
	Alternative H2	42

Table of Contents Cont'd

Section		Page
6.	MATRIX SCORING AND ALTERNATIVES COMPARISON	45
	General	45
	Matrix Scores	46
	Alternatives Comparison	49
	Cuts 2 and 3 Alternatives	50
	Cuts 4 and 5 Alternatives	53
7.	RECOMMENDATIONS	
	Spring Lake	58
	C.F. Industries	58
	Recommended Alternative	58
	Implementation Schedule	59

APPENDIXES

A - OPERATIONS AND BENEFICIAL USE
B - ENVIRONMENTAL EVALUATION OF ALTERNATIVES
C - SOCIAL IMPACTS OF DREDGE MATERIAL PLACEMENT
D - MATRIX EVALUATION CRITERIA
E - JULY 1984 RECON REPORT
F - SPRING LAKE EVALUATIONS
G - CORRESPONDENCE

Tables

Table		Page
1	- Principal Features of Pool 2	2
2	- GREAT I Dredge Cut Summary	3
3	- Alternative Placement Site Names and Numbers	7
4	- Summary of Alternative A1	13
5	- Summary of Alternative B1	16
6	- Summary of Alternative F1	19
7	- Summary of Alternative G1	23
8	- Summary of Alternative H1	25
9	- Summary of Alternative I1	28
10	- Summary of Alternative A2	31
11	- Summary of Alternative B2	34
12	- Summary of Alternative F2	37
13	- Summary of Alternative G2	40
14	- Summary of Alternative H2	42
15	- Matrix Evaluation of Cuts 2 and 3 Alternatives	47
16	- Matrix Evaluation of Cuts 4 and 5 Alternatives	48
17	- Summary of Pairwise Comparison of Alternatives	57

Plates

1 - Lower pool 2 study area
2 - Site 2-821.0-LM
3 - Site 2-819.4-RM
4 - Site 2-821.1-LM (Alts B1 & I1)
5 - Site 2-821.1-LM (Alts F1 & H1)
6 - Site 2-821.5-LM
7 - Site 2-832.5-RM
8 - Site 2-823.8-LM
9 - Site 2-827.2-RM

DREDGED MATERIAL PLACEMENT RECONNAISSANCE REPORT
LOWER POOL 2

INTRODUCTION

1.1 PURPOSE

The St. Paul District, U.S. Army Corps of Engineers is completing the planning for implementation of the Channel Maintenance Management Plan (CMMP) for the Upper Mississippi River, initiated with the Great River Environmental Action Team I (GREAT I) study. The CMMP consists of a series of recommended dredged material placement sites for maintenance of the Upper Mississippi River 9-foot navigation channel. This report evaluates dredged material placement alternatives for lower pool 2, that portion of pool 2 beginning at river mile 815.2 and extending upstream to river mile 828.3.

Alternative placement sites and placement methods were evaluated with consideration given to economic, environmental, and social values as recommended in the GREAT I report. Consideration was also given to cultural, aesthetic, and recreation factors. The intent of this report is to identify a long-term dredged material placement plan that minimizes environmental impacts, reflects sound engineering design, and is operationally implementable.

PROJECT DESCRIPTION

2.1 GENERAL PROJECT AREA

Lock and dam 2 is located at river mile 815.2 near Hastings, Minnesota. Pool 2, located entirely within Minnesota, extends upstream through Minneapolis and St. Paul to river mile 847.7. Upstream from river mile 829, pool 2 is largely confined by high bluffs and is heavily developed with residential, commercial, and industrial uses. Downstream to lock and dam 2, the pool broadens and is considerably less developed. The Minnesota River enters pool 2 near Fort Snelling at river mile 844. Spring Lake, a backwater area, is a dominant open water feature in lower pool 2. The principal features of lower pool 2 are listed in table 1.

Table 1
Principal Features of Pool 2

Length of pool	Mississippi River	32.5 river miles
	Minnesota River	25.0 river miles
River mile limits	Mississippi River	815.2 - 847.7
	Minnesota River	0.0 - 25.0
Project pool elevation		687.2 feet
Pool surface area (Mississippi River)		9,652 acres
Shoreline miles (Mississippi River)		110 miles

2.2 LOWER POOL 2 DREDGING

The GREAT I study identified six historic dredge cut locations in lower pool 2 (plate 1). The GREAT I developed characteristics for each dredge cut are summarized in table 2.

Table 2
GREAT I Dredge Cut Summary

Cut	Name	River Miles	Dredging Jobs Per 40 Years	MPFWG Quantity (cy) 1986-2025	Average Quantity/ Job (cy)
1	Upper Approach to Lock and Dam 2	815.5 - 815.9	4	41,500	10,400
2	Boulanger Bend Lower Light*	819.0 - 819.8	4	240,500	60,100
3	Boulanger Bend	820.8 - 821.4	4	455,500	113,900
4	Pine Bend Foot Light	822.7 - 823.7	10	379,500	38,000
5	Grey Cloud Slough	827.5 - 828.3	8	282,000	35,200
6	Below Cudahy	831.0 - 832.4	8	93,500	11,700

* Includes projections for the Freeborn Island and Nininger dredge cuts.

MPFWG (most probable future with GREAT I) quantities are based on the assumption that implementation of GREAT I recommendations will reduce future dredging quantities from historic levels. Dredge cuts 1 and 6 involve small quantities of dredging, and given improved navigation and survey capabilities, will probably not require dredging during the 40-year plan period. Therefore, long-term dredged material placement site planning for these dredge cuts is not included in this report.

OTHER PLANNING EFFORTS

3.1 GREAT I

The GREAT I study was completed in 1980. GREAT I recommended two placement sites to accomodate the 1,357,500 cubic yards of dredged material from cuts 2 through 5 in lower pool 2. GREAT I recommended that 696,000 cubic yards of dredged material from cuts 2 and 3 be taken to a 14-acre grassy field located on the lower end of Grey Cloud Island (GREAT I Site 2.35). GREAT I estimated that 240,000 cubic yards of the material placed at site 2.35 would be removed for beneficial use.

GREAT I recommended that the 661,500 cubic yards of dredged material from cuts 4 and 5 be placed at a site located on the right bank of the river immediately upstream of the I-494 bridge at river mile 832.5 (GREAT I Site 2.10). This site was a disturbed area adjacent to the South St. Paul stockyards. GREAT I estimated that all of the material placed at site 2.10 would be removed for beneficial use.

The GREAT I study recommended that further study be undertaken to develop a habitat restoration plan for Spring Lake (Further Study Item #25). This recommendation recognized the potential for using dredged material as part of plans to restore habitat quality in Spring Lake.

3.2 LOWER POOL 2 RECONNAISSANCE REPORT (July 1984)

In July 1984, the St. Paul District completed a reconnaissance report evaluating the GREAT I recommended dredged material placement plan and six alternative placement plans for dredge cuts 2 through 5. The July 1984 reconnaissance report (w/o appendices) is contained in appendix E of this report. The recommendation of the July 1984 reconnaissance report was that the dredged material from cuts 2 through 5 be used in development of a habitat restoration project for Spring Lake (alternative C3).

3.3 SPRING LAKE

During the period 1989-94 the St. Paul District conducted planning efforts to develop a fish and wildlife habitat restoration plan for Spring Lake involving the use of dredged material. A January 1991 problem appraisal report (Appendix F) concluded that alternative C3 as recommended in the July

1984 reconnaissance report was probably not implementable due to potential water quality effects, flood stage effects, recreational boat access constraints, and fish access concerns.

Alternative C2 would nearly close off Spring Lake, and as such, implementation of this plan would entail many of the same concerns as with alternative C3, especially the water quality concerns and the effects on flood stages.

As a result of the 1989-91 planning efforts, the District has concluded that alternative C3 as recommended in the 1984 reconnaissance report is not implementable. In addition, the District has concluded that alternative C2 is not implementable either, primarily because of flood stage effects and potential water quality concerns.

During 1994 the District investigated whether or not a smaller version of the Spring Lake project may be implementable, akin to alternative C1 as described in the 1984 reconnaissance report. The concept would be to isolate and protect a small portion of the upper end of Spring Lake (this concept was dubbed the "lake within the lake" alternative). Hydraulic modelling (Appendix F) indicates that various sizes of the "lake within the lake" option would increase 100-year flood stages at river mile 830 from .006 to .017 feet. For floodplain management purposes these values would be rounded to .01 and .02. Under existing floodplain regulations, increases of this magnitude in pool 2 would not normally be allowable.

As a result of the studies that have been conducted on Spring Lake, the St. Paul District conclusions concerning the feasibility of Spring Lake serving as a long-term dredged material placement site for lower pool 2 are as follows.

a. Complete or near complete closure of Spring Lake from the Mississippi River is not feasible due to potential water quality impacts and floodplain effects, i.e., the raising of flood stages. Therefore, the use of Spring Lake as a placement site for all of the dredged material from cuts 2 through 5 as recommended in the July 1984 reconnaissance report is not possible.

b. Floodplain impacts will limit the scale of any island and/or closure construction at Spring Lake. The volumes of dredged material that would be used would be too limited to provide a long-term dredged material placement solution for lower pool 2.

3.4 MISSISSIPPI NATIONAL RIVER AND RECREATION AREA

Lower pool 2 is within the boundaries of the Mississippi National River and Recreation Area (MNRRA), a unit of the national park system. The comprehensive management plan for the MNRRA contains the following goals for the MNRRA.

* preserve and enhance natural resources

* restore significant natural resources that have been adversely impacted in the past

* improve water quality in the river and move toward fishable and swimmable goals as defined in state and federal law

* recognize the role of the Mississippi River as a nationally significant natural ecosystem and migratory corridor for wildlife in the heart of the midcontinent

* encourage economic development activities that take advantage of the corridor's attributes in a manner that preserves, protects, and enhances the natural and cultural resources in the corridor

* enhance opportunities for public outdoor recreation, education, and scenic enjoyment throughout the MNRRA corridor

* Recognize the role of the Mississippi River as a working river & as the heart of midcontinent navigation.

ALTERNATIVES NOT INCLUDED IN THE ALTERNATIVE ASSESSMENT

During the GREAT I study, alternative placement sites were designated by a number such as "2.27." The "2" meant the site was located in pool 2. In some instance the numbers to the right of the decimal related to river miles, but in other instances, they had no particular geographical meaning. More recent channel maintenance planning efforts by the St. Paul District have used a numerical system indicating pool, river mile, left or right bank, and state location. For example, GREAT I site 2.27 would be site 2-827.2-RM, i.e., located in pool 2, at river mile 827.2, on the right (R) bank of the river, and in the State of Minnesota (M). In addition to the numberical designations above, most placement sites also have a common name. Table 3 below shows the GREAT I site number, the river mile/river bank/state number, and the common name for each of the alternative placement sites addressed in this report. The locations for these sites are shown on plate 1.

Table 3
Alternative Placement Site Names and Numbers

Common Name	GREAT I System	River Mile System
Freeborn Island	2.75	2-819.4-RM
Lower Grey Cloud Island Field	2.35	2-821.0-LM
Lower Boulanger Island	2.31A	2-821.1-LM
Upper Boulanger Island	2.31B	2-821.5-LM
Spring Lake	2.24	2-822.0-RM
Shiely Site	-	2-822.5-LM
C.F. Industries	-	2-823.4-RM
Pine Bend	2.25	2-823.8-LM
Grey Cloud Slough	2.27	2-827.2-RM
Armour Site	2.10	2-832.5-RM
NSP Site	2.05	2-832.5-LM

4.1 PLACEMENT SITES

4.1.1 NSP SITE (SITE 2-832.5-LM)

Site 2-832.5-LM is a 4-acre privately owned area near the Red Rock Industrial Park, and it is located immediately upstream of the I-494 bridge. This site was identified and evaluated in the July 1984 reconnaissance report (appendix E). Since that time, a building has been constructed on the site and, because of this, the site is no longer considered a viable alternative dredged material placement site.

4.1.3 SPRING LAKE (SITE 2-822.0-RM)

As previously discussed, Spring Lake is not considered a feasible long-term dredged material placement alternative. The one-time placement of dredged material for fish and wildlife habitat restoration may be possible (see Recommendations section).

4.1.4 C.F. INDUSTRIES (SITE 2-823.4-RM)

In 1989, C.F. Industries allowed the District to place a small amount (15,000 c.y.) of dredged material adjacent to their dock. This site is too small to be a long-term dredged material placement solution in lower pool 2. C.F. Industries owns an old borrow pit located at the top of the bluff above the river. Material could be placed in this site by barging it to the C.F. Industries dock and then rehandling the material to the borrow pit. This site was not evaluated in detail because it became apparent early in the evaluation process that dredged material could be placed in the Shiely sand and gravel pits on Grey Clould Island at a much lower cost. In addition, the C.F. Industries pit does not have capacity for 40 years of dredged material as the Shiely pits do. The overall environmental effects associated with use of either pit were considered comparable.

4.2 ALTERNATIVE PLACEMENT PLANS

The following dredged material placement alternatives, evaluated in the July 1984 reconnaissance report, were not included in the alternatives assessment for this report.

4.2.1 ALTERNATIVE C1

Alternative C1 is no longer considered a feasible alternative because it would require the use of site 2-832.5-LM, now unavailable due to building construction that has taken place on the property since 1984.

4.2.2 ALTERNATIVE C2

Alternative C2 is no longer considered a feasible alternative because it would involve a near total closure of Spring Lake (see earlier discussion concerning Spring Lake).

4.2.3 ALTERNATIVE C3

Alternative C3 is not considered a feasible alternative because it would involve a total closure of Spring Lake (see earlier discussion concerning Spring Lake).

4.2.4 ALTERNATIVE D

Alternative D is no longer considered a feasible alternative because it would require the use of site 2-832.5-LM, now unavailable due to building construction that has taken place on the property since 1984.

4.2.5 ALTERNATIVE E

Alternative E is no longer considered a feasible alternative because it would require the use of site 2-832.5-LM, now unavailable due to building construction that has taken place on the property since 1984.

ALTERNATIVE PLACEMENT PLANS AND EVALUATIONS

5.1 ALTERNATIVE PLACEMENT SITES

The following is a description of the alternative placement sites that make up the alternative placement plans evaluated in detail. The actual size of some of the placement sites varies with alternative.

5.1.1 FREEBORN ISLAND (SITE 2-819.4-RM)

Freeborn Island is a 6-acre island located in a predominantly open water portion of lower pool 2. The island has been used for dredged material placement in the past, the most recent use being in 1972. Since that time, the island has revegetated and is nearly covered by small trees and shrub growth. This site is owned by the Federal government.

5.1.4 LOWER GREY CLOUD ISLAND FIELD (SITE 2-821.0-LM)

This site is a 14-acre privately owned field on Lower Grey Cloud Island. This site is relatively flat and vegetated by grasses. This site is ostensibly owned by P.A.S. Associates.

5.1.3 LOWER BOULANGER ISLAND (SITE 2-821.1-LM)

Lower Boulanger Island is an approximately 10-acre island that is part of a chain of small islands lying between the navigation channel and Lower Grey Cloud Island. The island has been used for dredged material placement in the past, most recently in 1995. The habitat on the island is a mixture of bottomland forest, revegetating old dredged material deposits, and recently deposited sand. This site is ostensibly owned by P.A.S. Associates.

5.1.4 UPPER BOULANGER ISLAND (SITE 2-821.5-LM)

Upper Boulanger Island is an approximately 8-acre island that also is part of a chain of small islands lying between the navigation channel and Lower Grey Cloud Island. The island has been used for dredged material placement in the past, most recently in 1994. The habitat on the island is a mixture of bottomland forest, revegetating old dredged material deposits, and

recently deposited sand. This site is ostensibly owned by P.A.S. Associates.

5.1.5 SHIELY SITE (SITE 2-822.5-LM)

The Shiely site is the active sand and gravel pit operations on Lower Grey Cloud Island. No specific portion of the pit(s) have been identified for dredged material placement. For planning purposes, it is assumed that approximately 15 acres would be required to contain the projected amount of dredged material that would go to this site for the various alternatives.

5.1.6 PINE BEND (SITE 2-823.8-LM)

Pine Bend is a historic dredged material site located on a peninsula separating Baldwin Lake from the navigation channel. This site was last used for dredged material placement in 1995. The site is approximately 12 acres and the habitat consists of a mixture of bottomland forest, revegetating old dredged material deposits, and recently deposited sand. Cottage Grove has the Minnesota Department of Transportation (MNDOT) listed as the owner of the site. Washington County has eliminated this land from their records. Neither MNDOT nor any other State agency list this site on their records.

5.1.7 GREY CLOUD SLOUGH (SITE 2-827.2-RM)

This site is also a historic dredged material placement site. The site is about 9 acres in size and primarily bottomland forest. No precise records are available, but it appears that this site has not been used as a placement site since the late 1960's - early 1970's. The ostensible owner of this site is Macalester College. The site is part of an area known as the Katherine Ordway Natural Historical Study Area or Macalester Biology Center.

5.1.8 ARMOUR SITE (SITE 2-832.5-RM)

This site is located in an industrial-commercial area of South St. Paul, immediately upstream from the I-494 bridge. This site has been filled and is advertised for sale for commercial development. There is approximately 20 acres of property available, though only 4 acres would be required for a beneficial use stockpile site. The site is vegetated by a mixture of grasses and forbs typical of disturbed urban areas. The ostensible owner of this site is American AGCO, Inc.

5.2 ALTERNATIVE PLACEMENT PLANS FOR DREDGE CUTS 2 AND 3

As alternative plans were being developed and analyzed, it became readily evident that planning for dredged material placement in lower pool 2 could be divided in to two sub-planning efforts, one for dredge cuts 2 and 3, and one for dredge cuts 4 and 5. There was no overlap of sites save for the Shiely gravel pits. Since the Shiely site has unlimited capacity, any decisions made to use this site for cuts 2 and/or 3 would have no impact on any decisions made to use this site for cuts 4 and/or 5, and vice versa. Therefore, to simplify the planning effort and avoid the development of a cumbersome number of alternatives, it was decided to separate the planning for cuts 2 and 3 from the planning for cuts 4 and 5.

Six alternative placement plans were evaluated in detail for cuts 2 and 3. These included alternatives A1 (modified GREAT I) and B1 (historic placement) which were evaluated in the July 1984 reconnaissance report. Four new alternatives were developed and are addressed in this report.

During the period 1989-95, the St. Paul District placed dredged material at sites 2-821.1-LM (135,000 cy) and 2-821.5-LM (210,000 cy) under the agreement that this material would be removed for use in the Spring Lake project. The Spring Lake project is no longer considered a feasible dredged material placement option. However, the St. Paul District will honor the commitment to remove this material. Plans for removal of this material are addressed for each alternative.

5.2.1 ALTERNATIVE A1

5.2.1.1 General

Alternative A1 (table 4) is the GREAT I recommended plan modified to reflect adjusted placement site dimensions, and projected equipment use. Under this plan, an estimated 696,000 cubic yards of material from dredge cuts 2 and 3 would be placed at site 2-821.0-LM.

This alternative includes the removal of an estimated 345,000 cubic yards of dredged material from sites 2-821.1-LM and 2-821.5-LM placed during 1989-95. This material would be taken to site 2-822.5-LM.

Table 4
Summary of Alternative A1

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
821.0-LM	n.a.	n.a.	2	240,500	240,500	14	25'
			3	455,500			
822.5-LM	345,000 cubic yards would be taken to this site*					-	-

* 135,000 cy from site 2-821.1-LM and 210,000 cy from site 2-821.5-LM would be removed and taken to site 2-822.5-LM

5.2.1.2 Operations

Site 2-821.0-LM would be 14 acres in size (plate 2). Dredged material from cut 2 would be mechanically placed at site 2-821.0-LM, as the distance from cut 2 to the site is too far for hydraulic placement. An access channel would have to be dredged from the main channel into the site. Material from cut 3 could be placed at the site either mechanically or hydraulically, depending on equipment availability. Hydraulic placement would be the preferred method from an operational standpoint.

5.2.1.3 Beneficial Use

It is projected that 240,000 cubic yards of the 696,000 cubic yards placed at site 2-821.0-LM would be removed for beneficial use. The 345,000 cubic yards of material placed at site 2-822.5-LM would be put to passive beneficial use.

5.2.1.4 Fish and Wildlife

Sites 2-821.0-LM (14 acres) would be used for this alternative. Site 2-821.0-LM is a flat old field vegetated primarily by grasses. There are a few invading trees on the riverward side of the site. On the landward side of the site, there are a few rows of red pine 20 to 30 feet in height that were planted to serve as a windbreak. Use of the site for dredged material placement would result in a steady loss of habitat at the site as the area is incrementally taken for dredged material stockpiling. Because this site would be an active beneficial-use removal site, it is unlikely that any revegetation efforts would be undertaken during the project life. The habitat loss over 40-years for this site under alternative A1 is estimated to be 513 average annual habitat units (AAHU).

5.2.1.5 Water Quality

Particle size analysis indicates that the sediments in the Grey Cloud Slough cut and the Pine Bend Foot Light cut are primarily sand (95 percent). Downriver to the Boulanger Bend cut and the Boulanger Bend Lower Light cut, the percentage of sand decreases and the percentage of fines increases substantially. The percent of fine particles for the Boulanger Bend cut in 1978 samples was 45 and the percent of fine particles for the Boulanger Bend Lower Light cut in 1981 and 1994 samples was 85 and 97, respectively.

The few bulk chemical analysis samples available from cuts 2 and 3 (containing higher silt/clay contents) show the expected elevated levels of nutrient and heavy metals and the increased presence of PCB's and chlorinated hydrocarbon pesticides. PCB levels up to 170 ug/kg (ppb) were found while the pesticides were generally present in the 1 to 11 ug/kg range.

With this alternative, material from cut 2 would be dredged mechanically and transported to site 821.0-LM. Some material from the Boulanger Bend cuts could be placed directly by hydraulic dredge. Since much of the material would be placed mechanically, the effects on water quality with alternative A1 would be minor and temporary.

5.2.1.6 Cultural Resources

Site 2-821.0-LM has a high potential for containing cultural resources and a cultural resources survey would be required before the site could be used. Discovery of cultural resources at this site would not preclude its use for dredged material placement. However, because there are alternative placement sites available, there would be a strong impetus to select an alternative site.

5.2.1.7 Social and Recreation Effects

Site 2-821.0-LM is privately owned and located at the lower end of Grey Cloud Island. A residence is located only 300 feet from the site and a summer camp is located on land adjacent to the site. Placement of material at the site could cause some safety concerns during placement and removal. Because of the adjacent land use, adverse impacts could also accrue due to creation of a new non-beach placement site within viewing distance of a residential area and summer camp.

Under alternative A1, all dredged material would go directly to site 2-821.0-LM. This could have long term adverse impacts to recreation opportunities as no dredged material would be placed at riverine sites, creating the open sandy areas used by many river recreationists. This potential adverse effect could be offset to a large degree by development and implementation of a recreational beach plan for lower pool 2.

5.2.2 ALTERNATIVE B1

5.2.2.1 General

Alternative B (table 5) would involve the use of two historic placement sites, 2-819.4-RM and 2-821.1-LM. Material from channel maintenance over the next 40 years would be permanently placed at these sites with no beneficial use removal. Even though channel maintenance material placed at these sites in the future would not be removed, this alternative does include the removal of an estimated 345,000 cubic yards of dredged material from sites 2-821.1-LM and 2-821.5-LM placed during 1989-95. This material would be taken to site 2-822.5-LM.

Table 5
Summary of Alternative B1

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
819.4-RM	n.a.	n.a.	2	240,500	0	8	25'
821.1-LM	135,000	n.a.	3	455,500	0	14	25'
822.5-LM	345,000 cubic yards would be taken to this site*					-	-

* includes 210,000 cubic yards removed from site 2-821.5-LM

5.2.2.2 Operations

Cut 2

Material from cut 2 could be placed into site 2-819.4-RM either hydraulically or mechanically, depending on equipment availability. However, given the fine nature of the material in this cut, it is expected that hydraulic dredging and placement would be used in most instances. After 40 years, it is estimated that the site would cover about 8 acres (plate 3) with a final fill elevation approximately 25 feet above normal pool elevation.

Cut 3

Material from cut 3 could be placed into site 2-821.1-LM either hydraulically or mechanically, depending on equipment availability. However, it is expected that hydraulic dredging and placement would be used in most instances. After 40 years, it is estimated that the site would cover about 14 acres (plate 4) with a final fill elevation approximately 25 feet above normal pool elevation.

5.2.2.3 Beneficial Use

None of the material placed in the two riverine sites over the next 40 years would be used for beneficial use during this period. The 345,000 cubic yards unloaded to site 2-822.5-LM would be put to passive beneficial use.

5.2.2.4 Fish and Wildlife

Sites 2-819.4-RM (8 acres) and 2-821.1-LM (14 acres) would be used for this alternative. Use of these sites would result in the gradual loss of whatever fish and wildlife habitat is available there. The dredged material placed on the site would have limited habitat value, serving primarily as nesting sites for turtles and loafing sites for shorebirds and gulls.

Site 2-819.4-RM is an island/open-water area (5 acres of young bottomland forest and 3 acres of shallow aquatic) in the lower lake-like portion of pool 2. The island has been used for dredged material disposal in the past, the last time in 1972. The habitat loss over 40-years for this site under alternative B is estimated to be 428 AAHU.

Site 2-821.1-LM under alternative B1 consists of two small islands (Lower Bouglanger Island and an unnamed island) totaling 11 acres (3 acres of old dredged material, 4 acres of sand, and 4 acres of bottomland forest) and the 3-acre stretch of open water separating them. Both islands have been used for dredged material disposal in the past, Lower Boulanger Island in 1995. The habitat loss over 40-years for this site under alternative B is estimated to be 406 AAHU.

The combination of the use of the two sites under alternative B1 would result in the impacts on 3 acres of old dredged material, 4 acres of sand, 9 acres of bottomland forest, and 6 acres of shallow aquatic habitat, for an estimated total loss of 834 AAHU.

5.2.2.5 Water Quality

With this alternative containment sites would be constructed and expanded as needed at sites 2-819.4-RM and 2-821.1-LM. Material would be hydraulically placed directly in these containment sites and an effluent returned to the river. Some open water disposal would occur, because sites 2-819.4-RM and 2-821.1-LM involve some aquatic areas. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Acute toxic releases would not be likely to occur.

The material from the Boulanger Bend Lower Light, contains the most amount of fine material of all the dredge cuts being evaluated. Hydraulic placement of this material at site 2-819.4-RM, which includes 3 acres of open water, might cause some appreciable impacts on water quality during the disposal event. Use of this site would have the greatest impact on water quality of all the sites being considered. Because of concerns with the amount of fine material present in the dredge cut that would be placed at this site, use of this site under the various alternatives was assigned the lowest value permissible in the evaluation table B-10. Further investigation of the material from dredge cut 2 would be required prior to use of site 2-819.4-LM with hydraulic placement methods. This would be necessary to fully evlauate the effects of hydraulic placement of this material and to determine what special mitigative measures might be necessary to meet appropriate water quality criteria and/or standards.

Typo →

5.2.2.6 Cultural Resources

Neither of the sites have been surveyed for cultural resources. Historic dredged material placement practices on these sites would have buried any cultural resources present such that use of these site under alternative B1 would have no adverse effect.

missing word →

5.2.2.7 Social and Recreation Effects

Alternative B1 would have no appreciable socioeconomic effects.

Alternative B1 would have long term beneficial impacts on river recreation by perpetuating the existance of open sandy areas along the main channel that are preferred by many river recreationists. The demand for riverine beach areas in lower pool 2 is likely to increase as the Twin Cities population increases.

on Freeborn Is. we would not support this statement because would be sacrificing existing ecological value.

5.2.3 ALTERNATIVE F1

5.2.3.1 General

Alternative F1 would involve pre-excavating three historic dredged material placement sites to provide the capacity for 40 years for the projected dredging requirements from cuts 2 and 3. All of the material excavated from these three sites would be placed in the J.L. Shiely Co. (Shiely) sand and gravel pits on Lower Grey Cloud Island (site 2-822.5-LM).

All of the sites would be pre-excavated hydraulically with the material pumped directly to site 2-822.5-LM. The work would be done in one construction season (est. 1997) under one contract. The specifics concerning each individual site are discussed under "Operations" below. These three sites would then be used for placement of channel maintenance material over the next 40 years (table 6).

An estimated 345,000 cubic yards of dredged material placed at sites 2-821.1-LM and 2-821.5-LM during 1989-95 would be removed and taken to site 2-822.5-LM. This material would be removed as part of the pre-excavation at each of these sites.

Table 6
Summary of Alternative F1

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
819.4-RM	n.a.	240,500	2	240,500	0	7	16'
821.1-LM	n.a.	245,500	3	245,500	0	9	23'
821.5-LM	n.a.	210,000	3	210,000	0	4	5'
822.5-LM	696,000 cubic yards would be taken to this site					-	-

5.2.3.2 Operations

Cut 2

Site 2-819.4-LM would be excavated to 30 feet below normal pool, requiring the removal of about 240,500 cubic yards. Dredged material from cut 2 (est. 240,500 c.y.) would then be placed in this site over the next 40 years. Material from cut 2 could be placed into the site either hydraulically or mechanically, depending on equipment availability. However, given the fine nature of the material in this cut, it is expected that hydraulic dredging and placement would be used in most instances. After 40 years, it is estimated that the site would cover about 7 acres (plate 5) with a final fill elevation approximately 16 feet above normal pool elevation.

Cut 3

Sites 2-821.1-LM and 2-821.5-LM would be excavated to 30 feet below normal pool, requiring the removal of about 245,500 cubic yards from site 2-821.1-LM and about 210,000 cubic yards from site 2-821.5-LM. The 135,000 cubic yards and 210,000 cubic yards of material to be removed from sites 2-821.1-LM and 2-821.5-LM, respectively, to honor past commitments are included in these totals.

Dredged material from cut 3 (est. 455,500 c.y.) would be placed in these two sites over the next 40 years. Material from cut 3 could be placed into the sites either hydraulically or mechanically, depending on equipment availability. After 40 years, it is estimated that site 2-821.1-LM would cover about 9 acres (plate 5) with a final fill elevation approximately 23 feet above normal pool elevation. Site 2-821.5-LM would cover about 4 acres with a final fill elevation approximately 5 feet (plate 6) above normal pool elevation.

5.2.3.3 Beneficial Use

All of the material pre-excavated from the three riverine sites would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island. None of the material placed in the three riverine sites over the next 40 years would be used for beneficial use during this period.

5.2.3.4 Fish and Wildlife

With this alternative all the material for the 40-year planning period

would be excavated at year 1 from sites 2-819.4-RM (7 acres), 2-821.1-LM (9 acres), and 2-821.5-LM (4 acres) and placed at site 822.5-LM (15 acres). This would convert the existing habitat at these sites into a sand ring berm and deep water aquatic habitat. This deep water aquatic habitat would slowly be converted to sand habitat through subsequent periodic disposal of dredged material in the next 40 years.

Impacts of the use of site 2-819.4-RM would be similar to those described for alternative B1, except that 5 acres of bottomland forest and 2 acres of shallow aquatic habitat would be impacted, for a loss of 389 AAHU.

Impacts of the use of site 2-821.1-LM would be similar to those described for alternative B1, except that the lower unnamed island would not be used and less acres would be impacted (1 acre old dredged material, 4 acres sand, 2.5 acres of bottomland forest, and 1.5 acres of shallow aquatic). The habitat loss over 40-years for this site under alternative F1 is estimated to be 345 AAHU.

Site 2-821.5-LM is an island site that has been used for dredged material disposal in the past. The 4 acre area proposed for disposal consists of sand habitat. Most of the woody vegetation that is present on the island occurs around the edges of the island and would not be directly impacted. The value of the island as habitat for larger mammals, such as white-tailed deer, raccoon, fox, and skunks is probably limited by its small size and relative isolation from land areas. The habitat loss over 40-years for this site under alternative F1 is estimated to be 71 AAHU.

Site 2-822.5-LM is a 15-acre active/recently abandoned sand and gravel quarry, that presently has very limited wildlife value. The coarse barren substrate present at the site will greatly limit vegetative colonization, but the site will slowly eventually begin to revegetate. It is anticipated that the material transferred from the other sites will contain a fair amount of fine material and that the resultant soils will be of better quality than presently exists. This should allow a much more rapid colonization by plants and a long-term improvement of the quality of the habitat at the site. No net adverse impacts are expected.

The combination of the use of sites 2-819.4-RM, 2-821.1-LM, 2-821.5-LM, and 2-822.5-LM under alternative F1 would result in impacts on 1 acre of old dredged material, 23 acres of sand, 18.5 acres of bottomland forest, and 3.5 acres of shallow aquatic habitat, for an estimated total loss of 805 AAHU.

5.2.3.5 Water Quality

Under this alternative all pre-excavated material would be transferred to the site 2-822.5-LM by hydraulic dredging. Subsequent re-use of the excavated sites 2-819.4-RM, 2-821.1-LM, and 2-821.5-LM would most likely be done with hydraulic dredging. Sand berms would be created at all the sites to contain the material. Some open water disposal would occur in filling in the aquatic areas at sites 2-819.4-RM and 2-821.1-LM.

Turbidity and suspended solids would increase with turbidity plumes in the immediate disposal area and for a distance around the site. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. The concern with the hydraulic placement of material at site 2-819.4-RM would be the same as described for alternative B1.

5.2.3.6 Cultural Resources

None of the sites have been surveyed for cultural resources. Historic dredged material placement practices would have buried any cultural resources presentat the three sites that would be pre-excavated. Pre-excavation could affect currently unknown cultural resources at these sites. However, the potential for adverse effect is considered low.

Use of site 2-822.5-LM would have no effect on cultural resources.

5.2.3.7 Social and Recreational Effects

Alternative F1 would have no appreciable socioeconomic effects.

Alternative F1 will have mixed effects on recreation resources and opportunities. As indicated for alternative B1, riverine placement sites can provide open sandy areas desired by recreationists. Under alternative F1, some open sandy areas will likely be maintained along the shorelines at sites 2-819.3-RM, 2-820.9-LM, and 2-821.4-LM. However, because these sites will be pre-excavated, for many years they will consist primarily of open water inside a low diked area. This will limit the amount of open sandy area until the sites are filled to an elevation above normal pool.

NPS preferred alt.

5.2.4 ALTERNATIVE G1

5.2.4.1 General

All of the material dredged from cuts 2 and 3 would be placed directly into site 2-822.5-LM on Lower Grey Cloud Island (table 8).

An estimated 345,000 cubic yards of dredged material placed at sites 2-821.1-LM and 2-821.5-LM during 1989-95 would be removed to comply with commitments made by the St. Paul District when the material was placed. This material would also be taken to site 2-822.5-LM.

Table 8
Summary of Alternative G1

Site	Removal* to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Height
822.5-LM	n.a.	n.a	2	240,500	0	-	-
			3	455,500			

* 135,000 cy from site 2-821.1-LM and 210,000 cy from site 2-821.5-LM would be removed and also taken to site 2-822.5-LM.

Alt. G1 (cuts 2 & 3)

5.2.4.2 Operations

Because of location of site 2-822.5-LM, all of the material from normal channel maintenance would have to be mechanically dredged and barged to the site. Material would be barged to an unloading ramp where it would be loaded onto trucks and transported to a permanent location within the J.L. Shiely gravel pit (site 2-822.5-LM).

* Dropped the sentence saying the old barge channel may have to be maintained; however, stated at the meeting that although the sentence would be dropped from the text, it would still be a possibility. (I believe the sentence was dropped at Steve J.'s request).

5.2.4.3 Beneficial Use

All of the material placed at site 2-822.5-LM would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island.

5.2.4.4 Fish and Wildlife

Site 2-822.5-LM would be used for this alternative. With this alternative dredged material would be directly disposed of as dredging is required. The site would be incrementally impacted by future direct disposals. This would impact previously undisturbed areas that at that time would show some signs of vegetative recovery, thereby offsetting the gains in habitat quality projected for alternative G1. However, it is estimated that there will be no net loss in habitat quality for alternative G1.

5.2.4.5 Water Quality

Under this alternative all material would be mechanically dredged and placed at the site 2-822.5-LM. It would produce the least impacts on water quality of any of the alternatives considered.

5.2.4.6 Cultural Resources

Use of site 822.5-LM would have no adverse effect on cultural resources.

5.2.4.7 Social and Recreation Effects

Alternative G1 would have no appreciable socioeconomic effects.

Under alternative G1, all dredged material would go directly to site 2-822.5-LM. This could have long term adverse impacts to recreation opportunities as no dredged material would be placed at riverine sites, creating the open sandy areas used by many river recreationists. This potential adverse effect could be offset to a large degree by development and implementation of a recreational beach plan for lower pool 2.

5.2.5 ALTERNATIVE H1

5.2.5.1 General

Alternative H1 would involve pre-excavating site 2-821.1-LM to provide the capacity for 40 years for the projected dredging requirements from cuts 2 and 3. All of the material excavated from this site would be placed in the J.L. Shiely Co. (Shiely) sand and gravel pits on Lower Grey Cloud Island (site 2-822.5-LM). To provide the necessary capacity at this site would require a pre-excavation prior to use, and a re-excavation approximately one-half way through the 40-year planning period. The specifics are discussed under "Operations" below. The site would then be used for placement of channel maintenance material from cuts 2 and 3 over the next 40 years (table 9).

An estimated 345,000 cubic yards of dredged material placed at sites 2-821.1-LM and 2-821.5-LM during 1989-95 would be removed and taken to site 2-822.5-LM. This material would be removed at the time of the first pre-excavation of site 2-821.1-LM.

Table 9
Summary of Alternative H1

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM*	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
821.1-LM	n.a.	696,000	2 3	696,000	0	10	25'
821.5-LM	210,000	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
822.5-LM	906,000 cubic yards would be taken to this site					-	-

* Site 2-821.1-LM would be excavated twice, first in 1997 and then again approximately 20 years later.

5.2.5.2 Operations

Cut 2

Dredged material from cut 2 would be placed in site 2-821.1-LM. Because of the location of the site, the material from cut 2 would have to be mechanically dredged and barged to the site.

Cut 3

In the initial pre-excavation, site 2-821.1-LM would be excavated to 30 feet below normal pool, requiring the removal of about 348,000 cubic yards from the site. The 135,000 cubic yards to be removed from the site to honor past commitments is included in this total. The 210,000 cubic yards to be removed from site 2-821.5-LM would also be excavated at this time.

Dredged material from cut 3 would be placed in this site over the next 40 years. Material from cut 3 could be placed either hydraulically or mechanically, depending on equipment availability. The site would be re-excavated approximately 20 years into the planning period, with the material taken to site 2-822.5-LM. It is extimated that 348,000 cubic yards would be removed during this second excavation.

After 40 years, it is estimated that site 2-821.1-LM would cover about 10 acres (plate 5) with a final fill elevation approximately 25 feet above normal pool elevation.

5.2.5.3 Beneficial Use

All of the material placed at site 2-822.5-LM would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island. None of the material placed in site 2-821.1-LM during the second 20 years of the 40-year period would be used for beneficial use during this period.

5.2.5.4 Fish and Wildlife

Site 2-821.1-LM (10 acres) would be used for this alternative. The impacts at site 2-821.1-LM would be similar to those described for alternative F1. The use of site 2-821.1-LM under alternative H1 would result in impacts on 1 acre of old dredged material, 4 acres of sand, 2.5 acres of bottomland forest, and 2.5 acres of shallow aquatic habitat, for an estimated loss of 422 AAHU.

5.2.5.5 Water Quality

The effects on water quality for this alternative would be similar to those decribed for alternative F1, except that material from Boulanger Bend Lower Light would be mechanically dredged and placed at the site 2-821.1-LM, rather than at site 2-819.4-LM. The effects on water quality would be reduced because of this mechanical dredging and placement.

5.2.5.6 Cultural Resources

Site 2-821.1-LM has not been surveyed for cultural resources. Historic dredged material placement practices at the site would have buried any cultural resources present. Pre-excavation could affect currently unknown cultural resources at these sites. However, the potential for adverse effect is considered low.

Use of site 2-822.5-LM would have no adverse effect on cultural resources.

5.2.5.7 Social and Recreation Effects

Alternative H1 would have no appreciable socioeconomic effects.

Alternative H1 will have mixed effects on recreation resources and opportunities. As indicated for alternative B1, riverine placement sites can provide open sandy areas desired by recreationists. Under alternative H1, some open sandy areas will likely be maintained along the shorelines at site 2-821.1-LM. However, because this site will be pre-excavated, for many years it will consist primarily of open water inside a low diked area. This will limit the amount of open sandy area until it is filled to an elevation above normal pool.

5.2.6 ALTERNATIVE I1

5.2.6.1 General

Alternative I1 would involve pre-excavating sites 2-821.1-LM and 2-821.5-LM to provide the capacity for 40 years for the projected dredging requirements from cuts 2 and 3. All of the material excavated from this site would be placed in the J.L. Shiely Co. (Shiely) sand and gravel pits on Lower Grey Cloud Island (site 2-822.5-LM). To provide the necessary capacity at site 2-821.1-LM would require a pre-excavation prior to use, and a re-excavation approximately one-half way through the 40-year planning period. The specifics are discussed under "Operations" below. The sites would then be used for placement of channel maintenance material from cuts 2 and 3 over the next 40 years (table 10).

An estimated 345,000 cubic yards of dredged material placed at sites 2-821.1-LM and 2-821.5-LM during 1989-95 would be removed and taken to site 2-822.5-LM. This material would be removed at the time of the first pre-excavation of the sites.

Table 10
Summary of Alternative I1

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM*	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
821.1-LM	n.a.	455,500	2 3	455,500	0	8	20'
821.5-LM	n.a.	240,500	2 3	240,500	0	4	20'
822.5-LM	696,000 cubic yards would be taken to this site					-	-

* Site 2-821.1-LM would be excavated twice, first in 1997 and then again approximately 20 years later.

5.2.6.2 Operations

Cut 2

Dredged material from cut 2 would be placed in sites 2-821.1-LM and/or 2-821.5-LM. Because of the location of the sites, the material from cut 2 would have to be mechanically dredged and barged to the sites.

Cut 3

In the initial pre-excavation, site 2-821.1-LM would be excavated to 30 feet below normal pool, requiring the removal of about 348,000 cubic yards from the site. The 135,000 cubic yards to be removed from the site to honor past commitments is included in this total.

In the pre-excavation, site 2-821.5-LM would be excavated to 30 feet below normal pool, requiring the removal of about 240,500 cubic yards from the site. The 210,000 cubic yards to be removed from the site to honor past commitments is included in this total.

Dredged material from cut 3 would be placed in these sites over the next 40 years. Material from cut 3 could be placed either hydraulically or mechanically, depending on equipment availability. Site 2-821.1-LM would be re-excavated approximately 20 years into the planning period, with the material taken to site 2-822.5-LM. It is estimated that during this second excavation, 107,500 cubic yards would be removed from site 2-821.1-LM. ← typo

After 40 years, it is estimated that site 2-821.1-LM would cover about 8 acres (plate 4) with a final fill elevation approximately 20 feet above normal pool elevation, while site 2-821.5-LM would cover about 4 acres (plate 6) with a final fill elevation approximately 20 feet above normal pool elevation.

5.2.6.3 Beneficial Use

All of the material placed at site 2-822.5-LM would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island. None of the material placed in sites 2-821.1-LM and 2-821.5-LM during the second 20 years of the 40-year period would be used for beneficial use during this period.

5.2.6.4 Fish and Wildlife

Sites 2-821.1-LM (8 acres) and 2-821.5-LM (4 acres) would be used for this alternative. The impacts at these sites would be similar to those described for alternative F1. The use of site 2-821.1-LM and site 2-821.5-LM under alternative I1 would result in impacts on 1 acre of old dredged material, 8 acres of sand, 2.5 acres of bottomland forest, and 0.5 acres of shallow aquatic habitat, for an estimated loss of 319 AAHU.

5.2.6.5 Water Quality

The effects on water quality for this alternative would be similar to those decribed for alternative F1, except that material from Boulanger Bend Lower Light would be mechanically dredged and placed at the sites 2-821.1-LM and/or 2-821.5-LM, rather than at site 2-819.4-LM. The effects on water quality would be reduced because of this mechanical dredging and placement.

5.2.6.6 Cultural Resources

Sites 2-821.1-LM and 2-821.5-LM have not been surveyed for cultural resources. Historic dredged material placement practices at the sites would have buried any cultural resources present. Pre-excavation could affect currently unknown cultural resources at these sites. However, the potential for adverse effect is considered low.

Use of site 2-822.5-LM would have no adverse effect on cultural resources.

5.2.6.7 Social and Recreation Effects

Alternative I1 would have no appreciable socioeconomic effects.

Alternative I1 will have mixed effects on recreation resources and opportunities. As indicated for alternative B1, riverine placement sites can provide open sandy areas desired by recreationists. Under alternative I1, some open sandy areas will likely be maintained along the shorelines at sites 2-821.1-LM and 2-821.5-LM. However, because these sites will be pre-excavated, for many years they will consist primarily of open water inside a low diked area. This will limit the amount of open sandy area until it is filled to an elevation above normal pool.

5.3 ALTERNATIVE PLACEMENT PLANS FOR DREDGE CUTS 4 AND 5

Five alternative placement plans were evaluated in detail for cuts 4 and 5. These included alternatives A2 (modified GREAT I) and B2 (historic placement) that were evaluated in the July 1984 reconnaissance report. Three new alternatives were developed and are addressed in this report.

During the period 1989-95, the St. Paul District placed dredged material at site 2-823.8-LM (95,000 cy) under the agreement that this material would be removed for use in the Spring Lake project. The Spring Lake project is no longer considered a feasible dredged material placement option. However, the St. Paul District will honor the commitment to remove this material. Plans for removal of this material are addressed for each alternative.

5.3.1 ALTERNATIVE A2

5.3.1.1 General

Alternative A2 (table 10) is the GREAT I recommended plan modified to reflect adjusted placement site dimensions, and projected equipment use. Under this plan, an estimated 661,500 cubic yards of material from dredge cuts 4 and 5 would be placed at site 2-832.5-RM.

This alternative includes the removal of an estimated 95,000 cubic yards of dredged material from site 2-823.8-LM placed during 1989-95. This material would be taken to site 2-822.5-LM.

Table 10
Summary of Alternative A2

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
832.5-RM	n.a.	n.a.	4	379,500	661,500	4	-
			5	282,000			
822.5-LM	95,000 cubic yards would be taken to this site*					-	-

* 95,000 cy from site 2-823.8-LM would be removed and taken to site 2-822.5-LM

5.3.1.2 Operations

It is estimated that about 4 acres would be required at site 2-832.5-RM (plate 7). Dredged material from cuts 4 and 5 would be mechanically placed at site 2-832.5-RM due to the distance of the site from the dredge cuts. The material would be barged to an unloading ramp where it would be loaded on trucks and transported approximately 1,000 feet across a flood control dike and railroad tracks to site 2-832.5-RM.

5.3.1.3 Beneficial Use

It is projected that all of the material (661,500 cy) placed at site 2-832.5-RM would be removed for beneficial use. The 95,000 cubic yards placed at site 2-822.5-LM would be put to passive beneficial use.

5.3.1.4 Fish and Wildlife

Site 2-832.5-RM was at one time the cattle manure disposal area for the South St. Paul stockyards. The value of the site as wildlife habitat is low because of the sparse vegetation present. Without use, the quality of this habitat would improve. Use of the site would have minor effects upon fish and wildlife resources. The habitat loss over 40-years for this site under alternative A1 is estimated to be 192 AAHU.

5.3.1.5 Water Quality

Particle size analysis indicates that the sediments in the Grey Cloud Slough cut and the Pine Bend Foot Light cut are primarily sand (95 percent). Bulk chemical analysis of the sand sediments collected from the Grey Cloud Slough and Pine Bend Foot Light cuts shows the material to be relatively uncontaminated. Nutrient and heavy metal contents are low and comparable to the levels found in the "clean" main channel sands in pools 4 - 10. PCB's and chlorinated hydrocarbon pesticides were undetectable in nearly all samples at the 1.0 and 0.1 ug/kg detection limits used for the various compounds.

With this alternative, material would be dredged mechanically and transported to site 2-832.5-RM. Since all of the material would be placed mechanically, the effects on water quality with alternative A2 would be minor and temporary.

5.3.1.6 Cultural Resources

Use of site 2-832.5-RM would have no effect on cultural resources.

5.3.1.7 Social and Recreation Effects

Use of site 2-832.5-RM would have no socioeconomic effects.

Under alternative A2, all of the dredged material from cuts 4 and 5 would go directly to site 2-832.5-RM. This could have long term adverse impacts to recreation opportunities as no dredged material would be placed at riverine sites, creating the open sandy areas used by many river recreationists. This potential adverse effect could be offset to a large degree by development and implementation of a recreational beach plan for lower pool 2.

5.3.2 ALTERNATIVE B2 — BAD

5.3.2.1 General

Grey Cloud Slough

Alternative B2 (table 11) would involve the use of two historic placement sites (2-823.8-LM, and 2-827.2-RM). Material would be permanently placed at these sites with no beneficial use removal.

This alternative includes the removal of an estimated 95,000 cubic yards of dredged material from site 2-823.8-LM placed during 1989-95. This material would be taken to site 2-822.5-LM.

Table 11
Summary of Alternative B2

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
823.8-LM	95,000	n.a.	4	379,500	0	12	25'
827.2-RM	n.a.	n.a.	5	282,000	0	9	25'
822.5-LM	95,000 cubic yards would be taken to this site					-	-

5.3.2.2 Operations

Cut 4

Material from cut 4 could be placed into site 2-823.8-LM either hydraulically or mechanically, depending on equipment availability. However, it is expected that hydraulic dredging and placement would be used in most instances. After 40 years, it is estimated that the site would cover about 12 acres (plate 8) with a final fill elevation approximately 21 feet above normal pool elevation.

Cut 5

Material from cut 5 could be placed into site 2-827.2-RM either hydraulically or mechanically, depending on equipment availability. However, it is expected that hydraulic dredging and placement would be used in most instances. After 40 years, it is estimated that the site would cover about 9 acres (plate 9) with a final fill elevation approximately 21 feet above normal pool elevation.

5.3.2.3 Beneficial Use

None of the material placed in the two riverine sites over the next 40 years would be used for beneficial use during this period. The 95,000 cubic yards placed at site 2-822.5-LM would be put to passive beneficial use.

5.3.2.4 Fish and Wildlife

Sites 2-823.8-LM (12 acres) and 2-827.2-RM (9 acres) would be used for this alternative. Use of these sites would result in the gradual loss of whatever fish and wildlife habitat is available there. The dredged material placed on the site would have limited habitat value, serving primarily as nesting sites for turtles and loafing sites for shorebirds and gulls.

Site 2-823.8-LM lies on a long peninsula and was primarily old dredged material deposits in early stages of revegetation. The site was last used for dredged material placement in 1995, and with this operation 6.0 of the 9.5 acres of old dredged material was converted to bare sand habitat. About 2.5 acres of the site are relatively undisturbed bottomland forest. The habitat loss over 40-years for this site under alternative B is estimated to be 239 AAHU.

Site 2-827.2-RM has been used for some dredged material placement in the past but not for a significant amount of material. The vegetation on the site has withstood/recovered from the effects of deposition such that the plant community present is primarily bottomland forest (9 acres). The habitat loss over 40-years for this site under alternative B is estimated to be 405 AAHU.

The combination of the use of the two sites under alternative B2 would result in the impacts on 9.5 acres of sand and 11.5 acres of bottomland forest, for an estimated total loss of 644 AAHU.

5.3.2.5 Water Quality

With this alternative containment sites would be constructed and expanded as need at sites 2-823.8-LM and 827.2-RM. Material would be hydraulically placed directly in these containment sites and an effluent returned to the river. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Acute toxic releases would not be likely to occur.

5.3.2.6 Cultural Resources

Neither of the sites have been surveyed for cultural resources. Historic dredged material placement practices site 2-823.8-LM would have buried any cultural resources present such that use of this site under alternative B2 would have no adverse effect.

Site 2-827.2-RM has not been as severly affected by historic dredged material placement as the other sites and has moderate potential for containing cultural resources. A cultural resources survey would be required before the site could be used. Discovery of cultural resources at this site would not preclude its use for dredged material placement. However, given that there would be an affect on cultural resources and that there are alternative placement sites available, there would be a strong impetus to select an alternative site.

5.2.2.7 Social and Recreation Effects

Alternative B2 would have no appreciable socioeconomic effects.

Alternative B2 would have long term beneficial impacts on river recreation by perpetuating the existance of open sandy areas along the main channel that are preferred by many river recreationists. The demand for riverine beach areas in lower pool 2 is likely to increase as the Twin Cities population increases. The only tempering mechanism on this demand may be water quality conditions.

5.3.3 ALTERNATIVE F2

5.3.3.1 General

Alternative F2 would involve the pre-excavating a historic dredged material placement site (site 2-823.8-LM) to provide the capacity for 40 years for the projected dredging requirements for cuts 4 and 5. All of the material excavated from this site would be placed in the J.L. Shiely Co. (Shiely) sand and gravel pits on Lower Grey Cloud Island (site 2-822.5-LM).

The site would be pre-excavated hydraulically with the material pumped directly to site 2-822.5-LM. The work would be done in one construction season (est. 1997) under one contract. The specifics are discussed under "Operations" below. The site would then be used for placement of channel maintenance material over the next 40 years (table 12).

An estimated 95,000 cubic yards of dredged material placed at site 2-823.8-LM during 1989-95 would be removed and taken to site 2-822.5-LM. This material would be removed as part of the pre-excavation at this sites.

Table 12
Summary of Alternative F2

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
823.8-LM	n.a.	661,500	4 5	379,500 282,000	0	12	21'
822.5-LM	661,500 cubic yards would be taken to this site					-	-

5.3.3.2 Operations

Site 2-823.8-LM would be excavated to 30 feet below normal pool, requiring the removal of about 558,000 cubic yards. The 95,000 cubic yards of material to be removed from site 2-823.8-LM to honor past commitments is included in this total.

Dredged material from cuts 4 (est. 379,500 c.y.) and 5 (est. 282,000 c.y.) would then be placed in this site over the next 40 years. Material from cut 4 could be placed into the site either hydraulically or mechanically, depending on equipment availability. Material from cut 5 would have to be mechanically placed into the site. After 40 years, it is estimated that the site would cover about 12 acres (plate 8) with a final fill elevation approximately 21 feet above normal pool elevation.

5.3.3.3 Beneficial Use

All of the material pre-excavated from the site would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island. None of the material placed in the site over the next 40 years would be used for beneficial use during this period.

5.3.3.4 Fish and Wildlife

With this alternative all the material for the 40-year planning period would be excavated at year 1 from site 2-823.8-LM (12 acres) and placed at site 822.5-LM (15 acres). This would convert the existing habitat at site 2-823.8-LM into a sand ring berm and deep water aquatic habitat. This deep water aquatic habitat would slowly be converted to sand habitat through subsequent periodic disposal of dredged material in the next 40 years.

Impacts of the use of site 2-823.8-LM would be similar to those described for alternative B2, with a habitat loss of 266 AAHU.

Site 2-822.5-LM is a 15-acre active/recently abandoned sand and gravel quarry, that presently has very limited wildlife value. The coarse barren substrate present at the site will greatly limit vegetative colonization, but the site will slowly eventually begin to revegetate. It is anticipated that the material transferred from the other sites will contain a fair amount of fine material and that the resultant soils will be of better quality than presently exists. This should allow a much more rapid colonization by plants and a long-term improvement of the quality of the habitat at the site. No net adverse impacts are expected.

5.3.3.5 Water Quality

Under this alternative all pre-excavated material would be transferred to the site 2-822.5-LM by hydraulic dredging. Subsequent re-use of the excavated site 2-823.8-LM would most likely be done with hydraulic dredging. A sand berm would be created to contain the material.

ALT. G2 (cuts 4+5)

Turbidity and suspended solids would increase with turbidity plumes in the immediate disposal area and for a distance around the site. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur.

5.3.3.6 Cultural Resources

Site 2-823.8-LM has not been surveyed for cultural resources. Historic dredged material placement practices would have buried any cultural resources present. Pre-excavation could affect currently unknown cultural resources at these sites. However, the potential for adverse effect is considered low.

Use of site 2-822.5-LM would have no effect on cultural resources.

5.3.3.7 Social and Recreational Effects

Alternative F2 would have no appreciable socioeconomic effects.

Alternative F2 will have mixed effects on recreation resources and opportunities. As indicated for alternative B2, riverine placement sites can provide open sandy areas desired by recreationists. Under alternative F2, some open sandy areas will likely be maintained along the shoreline at site 2-823.8-LM. However, because this site will be pre-excavated, for many years they will consist primarily of open water inside a low diked area. This will limit the amount of open sandy area until the sites are filled to an elevation above normal pool.

5.3.4 ALTERNATIVE G2

NPS preferred alt.

5.3.4.1 General

All of the material dredged from cuts 4 and 5 would be placed directly into site 2-822.5-LM on Lower Grey Cloud Island (table 13).

An estimated 95,000 cubic yards of dredged material placed at site 2-823.8-LM during 1989-95 would be removed to comply with commitments made by the St. Paul District when the material was placed. This material would also be taken to site 2-822.5-LM.

Table 13
Summary of Alternative G2

Site	Removal* to Site 822.5-LM	Pre-excav to Site 822.5-LM	Channel Maintenance to Site Cut	CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Height
822.5-LM	n.a.	n.a	4	379,500	0	-	-
			5	282,000			

* 95,000 cy from site 823.8-LM would be removed and also taken to site 2-822.5-LM.

5.3.4.2 Operations

Because of location of site 2-822.5-LM, all of the material from normal channel maintenance would have to be mechanically dredged and barged to the site. Material would be barged to an unloading ramp where it would be loaded onto trucks and transported to a permanent location within the J.L. Shiely gravel pit (site 2-822.5-LM).

5.3.4.3 Beneficial Use

All of the material placed at site 2-822.5-LM would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island.

5.3.4.4 Fish and Wildlife

Site 2-822.5-LM would be used for this alternative. With this alternative dredged material would be directly disposed of as dredging is required. The site would be incrementally impacted by future direct disposals. This would impact previously undisturbed areas that at that time would show some signs of vegetative recovery, thereby offsetting the gains in habitat quality projected for alternative G2. However, it is estimated that there will be no net loss in habitat quality for alternative G2.

5.3.4.5 Water Quality

Under this alternative all material would be mechanically dredged and placed at the site 2-822.5-LM. It would produce the least impacts on water quality of any of the alternatives considered.

5.3.4.6 Cultural Resources

Use of site 822.5-LM would have no adverse effect on cultural resources.

5.3.4.7 Social and Recreation Effects

Alternative G2 would have no appreciable socioeconomic effects.

- shiely

Under alternative G2, all dredged material would go directly to site 2-822.5-LM. This could have long term adverse impacts to recreation opportunities as no dredged material would be placed at riverine sites, creating the open sandy areas used by many river recreationists. This potential adverse effect could be offset to a large degree by development and implementation of a recreational beach plan for lower pool 2.

5.3.5 ALTERNATIVE H2

5.3.5.1 General

Alternative H2 would involve pre-excavating site 2-823.8-LM to provide the capacity for 40 years for the projected dredging requirements from cuts 3 and 4. All of the material excavated from this site would be placed in the J.L. Shiely Co. (Shiely) sand and gravel pits on Lower Grey Cloud Island (site 2-822.5-LM). To provide the necessary capacity at this site under this alternative would require a pre-excavation prior to use, and a re-excavation approximately one-half way through the 40-year planning period. The specifics are discussed under "Operations" below. The site would then be used for placement of channel maintenance material from cuts 4 and 5 over the next 40 years (table 14).

Table 14
Summary of Alternative H2

Site	Removal to Site 822.5-LM	Pre-excav to Site 822.5-LM*	Channel Maintenance to Site Cut	Channel Maintenance to Site CY	Beneficial Use Removal	Size of Site at Yr 40 Acres	Size of Site at Yr 40 Height
823.8-LM	n.a.	661,500	4	379,500	0	8	20'
			5	282,000	0		
822.5-LM	661,500 cubic yards would be taken to this site					-	-

* Site 2-823.8-LM would be excavated twice, first in 1997 and then again approximately 20 years later.

5.3.5.2 Operations

Site 2-823.8 would be initially excavated 30 feet below normal pool, requiring the removal of about 331,000 cubic yards. The 95,000 cubic yards of material to be removed from site 2-823.8-LM to honor past commitments is included in this total. The material would be placed at site 2-822.5-LM.

Dredged material from cuts 4 and 5 would then be placed in this site over the next 40 years. Material from cut 4 could be placed into the site either hydraulically or mechanically, depending on equipment availability. Material

from cut 5 would be placed at the site mechanically.

After about 20 years the site will have reached capacity and would have to be reexcavated. Approximately 330,500 cubic yards of material would be removed and placed at site 2-822.5-LM.

After 40 years, it is estimated that the site would cover about 8 acres (plate 8) with a final fill elevation approximately 20 feet above normal pool elevation.

5.3.5.3 Beneficial Use

All of the material placed at site 2-822.5-LM would be put to passive beneficial use, i.e., reclamation of the Shiely sand and gravel pits on Lower Grey Cloud Island. None of the material placed in site 2-823.8-LM during the second 20 years of the 40-year planning period would be used for beneficial use during this period.

5.3.5.4 Fish and Wildlife

Site 2-823.8-LM (8 acres) and 2-822.5-LM (15 acres) would be used for this alternative. The impacts at site 2-823.8-LM would be reduced from those described for alternative F2 because the site would be limited to the areas that are already bare sand.

The combination of the use of sites 2-823.8-LM and 2-822.5-LM under alternative H2 would result in impacts on 23.0 acres of sand for an estimated loss of 133 AAHU.

5.3.5.5 Water Quality

The impacts associated with this alternative for site 2-823.8-LM would be the similar to those described earlier for this site under alternatives B2 and F2. The impacts associated with this alternative for site 2-822.5-LM would be similar to those described earlier for this site under alternative G2.

5.3.5.6 Cultural Resources

Site 2-823.8-LM has not been surveyed for cultural resources. Historic dredged material placement practices at this site would have buried any cultural resources present. Pre-excavation could affect currently unknown cultural resources at these sites. However, the potential for adverse effect is considered low.

Use of site 2-822.5-LM would have no adverse effect on cultural resources.

5.3.5.7 Social and Recreation Effects

Alternative H2 would have no appreciable socioeconomic effects.

Alternative H2 will have mixed effects on recreation resources and opportunities. As indicated for alternative B2, riverine placement sites can provide open sandy areas desired by recreationists. Under alternative H2, some open sandy areas will likely be maintained along the shoreline at site 2-823.8-LM. However, because this site will be pre-excavated, for many years it will consist primarily of open water inside a low diked area. This will limit the amount of open sandy area until the sites are filled to an elevation above normal pool.

MATRIX SCORING AND ALTERNATIVES COMPARISON

6.1 GENERAL

The St. Paul District, Corps of Engineers use a matrix to evaluate the dredged material placement alternatives. Development of the criteria used is an ongoing process that began with the process that began with the preparation of the first channel maintenance plan report for GREAT I implementation. The matrix used in this evaluation was developed from the matrix originally used by the District in the Dredge Material Placement Reconnnaissance Reports, from the mid-1980's, and modified by the matrix developed by the Rock Island District for their dredged material placement program.

The matrix uses index values to score the dredged material placement alternatives in six categories: dredging and material placement cost, impacts to natural resources, beneficial use, impacts to cultural resources, social impacts, and impacts to recreation. Index values used for evaluating placement alternatives range from 0 (least desirable) to 10 (most desirable).

The resulting index values, scored for the various categories, are then adjusted by multiplying them by a weight factor assigned to each category. The weight factor determines the relative importance of each category in the dredged material placement alternative evaluation process. The dredging and material placement cost and impacts to natural resources categories are assigned the highest weight factor, a weight factor of 30. Beneficial use and cultural resources are weighted by a factor of 10. Social impacts are weighted at 15 because District experience with implementing dredged material placement plans has indicated there are significant local concerns associated with operating placement sites near developed areas. These concerns can have a significant effect on how or whether a plan can be implemented. The remaining catergory of recreation has been assigned a weight factor of 5 because the District believes recreation resource effects do not have as much impact on implementing dredged material placement plans as the other categories. Recreational beach planning is being conducted independently of the long-term placement site planning.

Finally, the index values, multiplied by the weight factors, are totaled. The dredged material placement alternative with the highest total points becomes the preferred dredging and material placement alternative. A more detailed description of the matrix is included in Appendix D - Matrix Evaluation Criteria. The technical appendixes provide additional information on the scoring of specific alternatives.

MATRIX SCORES

6.2 MATRIX SCORES

Matrix scoring for the cut 2 and 3 alternatives is summarized in table 15, while the matrix scoring for the cut 4 and 5 alternatives is summarized in table 16. For the cut 2 and 3 alternatives, alternative G1 received the highest score with 780 points, followed by alternatives I1 (736 points) and H1 (714 points). Alternatives I1 and H1 scored within 10 percent of alternative G1, which is not considered a significant difference given the subjectivity of the matrix evaluation and the individual criteria used in scoring. The remaining alternatives (A1, B1, and F1) scored about 20-30 percent lower than alternative G1. A 20-30 percent difference is considered substantial enough to provide an accurate reflection of the relative overall merits of these alternatives.

For the cut 4 and 5 alternatives, alternative F2 received the highest score with 788 points, followed by closely by alternatives H2 (780 points), A2 (775 points), and G2 (750 points). These scores differ by less than 5 percent, which is not considered significant given the subjectivity of the matrix evaluation and the individual criteria used in scoring. The remaining alternative (B2) scored about 25 percent lower than alternative F2, which is considered an accurate reflection of the relative overall merit of this alternative.

Table 15. Matrix Evaluation of Cut 2 and Cut 3 Alternatives

Alt.	Dredging/Material Placement Cost Weight Factor = 30	Natural Resources: Water Quality Weight Factor = 8	Natural Resources: Aquatic/Terrestrial Weight Factor = 22	Beneficial Use Weight Factor = 10	Cultural Resources Weight Factor = 10	Social Effects Weight Factor = 15	Recreation Effects Weight Factor = 5	Total
A1	Index Score 7 x 30 Weighted Score 210	Index Score 6.3 x 8 Weighted Score 50	Index Score 6 x 22 Weighted Score 132	Index Score 6 x 10 Weighted Score 60	Index Score 2 x 10 Weighted Score 20	Index Score 6 x 15 Weighted Score 90	Index Score 6 x 5 Weighted Score 30	592
B1	Index Score 8 x 30 Weighted Score 240	Index Score 5.3 x 8 Weighted Score 42	Index Score 3 x 22 Weighted Score 66	Index Score 0 x 10 Weighted Score 0	Index Score 8 x 10 Weighted Score 80	Index Score 7 x 15 Weighted Score 105	Index Score 7 x 5 Weighted Score 35	568
F1	Index Score 7 x 30 Weighted Score 210	Index Score 5.3 x 8 Weighted Score 42	Index Score 3 x 22 Weighted Score 66	Index Score 10 x 10 Weighted Score 100	Index Score 8 x 10 Weighted Score 80	Index Score 8 x 15 Weighted Score 120	Index Score 7 x 5 Weighted Score 35	653
G1	Index Score 5 x 30 Weighted Score 150	Index Score 7.5 x 8 Weighted Score 60	Index Score 10 x 22 Weighted Score 220	Index Score 10 x 10 Weighted Score 100	Index Score 10 x 10 Weighted Score 100	Index Score 8 x 15 Weighted Score 120	Index Score 6 x 5 Weighted Score 30	780
H1	Index Score 6 x 30 Weighted Score 180	Index Score 6.3 x 8 Weighted Score 50	Index Score 7 x 22 Weighted Score 154	Index Score 10 x 10 Weighted Score 100	Index Score 8 x 10 Weighted Score 80	Index Score 8 x 15 Weighted Score 120	Index Score 6 x 5 Weighted Score 30	714
I1	Index Score 6 x 30 Weighted Score 180	Index Score 6.3 x 8 Weighted Score 50	Index Score 8 x 22 Weighted Score 176	Index Score 10 x 10 Weighted Score 100	Index Score 8 x 10 Weighted Score 80	Index Score 8 x 15 Weighted Score 120	Index Score 6 x 5 Weighted Score 30	736

Table 16. Matrix Evaluation of Cut 4 and Cut 5 Alternatives

Alt.	Dredging/Material Placement Cost Weight Factor = 30		Natural Resources: Water Quality Weight Factor = 8		Natural Resources: Aquatic/Terrestrial Weight Factor = 22		Beneficial Use Weight Factor = 10		Cultural Resources Weight Factor = 10		Social Effects Weight Factor = 15		Recreation Effects Weight Factor = 5		Total
A2	Index Score	5	Index Score	7.5	Index Score	10	Index Score	10	Index Score	8	Index Score	9	Index Score	6	
		x 30		x 8		x 22		x 10		x 10		x 15		x 5	
	Weighted Score	150	Weighted Score	60	Weighted Score	220	Weighted Score	100	Weighted Score	80	Weighted Score	135	Weighted Score	30	775
B2	Index Score	8	Index Score	6.3	Index Score	5	Index Score	0	Index Score	4	Index Score	7	Index Score	7	
		x 30		x 8		x 22		x 10		x 10		x 15		x 5	
	Weighted Score	240	Weighted Score	50	Weighted Score	110	Weighted Score	0	Weighted Score	40	Weighted Score	105	Weighted Score	35	580
F2	Index Score	7	Index Score	6.3	Index Score	9	Index Score	10	Index Score	8	Index Score	8	Index Score	6	
		x 30		x 8		x 22		x 10		x 10		x 15		x 5	
	Weighted Score	210	Weighted Score	50	Weighted Score	198	Weighted Score	100	Weighted Score	80	Weighted Score	120	Weighted Score	30	788
G2	Index Score	4	Index Score	7.5	Index Score	10	Index Score	10	Index Score	10	Index Score	8	Index Score	6	
		x 30		x 8		x 22		x 10		x 10		x 15		x 5	
	Weighted Score	120	Weighted Score	60	Weighted Score	220	Weighted Score	100	Weighted Score	100	Weighted Score	120	Weighted Score	30	750
H2	Index Score	6	Index Score	6.3	Index Score	10	Index Score	10	Index Score	8	Index Score	8	Index Score	6	
		x 30		x 8		x 22		x 10		x 10		x 15		x 5	
	Weighted Score	180	Weighted Score	50	Weighted Score	220	Weighted Score	100	Weighted Score	80	Weighted Score	120	Weighted Score	30	780

6.3 ALTERNATIVES COMPARISON

A more detailed comparison of the alternatives was considered warranted beyond that provided by the matrix evaluation. The reasons are as follows:

a. There are significant cost differences between many of the alternatives. These cost differences are considered of a magnitude requiring evaluation beyond that provided solely by the matrix.

b. The highest scoring alternative for cuts 2 and 3 has implications not addressed by the matrix evaluation. This alternative requires all of normal channel maintenance to be done mechanically because of the distance of the selected placement site from the dredge cuts. This limits the ability to respond to situations where the removal of a high volume of material in a short period of time may be necessary. If an emergency situation arose where hydraulic dredging was required, the lack of a prepared riverine placement site could result in additional environmental impacts.

c. For cuts 4 and 5, the four top scoring alternatives received scores within a range of 5%. Given the sensitivity of the matrix evaluation criteria, these scores would be considered essentially equal. Therefore, further analysis is required to evaluate the differences in these alternatives.

The process selected to systematically further evaluate the alternatives was a pair-wise comparison process. The first comparsions were between alternatives of similar nature. Then, the remaining alternatives were compared to narrow the choice down to the two alternatives making up the final comparison.

6.3.1 CUT 2 AND 3 ALTERNATIVES

Alternatives A1, B1, and F1 were considered to have scored low enough in the matrix evaluation not to warrant any further analysis. Alternative H1 was compared against alternative I1, with the preferred alternative from this comparison then compared against the highest scoring plan, alternative G1.

6.3.1.1 Alternative H1 vs. Alternative I1

Alternative H1 has an estimated total cost of approximately $4,820,000 vs. an estimated total cost of about $4,440,000 for alternative I1, a difference of $480,000. A present worth analysis shows that the average annual cost of alternative H1 would be about $187,000, while the average annual cost of alternative I1 would be about $167,000. (The present worth analysis is based on a simulation that assumes dredging events would occur on a regular basis at projected frequencies, e.g. dredge cut 2 would be dredged 4 times over the next 40 years at regular 10 year intervals (yrs 5, 15, 25, and 35)). The present worth analysis indicates that alternative I1 not only is less costly in terms of total dollars, it is also the better "investment" over time because it has a lower average annual cost.

Alternative I1 would effect about 12 acres of habitat resulting in an estimated loss of 319 AAHU, while alternative H1 would affect about 10 acres of habitat resulting in the loss of 422 AAHU. (It should be noted that in this and other subsequent pair-wise comparisons, the 15 acres within the Shiely sand and gravel pits are not included in the acres affected totals for each alternative.) The cost of achieving the 103 AAHU of less impact with alternative I1 would be $0 because alternative I1 has a lower cost (both total and average annual) than alternative H1.

In all other areas, (water quality, beneficial use, cultural resources, social and recreation effects), these two alternatives are essentially equal.

Because alternative I1 is less costly, has lower habitat impacts, and less potential water quality impacts, it is considered the preferred alternative over alternative H1.

6.3.1.2 Alternative I1 vs. Alternative G1

Alternative G1 has an estimated total cost of approximately $6,010,000 vs. an estimated total cost of about $4,440,000 for alternative I1, a difference of $1,570,000. A present worth analysis shows that the average annual cost of alternative G1 would be about $200,000, while the average annual cost of alternative I1 would be about $167,000. The present worth analysis indicates that alternative I1 not only is less costly in terms of total dollars, it is also the better "investment" over time because it has a lower average annual cost.

Alternative I1 would effect about 12 acres of habitat resulting in an estimated loss of 319 AAHU, while alternative G1 would effect no riverine habitat and have an estimated loss of 0 AAHU. The cost of achieving the 319 AAHU of less impact with alternative G1 would be about $10,300/AAHU (adjusted to the decimal equivalent used in habitat benefit analyses for UMRS-EMP habitat projects). As a point of comparison, most St. Paul District UMRS-EMP habitat projects have costs in the range of $500 - $2,000/AAHU.

Alternative G1 is preferable over alternative I1 in the areas of water quality and cultural resources. The difference in potential water quality effects is not considered significant because dredge cut 2, a cut with a high fine material content, would be dredged mechanically under both alternatives. Likewise, the difference in cultural resources is not considered significant as the lower score received by alternative I1 is a reflection of the minor potential for cultural resources to be present at already highly disturbed sites.

added this wording in this draft.

Alternative G1 would be slightly preferable from a beneficial use standpoint as 1,041,000 cubic yards would be placed in the Shiely sand and gravel pits for passive beneficial use, as compared to 695,000 cubic yards with alternative I1. This is not considered a significant difference as the primary beneficiary would be a single interest.

Alternative I1 would be slightly preferable from a recreation effects standpoint because sites 2-821.1-LM and 2-821.5-LM would be active sites under this plan and likely would provide some recreational beach opportunities. From the perspective of the goals of the MNRRA, alternative G1 would be preferable.

Alt. I1 vs. Alt. G1

In summary, the differences between alternatives G1 and I1 in the areas of water quality, cultural resources, beneficial use, social effects, and recreation effects are considered relatively minor. There is no significant

difference that would lead to the selection of one alternative over the other.

Alternative I1 has more operational flexibility than alternative G1, as under this alternative cut 3 could be dredged mechanically or hydraulically. With alternative G1 neither of the cuts could be dredged hydraulically.

Alternative G1 has a hidden environmental cost not reflected in the matrix. If emergency dredging conditions arise, or if the situation arises such that hydraulic dredging must be used for a particular dredging job at cut 3, dredged material placement would likely take place at the adjacent historic placement site. This will have habitat effects not reflected in the evaluation of alternative G1.

In this particular comparison, the basic difference between alternatives G1 and I1 comes down to cost and operational flexibility verses habitat effects. The conclusion is that the difference in habitat effects between alternatives G1 and H1 does not warrant the additional cost of alternative G1 ($1,570,000), and the loss of operational flexibility associated with that alternative. The cost of achieving the lesser habitat effects with alternative G1 ($10,300/AAHU) is over five times the cost normally considered reasonable for habitat enhancement with UMRS-EMP habitat projects in the St. Paul District.

Selection of alternative I1 over alternative G1 would be contrary to the matrix evaluation results where alternative G1 scored about 6 percent higher that alternative I1 (780 points vs 736 points). However, operational flexibility and the ability to respond in a timely manner to channel maintenance needs are not factors considered in the matrix evaluation. In this particular situation, it is considered important to have prepared sites capable of being used with hydraulic dredging in this reach of the river to respond to channel maintenance needs in a timely manner, and to a lesser extent, to minimize environmental effects should emergency dredging be required.

6.3.2 CUT 4 AND 5 ALTERNATIVES

For cuts 4 and 5, alternative F2 and H2 were compared because of their similarities, the only difference being whether or not to reduce the size of site 2-823.8-LM by having two excavations instead of one.

6.3.2.1 Alternative F2 vs Alternative H2

Alternative F2 has an estimated total cost of approximately $4,010,000 vs. an estimated total cost of about $4,270,000 for alternative H2, a difference of about $260,000. A present worth analysis shows that the average annual cost of alternative F2 would be about $178,000, while the average annual cost of alternative H2 would be about $147,000. While alternative F2 has a lower total dollar cost estimate, alternative H2 is the better long-term investment because it requires less up-front expenditures for site pre-excavation, delaying some of these costs for about 20 years.

Alternative F2 would effect about 12 acres of habitat resulting in an estimated loss of 266 AAHU, while alternative H2 would affect about 8 acres of habitat resulting in the loss of 108 AAHU. The cost of achieving the 158 AAHU of less habitat effect with alternative H2 would be $0 because it has a lower average annual cost.

Because the only difference between these alternatives is cost and the size of site 2-823.8-LM, they are equal in terms of water quality effects, beneficial use, cultural resource, social effects, and recreation effects.

In summary, while Alternative F2 is less costly in total dollars, the present worth analysis indicates Alternative H2 is more economical over the long term. Alternative H2 is preferable from the habitat effects standpoint.

The lower total dollar cost of alternative F2 do not appear to warrant the additional habitat effects associated with this alternative, especially considering that the present worth analysis indicates that over the long term, H2 is probably the better economical choice. Therefore, alternative H2 is the preferred alternative.

6.3.2.2 Alternative A2 vs. Alternative G2

The GREAT I plan (A2) was compared to alternative G2 because these are the two plans that remove all of the material from the floodplain. Alternative G2 has an estimated cost of approximately $5,950,000 vs. an estimated cost of about $5,330,000 for alternative A2, a difference of about $620,000. A present worth analysis shows that the average annual cost of alternative G2 would be about $173,000, while the average annual cost of alternative A2 would be about $185,000. This analysis indicates that the alternative that has the lowest total dollar cost (A2) is not necessarily the best investment because it requires a greater up-front investment (primarily real estate costs).

Alternative A2 would effect about 4 acres of habitat resulting in an estimated loss of 192 AAHU, while alternative G would effect no riverine habitat and have an estimated loss of 0 AAHU. The cost of achieving the 192 AAHU of less habitat effect with alternative G2 would be $0 because alternative G2 has a lower average annual cost than alternative A2.

In terms of beneficial use, it is projected that 100 percent of the material under alternative A2 would be put to active beneficial use, while with alternative G2, 100 percent of the material would be put to passive beneficial use.

Alternative G2 is slightly preferable from the cultural resources perspective, while alternative A2 is considered slightly preferable from a social effects perspective. These two alternatives are considered equal in terms of water quality effects and recreation effects. There is no significant difference to consider in the comparison of the two alternatives in these areas.

In summary, while alternative A2 is less costly in total dollars, alternative G2 has a lower average annual cost and less habitat effects. The conclusion is that alternative G2 is preferable to alternative A2 because of the lower average annual cost and less habitat effects. The lower average annual cost is considered the better indicator of the true economic differences between these two alternatives.

6.3.2.3 Alternative G2 vs. Alternative H2

Alternative G2 has an estimated total cost of approximately $5,950,000 vs. an estimated total cost of about $4,270,000 for alternative H2, a difference of about $1,680,000. A present worth analysis shows that the average annual cost of alternative G2 would be about $173,000, while the average annual cost of alternative H2 would be about $147,000. The present worth analysis indicates that alternative H2 not only is less costly in terms of total dollars, it is also the better "investment" over time because it has a lower average annual cost.

Alternative H2 would effect about 8 acres of habitat resulting in an estimated loss of 108 AAHU, while alternative G2 would have a habitat loss of 0 AAHU. The cost of achieving the 108 AAHU of less habitat effect with alternative G2 would be about $24,100/AAHU. As a point of comparison, most St. Paul District UMRS-EMP habitat projects have costs in the range of $500 - $2,000/AAHU.

Alternative G2 is preferable over alternative H2 in the areas of water quality and cultural resources. The difference in potential water quality effects is not considered significant because the sediments that would be dredged hydraulically (cut 4) are considered uncontaminated. Likewise, the difference in cultural resources is not considered significant as the lower score received by alternative H2 is a reflection of the minor potential for cultural resources being present at an already highly disturbed site.

Alternative G2 would be slightly preferable from a beneficial use standpoint as 756,500 cubic yards would be placed in the Shiely sand and gravel pits for passive beneficial use, as compared to 661,500 cubic yards with alternative H2. This is not considered a significant difference as the primary beneficiary would be a single interest.

Alternative H2 would be slightly preferable from a recreation effects standpoint because site 2-823.8-LM would be an active site under this plan and likely would provide some recreational beach opportunities. From the perspective of the goals of the MNRRA, alternative G2 would be preferable.

In summary, the differences between alternatives G2 and H2 in the areas of water quality, cultural resources, beneficial use, social effects, and recreation effects are considered relatively minor. There is no significant difference that would lead to the selection of one alternative over the other.

Alternative H2 has more operational flexibility than alternative G2, as under this alternative cut 4 could be dredged mechanically or hydraulically. With alternative G2 neither of the cuts could be dredged hydraulically. This is considered of some importance because of the relative high dredging frequency at cut 4 (25%).

Alternative G2 has a hidden environmental cost not reflected in the matrix. If emergency dredging conditions arise, or if the situation arises such that hydraulic dredging must be used for a particular dredging job at cut 4, dredged material placement would likely take place at the adjacent historic placement site. This will have habitat effects not reflected in the evaluation of alternative G2.

In this particular comparison, the basic difference comes down to cost and operational flexibility verses habitat effects, with the other factors being relatively minor. The conclusion is that the difference in habitat effects between alternatives G2 and H2 does not warrant the additional cost of alternative G2 ($1,680,000), and the loss of operational flexibility associated with that alternative. The cost of avoiding the habitat effects ($24,100/AAHU) is over ten times the cost normally considered reasonable for habitat enhancement with UMRS-EMP habitat projects in the St. Paul District.

6.3.3 SUMMARY

Table 17 summarizes the pairwise comparisons. The conclusion of this process is that alternative I1 is the preferred plan for cuts 2 and 3, and alternative H2 is the preferred plan for cuts 4 and 5.

Table 17
Summary of Pairwise Comparison of Alternatives

Comparison #	Alternatives	Alternative Eliminated	Alternative Retained
Cuts 2 and 3	H1 vs I1	H1	I1
	G1 vs. I1	G1	I1
Cuts 4 and 5	F2 vs. H2	F2	H2
	A2 vs. G2	A2	G2
	G2 vs. H2	G2	H2

NPS preferred

COE preferred

Summary matrix table

RECOMMENDATIONS

7.1 SPRING LAKE

The St. Paul District should consider placing dredged material at Spring Lake for the purpose of fish and wildlife habitat restoration if the opportunity presents itself. Development of a restoration plan and placement of the dredged material at Spring Lake would likely require a non-Federal sponsor under Section 204 authorities to cost share project implementation, and to assume operation and maintenance responsibility for the project once completed.

7.2 C.F. INDUSTRIES

The St. Paul District should continue to place dredged material adjacent to the C.F. Industries dock for beneficial use removal on an as needed basis, i.e., when local demand removes the material from the site. The District should pursue making a long-term arrangement with C.F. Industries for use of this site as a beneficial use removal site. Any material placed at the C.F. Industries dock would extend the useful life of the recommended long-term placement sites.

7.3 RECOMMENDED ALTERNATIVE

The recommended alternative for dredge cuts 2 and 3 in lower pool 2 is alternative I1.

The recommended alternative for dredge cuts 4 and 5 in lower pool 2 is alternative H2.

Implementation of these alternatives will require agreements for the use of the Shiely pits (site 2-822.5-LM) and acquisition of sites 2-821.1-LM, 2-821.5-LM, and 2-823.8-LM. A hydraulic analysis of sites 2-821.1-LM, 2-821.5-LM, and 2-823.8-LM will be required to confirm that use of these sites would have no appreciable floodplain effects.

7.4 IMPLEMENTATION SCHEDULE

Actions necessary for implementation of the recommended plan will be initiated immediately following completion of the review and approval process for this report. Appropriate Federal and State permits will be requested. Formal real estate actions for easements and land acquisition will commence. Specific funds for implementing the plan will be requested.

It is expected the earliest that the pre-excavation of sites 2-821.1-LM, 2-821.5-LM, and 2-823.8-LM could commence would be 1997.

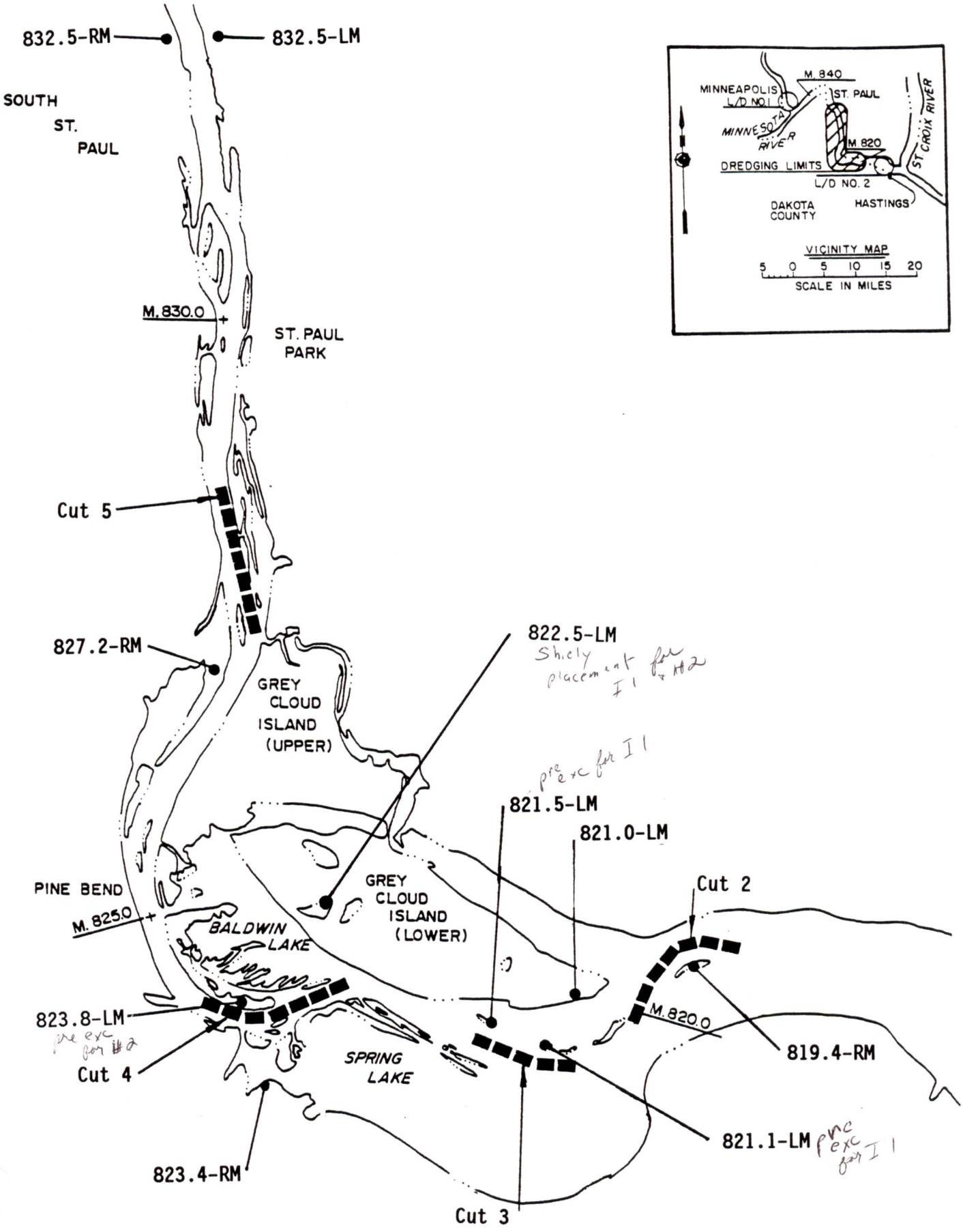
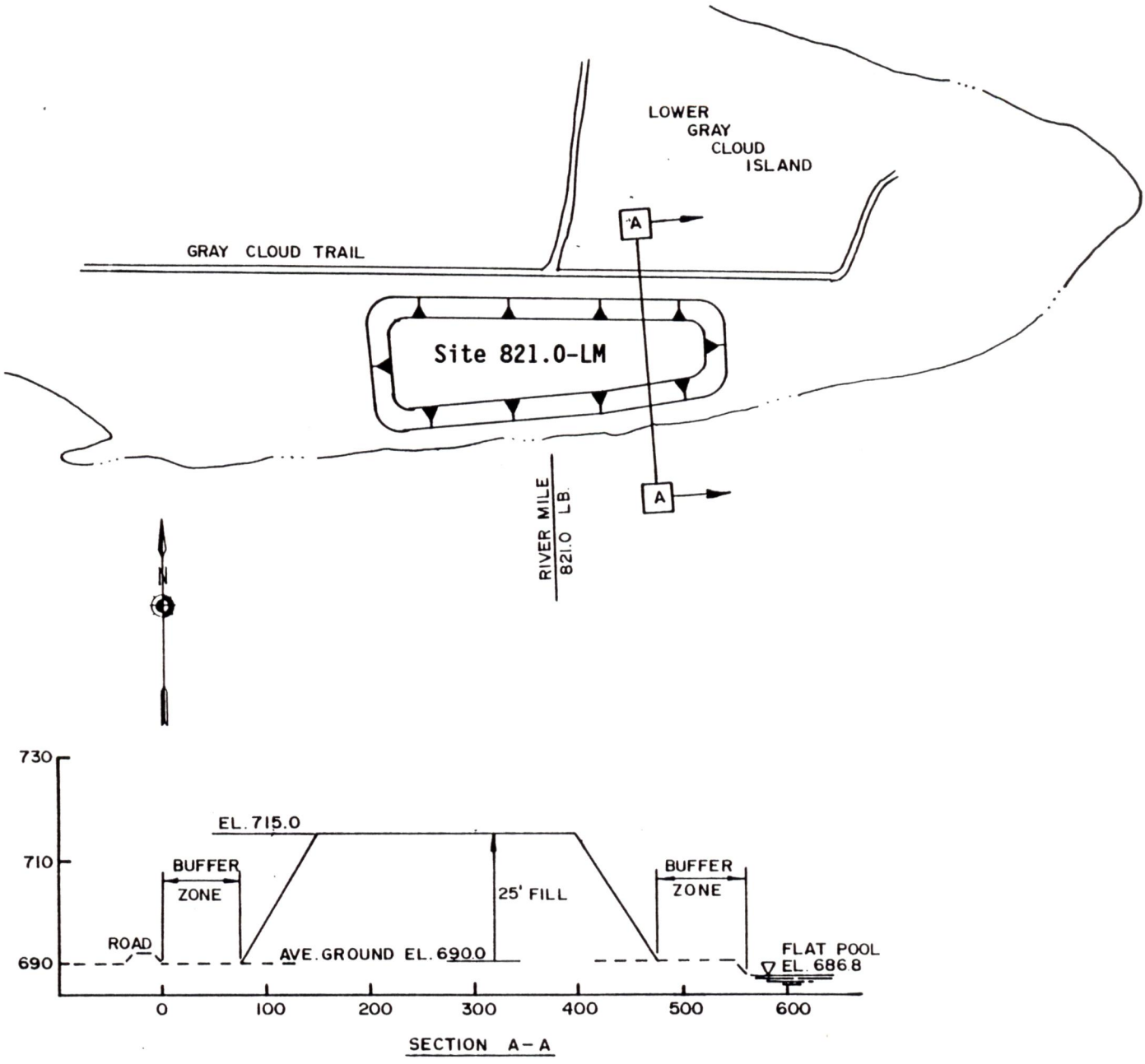
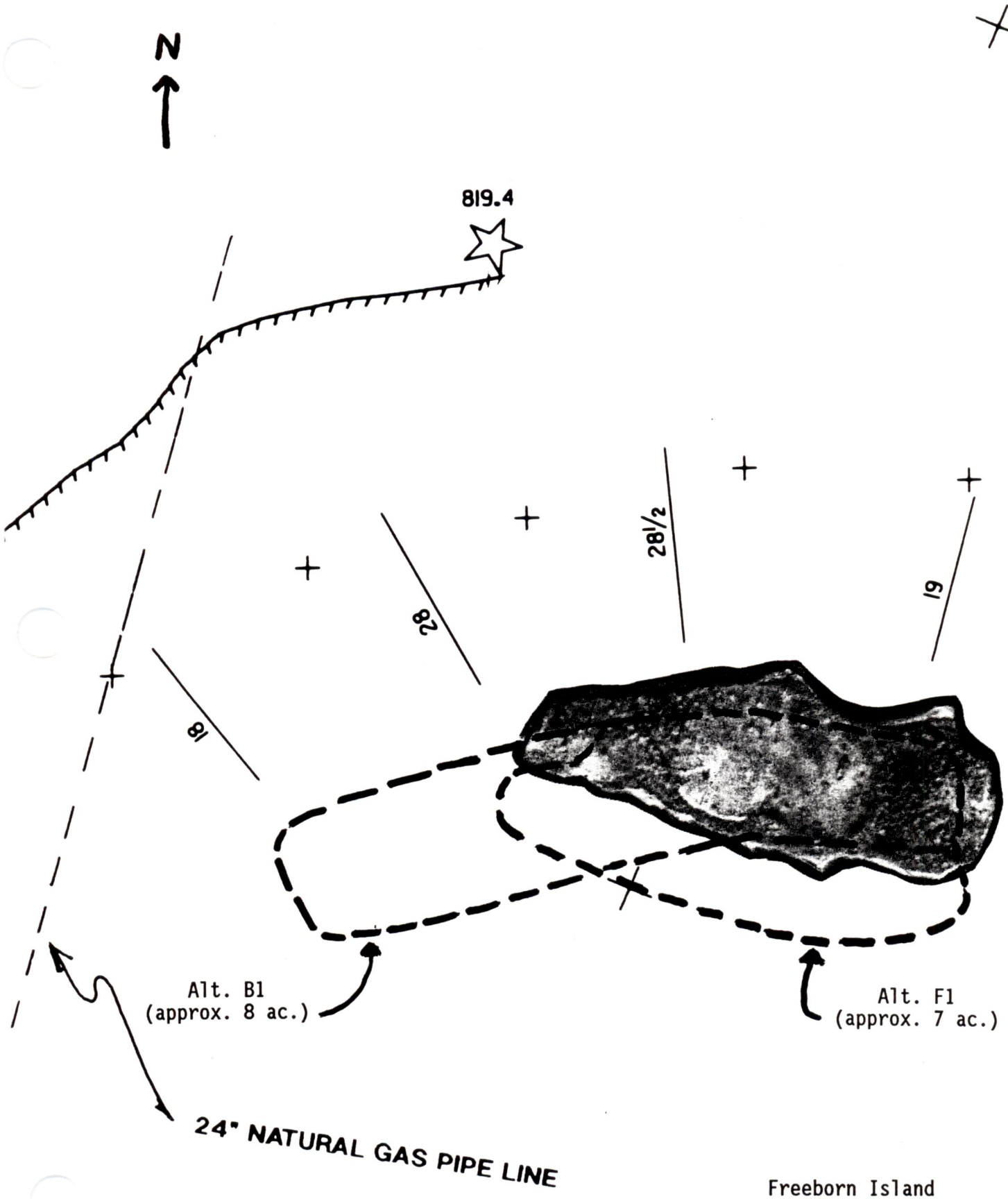

832.5-RM
832.5-LM
SOUTH ST. PAUL
M. 830.0
ST. PAUL PARK
Cut 5
827.2-RM
GREY CLOUD ISLAND (UPPER)
822.5-LM
Shiely placement for I 1 & #2
pre exc for I 1
821.5-LM
821.0-LM
PINE BEND
M. 825.0
BALDWIN LAKE
GREY CLOUD ISLAND (LOWER)
Cut 2
823.8-LM
pre exc for #2
Cut 4
SPRING LAKE
M. 820.0
819.4-RM
821.1-LM pre exc for I 1
823.4-RM
Cut 3
MINNEAPOLIS L/D NO. 1
M. 840
ST. PAUL
MINNESOTA RIVER
M. 820
ST. CROIX RIVER
DREDGING LIMITS
L/D NO. 2
DAKOTA COUNTY
HASTINGS
VICINITY MAP
5 0 5 10 15 20
SCALE IN MILES

Plate 1



SECTION A-A

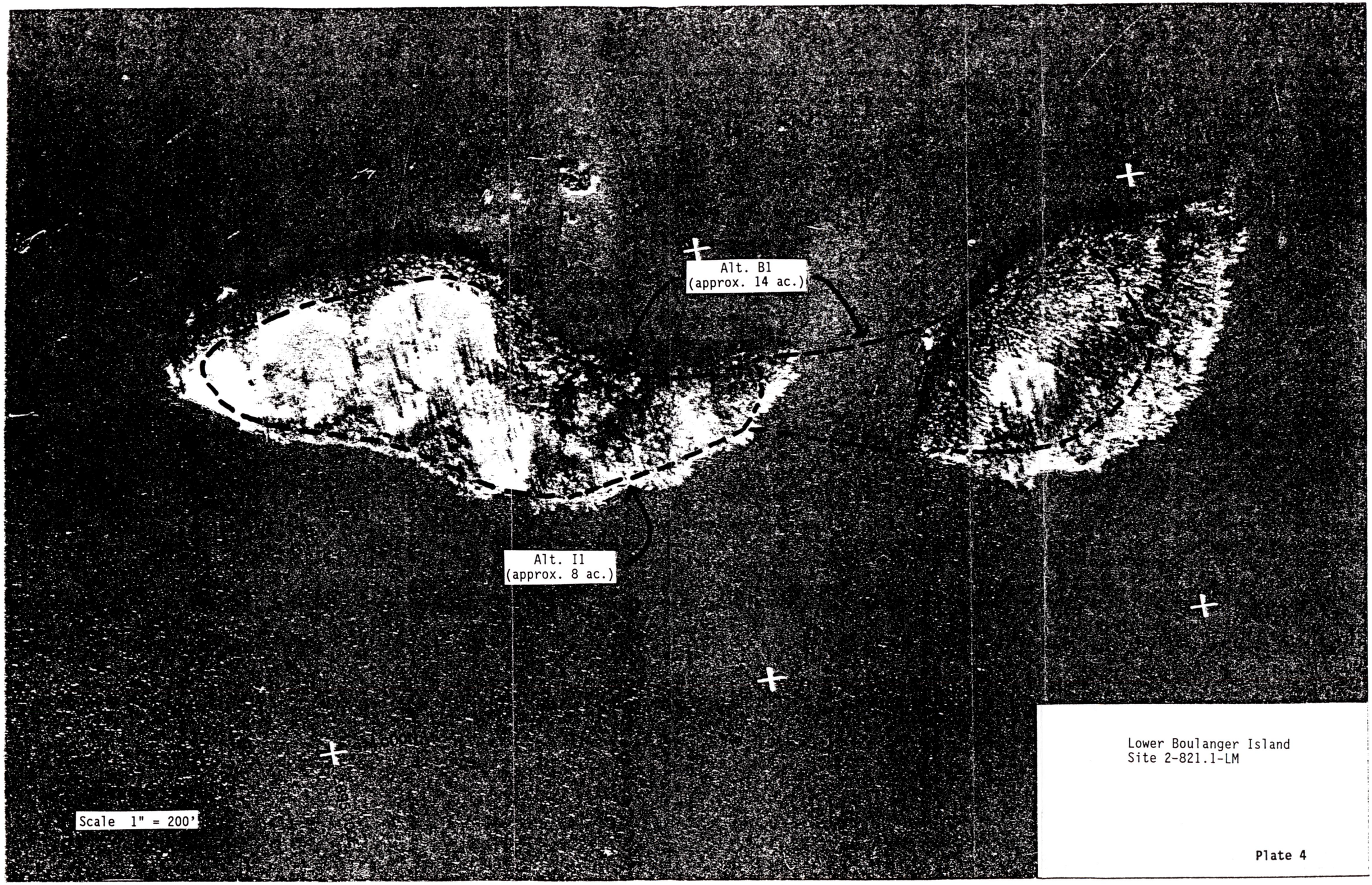
Plate 2



Freeborn Island
Site 2-819.4-RM

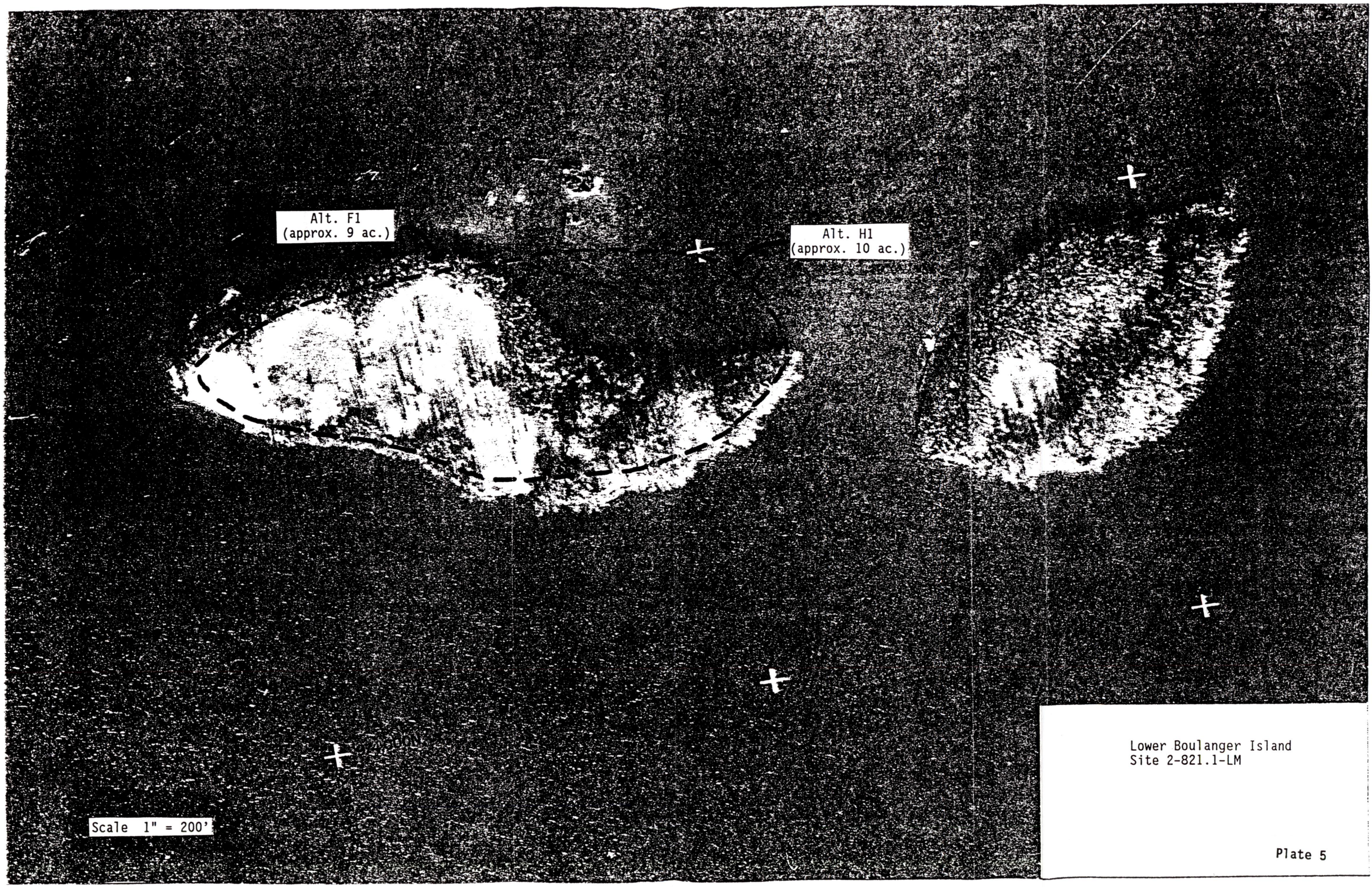
Approx. Scale 1" = 280'

Plate 3



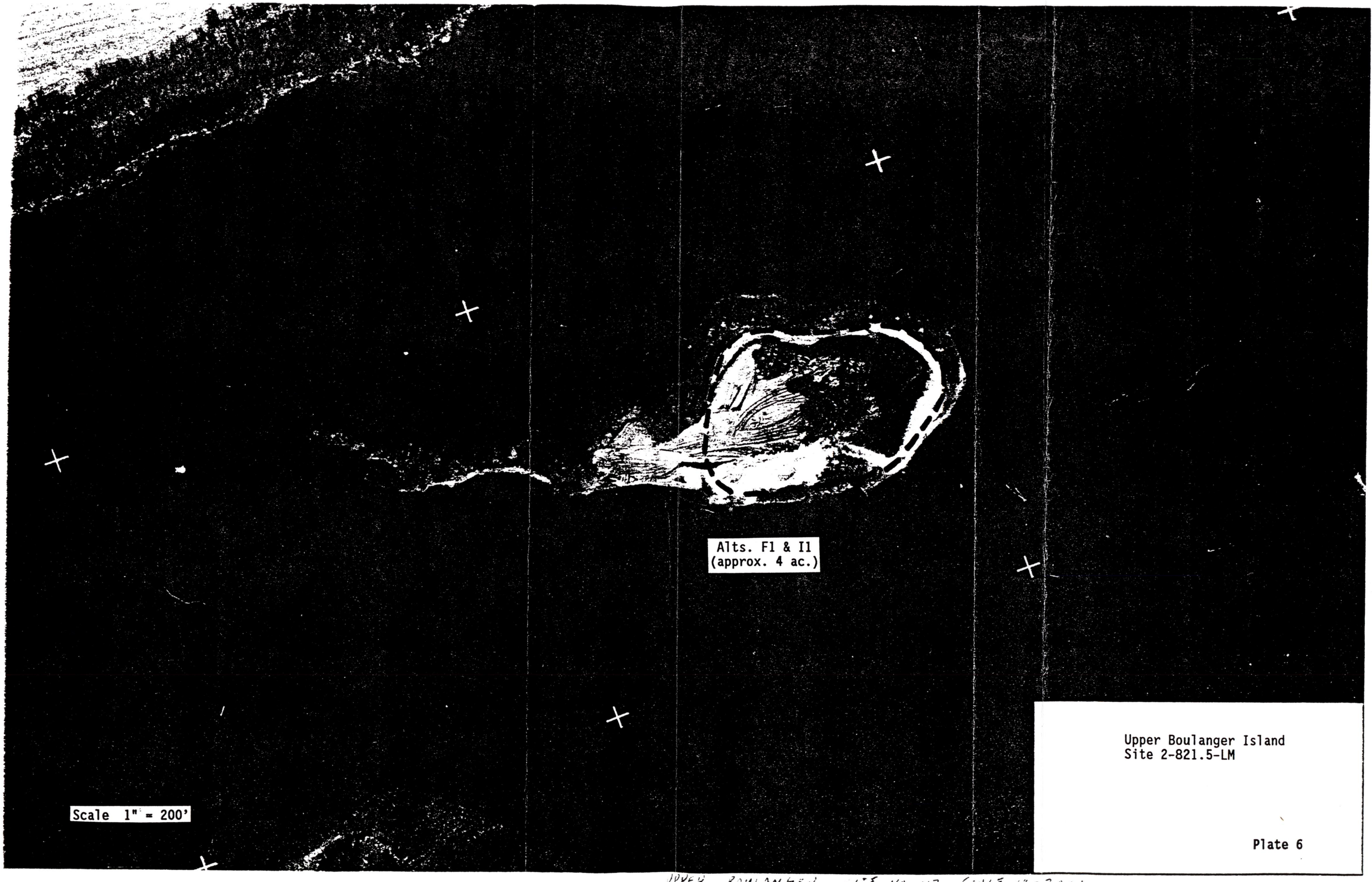
Lower Boulanger Island
Site 2-821.1-LM

Plate 4



Lower Boulanger Island
Site 2-821.1-LM

Plate 5



Upper Boulanger Island
Site 2-821.5-LM

Plate 6

UPPER BOULANGER SITE NO. 117 SCALE 1" = 200'

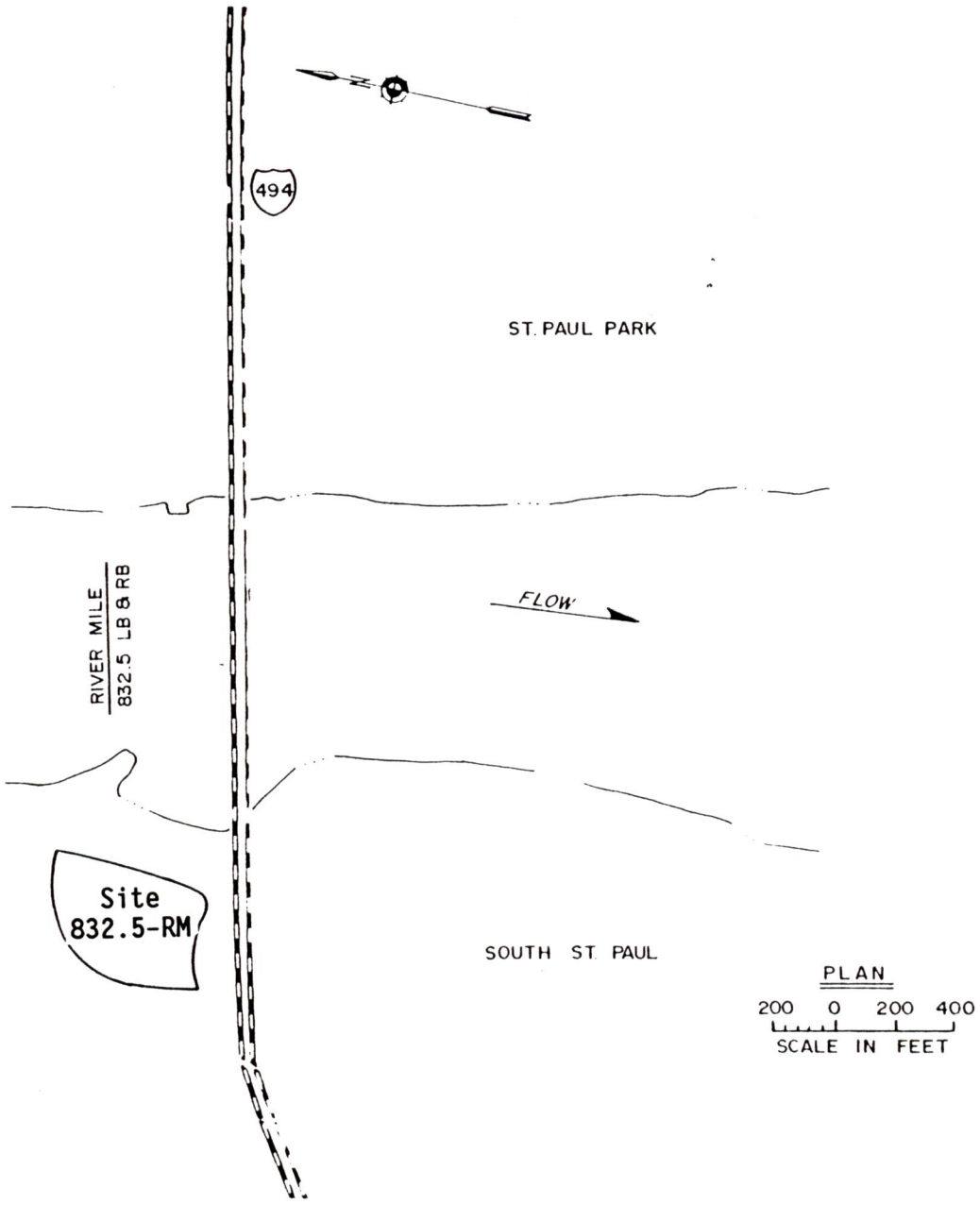
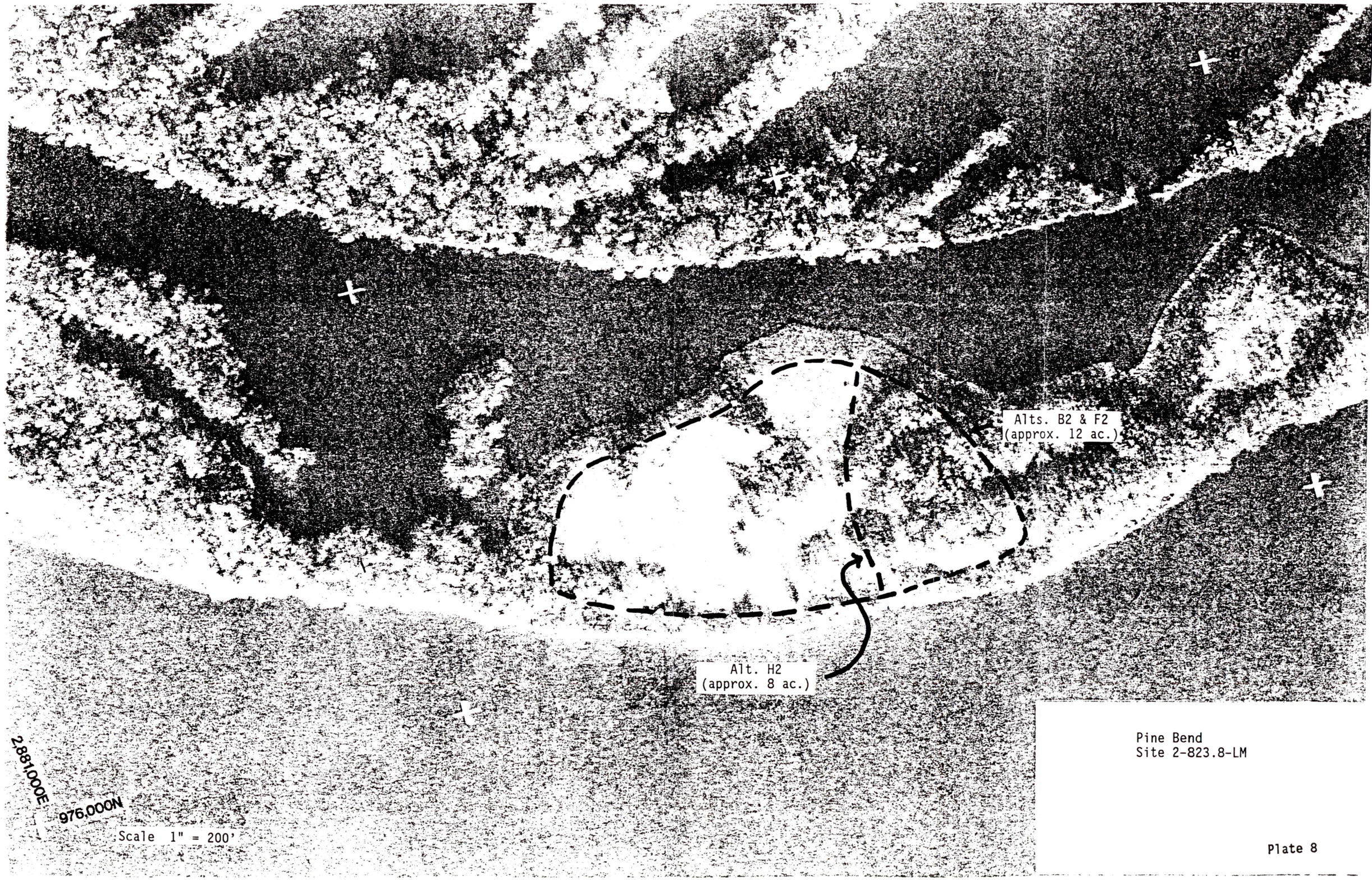
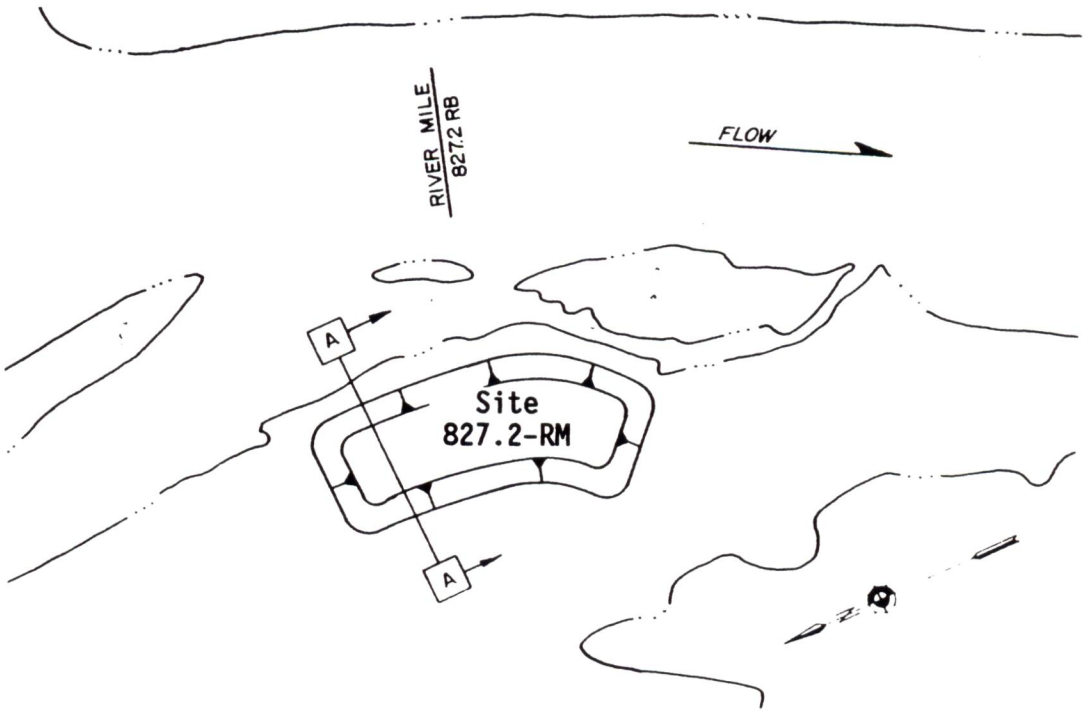

494
ST. PAUL PARK
FLOW
RIVER MILE
832.5 LB & RB
Site
832.5-RM
SOUTH ST. PAUL
PLAN
200 0 200 400
SCALE IN FEET

Plate 7



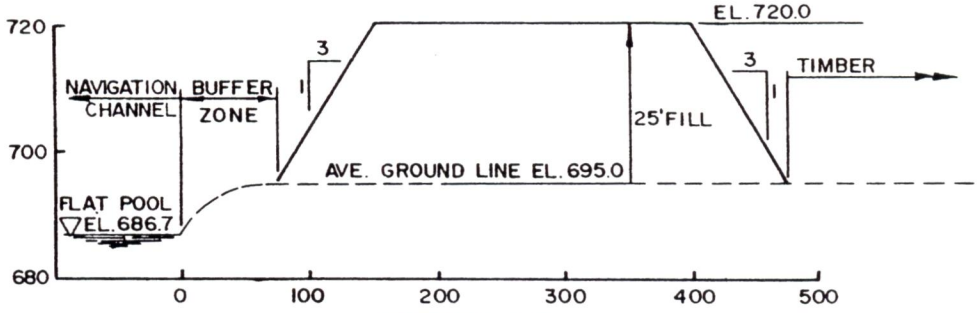
Pine Bend
Site 2-823.8-LM

Plate 8



PLAN

200 0 200 400
SCALE IN FEET



SECTION A-A

Plate 9

APPENDIX A

OPERATIONS AND BENEFICIAL USE

LOWER POOL 2 CHANNEL MAINTENANCE PLAN

Appendix A - Operations and Beneficial Use

Projected Dredging Quantities

The following four historic dredging reaches and projected 40 year dredging quantities are considered in this report:

	Dredge Cut	River Mile	40 Yr Qty	Events	Qty/Event
2	Boulanger Bend Lower	819.0-819.8	240,500	4	60,125
3	Boulanger Bend	820.0-821.4	455,500	4	113,875
4	Pine Bend	822.7-824.7	379,500	10	37,950
5	Grey Cloud Slough	827.5-828.3	282,000	8	35,250
		Total Quantity	1,357,500		

The projected dredging quantities are based on historic experience and the projected quantities estimated in the GREAT I Study. Tables 1 through 4 list all dredging events at each reach for the 1970-1993 time period. Quantities, averages, frequency, dredging depth, equipment and placement site information is provided.

It is emphasized that projecting future dredging quantities is very difficult because of the many variables and unknowns that influence channel maintenance. It cannot be done with much reliability, especially for a 40 year period. Actual future dredging quantities may be significantly different and will alter the life expectancy of the selected placement site/s accordingly by either lengthening or shortening it.

Operations Discussion

Each of the alternatives being studied includes a number of dredging components that have dredge material going from a particular cut to a placement site or from a temporary site to a permanent site. These components are listed in tables 5.1 and 5.2, with distances from the cut to the site and identification of the dredging method that is assumed would be used. Each component has been evaluated individually and a cost estimate prepared. The cost of all the components for a given alternative, plus any related placement site costs, comprise the total cost for the alternative. The general basis for the cost estimates is explained in the matrix evaluation criteria appendix. Tables 6.1 and 6.2 are a listing by component of the dredging costs from either a dredge cut to a placment site or from a temporary site to a permanent site. Tables 7.1 and 7.2 summarize the costs by alternative and establishes a matrix value. A discussion of the operational details associated with each placement site and dredging component follows:

Site 2-832.5-RM: This site was recommended by GREAT I as a long-term beneficial use site though it has never been used for the placement of channel maintenance dredge material. It currently is a vacant lot and for sale at an asking price of about $2.00/sq.ft., or nearly $900,000. Its location adjacent to I-494, the river, the railroad, and in an idustrial area make it an attractive site to developers. Operationally, the site would be difficult to access because of the flood dike, railroad, and street separating it from the river bank. It is also thought that significant dredging perpendicular to the channel would be necessary to unload material barges. Access channel maintenance would likely be frequent given the logical access alignment perpendicular to the channel flow. Unloading would be mechanically with either trucks or a conveyor used for crossing the obstacles. Hydraulic dredging would not be practical given the distant location of all dredge cuts.

Site 2-827.2-RM: This island site is a historic placement site that hasn't been use in numerous years. It would be used for hydraulic placement of material (282,000cy) from cut 5 under Alternative B2. After 40 years the site would cover 9 acres at an elevation of 25 feet above normal pool level. Prior to placement of material the site would require berming around the perimeter with installation of effluent return drop structures most likely on the downstream end of the site. Located close to cut 5, hydraulic dredging would allow expedient maintenance of the channel and the quick resumption of safe navigation.

Site 2-823.8-LM: This island site is also a historic placement site however has been used more recently then 2-827.2-RM. Under Alternative B2 the site would only be used for material from cut 4 (379,500cy). After 40 years the site would cover 12 acres to an elevation of 25 feet above normal pool. Under Alternatives F2 and H2 the site would be used for both cuts 4 and 5 alleviating the need for site 2-287.2-RM. Material from cut 4 would be hydraulically placed however cut 5 would be placed mechanically due to the distance. To prepare the site for both cuts the site would be excavated to a depth of 30 feet below normal pool with a ring dike remaining. After 40 years the 661,500 cy placed at the site would cover 12 acres (Alt. F2), or 8 acres (Alt. H2). The 661,500 cy removed during preparation would be hydraulically transferred to the Shiely Gravel Pit for reclamation purposes, and some benefical use. Some access channel dredging is expected for mechanical unloading at this site.

Site 2-822.5-LM: This site is an active gravel pit with sand and gravel loaded onto barges and transported daily to the Twin Cities. The landowner has expressed interest in obtaining dredged material for reclamation purposes. Under several alternatives material from the island sites would be transferred once or twice via hydraulic dredging to this site. Alternatives F1 and F2, where all of the islands would be excavated at once would be the most cost effective requiring only one mobilization/demobilization of dredging equipment. Alternatives H1, I1, and H2 would require two separate mobilizations. In return the size of the island sites would be reduced. Alternatives G1 and G2 have all of the material from Lower Pool 2 being placed at this site mechanically. Material would likely be unloaded near the existing loading dock at the upstream end of the site and then trucked or conveyed to the pit. These alternatives (G1 and G2) would also probably require some access channel maintenance periodically.

Site 2-821.5-LM: This site (Upper Boulanger Island) is a historic placement site accessible to hydraulic dredging. Under Alternatives F1 and I1 the site would be excavated and then refilled with up to 240,500 cy during the next 40 years resulting in a 4 acre site. A ring dike of island material would remain after excavation for retention of channel maintenance material.

Site 2-821.0-LM: This site (Lower Boulanger Island) is also a historic placement site accessible to hydraulic dredging. This site would be used under a number of alternatives (B1, F1, H1, and I1). Its size would vary depending on alternative and the amount of material placed at the site. Under three alternatives (F1, H1, and I1), the site would be preexcavated to provide the necessary capacity. Under alternatives H1 and I1, a second excavation would be required approximately one-half way through the 40-year planning period. This allows a reduction in the size of the site and/or avoids the need to use the Upper Boulanger Island site.

Site 2-820.5-LM: This site was also recommeded by GREAT I as a beneficial use site. It has not been used in the past and consists of 14 grassy acres at the lower end of Grey Cloud Island. Under Alternative A1 nearly 700,000 cy of material from cuts 2 and 3 would be placed at this site. Because of the distance, cut 2 would be mechanically dredged and placed at this site however cut 3 could be reached with hydraulic equipment, the preferred method. For mechanical dredging and access channel may have to be dredged into the site and then maintained in the future. For hydraulic dredging the site would have to be bermed and effluent return drop structures placed at the downstream end of the site. It is estimated that 240,000 cy would be removed for beneficial use leaving 456,000 cy on site at a final elevation of 25 feet above normal pool. This site is not considered in any other alternatives and because of known archaeological sites in the area would require a survey prior to placement.

Site 2-819.4-RM: This island site is a historic placement site for cut 2 though not used in recent years. Under Alternatives B1 and F1 the site would be used for the placement of 240,500 cy directly onto the existing island. The site would need to be bermed with drop structures put in place and would eventually cover an area of 8 acres to an elevation of 25 feet above normal pool. Under Alternative F1, 144,500 cy would be excavated from the site to a depth of 30 feet below normal pool prior to any future placement. The site would then be used for the hydraulic placement of 240,500 cy during the next 40 years resulting in a site covering only 6 acres to an elevation of 16 feet above normal pool. The excavated material would be transferred to the Shiely Gravel Pit.

Beneficial Use Discussion

Placing dredged material at locations where it would or could be used beneficially was a primary objective of the GREAT I Study and is an objective of the Corps of Engineers. Results of marketing studies conducted during the GREAT I study were used to determine a projected beneficial use for the selected sites. A post-GREAT survey conducted by the Wisconsin Department of Natural Resources under contract by the Corps of Engineers, supplements the earlier studies. This survey was summarized in a May 1982 report titled "Demands, Productive Uses and Economic Impacts of the Beneficial Use of Dredged Material

on the Upper Mississippi River". Results of this survey and the Corps of Engineers experience with past beneficial use are used to modify the GREAT report projections whenever appropriate. The District optimistically estimates beneficial use within reason, because at most locations it is untested and generally unknown what the demand may actually be. Beneficial use of dredged material is divided into two basic categories: active, which is removed from the site, and passive, which is left permanently for potential site development or enhancement.

Site Management - The District intends to actively pursue the beneficial use removal of material from placement sites. A program of notifying potential users and promoting use of the material has begun. Policy and legal issues relating to the donation of dredged material will be evaluated on a site by site basis. Removal of material for beneficial use at specific sites will be unrestricted unless problems develop that require instituting a management program. Governmental units having the greatest constituency will receive first priority for receiving material, followed by non-profit organizations, and then private interests. When non-government owned sites are used, the government will pursue an agreement from the landowner to allow beneficial use to the extent of the identified demand.

Specific Comments - The GREAT I report indicates an active beneficial use demand in Pool 2 of 995,000 cy. This includes 240,000 cy at 2-820.5-LM and 755,000 cy at site 2-832.5-RM. Alternatives A1 and A2, the modified GREAT I plan, takes maximum advantage of this demand however there would still be 456,000cy of material left at site 2-820.5-LM. This site is farther from the metro area then site 2-832.4-RM thereby resulting in an unmet demand for all of the material. Alternatives A1 and A2 are the only alternatives evaluated that takes into account active beneficial use of material in Lower Pool 2. However, with the exception of Alternatives B1 and B2, all of the other alternatives make passive beneficial use of material by using it for reclamation of a gravel pit. Alternatives B1 and B2 is the least costly per cubic yard, however, all of the material remains on island sites it is inaccessible.

Summary

Cuts 2 and 3 - Alternative A1 ($3.7 million), the modified GREAT I recommendation, provides for maximum active beneficial use of dredged material for these dredge cuts. Still, over 450,000 cubic yards of material is left on site. By comparison, Alternative B1 has the lowest overall cost at $3.2 million dollars. Alternative B1 has the most impact on the environment because all material is left on the islands and none of it is put to beneficial use. Alternative G1 takes all of the dredged material directly to the Shiely site for passive beneficial use. However, this alternative is the most costly at nearly $6.1 million.

Alternatives F1, H1, and I1 are similar in concept, using various combinations of historic sites that would be preexcavated to provide the necessary capacity. Alternative F1 ($3.9 million) is the least costly of these three options, approximately $900,000 less that the cost of the most expensive,

alternative H1 ($4.8 million). Alternative I1 would cost about $4.4 million. In some instances, these sites would require two excavations to limit the size of the sites.

In general, the alternatives become more expensive as more of the dredging is done mechanically. From an operational perspective, the preferred alternatives rely on hydraulic dredging for channel maintenance because not only is the cost less but it allows for removal of dangerous shoals in a much shorter period of time thereby increasing safety for the navigation industry. Alternatives that include reclamation of the Shiely Gravel Pit seem to allow a reasonable compromise between cost and beneficial use of the material even though the gravel pit is only considered passive beneficial use.

Cuts 4 and 5 - Alternative A2 ($5.3 million), the modified GREAT I recommendation, provides for complete active beneficial use of dredged material for these dredge cuts. By comparison, Alternative B2 has the lowest overall cost at $2.5 million dollars. Alternative B2 has the most impact on the environment because all material is left on the islands and none of it is put to beneficial use. Alternative G2 takes all of the dredged material directly to the Shiely site for passive beneficial use. However, this alternative is the most costly at over $5.9 million.

Alternatives F2 and H2 are similar in concept, using various combinations of historic sites that would be preexcavated to provide the necessary capacity. Alternative F2 ($4.1 million) is the least costly of these two options, approximately $200,000 less than alternative H2 ($4.3 million). Alternative I1 would cost about $4.4 million. In some instances, sites would require two excavations to limit their size.

In general, the alternatives become more expensive as more of the dredging is done mechanically. From an operational perspective, the preferred alternatives rely on hydraulic dredging for channel maintenance because not only is the cost less but it allows for removal of dangerous shoals in a much shorter period of time thereby increasing safety for the navigation industry. Alternatives that include reclamation of the Shiely Gravel Pit seem to allow a reasonable compromise between cost and beneficial use of the material even though the gravel pit is only considered passive beneficial use.

Table 5.1 - Dredging Components

25 Sep 1995

Dredge Cut or Temp Rehandling Site		Placement Site		Alternative	Distance - Cut to Site or Temp Site to Perm Site				Dredging			
No	Name/Mile	Number	Name		Lift	Water	Land	Est	Method	Quantity	Events	Qty/Event
2	Boulanger Bend Lower Light 819.0-819.8	2-821.0-LM	Grey Cloud Island	A1	25'	2000-6100 ft	1000 ft	5800 ft	Hyd	240,500	4	60,125
		2-822.5-LM	Shiely Gravel Pit	G1	80'	2000-6100 ft	8900 ft	2.5 mi	Mech			
		2-819.4-RM	Freeborn Island	B1,F1	25'	1800-2000 ft	0 ft	1900 ft	Hyd			
		2-821.5-LM	Up. Boulanger Isl.	I1	5'	2.5 mi	0 ft	2.5 mi	Mech			
		2-821.1-LM	Lo. Boulanger Isl.	H1	25'	2.1 mi	0 ft	2.1 mi	Mech			
3	Boulanger Bend 820.8-821.4	2-821.0-LM	Grey Cloud Island	A1	25'	2200-7000 ft	0 ft	1 mi	Hyd	455,500	4	113,875
		2-821.5-LM	Up. Boulanger Isl.	F1	5'	1000-6000 ft	0 ft	3500 ft	Hyd			
		2-821.1-LM	Lo. Boulanger Isl.	B1,F1,H1,I	25'	700-5400 ft	0 ft	1800 ft	Hyd			
		2-822.5-LM	Shiely Gravel Pit	G1	80'	1-2 mi	2200 ft	1.5 mi	Mech			
	Up. Boulanger 2-821.5-LM	2-822.5-LM	Shiely Gravel Pit	All	80'	5200 ft	2200 ft	1.4 mi	Hyd	210,000 240,500	1 1	210,000 240,500
	Lo. Boulanger 2-821.1-LM	2-822.5-LM	Shiely Gravel Pit	All	80'	7200 ft	2200 ft	1.8 mi	Hyd	135,000- 696,000	1- 2	135,000- 348,000
	Freeborn Island 2-819.4-RM	2-822.5-LM	Shiely Gravel Pit	F1	80'	14200 ft	2200 ft	3.1 mi	Hyd	240,500	1	240,500

Table 6.1 - Dredging and Rehandling Costs

26 Sep 95

Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Qty per Event	# of Events	Rate per Hour	Effective Time	Non-Effective Time					Total Time	Mob & Demob	Cost per Event	Cost per CY	40 Year Cost
									Set-up	Brk-Dwn	Site	Vessels	Misc.					
A1	2	240,500	2-821.0-LM	Hyd	60,125	4	510	117.89	25.94	15.85	61.96	24.50	14.41	281.88		$229,235	$3.81	$916,939
	3	455,500	2-821.0-LM	Hyd	113,875	4	510	223.28	49.12	30.02	117.35	46.39	27.29	496.19		$434,164	$3.81	$1,736,656
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1									$191,000	$428,600	$1.76	$428,600
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1									$40,000	$409,600	$1.76	$409,600
																		$3,491,795
B1	2	240,500	2-819.4-RM	Hyd	60,125	4	670	89.74	19.74	12.06	47.16	18.65	10.97	199.42		$174,492	$2.90	$697,968
	3	455,500	2-821.1-LM	Hyd	113,875	4	670	169.96	37.39	22.85	89.32	35.31	20.77	377.69		$330,483	$2.90	$1,321,932
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1									$191,000	$428,600	$1.76	$428,600
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1									$40,000	$409,600	$1.76	$409,600
																		$2,858,100
F1	2	240,500	2-819.4-RM	Hyd	60,125	4	670	89.74	19.74	12.06	47.16	18.65	10.97	199.42		$174,492	$2.90	$697,968
	3	245,500	2-821.1-LM	Hyd	122,750	2	670	183.21	40.31	24.63	96.29	38.07	22.39	407.13		$356,240	$2.90	$712,479
	3	210,000	2-821.5-LM	Hyd	105,000	2	590	177.97	39.15	23.93	93.53	36.98	21.75	395.48		$346,045	$3.30	$692,090
	2-819.4-RM	240,500	2-822.5-LM	Hyd	240,500	1									$191,000	$614,280	$1.76	$614,280
	2-821.1-LM	245,500	2-822.5-LM	Hyd	245,500	1									$40,000	$472,080	$1.76	$472,080
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1									$40,000	$409,600	$1.76	$409,600
																		$3,598,498
G1	2	240,500	2-822.5-LM	Mech	60,125	4									$50,000	$460,053	$6.82	$1,840,210
	3	455,500	2-822.5-LM	Mech	113,875	4									$50,000	$826,628	$6.82	$3,306,510
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1									$191,000	$428,600	$1.76	$428,600
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1									$40,000	$409,600	$1.76	$409,600
																		$5,984,920
H1	2	240,500	2-821.1-LM	Mech	60,125	4										$319,865	$5.32	$1,279,460
	3	455,500	2-821.1-LM	Hyd	113,875	4	670	169.96	37.39	22.85	89.32	35.31	20.77	377.69		$330,483	$2.90	$1,321,932
	2-821.1-LM	696,000	2-822.5-LM	Hyd	348,000	2									$191,000	$803,480	$1.76	$1,606,960
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1									$40,000	$409,600	$1.76	$409,600
																		$4,617,952
I1	2	240,500	2-821.5-LM	Mech	60,125	4										$319,865	$5.32	$1,279,460
	3	455,500	2-821.1-LM	Hyd	113,875	4	670	169.96	37.39	22.85	89.32	35.31	20.77	377.69		$330,483	$2.90	$1,321,932
	2-821.1-LM	455,500	2-822.5-LM	Hyd	227,750	2									$191,000	$591,840	$1.76	$1,183,680
	2-821.5-LM	240,500	2-822.5-LM	Hyd	240,500	1									$40,000	$463,280	$1.76	$463,280
																		$4,248,352

Table 7.1 - Placement Site Costs

26 Sep 95

Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Acres	Avg Fill Depth	Feet of Dike	Real Estate	Site Preparation & Management				Total Site Costs
									Clearing	Diking	Rip-rap	Lndscpe	
A1	2	240,500	2-821.0-LM	Hyd	14	25	3600	48,700	0	41,400	0	10,000	$100,100
	3	455,500	2-821.0-LM	Hyd									
	2-821.1-LM	135,000	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
	2-821.5-LM	210,000	2-822.5-LM	Hyd									
													$180,100
B1	2	240,500	2-819.4-RM	Hyd	8	25	3000	0	6,000	34,500	85,000	20,000	$145,500
	3	455,500	2-821.1-LM	Hyd	14	25	3200	11,300	9,000	36,800	50,000	20,000	$127,100
	2-821.1-LM	135,000	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
	2-821.5-LM	210,000	2-822.5-LM	Hyd									
													$352,600
F1	2	240,500	2-819.4-RM	Hyd	7	16	1800	0	6,000	20,700	90,000	15,000	$131,700
	3	245,500	2-821.1-LM	Hyd	9	23	1500	11,300	4,500	17,250	40,000	15,000	$88,050
	3	210,000	2-821.5-LM	Hyd	4	5	0	11,300	0	0	0	10,000	$21,300
	2-819.4-RM	240,500	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
	2-821.1-LM	245,500	2-822.5-LM	Hyd									
	2-821.5-LM	210,000	2-822.5-LM	Hyd									
													$321,050
G1	2	240,500	2-822.5-LM	Mech	15	Varies	0	50,000	0	0	0	30,000	$80,000
	3	455,500	2-822.5-LM	Mech									
	2-821.1-LM	135,000	2-822.5-LM	Hyd									
	2-821.5-LM	210,000	2-822.5-LM	Hyd									
													$80,000
H1	2	240,500	2-821.1-LM	Mech	10	25	3000	11,300	5,000	34,500	50,000	20,000	$120,800
	3	455,500	2-821.1-LM	Hyd									
	2-821.1-LM	696,000	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
	2-821.5-LM	210,000	2-822.5-LM	Hyd									
													$200,800
I1	2	240,500	2-821.5-LM	Mech	4	5	0	11,300	0	0	0	10,000	$21,300
	3	455,500	2-821.1-LM	Hyd	8	5	1100	11,300	4,500	12,650	0	10,000	$38,450
	2-821.1-LM	455,500	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
	2-821.5-LM	240,500	2-822.5-LM	Hyd									
													$139,750

Table 8.1 - Summary of Costs for Lower Pool 2 (Cuts 2 & 3)											26 Sep 95
Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Qty per Event	# of Events	Costs				Matrix Value
							Dredging	Site	Total	Unit	
A1	2	240,500	2-821.0-LM	Hyd	60,125	4	$916,939	$100,100			
	3	455,500	2-821.0-LM	Hyd	113,875	4	$1,736,656				
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1	$428,600	$80,000			
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1	$409,600				
							$3,491,795	$180,100	$3,671,895	5.28	7
B1	2	240,500	2-819.4-RM	Hyd	60,125	4	$697,968	$145,500			
	3	455,500	2-821.1-LM	Hyd	113,875	4	$1,321,932	$127,100			
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1	$428,600	$80,000			
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1	$409,600				
							$2,858,100	$352,600	$3,210,700	4.61	8
F1	2	240,500	2-819.4-RM	Hyd	60,125	4	$697,968	$131,700			
	3	245,500	2-821.1-LM	Hyd	122,750	2	$712,479	$88,050			
	3	210,000	2-821.5-LM	Hyd	105,000	2	$692,090	$21,300			
	2-819.4-RM	240,500	2-822.5-LM	Hyd	240,500	1	$614,280	$80,000			
	2-821.1-LM	245,500	2-822.5-LM	Hyd	245,500	1	$472,080				
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1	$409,600				
							$3,589,498	$321,050	$3,910,548	5.62	7
G1	2	240,500	2-822.5-LM	Mech	60,125	4	$1,840,210	$80,000			
	3	455,500	2-822.5-LM	Mech	113,875	4	$3,306,510				
	2-821.1-LM	135,000	2-822.5-LM	Hyd	135,000	1	$428,600				
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1	$409,600				
							$5,984,920	$80,000	$6,064,920	8.71	5
H1	2	240,500	2-821.1-LM	Mech	60,125	4	$1,279,460	$120,800			
	3	455,500	2-821.1-LM	Hyd	113,875	4	$1,321,932				
	2-821.1-LM	696,000	2-822.5-LM	Hyd	348,000	2	$1,606,960	$80,000			
	2-821.5-LM	210,000	2-822.5-LM	Hyd	210,000	1	$409,600				
							$4,617,952	$200,800	$4,818,752	6.92	6
I1	2	240,500	2-821.5-LM	Mech	60,125	4	$1,279,460	$21,300			
	3	455,500	2-821.1-LM	Hyd	113,875	4	$1,321,932	$38,450			
	2-821.1-LM	455,500	2-822.5-LM	Hyd	227,750	2	$1,183,680	$80,000			
	2-821.5-LM	240,500	2-822.5-LM	Hyd	240,500	1	$463,280				
							$4,248,352	$139,750	$4,388,102	6.30	6

Table 5.2 - Dredging Components

25 Sep 1995

Dredge Cut or Temp Rehandling Site		Placement Site		Alternative	Distance - Cut to Site or Temp Site to Perm Site				Dredging			
No	Name/Mile	Number	Name		Lift	Water	Land	Est	Method	Quantity	Events	Qty/Event
4	Pine Bend 822.7-823.7	2-832.5-RM	Armour (494) Site	A2	20'	9-10 mi	250 ft	9.3 mi	Mech	379,500	10	37,950
		2-823.8-LM	Pine Bend	B2,F2,H2	21'	700-5400 ft	100 ft	2400 ft	Hyd			
		2-822.5-LM	Shiely Gravel Pit	G2	80'	900-6300 ft	2200 ft	1.5 mi	Mech			
5	Grey Cloud Sl. 827.5-828.3	2-832.5-RM	Armour (494) Site	A2	20'	4-5 mi	250 ft	4.6 mi	Mech	282,000	8	35,250
		2-827.2-RM	Historic Site	B2	25'	1500-5800 ft	100 ft	2600 ft	Hyd			
		2-823.8-LM	Pine Bend	F2,H2	25'	3-4 mi	100 ft	3.5 mi	Mech			
		2-822.5-LM	Shiely Gravel Pit	G2	80'	5-6 mi	2200 ft	5.4 mi	Mech			
	Pine Bend Site 2-823.8-LM	2-822.5-LM	Shiely Gravel Pit	All	80'	6000 ft	2200 ft	1.5 mi	Hyd	95,000 661,500	1 1-2	95,000 661,500

Table 6.2 - Dredging and Rehandling Costs

26 Sep 95

Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Qty per Event	# of Events	Rate per Hour	Effective Time	Non-Effective Time					Total Time	Mob & Demob	Cost per Event	Cost per CY	40 Year Cost
									Set-up	Brk-Dwn	Site	Vessels	Misc.					
A2	4	379,500	2-832.5-RM	Mech	37,950	10										$281,969	$7.43	$2,819,685
	5	282,000	2-832.5-RM	Mech	35,250	8										$192,818	$5.47	$1,542,540
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1									$191,000	$358,200	$1.76	$358,200
																		$4,720,425
B2	4	379,500	2-823.8-LM	Hyd	37,950	10	670	56.64	12.46	7.62	29.77	11.77	6.92	125.87		$110,137	$2.90	$1,101,368
	5	282,000	2-827.2-RM	Hyd	35,250	8	590	59.75	13.14	8.03	31.40	12.41	7.30	132.77		$116,172	$3.30	$929,379
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1									$191,000	$358,200	$1.76	$358,200
																		$2,388,847
F2	4	379,500	2-823.8-LM	Hyd	37,950	10	670	56.64	12.46	7.62	29.77	11.77	6.92	125.87		$110,137	$2.90	$1,101,368
	5	282,000	2-823.8-LM	Mech	35,250	8										$187,530	$5.32	$1,500,240
	2-823.8-LM	661,500	2-822.5-LM	Hyd	661,500	1									$191,000	$1,355,240	$1.76	$1,355,240
																		$3,956,848
G2	4	379,500	2-822.5-LM	Mech	37,950	10									$50,000	$308,619	$6.62	$3,088,190
	5	282,000	2-822.5-LM	Mech	35,250	8									$50,000	$302,743	$7.17	$2,421,940
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1									$191,000	$358,200	$1.76	$358,200
																		$5,868,330
H2	4	379,500	2-823.8-LM	Hyd	37,950	10	670	56.64	12.46	7.62	29.77	11.77	6.92	125.87		$110,137	$2.90	$1,101,368
	5	282,000	2-823.8-LM	Mech	35,250	8										$187,530	$5.32	$1,500,240
	2-823.8-LM	661,500	2-822.5-LM	Hyd	330,750	2									$191,000	$773,120	$1.76	$1,546,240
																		$4,147,848

COSTS

Table 7.2 - Placement Site Costs

26 Sep 95

Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Acres	Avg Fill Depth	Feet of Dike	Real Estate	Site Preparation & Management				Total Site Costs
									Clearing	Diking	Rip-rap	Lndscpe	
A2	4	379,500	2-832.5-RM	Mech	4	Varies	0	504,000	0	0	0	25,000	$529,000
	5	282,000	2-832.5-RM	Mech									
	2-823.8-LM	95,000	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
													$609,000
B2	4	379,500	2-823.8-LM	Hyd	12	21	1200	18,500	9,000	13,800	0	10,000	$51,300
	5	282,000	2-827.2-RM	Hyd	9	25	2800	12,000	13,500	32,200	0	10,000	$67,700
	2-823.8-LM	95,000	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
													$199,000
F2	4	379,500	2-823.8-LM	Hyd	12	21	1200	18,500	9,000	13,800	0	10,000	$51,300
	5	282,000	2-823.8-LM	Mech									
	2-823.8-LM	661,500	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
													$131,300
G2	4	379,500	2-822.5-LM	Mech	15	Varies	0	50,000	0	0	0	30,000	$80,000
	5	282,000	2-822.5-LM	Mech									
	2-823.8-LM	95,000	2-822.5-LM	Hyd									
													$80,000
H2	4	379,500	2-823.8-LM	Hyd	8	25	700	18,500	3,000	8,050	0	10,000	$39,550
	5	282,000	2-823.8-LM	Mech									
	2-823.8-LM	661,500	2-822.5-LM	Hyd	15	Varies	0	50,000	0	0	0	30,000	$80,000
													$119,550

Table 8.2 - Summary of Costs for Lower Pool 2 (Cuts 4 &5)

26 Sep 95

Alt	Cut # or Temp Site	Quantity	Perm Site	Dredge Method	Qty per Event	# of Events	Costs				Matrix Value
							Dredging	Site	Total	Unit	
A2	4	379,500	2-832.5-RM	Mech	37,950	10	$2,819,685	$529,000			
	5	282,000	2-832.5-RM	Mech	35,250	8	$1,542,540				
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1	$358,200	$80,000			
							$4,720,425	$609,000	$5,329,425	8.06	5
B2	4	379,500	2-823.8-LM	Hyd	37,950	10	$1,101,368	$51,300			
	5	282,000	2-827.2-RM	Hyd	35,250	8	$929,379	$67,700			
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1	$358,200	$80,000			
							$2,388,947	$199,000	$2,587,947	3.91	8
F2	4	379,500	2-823.8-LM	Hyd	37,950	10	$1,101,368	$51,300			
	5	282,000	2-823.8-LM	Mech	35,250	8	$1,500,240				
	2-823.8-LM	661,500	2-822.5-LM	Hyd	661,500	1	$1,355,240	$80,000			
							$3,956,848	$131,300	$4,088,148	6.18	7
G2	4	379,500	2-822.5-LM	Mech	37,950	10	$3,088,190	$80,000			
	5	282,000	2-822.5-LM	Mech	35,250	8	$2,421,940				
	2-823.8-LM	95,000	2-822.5-LM	Hyd	95,000	1	$358,200				
							$5,868,330	$80,000	$5,948,330	8.99	4
H2	4	379,500	2-823.8-LM	Hyd	37,950	10	$1,101,368	$39,550			
	5	282,000	2-823.8-LM	Mech	35,250	8	$1,500,240				
	2-823.8-LM	661,500	2-822.5-LM	Hyd	330,750	2	$1,546,240	$80,000			
							$4,147,848	$119,550	$4,267,398	6.45	6

APPENDIX B

ENVIRONMENTAL EVALUATION OF ALTERNATIVES

APPENDIX B
ENVIRONMENTAL EVALUATION OF ALTERNATIVES

TABLE OF CONTENTS

INTRODUCTION B-1

FISH AND WILDLIFE B-1
Site 2-819.4-RM (2.75) B-1
Site 2-821.0-LM (2.35) B-2
Site 2-821.1-LM (2.31A) B-2
Site 2-821.5-LM (2.31B) B-3
Site 2-823.8-LM (2.25) B-4
Site 2-827.2-RM (2.27) B-5
Site 2-832.5-RM (2.10) B-5
Site 2-822.5-LM (Shiely) B-5

WATER QUALITY B-5
Site 2-819.4-RM (2.75) B-7
Site 2-821.0-LM (2.35) B-7
Site 2-821.1-LM (2.31A) B-7
Site 2-821.5-LM (2.31B) B-8
Site 2-823.8-LM (2.25) B-8
Site 2-827.2-RM (2.27) B-8
Site 2-832.5-RM (2.10) B-9
Site 2-822.5-LM (Shiely) B-9

CULTURAL RESOURCES B-9

Alternative A1 . . . . . B-9
Alternative B1 . . . . . B-10
Alternative F1 . . . . . B-10
Alternative G1 . . . . . B-10
Alternative H1 . . . . . B-10
Alternative I1 . . . . . B-11
Alternative A2 . . . . . B-11
Alternative B2 . . . . . B-11
Alternative F2 . . . . . B-12
Alternative G2 . . . . . B-12
Alternative H2 . . . . . B-12

APPENDIX B
ENVIRONMENTAL EVALUATION OF ALTERNATIVES

INTRODUCTION

This appendix summarizes the environmental effects of alternative dredged material placement plans for lower pool 2 of the Upper Mississippi River. These alternative plans are described earlier in the main report and other appendices. This appendix is not a document required by the National Environmental Policy Act of 1969 or Section 404(b)(1) of the Clean Water Act of 1977, nor is intended to be a substitute for any document required by those statutes.

FISH AND WILDLIFE

PLACEMENT SITES FOR DREDGE CUTS 2 AND 3

Site 2-819.4-RM (2.75) - Site 2-819.4-RM is an island/open-water area in the lower lake-like portion of pool 2. Use of this site occurs under alternatives B1 (8 acres) and F1 (7 acres). The island has been used for dredged material disposal in the past, the last time in 1974. There is a delta of dredged material extending out underwater around the island.

The island consists of low-lying vegetated dredged material deposits being colonized by grasses, herbs, and shrubs, plus areas vegetated by willows and cottonwoods. Most of the woody vegetation is found around the edges of the island. The value of the island as habitat for larger mammals, such as white-tailed deer, raccoon, fox, and skunks is probably limited by its small size and the relative isolation from land areas. This isolation, on the other hand, increases its value to waterfowl and other ground-nesting birds by reducing predation. It is not known how much waterfowl nesting takes place on the islands. Adjacent brood habitat could be a limiting factor in this area.

The shallow water portions of the site have probably been affected to some degree by past disposal actions. It is expected that the bottom sediments are a mixture of old silty sand dredged material and more recently deposited silts. Based upon aerial photography, what is known of lower pool 2 in terms of water quality, and a site visit in 1995, it is unlikely that there are normally any extensive aquatic plant beds present at the site. Some general fishery use probably occurs because the island does provide structure for fish to orient to. Also, the island breaks up the wind and provides some sheltered shallows that may attract fish.

Under alternative B, the habitat at the site would be gradually lost over the life of the project. Based upon past dredging frequencies and projected dredging volumes, the habitat loss would occur at the approximate rate of 2 acres every 10 years. Under alternative F1 the site would be excavated to 30 feet below low control pool and the material transferred to the

Shiely site. Deepwater aquatic habitat would be temporarily created, but would slowly be filled over 10 to 20 years with subsequent reuse of the site for normal maintenance dredging. The value of the dredged material placed at the site for wildlife would be limited to use by those species that use bare sand habitat, such as turtles (for nesting) and shorebirds (for nesting and loafing).

Because the site would lie in the open areas of lower pool 2, the potential would exist for wind and water to erode material from the site into adjacent aquatic habitats. The potential extent of this erosion and its impact are impossible to predict.

The loss of average annual habitat units would be 428 and 389 for alternatives B1 and F1, respectively (Table B-8).

Site 2-821.0-LM (2.35) - Site 2-821.0-LM is a 14-acre site located on the lower end of Grey Cloud Island, that would be used under alternative A1. The site is a flat old field vegetated primarily by grasses. There are a few invading trees on the riverward side of the site. On the landward side of the site, there are a few rows of red pine 20 to 30 feet in height that were planted to serve as a windbreak.

The site provides habitat for such wildlife as white-tailed deer, red fox, cottontail, striped skunk, mice, voles, pheasant, and a variety of songbirds. Use of the site for dredged material placement would result in a steady loss of habitat at the site as area is incrementally taken for dredged material stockpiling. Because this site would be an active beneficial-use removal site, it is unlikely that any revegetation efforts would be undertaken during the project life. The loss of average annual habitat units would be 513 for alternative A1 (Table B-8).

Site 2-821.1-LM (2.31A) - The size and quality of habitat that would be impacted at Site 2-821.1-LM varies depending on the alternative. Under alternative B1, the site would cover 14 acres consisting of two small islands totaling 11 acres and the 3-acre stretch of open water separating them. Both islands have been used for dredged material disposal in the past, the upper island in 1995. Under alternatives F1, H1 and I1 only the upstream island would be used and some adjacent aquatic areas, covering a total of 9, 10, and 8 acres, respectively. Judging from the volumes of material disposed in these areas and the hydraulic disposal procedures used, it is likely that there are deltas of dredged material extending out underwater from the backs of these islands.

The islands have sparsely vegetated dredged material deposits being colonized by grasses, herbs, and shrubs, plus areas vegetated by willows and cottonwoods. Most of the woody vegetation is found around the edges of the islands. The value of the islands as habitat for larger mammals, such as white-tailed deer, raccoon, fox, and skunks is probably limited by their small size of the islands and their relative isolation from land areas. This isolation, on the other hand, increases their value to waterfowl and other ground-nesting birds by reducing predation. It is not known how much waterfowl nesting takes place on these islands.

The shallow water portions of the site have probably been affected to some degree by past disposal actions. It is expected that the bottom sediments are a mixture of old silty sand dredged material and more recently deposited silts. Based upon aerial photography and what is known of lower pool 2 in terms of water quality, it is unlikely that there are any aquatic plant beds present at the site. Some general fishery use probably occurs because the island does provide structure for fish to orient to. Also, the island breaks up the wind and provides some sheltered shallow that may attract fish.

Under alternative B1, this site would be used as the long-term placement site for dredge cut 3. Use of this site would result in the gradual loss of whatever fish and wildlife habitat is available there. Based upon past dredging frequencies and projected dredging volumes, the habitat loss would occur at the approximate rate of 3 to 4 acres every 10 years. This site would be excavated either once (under alternative F1) or twice (under alternatives H1 and I1) to 30 feet below low control pool and the material transferred to the Shiely site. With alternative H1, the material from cut 2 would also be mechanically placed at this site. Deepwater aquatic habitat would be temporarily created, but would slowly be filled over 20 years with subsequent reuse of the site for normal maintenance dredging. The value of the dredged material placed at the site for wildlife would be limited to use by those species that use bare sand habitat, such as turtles (for nesting) and shorebirds (for nesting and loafing).

Because this site lies in the open areas of lower pool 2, the potential would exist for wind and water to erode material into adjacent aquatic habitats. The potential extent of this erosion and its impact are impossible to predict.

The loss of average annual habitat units would be 406, 345, 422 and 248 for alternatives B1, F1, H1 and I1 respectively (Table B-8).

Site 2-821.5-LM (2.31B) - Site 2-821.5-LM is a 4-acre island site in the lower lake-like portion of pool 2. The island has been used for dredged material disposal in the past. Judging from the volumes of material disposed in this area and the hydraulic disposal procedures used, it is likely that there is a delta of dredged material extending out underwater from the back of the island.

The island consists of sparsely vegetated dredged material deposits being colonized by grasses, herbs, and shrubs, plus areas vegetated by willows and cottonwoods. Most of the woody vegetation is found around the edges of the island. The 4 acre area proposed for disposal under Alternatives F1, H, and I consists of sand habitat. Most of the woody vegetation that is present occurs around the edges of the island. The value of the island as habitat for larger mammals, such as white-tailed deer, raccoon, fox, and skunks is probably limited by its small size relative isolation from land areas.

Under alternatives F1 and I1 the site would be excavated to 30 feet below low control pool and the material transferred to the Shiely site. Deepwater aquatic habitat would be temporarily created, but would slowly be filled over 20 years with subsequent reuse of the

site for normal maintenance dredging. The value of the dredged material placed at the site for wildlife would be limited to use by those species that use bare sand habitat, such as turtles (for nesting) and shorebirds (for nesting and loafing).

The loss of average annual habitat units would be 71 for alternatives F1 and I1 (Table B-8).

Because the site would lie in the open areas of lower pool 2, the potential would exist for wind and water to erode material from the site into adjacent aquatic habitats. The potential extent of this erosion and its impact are impossible to predict.

PLACEMENT SITES FOR DREDGE CUTS 4 AND 5

Site 2-823.8-LM (2.25) - This site is a historic placement site located on the left bank of the river. This site would be used as the long-term placement site for Pine Bend and Grey Cloud Slough dredge cuts under alternatives B2, F2, and H2. As designed for alternatives B2 and F2, the site would cover 12 acres and for H2, 8 acres. The site lies on a long peninsula and was primarily old dredged material deposits in early stages of revegetation. The site was last used for dredged material placement in 1995, and with this operation the 9.5 acres of old dredged material was converted to bare sand habitat. With alternative H2 , only 8 acres of the sand habitat would be impacted, because material would be excavated and transferred to the Shiely site twice during the 40-year planning period. About 2.5 acres of the site are relatively undisturbed bottomland forest, that would be impacted under alternatives B2 and F2.

No wildlife surveys have been conducted on the site. White-tailed deer, raccoon, striped skunk, cottontail rabbit, mice, killdeer, songbirds, and turtles would all be expected to use this area to varying degrees. In its current stage of revegetation, the site provides some suitable nesting habitat for waterfowl such as mallards and blue-winged teal.

Use of the site would result in loss of habitat at the site. Under alternative B2, the habitat at the site would be gradually lost over the life of the project. Based upon past dredging frequencies and projected dredging volumes, the habitat loss would occur at the approximate rate of 3 acres every 10 years. Under alternatives F2 and H2 the site would be excavated to 30 feet below low control pool and the material transferred to the Shiely site. Deepwater aquatic habitat would be temporarily created, but would slowly be filled over 20 years with subsequent reuse of the site for normal maintenance dredging. The value of the dredged material placed at the site for wildlife would be limited to use by those species that use bare sand habitat, such as turtles (for nesting) and shorebirds (for nesting and loafing).

This site lies on the left bank of the main channel. There would be some potential for secondary movement of material off the site from wind and water erosion. Prevailing westerly winds would tend to blow eroded material into a side channel/slough that borders the back of the site.

The loss of average annual habitat units would be 239 for alternative B2, 266 for alternative F2, and 108 for alternative H2 (Table B-14).

Site 2-827.2 -RM (2.27) - This site is a 9-acre area on the right bank of the river. The site has been used for some dredged material placement in the past but not for a significant amount of material. The vegetation on the site has withstood/recovered from the effects of deposition such that the plant community present is primarily bottomland forest.

No wildlife surveys have been conducted at this site. It is expected that the site is used by typical bottomland forest species such as white-tailed deer, raccoon, barred owl, woodpeckers, and forest songbirds.

Under alternative B2, this site would be used as the long-term placement site for the Grey Cloud Slough dredge cut (cut 5). The habitat at the site would be lost over the life of the project in increments as the disposal site is expanded to maintain capacity. The value of the site to wildlife would be significantly reduced. Shorebirds and turtles would be the only wildlife that would find much usable habitat at the site.

The average annualized loss in habitat units over 40-years for this site under alternative B2 was estimated to be 405 AAHU (Table B-14).

Site 2-832.5-RM (2.10) - Site 2-832.5-RM is a 4-acre area located on the right bank of the river. The site was at one time the cattle manure disposal area for the South St. Paul stockyards. It has recently been filled to grade by the current owners. The value of the site as wildlife habitat is somewhat low because of the sparse vegetation present. Without use, the quality of this habitat would improve. Use of the site under Alternative A2 for dredged material stockpiling would have minor effects upon fish and wildlife resources. The average annualized loss in habitat units over 40-years for this site under alternative A2 was estimated to be 192 AAHU (Table B-14).

Site 2-822.0-LM (Shiely) - The Shiely site is a 15-acre active/recently abandoned gravel quarry, that presently has very limited wildlife value. This site would used for all alternatives, except A and B alternatives. The coarse barren substrate present at the site will greatly limit vegetative colonization, but will slowly eventually begin to revegetate. It is anticipated that the material transferred from the other sites will contain a fair amount of fine material and that the resultant soils will be of higher quality than presently exists. This should allow a much more rapid colonization by plants and a long-term improvement of the quality of the habitat at the site. It is anticipated that for all the alternatives the better topsoil would offset any adverse impacts from the placement of the dredged material and that the net effect over the 40-year planning would be 0 loss in AAHU. However, it is anticipated that there would be a long-term gain in habitat quality at the Shiely site under all the alternatives.

WATER QUALITY

Sediment samples were collected from the dredge cuts in lower pool 2 in 1974, 1975, 1978, 1981, 1982, 1983, 1984, 1985, 1989 and 1994. In addition, sediments from the Boulanger Bend and Grey Cloud Slough cuts were used in bioassay testing in 1978 and 1980, respectively.

Particle size analysis of the samples indicates that the sediments in the Grey Cloud Slough cut and the Pine Bend Foot Light cut are primarily sand (95 percent). Downriver to the Boulanger Bend cut and the Boulanger Bend Lower Light cut, the percentage of sand decreases and the percentage of fines increases substantially. The percent of fine particles for the Boulanger Bend cut in the 1978 samples was 45 and the percent of fine particles for the Boulanger Bend Lower Light cut 1981 and 1994 samples was 85 and

Lower pool 2 is the settling basin for a large amount of the fine sediment carried into the pool by the Minnesota River. it appears that the two lower dredge cuts are in that area of lower pool 2 where this fine material begins to settle out in substantial quantities.

Bulk chemical analysis of the sand sediments collected from the Grey Cloud Slough and Pine Bend Foot Light cuts shows the material to be relatively uncontaminated. Nutrient and heavy metal contents are low and comparable to the levels found in the "clean" main channel sands in pools 4 through 10. PCB's and chlorinated hydrocarbon pesticides were undetectable in nearly all samples at the 1.0 and 0.1 ug/kg detection limits used for the various compounds.

The few samples available from the two lower cuts (containing higher silt/clay contents) show the expected elevated levels of nutrient and heavy metals and the increased presence of PCB's and chlorinated hydrocarbon pesticides. PCB levels up to 170 ug/kg (ppb) were found while the pesticides were generally present in the 1 to 11 ug/kg range.

The 1980 acute toxicity bioassay (Marking, et al., 1980) used a relatively uncontaminated sand sediment from the Grey Cloud Slough dredge cut. Using nine different aquatic test organisms, no acute toxicity occurred that could be attributed to the sediments.

The 1978 bioaccumulation and acute toxicity bioassay (Peddicord, et al., 1980) used (among others) a moderately contaminated sediment taken from the Boulanger Bend dredge cut. Seven different organisms were used in the bioassay. The following, taken from the abstract, summarizes the findings:

"All three test sediments were of low toxicity to all species except the amphipods, in that no sediment produced statistically greater mortality than occurred in the controls and reference sediment. Although statistical comparisons were not made, amphipod mortality in some UMR sediments apparently exceeded that in the controls but probably not that in the reference sediment. Bioaccumulation was the exception, rather than the rule, with 72 species-sediment-contaminant combinations being studied and bioaccumulation potential being indicated in 8 (11 percent) of the cases. Even in these cases, resulting concentrations were

below those considered likely to cause adverse impacts."

Based on the available data, further sediment investigations would be warranted for the lower part of the cut 3 and all of cut 2. Some limited amount of additional sediment and water quality data were collected during the 1995 dredging operations. A report on this study should be available in November, 1995.

Site 2-819.4-RM (2.75) - Site 2-819.4-RM is an island/open-water area in the lower lake-like portion of pool 2. Use of this site would entail expansion under some of the alternatives into between 2 to 3 acres of open water. This site would be used primarily by hydraulic dredging. Turbidity and suspended solids would increase during open water disposal of dredged material, with turbidity plumes in the immediate disposal area and for a distance around the site. Sand berms would be created to contain the material. Use of this site would have the greatest impact on water quality of all the sites considered, because of the amount of fine material present in cut 2 and the hydraulic placement of the material. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are very possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Because of concerns with the amount of fine material present in the dredge cuts that would be placed at this site, use of this site under the various alternatives was assigned the lowest value permissible in the evaluation table B-15. If this site is used hydraulically, additional sediment investigations would be warranted to fully evaluate the effects of the disposal operation and to determine what additional special mitigative measures might be necessary to meet appropriate water quality criteria and/or standards.

Site 2-821.0-LM (2.35) - This site is a grass covered field on the lower end of Grey Cloud Island and would be used with both hydraulic and mechanical dredging. Restraining and directional berms would be used to confine the dredged material in the designated area. A drop structure or weir might also be installed to further control the material placement and return water. Low level releases of some contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Use of this site would have only minor water quality impacts.

Site 2-821.1-LM (2.31A) - This site is a privately owned island that has been used for dredged material disposal in the past and which is only sparsely vegetated. Use of this site would entail expansion into open water for alternatives B1, F1, H1 and I1. This site would be used primarily for hydraulic dredging. Sand berms would be created to contain the material. Turbidity and suspended solids would increase during open water disposal of dredged material, with turbidity plumes in the immediate disposal area and for a distance downstream. Material that would be placed at this site would come from the Boulanger Bend dredge cut

(cut 3), which is intermediate in quality and texture of the four dredge cuts in lower pool 2. Under alternative H1, mechanically dredged material from cut 2 would also be placed on this site. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Concerns with contaminants, especially alternative H2 which also involves placement of material from cut 2, would have to be furthered addressed, prior to implementing any of these alternatives.

Site 2-821.5-LM(2.31B) - This site is a privately owned island that has been used for dredged material disposal in the past and which is only sparsely vegetated. This site would be used primarily for hydraulic dredging. Sand berms would be created to contain the material. Turbidity and suspended solids would increase during open water disposal of dredged material, with turbidity plumes in the immediate disposal area and for a distance downstream. Material that would be placed at this site would come from the Boulanger Bend dredge cut, which is intermediate in quality and texture of the four dredge cuts in lower pool 2. Low level releases of contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Use of this site would have only relatively minor and short-term water quality impacts.

Site 2-823.8-LM (2.25) - This site lies on a long peninsula and has been used in the past for dredged material disposal. The site would be used with both mechanical (material from cut 5) and hydraulic dredging (material from cut 4) for alternatives B2 F2 and H2. Restraining and directional berms would be used to confine the dredged material in the designated area. A drop structure or weir might also be installed to further control the material placement and return water. Material that would be placed at this site from Grey Cloud and Pine Bend dredge cuts are the coarsest and cleanest of the four dredge cuts in lower pool 2. Low level releases of some contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Use of this site would have minor water quality impacts.

Site 2-827.2-RM (2.27) - This site is located at the upstream end of Grey Cloud Island. The site would be used with both mechanical and hydraulic dredging. Restraining and directional berms would be used to confine the dredged material in the designated area. A drop structure or weir might also be installed to further control the material placement and return water. Low level releases of some contaminants, such as heavy metals, PCBs, or pesticides, are possible. However, these compounds have a strong affinity for fine sediment particles. Some

of these compounds could be released into the aquatic system for a short period of time until they were readsorbed to sediment particles or taken up by some biological form. Acute toxic releases would not be likely to occur. Use of this site would have minor water quality impacts.

Site 2-832.5-RM (2.10) - This site would be used with mechanical dredging. Use of this site would have no appreciable adverse water quality effects.

Site 2-822.0-LM (Shiely) - All material would be placed here hydraulically for alternatives F, H, and I and mechanically for alternative G. The coarse nature of the existing soils should maximize seepage and in combination with the size of the site for ponding, the quality of any effluent return should be reasonably high. However, prior to use further investigation needs to be done to determine if there may be concerns with potential contamination of local potable water supplies, if any exists.

Table 4 in the main report compares the approximate amounts of material that would be handled by various dredging methods with the lower pool 2 alternatives. None of the alternatives would be expected to have any significant adverse water quality impacts. However, when comparing alternatives from a water quality perspective, those plans that maximize mechanical placement would be preferable over those that emphasize hydraulic placement and/or in-water rehandling of dredged material. This was one of the main factors that was used in assigning values to the alternatives in table B-15 and B-16.

CULTURAL RESOURCES

Alternative A1

The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources.

Site 2.35 is located on the southern end of Grey Cloud Island in a former agricultural field that is now overgrown with grass, shrubs and small trees. Grey Cloud Island was surveyed for archeological sites in the fall of 1971 by the Minnesota Historical Society. However, review of the report of investigation does not indicate if disposal site 2.35 was actually included in the investigation, and, if it were, the survey methods which may have been used for the investigations. Based on the proximity of the disposal site to Schilling archeological site, a National Register of Historic Places property, it is likely that other archeological sites may exist on lower Grey Cloud Island. In reviewing this disposal site under the GREAT Study, the St. Paul District recommended an archeological survey of Site 2.35, and while this survey was scheduled to be conducted in the summer of 1984, it was never completed. This alternative is considered to have a high potential to locate additional cultural resources in disposal site 2.35, therefore, it was given a score of 2 for the cultural resources element of the evaluation matrix.

Alternative B1

None of these disposal sites have been surveyed for archeological or historic resources. Sites 2.75 and 2.31A have been used historically for the placement of dredged material. While archeological and historic resources could be buried beneath historic dredged material, the addition of dredge material to these disposal sites would not have a significant impact on deeply buried archeological sites.

The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. This alternative is considered to have a low potential for the location of additional cultural resources in the disposal sites, therefore, it was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative F1

None of these disposal sites have been surveyed for archeological or historic resources. Sites 2.75, 2.31A, and 2.31B have been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at these sites. If archeological sites were located at these disposal sites they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be extremely difficult and expensive. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, this alternative was thought to have a low potential for further impacts to cultural resources. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Based on the evaluation of this alternative, it was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative G1

This alternative would place all dredged material directly into the Shiely sand and gravel pits through hydraulic dredging. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Based on the evaluation of this alternative, it was given a score of 10 for the cultural resources element of the evaluation matrix.

Alternative H1

None of these disposal sites have been surveyed for archeological or historic resources. Sites 2.31A has been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at this site. If archeological sites were located at Site 2.31A they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be

extremely difficult and expensive. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, this alternative was thought to have a low potential for further impacts to cultural resources. Based on the evaluation of this alternative, it was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative I1

None of these disposal sites have been surveyed for archeological or historic resources. Sites 2.31A, and 2.31B have been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at these sites. If archeological sites were located at these disposal sites they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be extremely difficult and expensive. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, this alternative was thought to have a low potential for further impacts to cultural resources. Based on the evaluation of this alternative, it was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative A2

Site 2.10 has never been surveyed for cultural resources. This site has been severely disturbed by past activities, including its use as a manure disposal site and subsequent filling of the site to its present grade. It is highly unlikely that this site would contain undisturbed cultural resources that would meet the criteria of the National Register of Historic Places. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Based on the evaluation of this alternative, it was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative B2

Site 2.25 has been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at this site. If archeological sites were located at Site 2.25 they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be extremely difficult and expensive. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, these disposal site was thought to have a low potential for further impacts to cultural resources.

Site 2.27 has had some dredge material previously placed on this 9-acre site, however, much of the site has not been impacted by past disposal activities. Based on a review of this site's physiographic setting both today and in the late 1900's, this site is felt to have a moderate potential to have undiscovered archeological or historic resources found at this location. Therefore the alternative was given a score of 4 for the cultural resources element of the evaluation matrix.

Alternative F2

Site 2.25 has been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at this site. If archeological sites were located at Site 2.25 they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be extremely difficult and expensive. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, Site 2.25 and the Shiely site were thought to have a low potential for further impacts to cultural resources. Therefore the alternative was given a score of 8 for the cultural resources element of the evaluation matrix.

Alternative G2

This alternative would place all dredged material directly into the Shiely sand and gravel pits through hydraulic dredging. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Based on the evaluation of this alternative, it was given a score of 10 for the cultural resources element of the evaluation matrix.

Alternative H2

Site 2.25 has been used historically for the placement of dredged material. It is possible that archeological and historic resources could be buried beneath historic dredged material at this site. If archeological sites were located at Site 2.25 they would be destroyed during the pre-excavation of the disposal sites. Because this pre-excavation is being done hydraulically, archeological survey at the disposal site in advance of disposal site preparation would be extremely difficult and expensive. The Shiely disposal site is a gravel pit that has no potential to contain undisturbed archeological or historic resources. Because of the current impacts to these disposal sites and the difficulty in locating unknown archeological sites, Site 2.25 and the Shiely site were thought to have a low potential for further impacts to cultural resources. Therefore the alternative was given a score of 8 for the cultural resources element of the evaluation matrix.

Table B-1 Acres of Habitat Effected for Alternatives and Placement Sites
For Dredge Cuts 2 and 3

Alternative	Site	Old Dredge Material	Sand	Upland Forest	Upland Herb.	Brush & Willow	Bottomland Forest	Marsh	Shallow Aquatic	Deep Aquatic	Total
A1	Total	0	0	0	14	0	0	0	0	0	14
	2-821.0-LM				14						14
B1	Total	3	4	0	0	0	9	0	6	0	22
	2-819.4-RM						5		3		8
	2-821.1-LM	3	4				4		3		14
F1	Total	1	23	0	0	0	7.5	0	3.5	0	35
	2-819.4-RM						5		2		7
	2-821.1-LM	1	4				2.5		1.5		9
	2-821.5-LM		4								4
	2-822.5-LM		15								15
G1	Total	0	15	0	0	0	0	0	0	0	15
	2-822.5-LM		15								15
H1	Total	1	8	0	0	0	2.5	0	2.5	0	14
	2-821.1-LM	1	4				2.5		2.5		10
	2-821.5-LM		4								4
I1	Total	1	23	0	0	0	2.5	0	0.5	0	27
	2-821.1-LM	1	4				2.5		0.5		8
	2-821.5-LM		4								4
	2-822.5-LM		15								15

For Dredge Cuts 4 and 5

Alternative	Site	Old Dredge Material	Sand	Upland Forest	Upland Herb.	Brush & Willow	Bottomland Forest	Marsh	Shallow Aquatic	Deep Aquatic	Total
A2	Total	0	0	0	4	0	0	0	0	0	4
	2-832.5-RM				4						4
B2	Total	0	9.5	0	0	0	11.5	0	0	0	21
	2-823.8-LM		9.5				2.5				12
	2-827.2-RM						9				9
F2	Total	0	24.5	0	0	0	2.5	0	0	0	27
	2-823.8-LM		9.5				2.5				12
	2-822.5-LM		15								15
G2	Total	0	15	0	0	0	0	0	0	0	15
	2-822.5-LM		15								15
H2	Total	0	23	0	0	0	0	0	0	0	23
	2-823.8-LM		8								8
	2-822.5-LM		15								15

Table B-2. Habitat Evaluation for Alternative A1

Site 2-821.1-LM Without Project - Total of 14 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Upland Herbaceous	14	79	0.69	
1	Upland Herbaceous	14	79	0.69	763.1
20	Upland Herbaceous	14	79	0.69	14499.7
21	Upland Herbaceous	14	79	0.69	763.1
40	Upland Herbaceous	14	79	0.69	14499.7
Total Relative Habitat Units - Without Project					30525.6

With Project - Total of 14 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Upland Herbaceous	6	79	0.69	
	Upland Herbaceous	8	79	0.69	
1	Sand	6	18	0.20	174.3
	Upland Herbaceous	8	79	0.69	436.1
20	Sand	9	18	0.20	513.0
	Upland Herbaceous	5	79	0.69	6732.0
21	Sand	12	18	0.20	37.8
	Upland Herbaceous	2	79	0.69	190.8
40	Sand	12	18	0.20	820.8
	Sand	2	18	0.20	1104.1
Total Relative Habitat Units - With Project					10008.9
Site 2-821.1-LM - Loss of Average Annual H.U. with Project					-512.9
Alternative A1 (with sites 2-832.5-RM & 2-821.1-LM) - Loss of Average Annual Habitat Units					-512.9

* RHU are acres x HUV x RVI. The columns of RHU values were calculated by taking the mean of the preceding target year RHU and the subject target year RHU times the number of intervening years between target years, or in other words the total RHU between the two target years. Total Relative Habitat Units, with and without project are for the entire 40 year planning period.

Table B-3. Habitat Evaluation for Alternative B1

Site 2-819.4-RM Without Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Young Bott. Forest	5	71	0.71	
	Shallow Aquatic	3	87	0.98	
1	Young Bott. Forest	5	71	0.71	252.1
	Shallow Aquatic	3	87	0.98	255.8
20	Mature Bott. Forest	5	77	0.71	4991.3
	Shallow Aquatic	3	87	0.98	4859.8
21	Mature Bott. Forest	5	77	0.71	273.4
	Shallow Aquatic	3	87	0.98	255.8
40	Mature Bott. Forest	5	77	0.71	5193.7
	Shallow Aquatic	3	87	0.98	4859.8
Total Relative Habitat Units - Without Project					20941.6

With Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Young Bott. Forest	5	71	0.71	
	Shallow Aquatic	3	87	0.98	
1	Sand	5	18	0.20	135.0
	Shallow Aquatic	3	87	0.98	255.8
20	Sand	5	18	0.20	342.0
	Sand	3	18	0.20	2532.5
21	Sand	5	18	0.20	18.0
	Sand	3	18	0.20	10.8
40	Sand	5	18	0.20	342.0
	Sand	3	18	0.20	205.2
Total Relative Habitat Units - With Project					3841.3
Site 2-819.4-RM - Loss of Average Annual H.U. with Project					-427.5

Site 2-821.1-LM Without Project - Total of 14 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	4	77	0.71	
	Shallow Aquatic	3	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	3	43	0.44	
1	Mature Bott. Forest	4	77	0.71	218.7
	Shallow Aquatic	3	87	0.98	255.8
	Sand	4	18	0.20	14.4
	Old Dredged Material	3	43	0.44	56.8
20	Mature Bott. Forest	4	77	0.71	4154.9
	Shallow Aquatic	3	87	0.98	4859.8
	Old Dredged Material	4	43	0.44	855.8
	Upland Herbaceous	3	79	0.69	2092.8
21	Mature Bott. Forest	4	77	0.71	218.7
	Shallow Aquatic	3	87	0.98	255.8
	Old Dredged Material	4	43	0.44	75.7
	Upland Herbaceous	3	79	0.69	163.5
40	Mature Bott. Forest	4	77	0.71	4154.9
	Shallow Aquatic	3	87	0.98	4859.8
	Upland Herbaceous	4	79	0.69	2790.3
	Upland Forest	3	84	0.80	3468.7
Total Relative Habitat Units - Without Project					28496.4

With Project - Total of 14 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	4	77	0.71	
	Shallow Aquatic	3	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	3	43	0.44	
1	Mature Bott. Forest	4	77	0.71	218.7
	Shallow Aquatic	3	87	0.98	255.8
	Sand	4	18	0.20	14.4
	Sand	3	18	0.20	33.8
20	Mature Bott. Forest	4	77	0.71	4154.9
	Shallow Aquatic	3	87	0.98	4859.8
	Sand	4	18	0.20	273.6
	Sand	3	18	0.20	205.2
21	Sand	4	18	0.20	116.5
	Sand	3	18	0.20	133.3
	Sand	4	18	0.20	14.4
	Sand	3	18	0.20	10.8
40	Sand	4	18	0.20	273.6
	Sand	3	18	0.20	205.2
	Old Dredged Material	4	43	0.44	855.8
	Old Dredged Material	3	43	0.44	641.8
Total Relative Habitat Units - With Project					12267.6
Site 2-821.1-LM - Loss of Average Annual H.U. with Project					-405.7
Alternative B1 (with sites 2-819.4-RM and 2-821.1-LM) - Loss of A.A.H.U.					-833.2

Table B-4. Habitat Evaluation for Alternative F1

Site 2-819.4-RM Without Project - Total of 7 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Young Bott. Forest	5	71	0.71	
	Shallow Aquatic	2	87	0.98	
1	Young Bott. Forest	5	71	0.71	252.1
	Shallow Aquatic	2	87	0.98	170.5
20	Mature Bott. Forest	5	77	0.71	4991.3
	Shallow Aquatic	2	87	0.98	3239.9
21	Mature Bott. Forest	5	77	0.71	273.4
	Shallow Aquatic	2	87	0.98	170.5
40	Mature Bott. Forest	5	77	0.71	5193.7
	Shallow Aquatic	2	87	0.98	3239.9
Total Relative Habitat Units - Without Project					17531.2

With Project - Total of 7 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Young Bott. Forest	5	71	0.71	
	Shallow Aquatic	2	87	0.98	
1	Deep Aquatic	5	43	0.44	173.3
	Sand	2	18	0.20	88.9
20	Sand	5	18	0.20	1069.7
	Sand	2	18	0.20	136.8
21	Sand	5	18	0.20	18.0
	Sand	2	18	0.20	7.2
40	Sand	5	18	0.20	342.0
	Sand	2	18	0.20	136.8
Total Relative Habitat Units - With Project					1972.7
Site 2-819.4-RM - Loss of Average Annual H.U. with Project					-389.0

Site 2-821.1-LM Without Project - Total of 9 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	1.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	1.5	87	0.98	127.9
	Sand	4	18	0.20	14.4
	Old Dredged Material	1	43	0.44	18.9
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	1.5	87	0.98	2429.9
	Old Dredged Material	4	43	0.44	855.8
	Upland Herbaceous	1	79	0.69	697.6
21	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	1.5	87	0.98	127.9
	Old Dredged Material	4	43	0.44	75.7
	Upland Herbaceous	1	79	0.69	54.5
40	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	1.5	87	0.98	2429.9
	Upland Herbaceous	4	79	0.69	2790.3
	Upland Forest	1	84	0.80	1156.2
Total Relative Habitat Units - Without Project					16246.0

With Project - Total of 9 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	1.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Sand	2.5	18	0.20	72.8
	Deep Aquatic	1.5	43	0.44	78.1
	Deep Aquatic	4	43	0.44	45.0
	Deep Aquatic	1	43	0.44	18.9
20	Sand	2.5	18	0.20	171.0
	Sand	2.5	18	0.20	355.1
	Sand	4	18	0.20	855.8
	Sand	1	18	0.20	213.9
21	Sand	2.5	18	0.20	9.0
	Sand	1.5	18	0.20	7.2
	Sand	4	18	0.20	14.4
	Sand	1	18	0.20	3.6
40	Sand	2.5	18	0.20	171.0
	Sand	1.5	18	0.20	102.6
	Sand	4	18	0.20	273.6
	Sand	1	18	0.20	68.4
Total Relative Habitat Units - With Project					2460.5
Site 2-821.1-LM - Loss of Average Annual H.U. with Project					-344.6

Site 2-821.5-LM Without Project - Total of 4 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Sand	4	20	0.18	
1	Sand	4	20	0.18	14.4
20	Old Dredge Material	4	43	0.44	855.8
21	Old Dredge Material	4	43	0.44	75.7
40	Upland Herbaceous	4	79	0.69	2790.3
Total Relative Habitat Units - Without Project					3736.2

With Project - Total of 4 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Sand	2	20	0.18	
	Sand	2	20	0.18	
1	Sand	2	20	0.18	7.2
	Deep Aquatic	2	43	0.44	22.5
20	Sand	2	18	0.20	136.8
	Sand	2	18	0.20	427.9
21	Sand	2	18	0.20	7.2
	Sand	2	18	0.20	7.2
40	Sand	2	18	0.20	136.8
	Sand	2	18	0.20	136.8
Total Relative Habitat Units - With Project					882.4
Site 2-821.5-LM - Loss of Average Annual H.U. with Project					-71.3

Site 2-822.5-LM Without Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - Without Project					0.0

With Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - With Project					0.0
Site 2-822.5-LM - Loss of Average Annual H.U. with Project					0.0
Alter. F1 (with sites 2-819.4-RM, 2-821.1-LM, & 2-822.5-RM) - Loss of A.A.H.U.					-804.9

Assumptions used for Alternative F1:

1.) Sites 2-819.4-RM, 2-821.1-LM, 2-821.5-LM, & 2-823.8-RM would be excavated to 30 feet below LCP, creating deep water aquatic habitat, that with reuse would be filled to sand habitat in 20 years. Since this temporarily created deep water habitat would be isolated by a sand berm and periodically impacted by disposal of dredged material, a HUV and RVI comparable to old dredged material was assigned

2). At the 2-822.5-LM Site, it is assumed that placement of finer dredged material would create a better topsoil and thereby offset any adverse impacts associated with dredged material use of the site.

Table B-5. Habitat Evaluation for Alternative G1.

Site 2-822.5-LM Without Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - Without Project					0.0

With Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - With Project					0.0
Site 2-822.5-LM - Loss of Average Annual H.U. with Project					0.0
Alternative G1 (2-822.5-LM) - Loss of Average Annual Habitat Units					0.0

Table B-6. Habitat Evaluation for Alternative H1.

Site 2-821.1-LM Without Project - Total of 10 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	2.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	2.5	87	0.98	213.2
	Sand	4	18	0.20	14.4
	Old Dredged Material	1	43	0.44	18.9
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	2.5	87	0.98	4049.9
	Old Dredged Material	4	43	0.44	855.8
	Upland Herbaceous	1	79	0.69	697.6
21	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	2.5	87	0.98	213.2
	Old Dredged Material	4	43	0.44	75.7
	Upland Herbaceous	1	79	0.69	54.5
40	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	2.5	87	0.98	4049.9
	Upland Herbaceous	4	79	0.69	2790.3
	Upland Forest	1	84	0.80	1156.2
Total Relative Habitat Units - Without Project					19656.4

With Project - Total of 10 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	2.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Sand	2.5	18	0.20	72.8
	Deep Aquatic	2.5	43	0.44	130.2
	Deep Aquatic	4	43	0.44	45.0
	Deep Aquatic	1	43	0.44	18.9
20	Sand	2.5	18	0.20	171.0
	Sand	2.5	18	0.20	534.9
	Sand	4	18	0.20	855.8
	Sand	1	18	0.20	213.9
21	Sand	2.5	18	0.20	9.0
	Sand	2.5	18	0.20	9.0
	Sand	4	18	0.20	14.4
	Sand	1	18	0.20	3.6
40	Sand	2.5	18	0.20	171.0
	Sand	2.5	18	0.20	171.0
	Sand	4	18	0.20	273.6
	Sand	1	18	0.20	68.4
Total Relative Habitat Units - With Project					2762.6
Site 2-821.1-LM - Loss of Average Annual H.U. with Project					-422.3

Site 2-822.5-LM Without Project - Total of 15 acres.

Same as alternative F1	
Total Relative Habitat Units - Without Project	0.0

With Project - Total of 15 acres.

Same as alternative F1	
Total Relative Habitat Units - With Project	0.0
Site 2-822.5-LM - Loss of Average Annual H.U. with Project	0.0
Alternative H1 (2-821.1-LM & 2-822.5-LM) - Loss of A.A.H.U.	**-422.3**

Table B-7. Habitat Evaluation for Alternative I1.

Site 2-821.1-LM Without Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	0.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	0.5	87	0.98	42.6
	Sand	4	18	0.20	14.4
	Old Dredged Material	1	43	0.44	18.9
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	0.5	87	0.98	810.0
	Old Dredged Material	4	43	0.44	855.8
	Upland Herbaceous	1	79	0.69	697.6
21	Mature Bott. Forest	2.5	77	0.71	136.7
	Shallow Aquatic	0.5	87	0.98	42.6
	Old Dredged Material	4	43	0.44	75.7
	Upland Herbaceous	1	79	0.69	54.5
40	Mature Bott. Forest	2.5	77	0.71	2596.8
	Shallow Aquatic	0.5	87	0.98	810.0
	Upland Herbaceous	4	79	0.69	2790.3
	Upland Forest	1	84	0.80	1156.2
Total Relative Habitat Units - Without Project					12835.6

With Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Shallow Aquatic	0.5	87	0.98	
	Sand	4	18	0.20	
	Old Dredged Material	1	43	0.44	
1	Sand	2.5	18	0.20	72.8
	Deep Aquatic	0.5	43	0.44	26.0
	Deep Aquatic	4	43	0.44	45.0
	Deep Aquatic	1	43	0.44	18.9
20	Sand	2.5	18	0.20	171.0
	Sand	0.5	18	0.20	107.0
	Sand	4	18	0.20	855.8
	Sand	1	18	0.20	213.9
21	Sand	2.5	18	0.20	9.0
	Deep Aquatic	0.5	43	0.44	5.6
	Deep Aquatic	4	43	0.44	45.0
	Deep Aquatic	1	43	0.44	11.3
40	Sand	2.5	18	0.20	171.0
	Sand	0.5	18	0.20	107.0
	Sand	4	18	0.20	855.8
	Sand	1	18	0.20	213.9
Total Relative Habitat Units - With Project					2929.1
Site 2-821.1-LM - Loss of Average Annual H.U. with Project					-247.7

Site 2-821.5-LM Without Project - Total of 4 acres.

Same as alternative F1	
Total Relative Habitat Units - Without Project	3736.2

With Project - Total of 4 acres.

Same as alternative F1	
Total Relative Habitat Units - With Project	882.4
Site 2-821.5-LM - Loss of Average Annual H.U. with Project	-71.3

Site 2-822.5-LM Without Project - Total of 15 acres.

Same as alternative F1	
Total Relative Habitat Units - Without Project	0.0

With Project - Total of 15 acres.

Same as alternative F1	
Total Relative Habitat Units - With Project	0.0
Site 2-822.5-LM - Loss of Average Annual H.U. with Project	0.0
Alternative I (2-821.1-LM, 2-821.5-LM, & 2-822.5-LM) - Loss of Average Annual Habitat Units	**-319.0**

Table B-8. Summary of Average Annual Habitat Unit Loss and Matrix Values for Alternatives for Dredge Cuts 2 and 3 in Lower Pool 2

Alternatives	Sites	AAHU	Matrix Value
A1	Total	-513	6
	2-821.1-LM	-513	
B1	Total	-833	3
	2-819.4-RM	-428	
	2-821.1-LM	-406	
F1	Total	-805	3
	2-819.4-RM	-389	
	2-821.1-LM	-345	
	2-821.5-LM	-71	
	2-822.5-LM	0	
G1	Total	0	10
	2-822.5-LM	0	
H1	Total	-422	7
	2-821.1-LM	-422	
	2-822.5-LM	0	
I1	Total	-319	8
	2-821.1-LM	-248	
	2-821.5-LM	-71	
	2-822.5-LM	0	

Matrix values were calculated based on subtracting 1 matrix unit per 100 habitat units, above 200 Habitat Units, from the maximum value of 10

Table B-9. Habitat Evaluation for Alternative A2

Site 2-832.5-RM Without Project - Total of 4 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Upland Herbaceous	4	71	0.69	
1	Upland Herbaceous	4	71	0.69	196.0
20	Upland Herbaceous	4	77	0.69	3880.6
21	Upland Herbaceous	4	77	0.69	212.5
40	Upland Herbaceous	4	77	0.69	4037.9
Total Relative Habitat Units - Without Project					8326.9

With Project - Total of 4 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Upland Herbaceous	4	71	0.69	
1	Sand	4	18	0.20	105.2
20	Sand	4	18	0.20	273.6
21	Sand	4	18	0.20	14.4
40	Sand	4	18	0.20	273.6
Total Relative Habitat Units - With Project					666.8
Site 2-832.5-RM - Loss of Average Annual H.U. with Project					-191.5
Alternative A1 (with sites 2-832.5-RM & 2-821.1-LM) - Loss of Average Annual Habitat Units					**-191.5**

* RHU are acres x HUV x RVI. The columns of RHU values were calculated by taking the mean of the preceding target year RHU and the subject target year RHU times the number of intervening years between target years, or in other words the total RHU between the two target years. Total Relative Habitat Units, with and without project are for the entire 40 year planning period.

Table B-10. Habitat Evaluation for Alternative B2

Site 2-823.8-RM Without Project - Total of 12 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Sand	9.5	20	0.18	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Sand	9.5	20	0.18	34.2
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Old Dredge Material	9	43	0.44	1942.6
21	Mature Bott. Forest	2.5	77	0.71	136.7
	Old Dredge Material	9	43	0.44	170.3
40	Mature Bott. Forest	2.5	77	0.71	2596.8
	Upland Herbaceous	9	79	0.69	6278.3
Total Relative Habitat Units - Without Project					13892.3

With Project - Total of 12 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Sand	9.5	20	0.18	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Sand	9.5	20	0.18	34.2
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Sand	9.5	20	0.18	649.8
21	Sand	2.5	20	0.18	72.8
	Sand	9.5	20	0.18	34.2
40	Sand	2.5	20	0.18	171.0
	Sand	9.5	20	0.18	649.8
Total Relative Habitat Units - With Project					4345.3
Site 2-823.8-RM - Loss of Average Annual H.U. with Project					-238.7

Site 2-827.2-RM Without Project - Total of 9 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	9	77	0.71	
1	Mature Bott. Forest	9	77	0.71	492.0
20	Mature Bott. Forest	9	77	0.71	9348.6
21	Mature Bott. Forest	9	77	0.71	492.0
40	Mature Bott. Forest	9	77	0.71	9348.6
Total Relative Habitat Units - Without Project					19681.2

With Project - Total of 9 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	5	77	0.71	
	Mature Bott. Forest	4	77	0.71	
1	Sand	5	18	0.20	145.7
	Mature Bott. Forest	4	77	0.71	218.7
20	Sand	5	18	0.20	342.0
	Sand	3	18	0.20	2180.1
21	Sand	5	18	0.20	18.0
	Sand	3	18	0.20	10.8
40	Sand	5	18	0.20	342.0
	Sand	3	18	0.20	205.2
Total Relative Habitat Units - With Project					3462.4
Site 2-827.2-RM - Loss of Average Annual H.U. with Project					-405.5
Alternative B (with sites 2-819.4-RM, 2-821.1-LM, 2-823.8-RM, & 2-827.2-RM) - Loss of A.A.H.U.					**-644.1**

Table B-11. Habitat Evaluation for Alternative F2

Site 2-823.8-RM Without Project - Total of 12 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Sand	9.5	20	0.18	
1	Mature Bott. Forest	2.5	77	0.71	136.7
	Sand	9.5	20	0.18	34.2
20	Mature Bott. Forest	2.5	77	0.71	2596.8
	Old Dredge Material	9	43	0.44	1942.6
21	Mature Bott. Forest	2.5	77	0.71	136.7
	Old Dredge Material	9	43	0.44	170.3
40	Mature Bott. Forest	2.5	77	0.71	2596.8
	Upland Herbaceous	9	79	0.69	6278.3
Total Relative Habitat Units - Without Project					13892.3

With Project - Total of 12 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Mature Bott. Forest	2.5	77	0.71	
	Sand	9.5	20	0.18	
1	Sand	2.5	20	0.18	72.8
	Deep Aquatic	9.5	43	0.44	107.0
20	Sand	2.5	20	0.18	171.0
	Sand	9.5	20	0.18	2032.4
21	Sand	2.5	20	0.18	9.0
	Sand	9.5	20	0.18	34.2
40	Sand	2.5	20	0.18	171.0
	Sand	9.5	20	0.18	649.8
Total Relative Habitat Units - With Project					3247.2
Site 2-823.8-RM - Loss of Average Annual H.U. with Project					-266.1

Site 2-822.5-LM Without Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - Without Project					0.0

With Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - With Project					0.0
Site 2-822.5-LM - Loss of Average Annual H.U. with Project					0.0
Alter. F2 (with sites 2-819.4-RM, 2-821.1-LM, 2-821.5-LM, 2-823.8-RM, & 2-822.5-LM) - Loss of A.A.H.U.					**-266.1**

Assumptions used for Alternative F:

1.) Sites 2-819.4-RM, 2-821.1-LM, 2-821.5-LM, & 2-823.8-RM would be excavated to 30 feet below LCP, creating deep water aquatic habitat, that with reuse would be filled to sand habitat in 20 years. Since this temporarily created deep water habitat would be isolated by a sand ber and periodically impacted by disposal of dredged material, a HUV and RVI comparable to old dredged material was assigned

2). At the 2-822.5-LM Site, it is assumed that placement of finer dredged material would create a better topsoil and thereby offset any adverse impacts associated with dredged material use of the site.

Table B-12. Habitat Evaluation for Alternative G2.

Site 2-822.5-LM Without Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - Without Project					**0.0**

With Project - Total of 15 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
No analysis performed - assumed no habitat impacts					0.0
Total Relative Habitat Units - With Project					**0.0**
Site 2-822.5-LM - Loss of Average Annual H.U. with Project					**0.0**
Alternative G (2-822.5-LM) - Loss of Average Annual Habitat Units					**0.0**

Table B-13. Habitat Evaluation for Alternative H2.

Site 2-823.8-RM Without Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Sand	8	20	0.18	
1	Sand	8	20	0.18	28.8
20	Old Dredged Material	8	43	0.44	1711.5
21	Old Dredged Material	8	43	0.44	151.4
40	Upland Herbaceous	8	79	0.69	5580.7
Total Relative Habitat Units - Without Project					**7472.4**

With Project - Total of 8 acres.

Target Year	Habitat Type	Acres	HUV	RVI	RHU
0	Sand	1.5	20	0.18	
	Sand	6.5	20	0.18	
1	Sand	1.5	20	0.18	5.4
	Deep Aquatic	6.5	43	0.44	73.2
20	Sand	1.5	20	0.18	102.6
	Sand	6.5	20	0.18	1390.6
21	Sand	1.5	20	0.18	5.4
	Deep Aquatic	6.5	43	0.44	73.2
40	Sand	1.5	20	0.18	102.6
	Sand	6.5	20	0.18	1390.6
Total Relative Habitat Units - With Project					**3143.6**
Site 2-823.8-RM - Loss of Average Annual H.U. with Project					**-108.2**

Site 2-822.5-LM Without Project - Total of 15 acres.

Same as alternative F2	
Total Relative Habitat Units - Without Project	**0.0**

With Project - Total of 15 acres.

Same as alternative F2	
Total Relative Habitat Units - With Project	**0.0**
Site 2-822.5-LM - Loss of Average Annual H.U. with Project	**0.0**
Alternative H (2-821.1-LM, 2-821.5-LM, 2-823.8-RM, & 2-822.5-LM) - Loss of A.A.H.U.	**-108.2**

Table B-14. Summary of Average Annual Habitat Unit Loss and Matrix Values for Alternatives for Cuts 4 and 5 in Lower Pool 2

Alternatives	Sites	AAHU	Matrix Value
A2	**Total**	**-192**	**10**
	2-832.5-RM	-192	
B2	**Total**	**-644**	**5**
	2-823.8-RM	-239	
	2-827.2-RM	-405	
F2	**Total**	**-266**	**9**
	2-823.8-RM	-266	
	2-822.5-LM	0	
G2	**Total**	**0**	**10**
	2-822.5-LM	0	
H2	**Total**	**-108**	**10**
	2-823.8-RM	-108	
	2-822.5-LM	0	

Matrix values were calculated based on subtracting 1 matrix unit per 100 habitat units, above 200 Habitat Units, from the maximum value of 10

Table B-15. Water Quality Evaluation of Alternatives for Lower Pool 2 (cuts 2 and 3).

	A1		B1			F1					G1		H1			I1			
	2-821.0-LM Cuts 2&3		2-819.4-RM Cut 2	2-821.1-LM Cut 3		2-819.4-RM Cut 2	2-821.1-LM Cut 3	2.821.5-LM Cut 3	2-822.5-LM Trans		2-822.5-LM Cuts 2&3		2-821.1-LM Cuts 2&3	2-822.5-LM Trans		2-821.1-LM Cut 2&3	2.821.5-LM Cut 3	2-822.5-LM Trans	
DISCHARGE TYPE	Site	ALT. AVG.	Site	Site	ALT.	Site	Site	Site	Site	ALT.	Site	ALT.	Site	Site	ALT.	Site	Site	Site	ALT.
Confined disposal - adequate retention (=2.5)	2.5								2.5		2.5			2.5				2.5	
Confined disposal - inadequate retention (=1.25)				1.25			1.25	1.25					1.25			1.25	1.25		
Unconfined disposal (=1.25)																			
Direct open water (=0.25)			0.25			0.25													
DISCHARGE AREA CHARACTERISTICS																			
Non-sensitive area - adequate mixing (=2.5)									2.5		2.5			2.5				2.5	
Non-sensitive area - inadequate mixing (=1.25)				1.25			1.25	1.25					1.25			1.25	1.25		
Sensitive area - adequate mixing (=1.25)	1.25																		
Sensitive area - inadequate mixing (=0.25)			0.25			0.25													
NATURE OF DISCHARGE																			
Short duration (< 1 week) (=2.5)				2.5			2.5	2.5					2.5			2.5	2.5		
Long duration (> 1 week) (=1.25)	1.25		1.25			1.25			1.25		1.25			1.25				1.25	
Infrequent (=2.5)			2.5			2.5			2.5					2.5				2.5	
Frequent (=1.25)	1.25			1.25			1.25	1.25			1.25		1.25			1.25	1.25		
TOTAL	6.25	**6.3**	4.25	6.25	**5.3**	4.25	6.25	6.25	8.75	**5.3**	7.5	**7.5**	6.25	8.75	**6.3**	6.25	6.25	8.75	**6.3**

Hydraulic use of site 2-819.4-RM was given lowest value permissible for each of the categories because of the fine nature of the sediments and concerns with contaminants (except for the frequency category, because it would only happen several times over the 40-year period).

* Note: Average for alternatives with double handling (F1, H1, and I1) do not include value of transferring to Shiely, which would artificially increase matrix value for these alternatives.

Table B-16. Water Quality Evaluation of Alternatives for Lower Pool 2 (Cuts 4 and 5).

	A2		B2			F2			G2		H2		
	2-832.5-RM Cuts 4&5 Site	ALT. AVG.	2-823.8-LM Cut 4 Site	2-827.2-RM Cut 5 Site	ALT. AVG.	2-823.8-LM Cuts 4 &5 Site	2-822.5-LM Trans Site	ALT. AVG.	2-822.5-LM Cuts 4 &5 Site	ALT. AVG.	2-823.8-LM Cuts 4 &5 Site	2-822.5-LM Trans Site	ALT. AVG.
DISCHARGE TYPE													
Confined disposal - adequate retention (=2.5)	2.5						2.5		2.5			2.5	
Confined disposal - inadequate retention (=1.25)			1.25	1.25		1.25					1.25		
Unconfined disposal (=1.25)													
Direct open water (=0.25)													
DISCHARGE AREA CHARACTERISTICS													
Non-sensitive area - adequate mixing (=2.5)	2.5						2.5		2.5			2.5	
Non-sensitive area - inadequate mixing (=1.25)			1.25	1.25		1.25					1.25		
Sensitive area - adequate mixing (=1.25)													
Sensitive area - inadequate mixing (=0.25)													
NATURE OF DISCHARGE													
Short duration (< 1 week) (=2.5)			2.5	2.5		2.5					2.5		
Long duration (> 1 week) (=1.25)	1.25						1.25		1.25			1.25	
Infrequent (=2.5)							2.5						
Frequent (=1.25)	1.25		1.25	1.25		1.25			1.25		1.25	1.25	
TOTAL	7.50	**7.5**	6.25	6.25	**6.3**	6.25	8.75	**6.3**	7.5	**7.5**	6.25	7.5	**6.3**

* Note: Average for alternatives with double handling (F2, and H2) do not include value of transferring to Shiely, which would artificially increase matrix value for these alternatives.

Table B-17

Cultural Resources Matrix Evaluation
Upper Mississippi River - Pool 2

Alternative	Placement Site	Score
Alternative A1	2.35 Shiely	2
Alternative B1	2.75 2.31A Shiely	8
Alternative F1	2.75 2.31A 2.31B Shiely	8
Alternative G1	Shiely	10
Alternative H1	2.31A Shiely	8
Alternative I1	2.31A 2.31B Shiely	8
Alternative A2	2.10 Shiely	8
Alternative B2	2.25 2.27 Shiely	4
Alternative F2	2.25 Shiely	8
Alternative G2	Shiely	10
Alternative H2	2.25 Shiely	8

Notes: Site 2.10 and site 2.35 were approved for use by the Minnesota SHPO in a letter of June 27, 1984.

Sites 2.75, 2.31A, 2.31B, and 2.25 were approved for use by the Minnesota SHPO in letters of January 6, 1984, January 9, 1984, and June 27, 1984.

The Shiely site has been severely damaged through gravel operations and has no potential to contain significant archeological or historic resources.

APPENDIX C

SOCIAL IMPACTS OF DREDGE MATERIAL PLACEMENT

SOCIAL IMPACTS OF DREDGED MATERIAL PLACEMENT
LOWER POOL 2

CUTS 2 AND 3 ALTERNATIVES

Alternative A1 - Site 2-821.0-LM is privately owned and located at the lower end of Grey Cloud Island. A residence is located only 300 feet from the site and a summer camp is located on land adjacent to the site. Placement of material at this site could create some safety concerns during placement and removal. Because of the somewhate incompatible adjacent land use, adverse impacts could occur due to creation of a new placement site within viewing of a residential area and the summer camp.

Alternative B1 - This alternative uses three riverine placement sites. Material would be placed permanently with no beneficial use removal. No appreciable negative social impacts would be associated with use of these sites.

Alternatives F1, H1 and I1 - These alternatives are variations of alternative B1 with additional feature of placing material at the Shiely site. Material placed at the Shiely site could be used to improve areas degraded by sand and gravel mining operations. No appreciable negative social effects would be associated with any of these alternatives.

Alternative G1 - All material dredged from cuts 2 and 3 would be placed at the Shiely site. Material placed at this site could be used to improve areas degraded by sand and gravel mining operations. No appreciable negative social effects would be associated with this alternative.

CUTS 4 AND 5 ALTERNATIVES

Alternative A2 - All material would be placed at a commercial-industrial site. The largest effect would be placing this property in Government ownership and taking it off of the tax roles. Since it is commercial-industrial property, the property tax revenue generated from this site, if developed, would likely be substantial.

Alternative B2 - This alternative uses two riverine placement sites. Material would be placed permanently with no beneficial use removal. No appreciable negative social impacts would be associated with use of these sites.

Alternatives F2 and H2 - These alternatives are variations of alternative B2 with additional feature of placing material at the Shiely site. Material placed at the Shiely site could be used to improve areas degraded by sand and gravel mining operations. No appreciable negative social effects would be associated with any of these alternatives.

Alternative G2 - All material dredged from cuts 4 and 5 would be placed at the Shiely site. Material placed at this site could be used to improve areas degraded by sand and gravel mining operations. No appreciable negative social effects would be associated with this alternative.

MATRIX SCORING FOR CUTS 2 AND 3

Dredged Material Demand - Alternative G1 was given a 6 because all of the material would be put to passive beneficial use. Alternative B1 was given a 0 because none of the material would be put to beneficial use.

Impacts on Competing Firms - Alternative A1 was given a 5 because providing free sand could affect commercial providers of sand in the area.

Adjacent Land Use - Alternative A1 was given a 2 because of the adjacent residential property and summer camp.

Public Safety - Alternative A1 was given a 3 because of the adjacent residential property and summer camp.

Maintenance Costs - Alternative A1 was given a 2 because development of site 2-820.1-LM as a beneficial use removal site could increase maintenance requirements on local roads.

Property Values/Tax Revenues - Alternative A1 was given a 4 because use of this site may devalue adjacent residential property values. Also converting this site to Government ownership would reduce tax revenues.

Aesthetic Values - Alternative A1 was given a 0 because it would be a substantial intrusion on a rural residential area.

Recreation Opportunities - Alternatives B1 and F1 were given a 4 because they would likely create more recreational beach opportunities due to the larger sizes of the sites.

MATRIX SCORING FOR CUTS 4 AND 5

Dredged Material Demand - Alternative A2 was given an 8 because all of the material would go to active beneficial use. Alternative G2 was given a 6 because all of the material would be put to passive beneficial use. Alternative B2 was given a 0 because none of the material would be put to beneficial use.

Supply of Existing Material - Alternative A2 was given an 8 because all of the material would go to an area of high beneficial use demand.

Impacts on Competing Firms - Alternative A2 was given a 5 because providing free sand could affect commercial providers of sand in the area.

Property Values/Tax Revenues - Alternative A2 was given a 2 because converting this site to Government ownership could substantially reduce tax revenues compared to the alternative of developing this property to commercial use.

Aesthetic Values - Alternative B2 was given a 2 because it would involve developing a placement site at site 2-827.2-RM which is predominantly wooded at this time.

Recreation Opportunities - Alternatives B2 was given a 4 because it would likely create more recreational beach opportunities due to more use of riverine sites.

Cuts 2 and 3 – Social and Recreational Effects Matix Criteria Scoring

Parameter	Range	Alt A1	Alt B1	Alt F1	Alt G1	Alt H1	Alt I1
Dredged Material Demand	0–8	4	0	4	6	4	4
Supply of Existing Material	0–8	4	4	4	4	4	4
Impacts on Competing Firms	0–7	5	7	7	7	7	7
Impacts on Area Employment	0–7	7	7	7	7	7	7
Residential Development	0–5	3	5	5	5	5	5
Land Availability	0–5	3	3	3	3	3	3
Public Opposition	0–5	2	3	3	3	3	3
Adjacent Land Use	0–5	2	5	5	5	5	5
Existing Public Facilities	0–5	3	3	3	3	3	3
Planned Public Facilities	0–5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Public Safety	0–5	3	5	5	5	5	5
Maintenance Costs	0–5	2	5	5	5	5	5
Property Values/Tax Revenues	0–10	4	6	6	6	6	6
Life, Health, and Safety	0–10	8	8	8	8	8	8
Aesthetic Values	0–5	0	3	3	5	4	4
Noise Levels	0–5	3	5	5	5	5	5
Total Social Score	–	53	69	73	77	74	74
Adjusted Score (Total Score/95)		56	73	77	81	78	78

Parameter	Range	Alt A1	Alt B1	Alt F1	Alt G1	Alt H1	Alt I1
Existing Recreational Facilities	0–5	3	3	3	3	3	3
Recreation Opportunities	0–5	3	4	4	3	3	3
Total Recreation Score	–	6	7	7	6	6	6

Cuts 4 and 5 – Social and Recreational Effects Matix Criteria Scoring

Parameter	Range	Alt A2	Alt B2	Alt F2	Alt G2	Alt H2
Dredged Material Demand	0–8	8	0	4	6	4
Supply of Existing Material	0–8	8	4	4	4	4
Impacts on Competing Firms	0–7	5	7	7	7	7
Impacts on Area Employment	0–7	7	7	7	7	7
Residential Development	0–5	5	5	5	5	5
Land Availability	0–5	5	3	3	3	3
Public Opposition	0–5	5	3	3	3	3
Adjacent Land Use	0–5	5	5	5	5	5
Existing Public Facilities	0–5	3	3	3	3	3
Planned Public Facilities	0–5	n.a.	n.a.	n.a.	n.a.	n.a.
Public Safety	0–5	5	5	5	5	5
Maintenance Costs	0–5	5	5	5	5	5
Property Values/Tax Revenues	0–10	2	6	6	6	6
Life, Health, and Safety	0–10	8	8	8	8	8
Aesthetic Values	0–5	5	2	4	5	4
Noise Levels	0–5	5	5	5	5	5
Total Social Score	–	81	68	74	77	74
Adjusted Score (Total Score/95)		85	72	78	81	78

Parameter	Range	Alt A2	Alt B2	Alt F2	Alt G2	Alt H2
Existing Recreational Facilities	0–5	3	3	3	3	3
Recreation Opportunities	0–5	3	4	3	3	3
Total Recreation Score	–	6	7	6	6	6

APPENDIX D

MATRIX EVALUATION CRITERIA

TABLE OF CONTENTS
MATRIX EVALUATION CRITERIA
APPENDIX D

A. GENERAL D-1

B. DREDGING AND MATERIAL PLACEMENT COSTS D-1

1. Hydraulic Dredging: D-2
   a. Dredge and Plant Rental Cost D-3
   b. Time Required to Complete a Job D-3
   c. Other Costs D-4
2. Mechanical Dredging D-5
   a. Per Cubic Yard Unit Cost D-5
   b. Transportation of Dredged Material D-5
   c. Other Costs D-5

C. NATURAL RESOURCES D-6

1. Water Quality: D-6
2. Aquatic and Terrestrial D-7
   a. Identification of Habitats Impacted D-7
   b. Determination of Habitat Unit Values (HUV) D-8
   c. Estimation of Habitat Losses over the Project Life D-8
   d. Trade-off Analysis D-8
   e. Quantify Habitat Impacts D-10
   f. Literature Cited D-10

D. BENEFICIAL USE D-11

E. CULTURAL RESOURCES D-13

F. SOCIAL IMPACTS D-14

Category 1 - Business and Industrial Activity and Employment D-15
Category 2 - Community Cohesion D-16
Category 3 - Public Services and Facilities D-17
Category 4 - Property Values and Tax Revenues D-18
Category 5 - Life, Health, and Safety D-18
Category 6 - Aesthetic Values and Noise Levels
part 1 . . . . . D-19
Category 6 - Aesthetics and Noise Levels
part 2 . . . . . D-20

G. RECREATION D-21

Category 1 - Existing Recreation Facilities D-21
Category 2 - Recreation Opportunities D-21

MATRIX EVALUATION CRITERIA
APPENDIX D

A. GENERAL

A matrix is used by the St. Paul District, Corps of Engineers (CENCS) to evaluate the various dredged material placement alternatives proposed for the various site plans. The development of the criteria used is an on-going process that began with the preparation of the first channel maintenance plan report for GREAT implementation. The matrix used here was developed from the matrix originally used by CENCS in the Dredged Material Placement Reconnaissance Reports, from the mid-1980's, and modified by the matrix developed by the Rock Island District, Corps of Engineers (CENCR) for their dredged material placement program.

The CENCS matrix uses index values to score the dredged material placement alternatives in six different categories: dredging and material placement cost, impacts to natural resources, beneficial use, impacts to cultural resources, social impacts, and impacts to recreation. Index values used for evaluating placement alternatives range from 0 (least desirable) to 10 (most desirable).

The resulting index values, scored for the various categories, are then adjusted by multiplying them by a weight factor which is assigned to each category. The weight factor determines the relative importance of each category in the dredged material placement alternative evaluation process. The dredging and material placement cost and impacts to the natural resources categories were assigned the highest weight factors. Both are assigned a weight factor of 30. Beneficial use and cultural resources are equally weighted at 10. Social impacts are weighted at 15 because the experience CENCS has had with implementing plans has indicated that there are significant local concerns related to operating placement sites near developed areas. These concerns can have a significant effect on how or whether a plan can be implemented. The remaining category of recreation has been set at 5 because CENCS does not believe that it will have as much of an impact on implementing placement plans as the other categories. Recreational beach planning is being conducted independent of the long term placement site planning.

Finally, the index values, multiplied by their appropriate weight factor, are totaled. The dredged material placement alternative with the highest total points becomes the preferred dredging and material placement alternative.

Following are the criteria used to assign index values in the various evaluation categories.

B. DREDGING AND MATERIAL PLACEMENT COSTS (Weight Factor = 30)

The cost to dredge is partially dependent on the dredged material placement alternative selected. The dredging and Material Placement Cost Matrix ranks the dredged material placement alternatives by the estimated cost to dredge and place the dredged material. This section describes the process which will be used to estimate the cost to dredge, transport, and place the dredged material for the placement site alternatives being evaluated in the site plans. The estimated costs may lack refinement, but they are considered to be reliable for their intended use for alternative comparison.

The estimated costs will be converted to cost per cubic yard units. Index values are then assigned to ranges of cost per cubic yard values. The index values for ranges of cost per cubic yard are shown in TABLE D-1.

TABLE D-1
Dredging and Material Placement
Cost Index Values

Value	Criteria
10	$0.0 - $2.50 per cu. yd.
9	$2.51 - $3.75 per cu. yd.
8	$3.76 - $5.00 per cu. yd.
7	$5.01 - $6.25 per cu. yd.
6	$6.26 - $7.50 per cu. yd.
5	$7.51 - $8.75 per cu. yd.
4	$8.76 - $10.00 per cu. yd.
3	$10.01 - $11.25 per cu. yd.
2	$11.26 - $12.50 per cu. yd.
1	$12.51 + per cu. yd.

The cost per cubic yard of material dredged is calculated by dividing the estimated total cost to perform the dredging and placement operation by the estimated long-term dredging quantities for the site plan.

The dredging and material placement costs do not include mobilization costs to place the dredge and its normal attendant plant on site. Such costs are not usually affected by the placement alternative. Rather, mobilization costs are affected by factors that cannot be predicted, such as distance from the previous job, direction the dredge has to travel, dredge and equipment readiness, and river conditions. Thus, the calculated costs used to determine index values are less than the dredging costs that the St. Paul District uses for other purposes and reports.

Two types of dredging are usually considered for channel maintenance dredging in the St. Paul District: hydraulic dredging and mechanical dredging. Placement site requirements for the dredged material resulting from the different types of dredging are also different. Thus, a different methodology is used to estimate the costs of performing the two different types of dredging and dredged material placement.

Following is an explanation of how the costs are estimated to dredge and implement the various dredged material placement alternatives being evaluated in the site plans.

1. Hydraulic Dredging: It is assumed that all hydraulic dredging will be performed by the Government-owned Dredge THOMPSON. The cost to hydraulically dredge and place the material is calculated from the rental cost of the dredge and its attendant plant, the time required to complete the job, and the cost and time needed to implement other requirements for placing dredged material.

a. Dredge and Plant Rental Cost: A plant rental rate has been given to the Dredge THOMPSON and its attendant plant. The rent pays for the operation and maintenance of the dredge and its attendant plant. For the purpose of the cost estimates, a rate $21,000 per day, or $875 per hour, has been adopted. This rate is an average over the last few years and can reasonably be expected for the Dredge THOMPSON in the near future. To compute the cost, the hourly rental rate is multiplied by the estimated hours required to complete the job.

b. Time Required to Complete a Job: A dredging operation is divided into "effective" pumping and "noneffective" time. The effective pumping time is the time during which the dredge is excavating and pumping the material to the placement site. Examples of noneffective time are the time required to pass a tow, the time to perform minor repairs, the time required to move the "end" of the discharge line, or the time required for other work related to the material placement operation.

A production rate is used to determine the effective pumping time required for the dredge at a specific job. A production rate is the average number of cubic yards per hour dredged when the dredge is effectively pumping. For example, if, from historical data, it is known that the dredge's production rate is 1,000 cubic yards per hour for a given set-up and material type, to determine the effective pumping time required to dredge 10,000 cubic yards, divide the dredge's production rate into the quantity to determine that it will require 10 hours of effective pumping time.

As alluded to in the preceding paragraph, the production rate as affected by the dredge equipment being used(set up) and the type of material being dredged. Technically, the production rate is affected by the discharge pipe diameter, the velocity of the discharge flow, and the concentration of the dredged material in the discharge slurry. The Dredge THOMPSON'S discharge pipe diameter is a constant 20 inches. (This is true whether or not the booster barge MULLEN is being used.)

The velocity of the flow in the discharge pipeline is primarily dependent on discharge pipe length (assuming that all of the available horsepower of the dredge and booster pumps are being used). As more pipeline is added, increasing the length of the discharge pipeline, the flow velocity of the discharge is reduced, thereby reducing the production rate.

The concentration of dredged material in the discharge slurry is affected by the type of material being dredged, Heavy material (coarse sand or gravel) requires higher flow velocity in the pipeline than light material. Higher velocities prevent the material from settling out in the pipeline. However, as the concentration of material in the slurry increases, the velocity decreases. Thus, the heavier the material, the higher the velocity requirements, and the lower the slurry's concentration of material can be to maintain the required velocity. For light river channel sand, concentrations as high as 20 percent may be realized by the dredge THOMPSON. For coarse gravel material, concentrations as low as 5 percent may be realized by the Dredge THOMPSON.

The concentration of dredged material in the discharge slurry also is affected by the height of the face of the dredge cut. If the material is not available to dredge, more water is pumped, A dredge is usually more efficient when dredging a cut with a large face.

In summary, the Dredge THOMPSON can dredge more material per unit of time when a job requires a short pipeline to reach the placement site and the material to be dredged is light sand with a large average face. The production rate is decreased as the distance to the placement site is increased (necessitating a longer discharge pipeline), the material to be dredged becomes coarser, or the average face of the dredge cut becomes smaller.

The production rate for a historical dredge cut on the UMR in CENCS is estimated from historical data. Specifically, the production rate is calculated from the Dredge THOMPSON'S daily logs. For a given recurring dredge cut, it is usually correct to assume that the material type is the same from event to event and that the shoaling patterns are similar, resulting in similar average face, from event to event. (The type of material to be dredged and the shoaling patterns for a given dredge cut are usually characteristic of the dredge cut.) The one variable is the length of the discharge pipeline. This length is determined by the location of the placement site. Enough information is available in the daily logs to develop relationships between production rate and pumping distance for various types of material and various average faces. Thus, the effective pumping time for a given site plan can be estimated from historical data. This is the approach used in the site plans to estimate effective pumping time.

The noneffective time accounts for the time spent on activities to support the dredging and material placement operation. Included in the noneffective time are the time spent to perform routine maintenance and minor repairs to the dredge, the time spent to advance the dredge and make adjustments to the discharge pipeline, the time spent to "break" the pipeline and move the dredge out of the way to pass tows, and the time spent to set up and tear down the job.

The placement site, or alternative, also may have some requirements or conditions that must be met or complied with which increase the time required to complete the job. An example would be a requirement to shape the material during placement which necessitates frequently moving the discharge pipe. The placement alternative may require site preparations such as berming to control the return water and to contain the dredged material or adjustments may be required to a drop structure. These activities normally are performed by the dredge's crew and are also considered noneffective time.

The noneffective time also will be estimated from historical data (daily logs). For placement alternatives where no historical information exists, noneffective time will be estimated using conventional construction estimating methods.

c. Other Costs: Other costs such as land acquisition, site preparation, and site management, or any activity performed to implement the dredged material placement alternative not accomplished with the dredge's plant, will increase the cost per cubic yard and thereby reduce the index value. These other costs will be calculated as cost per cubic yard by spreading the cost over the alternative's estimated capacity.

In summary, for channel maintenance dredging using a hydraulic dredge, the estimated cost of the dredging and dredged material placement will be based on a dredge plant rental rate of $21,000 per day, the time estimated to complete the operation, and the cost to perform other activities in support of the dredged material placement alternative. The plant rental of $21,000 per day is the rate that reasonably can be expected for the Dredge THOMPSON in the near future. The

estimated time to complete the operation will be the sum of the effective pumping and noneffective time. Both the effective and noneffective time will be estimated from historical data. The other activities that need to be performed in support of the placement alternative also will be estimated from historical data. The other activities that need to be performed in support of the placement alternative also will be estimated from historical data, if such data exist. If the data does not exist, conventional estimating methods will be used to estimate the cost. All cost estimates used to determine cost index values for the various dredged material placement alternatives will be fully documented in the individual site plan reports.

2. Mechanical Dredging: Most mechanical dredging in the St. Paul District will be conducted by contract. The cost to mechanically dredge and place material is calculated from the per cubic yard unit cost and the transportation of dredged material by barge to a placement site in the current contract and the cost and time needed to implement other requirements for placing dredged material.

a. Per Cubic Yard Unit Cost: The St. Paul District awards a mechanical dredging contract for each year in which the contractor bids a price for dredging per cubic yard and miscellaneous mobilization and other contract costs. The price has varied over the years and has been going up. For the purpose of estimating costs of the alternatives, a per cubic yard unit cost of $5.32 will be used which is the average 1994-1996 contract price. To compute the cost, the per cubic yard unit cost is added to any additional costs for transportation of material and other costs required for placement of dredged material.

b. Transportation of Dredged Material: There will be no extra costs associated with transportation of dredged material if the placement site is located within four river miles of the dredge cut. The transportation distance is measured from the center of the dredge cut along the midchannel sailing line (as detailed on the Upper Mississippi River Navigation Charts) to the center of the navigation channel at a point perpendicular to the center of the placement site, to the nearest tenth of a mile. If transportation is between four and eight miles, a cost of $0.25 per cubic yard, per mile is added to the cost of dredging. If transportation is over eight miles, a cost of $0.85 per cubic yard, per mile is added to the cost of dredging. These transportation costs are the averages taken from the 1994-1996 mechanical dredging contract.

c. Other Costs: Other costs such as land acquisition, site preparation, and site management, or any activity performed to implement the dredged material placement alternative not accomplished with the mechanical contractor's equipment, will increase the cost per cubic yard and thereby reduce the index value. These other costs will be calculated as cost per cubic yard by spreading the cost over the alternative's estimated capacity.

In summary, for channel maintenance dredging using a mechanical dredge, the estimated cost of the dredging and dredged material placement will be based on a per cubic yard dredging cost of $5.32, plus transportation of dredged material costs if the distance is greater than 4 miles, plus the cost to perform other activities in support of the dredged material placement alternative.

The per cubic yard dredging cost and the transportation costs were taken from the 1994 mechanical dredging contract. These prices can reasonably be expected for mechanical dredging in the near future. The other activities that need to be performed in support of the placement alternative also will

be estimated from historical data, if such data exist. If the data does not exist, conventional estimating methods will be used to estimate the cost. All cost estimates used to determine cost index values for the various dredged material placement alternatives will be fully documented in the individual site plan reports.

C. NATURAL RESOURCES (Weight Factor = 30)

Within the Environmental Matrix, there are two broad categories for evaluation: water quality and the aquatic and terrestrial ecosystem. Of the possible 30 points for the natural resources weight factor, 8 are designated for water quality, 22 to the aquatic and terrestrial ecosystem. Following is a description of both.

1. Water Quality: The basic assumption with the following worksheet is that the dredged material being considered is uncontaminated sand typical of the majority of dredge cuts on the Upper Mississippi River within the St. Paul District. When the dredged material is contaminated, the worksheet would not be used, and the impact values will be assigned without the use of pre-established criteria.

In addition to the effects on the water column, the physical effects on the aquatic ecosystem of in-water rehandling or effluent from disposal areas are included in the evaluation provided the integrity of site is not significantly altered or the disruptions would not occur over long periods. If a site would be dramatically altered, or there would be long-term disruptions, the evaluation of impact would be included in the ecosystem worksheet.

Impact Considerations

Discharge Type	
1. Confined disposal with adequate retention	2.50_____
2. Confined disposal without adequate retention	1.25_____
3. Unconfined disposal	1.25_____
4. Direct open water	0.25_____
Discharge Area Characteristics	
1. Non-sensitive area with adequate mixing	2.50_____
2. Non-sensitive area without adequate mixing	1.25_____
3. Sensitive area with adequate mixing	1.25_____
4. Sensitive area without adequate mixing	0.25_____
Nature of Discharge (check 2)	
1. Short duration (<1 week)	2.50_____
2. Long duration (>1 week)	1.25_____
3. Infrequent	2.50_____
4. Frequent	1.25_____
Other _____	_____
TOTAL	_____

2. Aquatic and Terrestrial: Index values assigned to natural resource impacts from the dredged material placement alternatives will be calculated by the procedure developed by Wege and Palesh (1982, 1983). The 1982 procedure was generally accepted at the Channel Maintenance Forum in 1983 for its use in pool 4 of the Upper Mississippi River. Wege and Palesh (1983) was a later accepted procedure within the St. Paul District. These procedures quantify the relative impacts and benefits of dredged material placement to the natural resources. HEP was initially developed to compensate habitat losses associated with development plans, but has since been useful as a planning tool to evaluate project alternatives during early planning stages.

The proposed HEP methodology involves five steps:

1. Identification of habitat types to be affected by the project.

2. Assigning numerical habitat values to each habitat type.

3. Estimating habitat losses or gains in acres over the project life.

4. Performing a trade-off analysis to compare different habitat types.

5. Quantifying habitat losses in terms of relative habitat units.

a. Identification of Habitats Impacted: The disposal alternatives selected for evaluation could impact ten different habitat types.

Old Dredged Material - Old disposal site habitats on the river can vary greatly. The typical old disposal site habitat is a mosaic of sand deposits in early stages of revegetation and pockets of trees and shrubs that were able to withstand the dredged material deposition. It is expected through succession this habitat would return to a condition similar to bottomland forest habitat.

Brush and Willow. Areas dominated by dense shrub growth, mostly willows, are included in this habitat type.

Sand. These are areas dominated by bare sand with little or no vegetation. This habitat type would be also be created by dredged material placement.

Bottomland Forest. This habitat type is undisturbed bottomland forest areas with mature trees. The habitat type is assumed to be a climax community.

Marshes - Wetland areas characterized by dense stands persistent emergent vegetation such as sedges, cattails, bur reed, common reed, etc.

Shallow Aquatic - Shallow water areas generally less than four feet deep characterized by abundant floating-leaved or submerged vegetation such as coontail, white water lily, and pondweeds.

Terrestrial Herbaceous - Upland sites generally dominated by herbaceous vegetation. Some scattered shrub and young tree growth may be present.

Terrestrial Woody - Upland sites dominated by woody vegetation. It is expected that most high disposal sites would eventually evolve into this habitat type in 40+ years.

Cropland - Actively farmed areas.

Deep Aquatic - Water areas generally deeper than four feet such submergent aquatic vegetation is not common.

b. Determination of Habitat Unit Values (HUV): Habitat types have been evaluated for terrestrial and aquatic species. Ten evaluation species were selected for each habitat type and combined to evaluate those habitats providing both the terrestrial and aquatic benefits (see table on page D-8.1). The evaluation species were selected by an evaluation team and were a representation of an ecological cross-section of the fish and wildlife community of each habitat type. The habitats were evaluated by identifying the existing characteristics of the habitat at each location and determining by consensus of the team how well those characteristics fulfilled the habitat requirements of the selected evaluation species. Numerical ratings for each evaluation species were based on a scale of 0-10, and since 10 species were used to evaluate each habitat, HUV from 0-100 were possible.

c. Estimation of Habitat Losses over the Project Life: The HEP evaluation quantifies habitat losses or gains over the project life in terms of habitat units (HU) by multiplying habitat quality (or HUV) by the change in habitat quantity (acres). It compares habitat impacts of dredged material disposal to habitat changes occurring over the project life in the absence of any disposal. A prediction of future habitat changes due to natural succession or anticipated developments must be made for the 40-year time period for each habitat type. This results in a gradual change in habitat values over 40 years. Since bottomland forest was considered to be at a climax stage of succession, no change in habitat value was anticipated over the project life. Target years are selected representing important time periods when significant changes in habitat quantity occur. For many projects, losses occur at one point in time (e.g. wetland filling), while others occur gradually from disposal over a 40-year period. Target year zero represents the existing or baseline conditions for each habitat. Target year 1 is the start of dredged material disposal.

d. Trade-off Analysis: Evaluating dredged material disposal alternatives often involve losses of dissimilar habitats making it difficult to compare losses between habitat types and alternatives. The first step in the trade-off analysis is to develop Relative Value Criteria (RVC) used to determine the intrinsic values of habitats. The following criteria were selected:

Scarcity - The abundance of the habitat.
Diversity - The ability of the habitat to support a diverse fauna.
Manageability - Whether or not the habitat can be managed given its nature and location.
Replaceability - Whether or not the habitat can be replaced either by natural succession or by man.
Productivity - The primary productivity of the habitat.

A pairwise comparison of each of the above criteria was performed to rank their importance to each other. Scarcity, diversity, and productivity were considered equally important and received a relative weight of 0.27. Manageability and replaceability were considered equal and received a relative weight of 0.10.

The next step is to compare habitats selected for the project site to the RVC. These values need to be determined for each project area based on the quality and quantity of habitat types. Habitats are ranked against the criteria on a 0.1 to 1.0 scale as follows:

0.1 ----------**Scarcity**---------- 1.0
common rare

0.1 ----------**Diversity**---------- 1.0
low high

0.1 ----------**Manageability**---------- 1.0
difficult easy

0.1 ----------**Replaceability**---------- 1.0
easy impossible

0.1 ----------**Productivity**---------- 1.0
low high

The value chosen for the RVC is then multiplied by the relative weight. For example, a habitat type with a diversity RVC of 0.4 would be multiplied by 0.27 for a index value of 0.108. The index values are added together within each habitat type, and their totals are divided by the largest summation of the habitat types to determine the Relative Value Indices (RVI). See table on page D-9.1. If, for example the shallow aquatic habitat type has the highest sum of index values of 0.6. The RVI for this habitat type would be 1.0 (0.6/0.6=1). If the sum for another habitat type is 0.3, its RVI would be 0.5 (0.3/0.6=0.5). This ranks the relative value of each habitat type on a 0-1 scale.

Habitat Type	**HUV**	**RVI**
Sand	18	.20
Old dredged material	43	.44
Cropland	56	.62
Disturbed bottomland	57	.58
Brush and willow	64	.52
Bottomland forest	77	.71
Terrestrial herbaceous	79	.69
Deep aquatic	80	.94
Terrestrial woody	84	.80
Marsh	86	1.00
Shallow aquatic	87	.98

e. Quantify Habitat Impacts: The final step in the HEP is to quantify habitat impacts in terms of Habitat Units (HU) by multiplying the HUV for the habitat types by the impact area. To display project benefits and costs, HU displayed are annualized over the project life. Since it is a trade-off analysis, relative habitat units (RHU) are calculated by multiplying HU by RVI. For each alternative, the RHU is calculated to determine the gain or loss for each habitat type. In calculating the impacts of dredged material disposal, comparisons of the with and without project conditions were done for various target years within the 40-year planning period. The selection of appropriate target years is made for each report based on the sites and alternatives being considered. In all cases the target years 0, 1 and 40 years are used. Additional target years are included in the analysis, if there is reason to believe that there would be events that would change the values between target years 1 and 40. For example, a confined placement site would be constructed on a portion of a site in year 1 to accomodate 20 years of dredged material. At year 21, the remainer of the disposal site would be converted into a confined material placement site to handle the last 20 years of dredged material. Mean RHU values between the target years are then calculated and multiplied by the number of years between the target years to yield the total RHU value for the time period period between the two targets years. These time increments are then added to yield the total relative habitat values for the 40 year planning period. The method is used for both the with and the without project conditions. The difference between the total RHU for the with and without project conditions is then annualized (divided by 40 years) to yield the Average Annual Habitat Unit (AAHU) loss or gain from the project. Matrix values were determined by comparing all the various alternatives considered in pool plans that have been or in the process of being completed. As to be expected, the AAHU was partially dependent on the volume of dredged material that was being planned for. In the past, a straight line scale of 0 to 1000 habitat units has been used. To provide consistency with past efforts, but also to account for information that has been gained through these past efforts, a revised matrix scale was prepared. Matrix values were assigned based on the following revised matrix scale.

Change in RHU Criteria	Matrix Value	# of Occurrences in Past Pool Reports
< -200	10	3
-201 to -300	9	5
-301 to -400	8	6
-401 to -500	7	3
-501 to -600	6	4
-601 to -700	5	4
-701 to -800	4	4
-801 to -900	3	3
-901 to -1000	2	3
-1001 to -1100	1	5
> -1101	0	6

f. Literature Cited:

Wege, G.L., and G.D. Palesh. 1982. Habitat evaluation of dredged material disposal alternatives using the habitat evaluation procedures (HEP). U.S. Fish and Wildlife Service, Twin Cities Field Office. 28pp.

Wege, G.L., and G.D. Palesh. 1983. Standards for use with the habitat evaluation procedures (HEP) to evaluate dredged material disposal alternatives on the Upper Mississippi River (GREAT-I). U.S. Fish and Wildlife Service, Twin Cities Field Office. 11pp.

D. BENEFICIAL USE (Weight Factor = 10)

Generally defined, beneficial use of dredged material is the productive use of the material by the public or private sectors. Examples of common beneficial uses of dredged material in the St. Paul District are upland habitat development, wetland creation, aquatic habitat enhancement, creation of areas for bird nesting, beach nourishment, winter road maintenance, levee repair and improvement, aggregate for concrete, lining flyash pits, bank protection, and general purpose fill. Placing dredged material at locations where it could or would be used beneficially was a planning objective of the GREAT I study and is an objective of the Corps of Engineers.

A market survey was conducted in 1977-1978 to determine the demand for dredged material as part of the GREAT I study. In 1982, the Wisconsin Department of Natural Resources under contract by the St. Paul District Corps of Engineers completed a report titled Demands, Productive Uses And Economic Impacts Of The Beneficial Use Of Dredged Material On The Upper Mississippi River. This report updated the GREAT I information and in addition to this report, there have been and there will continue to be supplemental reports for specific areas depending on how current the data is. These reports will serve as the basis for identifying potential users of dredged material and in developing the site plans. During the development of the site plans, all known potential beneficial users in the area will be contacted, and a plan for beneficial use will be formulated for each site plan where it is operationally feasible.

The dredged material placement alternatives that provide beneficial use potential for the dredged material will be considered in evaluating the alternatives using the matrix. Those alternatives with beneficial use potential will be assigned index values ranging from 0 (no beneficial use potential) to 10 (active beneficial use). The index value will then be adjusted by the weight factor and incorporated into the matrix. The beneficial use index values and the corresponding criteria are shown in TABLE D-2.

TABLE D-2

Beneficial Use Index Values

Value	Criteria
10	The alternative placement site would be actively used as a beneficial use site for dredged material outside the floodplain and provide local economic benefits.
8	The alternative placement site would be actively used as a beneficial use site for dredged material within the floodplain and provide environmental or recreational benefits.
6	The alternative placement site has **high** potential for use of the dredged material. Criteria considered: a) The site is located in an area where identified potential users of the dredged material have indicated high demand. b) Good access to the site is available or a local sponsor or benefactor is willing to develop access to the site.
4	The alternative placement site has **moderate** potential for use of the dredged material. Criteria considered: a) The site is located in an area where identified potential users of the dredged material have indicated moderate demand. b) Existing access is poor and there is a moderate potential for improvement of access.
2	The alternative placement site has **low** potential use of the dredged material. Criteria considered: a) The site is located in an area where identified potential users of the dredged material have indicated low demand. b) Access to the site is not available and no local sponsor or benefactor can be identified to develop access to the site.
0	The alternative placement site has no potential for beneficial use of dredged material.

E. CULTURAL RESOURCES (Weight Factor = 10)

Comprehensive archeological and historic surveys have not been completed for the entire Upper Mississippi River. Some pools within the St. Paul District have detailed information on cultural resources while others have little current survey information. In addition, some pools have an existing body of landform data on which more scientific predictions of site locations can be made. Some dredge disposal sites have been intensively surveyed for cultural resources, others will require survey before being used and yet others will not need any further survey efforts.

The following matrix follows the matrices completed for the Dredge Material Placement Reconnaissance Reports by the St. Paul District in the early 1980's and that done by the Rock Island District in their Long-Term Management Strategy for Dredge Material Placement. While the criteria remain basically the same as those used in the 1980's by St. Paul, like the more recent efforts by Rock Island, we have attempted to use all existing data on known and predicted resource locations, and their association with changing landform information when this information was available.

Coordination with the State Historic Preservation Officers, the State Archeologists and the National Park Service has been completed for a large majority of the disposal sites and will be completed for all new sites added as a result of this study.

Points	Criteria
10	***No potential*** for impact to cultural resources based on recent age of landform or negative survey results.
8	***Negligible potential*** for cultural resources impacts based on knowledge of surveys in similar physiographic settings or avoidance of impacts on known resources.
6	***Low potential*** for impacts to cultural resources based on knowledge of surveys in similar physiographic settings or no knowledge of known properties from historic records in the vicinity of the disposal area.
4	***Moderate potential*** for impacts to cultural resources based on knowledge of surveys in similar physiographic settings or knowledge of known properties in the vicinity of the disposal area.
2	***High potential*** for cultural resources located in the disposal area or cultural resources exist at the placement site which have not been evaluated against the criteria of the National Register of Historic Places.
0	***Extreme potential*** for properties listed on or determined eligible for the National Register of Historic Places to be effected by placement.

F. SOCIAL IMPACTS (Weight Factor = 15)

Socioeconomic criteria will be utilized to evaluate dredged material placement site alternatives in terms of social impacts. These evaluation criteria will account for the positive and negative impacts for the following categories:

(1) business and industrial activity and employment
(2) community cohesion
(3) public services and facilities
(4) property values and tax revenues
(5) life, health, and safety
(6) aesthetic values and noise levels

The evaluation process for social impacts is similar to process used to evaluate the recreational use potential. The social impacts of the dredged material placement alternatives will be evaluated based on a point system. The maximum amount of points any one alternative can attain will be 100. Points will be given by assessing the alternative in the six socioeconomic categories listed previously. The maximum amount of points that can be scored in any category is based on the overall importance of the category relative to the other socioeconomic categories.

Point values and criteria tables for assessing social impacts are shown on the following pages.

Category 1 - Business and Industrial Activity and Employment

Maximum Points - 30

Criteria	Qualifier	Points
Dredged material demand	High demand	8
	High potential use	6
	Potential use	4
	No known potential use	2
	No potential use	0
Supply of existing material	Inadequate supply	8
	Significant supply	4
	Many local sources of supply	0
Impacts on competing firms	No adverse impacts	7
	Possible adverse impacts	5
	Probable adverse impacts	3
	Competing firms expressing opposition	1
Impacts on area employment	No adverse impacts	7
	No expected impacts	4
	Possible adverse impacts	1

Category 2 - Community Cohesion

Maximum points - 20

Criteria	Qualifier	Points
Residential development	None within one mile of site	5
	None within 1/2 mile of site	4
	Limited development (rural)	3
	Moderate development	2
	High development	1
	Dense development	0
Land availability	Willing seller (no condemnation)	5
	Unknown if willing seller	3
	No willing seller	0
Public opposition	No potential opposition	5
	No opposition expressed	3
	Possible opposition	2
	Opposition from some businesses and residents	1
	Large public opposition	0
Adjacent land use	Compatible	5
	Mixed, some compatible	2
	Incompatible	0

Category 3 - Public Services and Facilities

Maximum points - 20

Criteria	Qualifier	Points
Existing public facilities	Improve facilities	5
	Maintain facilities	4
	No change	3
	Slight adverse impact	2
	Adverse impacts	1
	Detrimental impacts	0
Planned public facilities	Provide additional needed facilities	5
	Provide new but unneeded facilities	3
	Slight adverse impacts	2
	Adverse impacts	1
	Detrimental impacts	0
Public Safety	No resulting safety threat	5
	Slight safety threat	3
	Resulting safety threat	1
	Public attraction with significant safety threat	0
Maintenance costs	No change	5
	Some increase	2
	Significant increase	0

Category 4 - Property Values and Tax Revenues

Maximum points - 10

Criteria	Qualifier	Points
Property values and tax revenues of placement site or adjacent land	Improves and increases	10
	Slight improvement and increase	8
	No impacts	6
	Slight decrease	4
	Decrease	2
	Severe decrease	0

Category 5 - Life, Health, and Safety

Maximum points - 10

Criteria	Qualifier	Points
Life, health, and safety	Improves current conditions	10
	No adverse impacts	8
	No change to current conditions	6
	No improvements to current risky conditions	4
	Adverse impacts	2
	Unacceptable creation of dangerous conditions	0

Category 6 - Aesthetic Values and Noise Levels
part 1

Criteria	Qualifier	Points
Aesthetic Values	Enhanced aesthetics due to use of material to replenish an existing beach; no impacts due to replenishing local existing material stockpile	5
	No significant impact due to material being placed on an existing placement site	4
	Minimal impacts due to the creation of a new beach area in area of sparse vegetation	3
	Moderate impact due to the creation of a new beach in area of heavy vegetation	2
	Adverse impact due to creation of an emerged island in the river	1
	Adverse impact due to creation of new non-beach placement site within viewing distance of residential area	0

Category 6 - Aesthetics and Noise Levels
part 2

Criteria	Qualifier	Points
Noise levels	No permanent impacts; no significant temporary impacts during material placement	5
	No significant permanent impacts; no significant temporary impacts during material placement	4
	No significant permanent impacts; adverse temporary impacts during material placement	3
	Adverse permanent impacts due to recreation beach activities (rural area); adverse temporary impacts during material placement	2
	Adverse permanent impacts due to recreation beach activities (urban area); adverse temporary impacts during material placement	1
	Permanent adverse impacts due to beneficial use activities; adverse temporary impacts due to material placement	0

G. RECREATION (Weight Factor = 5)

Point values and criteria tables for assessing recreation impacts are shown below.

Category 1 - Existing Recreation Facilities

Maximum 5 points

Qualifier	Points
Improve Facilities	5
Maintain Facilities	4
No Change	3
Slight adverse impact	2
Adverse impacts	1
Detrimental impacts	0

Category 2 - Recreation Opportunities

Maximum 5 points

Qualifier	Points
Provide additional needed facilities (Demand exceeds supply)	5
Provide new facilities/low demand (Supply exceeds demand)	4
No affect	3
Slight adverse impact	2
Adverse impacts	1
Detrimental impacts	0

APPENDIX E

JULY 1994 RECON REPORT

DREDGED MATERIAL PLACEMENT
RECONNAISSANCE REPORT
LOWER POOL 2

GREAT I Implementation
9-Foot Channel Project
Upper Mississippi River Mile
815.2 - 828.3

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July 1984

TABLE OF CONTENTS

Item	Page
INTRODUCTION	1
GENERAL DESCRIPTION	1
Recreational Facilities	2
Commercial Navigation	2
Cultural Resources	2
Natural Resources	2
DREDGE CUTS	3
DREDGED MATERIAL PLACEMENT SITES	3
GREAT I Dredged Material Placement (DMP) Sites	3
Alternative Dredged Material Placement (DMP) Sites	4
BENEFICIAL USE	6
ALTERNATIVE DEVELOPMENT	6
GREAT I Channel Maintenance Plan (CMP)	7
Alternative A1	7
Alternative B	8
Alternative C1	9
Alternative C2	10
Alternative C3	11
Alternative D	12
Alternative E	12
THALWEG DISPOSAL	16
POTENTIAL GEOTECHNICAL IMPACTS	16
MATRIX EVALUATION	17
Discussion	17
RECOMMENDED DREDGED MATERIAL PLACEMENT PLAN	19
Proposal and Rationale	19
Implementation Schedule	19

TABLES

1 - Principal Features of Lower Pool 2	2
2 - Dredge Cut Summary	3
3 - GREAT I DMP Sites	4
4 - Alternative DMP Sites	5
5 - Alternative Summary	14
6 - Summary of Alternative Impacts	15
7 - Dredged Material Placement Evaluation Matrix	18

TABLE OF CONTENTS (Cont.)

Item

FIGURES

1 - Vicinity and Location Map

APPENDIXES

A - Details of Alternative Plans
B - Environmental Evaluation
C - Hydraulic Investigations
D - Recreation, Visual Resources
E - Operational Evaluation
F - Matrix Evaluation Criteria
G - Correspondence

DREDGED MATERIAL PLACEMENT
RECONNAISSANCE REPORT
LOWER POOL 2

GREAT I Implementation
9-Foot Channel Project
Upper Mississippi River Mile
815.2 - 828.3

INTRODUCTION

The St. Paul District, U.S. Army Corps of Engineers is in the process of implementing the GREAT I Channel Maintenance Plan (CMP) for the Upper Mississippi River. The GREAT I CMP consists of a series of recommended dredged material placement sites for the maintenance of a 9-foot navigation channel during the 40-year period from 1986 to 2025. This reconnaissance report addresses the feasibility of GREAT I dredged material placement recommendations along with alternative placement plans thought to have merit by the District.

This report specifically addresses the dredge cuts and dredged material placement sites for lower pool 2. Lower pool 2 is defined as that portion of pool 2 beginning at river mile 815.2 and extending upstream to river mile 828.3. GREAT I CMP sites, alternative placement sites, and alternative placement methods are evaluated with consideration given to economic, environmental, and social values as recommended in the public notice letter for the final GREAT I and II reports. Consideration is also given to aesthetic and recreational factors as recommended in GREAT I, Volume I. Appendixes A thru G in the back of this report contain further information as to the details/evaluations of the various placement sites for dredge cuts 2, 3, 4, and 5. The intent of this report is to identify a long-term dredged material placement plan that minimizes any adverse environmental impacts, reflects sound engineering design, and is operationally implementable.

GENERAL DESCRIPTION

Lock and dam 2 is located at river mile 815.2 near Hastings, Minnesota. Pool 2, which is located entirely within Minnesota, extends upstream through St. Paul and Minneapolis. Upper pool 2 upstream from river mile 829 is largely confined by high bluffs and is heavily developed with residential, commercial, and industrial establishments. Downstream to lock and dam 2, the pool broadens and is considerably less developed. The Minnesota River enters pool 2 near Fort Snelling. Spring Lake, a backwater area, is the dominant open water feature of lower pool 2. The principal features of lower pool 2 are listed in table 1.

Table 1
Principal Features of Pool 2

Length of pool	Mississippi River	32.5 river miles
	Minnesota River	25.0 river miles
River mile limits	Mississippi River	815.2 - 847.7
	Minnesota	0.0 - 25.0
Average pool elevation		687.2 feet
Pool surface area		9,652 acres
		(Mississippi River segment)
Shoreline miles		110 miles
(Meandering outer perimeter)		(Mississippi River segment)

RECREATIONAL FACILITIES

None of the dredged material placement sites considered would have a significant adverse impact on recreation in lower pool 2. Alternatives C1, C2, and C3 involve various degrees of closure of Spring Lake to flow from the main channel. This would result in improved water quality and enhance recreational opportunities in this area. Alternative C3 would involve complete closure of Spring Lake and would provide additional land area for implementation of the Spring Lake Park Reserve master plan for phase two development.

COMMERCIAL NAVIGATION

Existing commercial navigation facilities in this pool would not be impacted by dredging in lower pool 2.

CULTURAL RESOURCES

As of May 1984, no properties listed on or eligible for inclusion on the National Register of Historic Places would be impacted by use of any of the proposed placement sites. Of the placement sites considered, site 2.35 would require an archaeological survey prior to use. All of the proposed dredged material placement sites have been coordinated with the Minnesota and Wisconsin State Historical Preservation offices, State Archaeologists, and the National Park Service.

NATURAL RESOURCES

Fish habitat in lower pool 2 is generally poor due to periodically poor water quality. Wildlife habitat is generally good in Pig's Eye Lake and Grey Cloud

Island. There is a unique heron-egret rookery at the border of Pig's Eye Lake.

DREDGE CUTS

GREAT I identified six historic dredge cut locations in lower pool 2 as outlined on figure 1. The characteristics of each cut are summarized in table 2.

Table 2
Dredge Cut Summary
Lower Pool 2

Dredge Cut	River Mile Location	Estimated No. of Jobs	MPFWG Quantity (Cubic Yards) 1986-2025	Average Quantity per Job (Cubic Yards)
1 - Upper Approach to lock and dam 2	815.5-815.9	4	41,500	10,400
2 - Boulanger Bend Lower Light	819.0-819.8	4	240,500	60,100
3 - Boulanger Bend	820.8-821.4	4	455,500	113,900
4 - Pine Bend Foot Light	822.7-823.7	10	379,500	38,000
5 - Grey Cloud Slough	827.5-828.3	8	282,000	35,200
6 - Below Cudahy	831.0-832.4	8	93,500	11,700

The total projected dredge cut quantity of 1,357,500 cubic yards from cuts 2, 3, 4, and 5 is based on the 40-year channel maintenance period representing the Most Probable Future with GREAT (MPFWG). MPFWG quantities are based on the assumption that the implementation of GREAT I recommendations will reduce future dredging quantities from historic levels. Sizing and impact evaluations of all dredged material placement sites in this report are based on MPFWG projected quantities. Dredge cuts 1 and 2 involve small quantities of dredging and given the improved navigation and survey capabilities, will probably not require dredging during the 40-year plan period.

DREDGED MATERIAL PLACEMENT SITES

GREAT I DREDGED MATERIAL PLACEMENT (DMP) SITES

GREAT I selected two DMP sites (2.10 and 2.35) for placement of dredged material from cuts 2, 3, and 5. The maximum site development dimensions of these sites, as presented in the GREAT report, are listed in table 3 under GREAT. Also listed, under Present, are the current maximum site development dimensions required and available for alternative material placement plans discussed in subsequent sections of this report.

Table 3
GREAT I DMP Sites
Lower Pool 2

Site	Maximum DMP Site Development Dimensions						Notes
	Capacity		Area (Acres)		Pile Height (feet)		
	GREAT	Present	GREAT	Present	GREAT	Present	
2.10	800,000	755,000	25.0	4.0	25.0	NA	1
2.35	700,000	240,000	25.0	20.0	25.0	15.5	

1. 4.0-acre stockpile area.

The GREAT I DMP sites are described in more detail in the following paragraphs.

Site 2.10. Site 2.10 is a 4.0 acre, privately owned site located at R.M. 832.5 RB near the South St. Paul stockyards. The site is surrounded by a flood levee and was a one-time cattle manure disposal area. The site has been recently filled and appears ready for development. The present value of the site as wildlife habitat is minimal since the site is essentially bare soil. Material from cuts 4 and 5 would be placed at this site by mechanical methods. The site is accessible for beneficial use removal.

Site 2.35. Site 2.35 is a privately owned, 14-acre site located on the lower end of Grey Cloud Island at R.M. 821.8 LB. The site is a flat field vegetated primarily by grasses. Dredged material would be placed at this site by mechanical methods from cuts 2 and 3 and a portion removed for beneficial use. Approximately 456,500 cubic yards would remain permanently in place at this site.

ALTERNATIVE DREDGED MATERIAL PLACEMENT (DMP) SITES

In addition to the GREAT I recommended sites, alternative sites are being evaluated as DMP sites in this report. The maximum site development dimensions of these sites as presented in the GREAT I report are listed in table 4 under GREAT. Also listed, under Present, are the current maximum site dimensions required and available for alternative material placement plans detailed in subsequent sections of this report.

Table 4
Alternative DMP Sites
Lower Pool 2

Site	Maximum DMP Site Development Dimensions					
	Capacity (CY)		Acres		Pile Height (Feet)	
	GREAT	Present	GREAT	Present	GREAT	Present
2.05	1,370,000	1,357,000	43.0	4.0	25	NA
2.24A*	--	379,500	--	27.5	--	8
2.24B*	--	978,000	--	46.0	--	13
2.24C*	--	282,000	--	13.7	--	13
2.25	220,000	379,500	9.0	25.0	15	12
2.27	20,000	282,000	2.8	25.0	5	9
2.31	140,000	455,500	3.4	25.0	25	14

* Site was not evaluated in the GREAT I report.

The alternative DMP sites are described in more detail in the following paragraphs.

Site 2.05. Site 2.05 is a 4-acre, privately owned area near Red Rock Industrial Park at R.M. 832.5 LB. The site is forested and would be used for stockpiling of dredged material from cuts 2, 3, 4, and 5, depending on the alternative. An additional two acres of mixed wooded and old field habitats would be lost to the construction of an access road to the site. Material would be placed at the site by mechanical methods.

Sites 2.24A, 2.24B, 2.24C. Sites 2.24A, 2.24B, and 2.24C are located between R.M. 820.0 RB and 823.0 RB along the riverward side of Spring Lake. Material would be placed mechanically in open water at each site to form a dike configuration varying from 150 to 200 feet in width. The resulting dike would act as a barrier to prevent intermixing of surface water from the main channel with Spring Lake. Site 2.24 involves approximately 6,000 lineal feet of dike and would form only a partial closure on the north end of Spring Lake. Site 2.24A and B together would involve 16,000 lineal feet of dike and increase the length of closure. Site 2.24C would involve 20,000 lineal feet of dike and would completely close Spring Lake from the main channel, thereby providing flood protection up to the 17-year occurrence. If sites 2.24A, B, and C are used simultaneously, all of the material from cuts 2, 3, 4, and 5 can be accommodated. All of the land area in these sites is federally owned.

Site 2.25. Site 2.25 is a federally-owned historic site located near Baldwin Lake at R.M. 824.1 LB. The 12-acre site lies on a long peninsula and is primarily old dredged material in various stages of revegetation. The site was last used for dredged material placement in the mid-1970's. Material from cut 4 would be placed at this site by mechanical dredging methods. The site is not accessible for beneficial use removal.

Site 2.27. This site is also a federally-owned historic disposal site and is located at R.M. 827.8 RB near the upstream end of Grey Cloud Island. Vegetation on this 9-acre area consists primarily of bottomland forest. Material from cut 5 would be placed at the site by mechanical methods and would remain permanently in place.

Site 2.31. Site 2.31 consists of two islands located at Boulanger Island at R.M. 821.1 LB. Both islands consist of a total of 14 acres and have been used for dredged material placement in the past. Three acres of this site consists of open water, whereas the land area is sparsely vegetated and consists of grasses, herbs, shrubs, and some larger trees. Material from cut 3 would be placed at this site by mechanical methods and remain permanently in place. The site is federally owned.

Site 2.75. Site 2.75 is a federally-owned historic placement site located at R.M. 819.4 RB. The 8-acre site is an island/open water area consisting of three acres of sparsely vegetated dredged material and five acres of open water. This site would be permanently filled by mechanical placement of dredged material from cut 2.

BENEFICIAL USE

Placing dredged material at locations where it would or could be used beneficially was a primary objective of the GREAT I study. Beneficial use of dredged material is divided into two basic categories: active, which is removed from the site and passive, which is left permanently for potential site development or enhancement.

The GREAT I report projected a total active beneficial use of 995,000 cubic yards for placement sites within lower pool 2. This includes 240,000 and 755,000 cubic yards at site 2.10 to be used by the City of St. Paul and Dakota County. A potential active beneficial use demand of 1,900,000 cubic yards exists at site 2.10, however, there is insufficient material in lower pool 2 to satisfy this demand. Depending on the channel maintenance alternative, the entire quantity of material dredged from lower pool 2 (1,357,500 cubic yards) could be removed for beneficial use from site 2.05. Sites 2.25, 2.27, 2.31, and 2.75 are not accessible by land vehicle and were not considered as beneficial use sites. At sites 2.24A, 2.24B, and 2.24C, dredged material would be permanently placed and contribute to enhancement of recreational opportunities in Spring Lake. For this reason, all material placed at these sites was considered to have passive beneficial use. Material placed at these sites would range from 282,000 to 1,357,500 cubic yards depending on the alternative.

ALTERNATIVE DEVELOPMENT

Eight alternative channel maintenance plans (A, A1, B, C1, C2, C3, D, and E) have been formulated for lower pool 2 based on dredge cuts 2 through 5 and the dredged material placement sites as discussed previously. Alternative A is the GREAT I recommended plan, however, this alternative was not directly evaluated in this report. Because of changes in the dimensions of the various placement sites and deletion of cuts 1 and 6, a modified alternative, alternative A1, was substituted for alternative A. The six remaining alternative

plans were formulated by the St. Paul District. The following paragraphs contain descriptions of the GREAT I Channel Maintenance Plan (CMP) and the alternative maintenance plans. The description of each alternative plan is followed by a summary discussion of the principle economic, environmental, hydraulic, cultural, visual, recreational, and social effects of that alternative. Table 5 summarizes the placement site volume, area, pile height, and beneficial use combinations for each alternative and table 6 summarizes the major impacts of each alternative. More detailed information pertaining to the alternatives can be found in appendixes A through G.

GREAT I CHANNEL MAINTENANCE PLAN (CMP)

GREAT I selected two placement sites (2.10 and 2.35) to accommodate the placement of 1,357,500 cubic yards of dredged material from cuts 2 through 5. Under this plan, 696,000 cubic yards of material from cuts 2 and 3 would have been placed at site 2.35, with 240,000 cubic yards of this material removed for active beneficial use. Approximately 755,000 cubic yards from cuts 4, 5, and 6 would have been temporarily placed at site 2.10 and cut 1, consisting of 41,500 cubic yards, would have been temporarily placed at site 2.30. Since dredging of cuts 1 and 6 will probably not be required, a revised alternative, alternative A1, was formulated. The GREAT I CMP also gave consideration to the use of site 2.24A, B, and C for Spring Lake enhancement measure. It was the recommendation of the team that, if the potential impacts of this action were favorable, sites 2.24A, B, and C be the recommended placement sites for cuts 2, 3, and 4.

ALTERNATIVE A1

Description. This alternative is the GREAT I CMP for lower pool 2 modified to reflect the revisions in placement site dimensions and the deletion of cuts 1 and 6. Under this plan, 696,000 cubic yards of material from cuts 2 and 3 would be mechanically placed at site 2.35 and 661,500 cubic yards of material from cuts 4 and 5 would be mechanically placed at site 2.10. Of this material, 240,000 cubic yards at site 2.35 and all of the material at site 2.10 would be removed for active beneficial use.

Economic. This alternative has the highest overall dredging cost with a total cost of $8,424,825. This is $1,321,025 more than alternative B, the least costly alternative. Although the site development costs are negligible, truck or conveyer handling of cuts 3 and 4 and long barging distances contribute to the high cost of this alternative.

Environmental. A total of 18 acres at sites 2.10 and 2.35 would be impacted with this alternative. The 4-acre stockpile area at site 2.10 is a former manure disposal area and would not be adversely impacted. At site 2.35, 14 acres of old field habitat would be impacted. In terms of average annual habitat units lost, this alternative is the second lowest of the alternatives with the exception of the Spring Lake enhancement alternatives (C1, C2, and C3). There would be no appreciable water quality effects with this alternative since placement of all material at these sites would be by direct mechanical dredging methods.

Hydraulics. There are no appreciable effects on the Mississippi River water surface profiles, velocities, and flow distributions with this alternative.

Cultural. Site 2.35 is located on Grey Cloud Island near numerous known archaeological sites. As such, an archaeological survey would be required prior to use of this site. No survey would be required at site 2.10.

Recreation. There would be negligible impacts on recreation resulting from the use of sites 2.10 and 2.35.

Visual. Visual impacts at site 2.10 would be minimal owing to the high degree of development in this area. At site 2.35, visual impacts would be tempered somewhat by an existing red pine wind break. Establishment of a visual screen along the channel side of the site would reduce potential visual impacts when viewed from Spring Lake Park Reserve.

Social. To be furnished in draft report.

ALTERNATIVE B

Description. This alternative involves the use of four historical placement sites, 2.75, 2.31, 2.25, and 2.27, for placement of cuts 2, 3, 4, and 5 respectively. All of the material would be dredged mechanically, rehandled and mechanically placed at these sites. None of the material placed would be used for active beneficial use since it is not feasible to construct land access to these sites. Riprap slope protection in the water fill areas of sites 2.75 and 2.31 would be required.

Economic. Alternative B is the least costly of the alternatives and has a total dredging cost of $7,103,800. Site development costs are higher than for the other alternatives (except alternative C1), however, each historical placement site is located near the designated dredge cut, and barging distances, therefore, are short.

Environmental. A total of 43 acres of habitat at sites 2.25, 2.27, 2.31, and 2.75 would be impacted with this alternative. All of these sites are former placement sites and the areas impacted would include 24 acres of old dredged material, 10 acres of bottomland forest, one acre of shallow aquatics, and 8 acres of open water. This alternative ranks the highest in terms of average annual habitat units lost. There would be no significant water quality impact at sites 2.25 and 2.27 since dredged material would be placed on land by direct mechanical methods. At sites 2.31 and 2.75, however, a portion of the material would be placed in open water areas and some localized short-term increases in turbidity and suspended solids would result.

Hydraulics. There are no appreciable effects on the Mississippi River water surface profiles, velocities, and flow distributions with this alternative.

Cultural. Additional cultural resources survey work would not be required for any of the DMP sites under this alternative.

Recreation. There would be minimal effects on recreation in lower pool 2 resulting from the use of any of the placement sites with this alternative.

Visual. Filling of open water areas to a 25 foot pile height would result in major adverse visual impacts at site 2.31 and 2.75 when viewed from the main channel. Major adverse visual impacts would also result from the 25-foot pile heights at sites 2.25 and 2.27, however, these impacts could be lessened by providing an adequate setback and preserving existing vegetation at the perimeter of these sites.

Social. To be furnished in draft report.

ALTERNATIVE C1

Description. This alternative involves the placement of 379,500 cubic yards of material from cut 4 at site 2.24A. Material would be mechanically dredged and placed in open water in a 6,000 foot long dike at the north end of Spring Lake. This dike will provide closure of Spring Lake from the main channel at this location. Material from cuts 2 and 3 would be mechanically placed at site 2.35 and material from cut 5 would be mechanically placed at site 2.05. Approximately 240,000 cubic yards from site 2.35 and all of the material from site 2.05 (282,000 cubic yards) would be removed for beneficial use.

Economic. Alternative C1 has the second lowest overall dredging cost with a total cost of $7,129,500 or $25,700 more than alternative B. Site development costs are negligible for this alternative, however, barging distances are slightly longer than for alternative B, thus contributing to higher dredging costs.

Environmental. A total of 47.5 acres of habitat would be impacted with this alternative. Of this total, 27.5 acres is open water at site 2.24A, 5 acres of upland and one acre of old field at site 2.05, and 14 acres of old field at site 2.35. An HEP evaluation was not made for this alternative because of the potential habitat benefits in Spring Lake. Placement of material at site 2.24A would permanently destroy the existing benthic community, cause short-term increases in suspended solids and turbidity due to open water placement, and possibly increase the likelihood of winter fish kills in Spring Lake. Long-term water quality in Spring Lake, however, might increase as a result of dredged material placement at this site. No significant water quality impacts would result from direct mechanical placement of dredged material at sites 2.05 and 2.35.

Hydraulics. No appreciable effects on the Mississippi River water surface profiles, velocities, and flow distributions would result from placement of material at sites 2.05 and 2.35. At site 2.24A, a 3,000 foot long weir would restrict flood flows from entering Spring Lake from the upstream end for flood flows less than a 17-year frequency. The lake, however, would flood from backwater from the main channel entering the downstream end of the lake. During a 100-year frequency event, a 0.5 to 0.7 foot rise in the water surface profile would result from placement of dredged material at this site.

Cultural. A cultural resources survey would not be required at sites 2.05 and 2.24A. Site 2.35 is located on Grey Cloud Island near numerous known archaeological sites and would require a survey prior to placement of dredged material.

Recreation. There would be negligible impacts on recreation resulting from the use of sites 2.05 and 2.35. Closure of the upstream portion of Spring Lake at site 2.24A would have slight positive impact on recreation in this area.

Visual. Minimal visual impacts would result from placement of material at site 2.05 since this site is located in a developed area. At site 2.35, an existing red pine windbreak would serve to partially screen the north end of this site. Establishment of a visual screen along the channel side of this site would also reduce potential visual impacts. Long-term visual impacts at site 2.24A should be minor.

Social. To be furnished in draft report.

ALTERNATIVE C2

Description. This alternative involves placement of 978,000 cubic yards of material from cuts 2, 3, and 5 at site 2.24B. The remaining 379,500 cubic yards of material from cut 4 would be placed at site 2.24A. Material would be mechanically dredged and placed in open water in a 16,000 foot long dike that would isolate the majority of Spring Lake from the main channel. None of the material would be removed for active beneficial use.

Economic. The total dredging cost for this alternative is $7,129,500 and is identical to alternative C1. This alternative also has negligible site development costs, however, longer barging distances contribute to higher dredging costs than for alternative B.

Environmental. A total of 73.5 acres at sites 2.24A and 2.24B would be impacted with this alternative. All of the material placed at these sites would be placed in open water to form a dike that would partially close Spring Lake from direct flows from the main channel. An HEP evaluation was not made for this alternative because of the potential habitat benefits in Spring Lake. Placement of material at sites 2.24A and 2.24B would permanently destroy the existing benthic community, cause short-term increases in suspended solids and turbidity due to open water placement, and possibly increase the likelihood of winter fish kills. Long-term water quality in Spring Lake, however, might increase as a result of dredged material placement at this site.

Hydraulics. A 3000 foot long weir at site 2.24A and a 10,000 foot long dike at site 2.24B would restrict flood flows from entering Spring Lake from the upstream end for flood flows less than a 17-year frequency. The lake, however, would flood from backwater from the main channel entering the downstream end of the lake. During a 100-year frequency event, a 0.5 to 0.7 foot rise in the water surface profile would result from placement of dredged material at this site.

Cultural. A cultural resources survey would not be required at either site 2.24A or site 2.24B.

Recreation. Closure of Spring Lake due to placement of dredged material at sites 2.24A and 2.24B would have a positive impact on recreation in this area.

Visual. Long-term visual impacts at sites 2.24A and 2.24B should be minor.

Cultural. To be furnished in draft report.

ALTERNATIVE C3

Description. This alternative involves the placement of all material from cuts 2, 3, 4, and 5 (1,379,500 cubic yards) at sites 2.24A, B, and C along the riverward side of Spring Lake. Material would be placed in a continuous 20,000 foot long dike and form a complete closure of Spring Lake to flows from the main channel. The dike would be constructed to a 17-year occurrence flood protection elevation. None of the material would be removed for active beneficial use.

Economic. This alternative has the second highest dredging cost with a total cost of $8,177,900 or $1,074,100 more than for alternative B. Dredging costs are only slightly higher than for alternative B, however, site development costs are the highest of all the alternatives with a total cost of $992,000. This cost is associated with riprap protection of the inlet and outlet weirs at Spring Lake.

Environmental. A total of 75.7 acres of habitat would be impacted at sites 2.24A, 2.24B, and 2.24C with this alternative. All of the material would be placed in open water to form a complete closure of Spring Lake from the main channel. An HEP evaluation was not made for this alternative because of the potential habitat benefits in Spring Lake. Placement of material at sites 2.24A, 2.24B, and 2.24C would permanently destroy the existing benthic community, cause short-term increases in suspended solids and turbidity due to open water placement, and very likely increase the likelihood of winter fish kills. Long-term water quality in Spring Lake, however, would increase due to the elimination of the poor quality water that presently flows into the lake from the main channel.

Hydraulics. A 3,000 foot long entrance weir at site 2.24A, a 10,000 foot long dike at site 2.24B, and a 2,000 foot long exit weir at site 2.24C would restrict flood flows from entering Spring Lake for events less than a 17-year frequency. During a 100-year frequency event, a 0.5 to 0.7 foot rise in the water surface profile would result from placement of dredged material at this site.

Cultural. A cultural resources survey would not be required at sites 2.24A, 2.24B, and 2.24C.

Recreation. Closure of Spring Lake due to placement of dredged material at sites 2.24A, 2.24B, and 2.24C would significantly increase the recreational value of Spring Lake Park Reserve. This alternative would permit the implementation of phase 2 development at this park reserve.

Visual. Long-term visual impacts would be negligible with this alternative.

Social. To be furnished in draft report.

ALTERNATIVE D

Description. Alternative D involves the placement of material from cuts 2, 3, 4, and 5 at site 2.05. This site is a stockpile site and all material would be removed for active beneficial use. All dredged material would be placed by mechanical methods.

Economic. This alternative ranks fourth in terms of overall dredging costs with a total cost of $7,683,075 of $579,275 more than for alternative B. Site development costs are negligible, however, barging distances are longer than for alternative B.

Environmental. Under this alternative, 6 acres of habitat at site 2.05 would be impacted including 5 acres of upland forest and one acre of old field. This area is a stockpile site and all dredged material would be eventually removed for beneficial use. Since dredged material would be placed on land by direct mechanical methods, there would be no significant adverse water quality impacts at this site.

Hydraulics. There are no appreciable effects on the Mississippi River water surface profiles, velocities, and flow distributions with this alternative.

Cultural. A cultural resources survey would not be required at site 2.05.

Recreation. Recreational impacts at site 2.05 would be negligible.

Visual. Visual impacts at site 2.05 would also be negligible since this site is located in an area that is highly developed.

Social. To be furnished in draft report.

ALTERNATIVE E

Description. Alternate E involves the use of sites 2.05 and 2.35 for placement of dredged material. Material from cuts 2 and 3 (696,000 cubic yards) would be mechanically placed at site 2.35 and 240,000 cubic yards would be removed for beneficial use. Material from cuts 4 and 5 (661,500 cubic yards) would be mechanically placed at site 2.35 and all of this material would be removed for beneficial use.

Economic. The total dredging cost for this alternative is $7,300,275 or $196,475 more than for alternative B. This alternative has the third highest dredging cost of the alternatives owing primarily to barging distance to the material placement sites.

Environmental. A total of 20 acres of habitat at sites 2.05 and 2.35 would be impacted with this alternative. At site 2.05, 5 acres of upland forest and one acre of old field would be impacted and at site 2.35, 14 acres of old field would be impacted. In terms of average annual habitat units, this alternative has second highest degree of impact (excluding the Spring Lake enhancement alternatives C1, C2, and C3). Since dredged material would be placed on land by direct mechanical methods, there would be no significant adverse impacts on water quality.

Hydraulics. There are no appreciable effects on the Mississippi River water surface profiles, velocities, and flow distributions with this alternative.

Cultural. Site 2.35 is located on Grey Cloud Island near numerous known archaeological sites, thus a survey would be required prior to use of this site. A survey would not be required at site 2.05.

Recreation. There would be negligible impacts on recreation at either of these sites.

Visual. Visual impacts at site 2.35 would be tempered somewhat by an existing red pine windbreak. Establishment of a visual screen along the channel side of the site would reduce potential visual impacts when viewed from Spring Lake. Visual impacts at site 2.05 would be negligible.

Social. To be furnished in draft report.

Table 5
Alternative Summary
Lower Pool 2

Alt.	Site	Cut	Quantity Cut	Quantity Site	Beneficial Use Removal	Quantity On Site	Fill Depth	Acres
A	2.30	1	41,500	41,500	41,500	0	10'	3.5
	2.35	2 3	240,500 455,500	696,000	240,000	456,000	25'	25.0
	2.10	4 5 6	379,500 282,000 93,500	755,000	755,000	0	25'	25.0
A1	2.35	2 3	240,500 455,500	696,000	240,000	456,500	20'	15.5
	2.10	4 5	379,500 282,000	661,500	661,500	0	N/A	4.0
B	2.75	2	240,500	240,500	0	240,500	25'	8.0
	2.31	3	455,500	455,500	0	455,500	25'	14.0
	2.25	4	379,500	379,500	0	379,500	25'	12.0
	2.27	5	282,000	282,000	0	282,000	25'	9.0
C1	2.35	2 3	240,500 455,500	696,000	240,000	456,000	25'	14.0
	2.24A	4	379,500	379,500	0	379,500	8'	27.5
	2.05	5	282,000	282,000	282,000	0	N/A	4.0
C2	2.24B	2 3 5	240,500 455,500 282,000	978,000	0	978,000	13'	46.0
	2.24A	4	379,000	379,500	0	379,500	8'	27.5
C3	2.24B	2 3	240,500 455,500	696,000	0	696,000	13'	34.5
	2.24A	4	379,500	379,500	0	379,500	8'	27.5
	2.24C	5	282,000	282,000	0	282,000	13'	13.7
D	2.05	2 3 4 5	240,500 455,500 379,500 282,000	1,357,500	1,357,500	0	N/A	4.0
E	2.35	2 3	240,500 455,500	696,000	240,000	456,000	25'	14.0
	2.05	4 5	379,500 282,000	661,500	661,500	0	N/A	4.0

Table 6
Summary of Alternative Impacts
Lower Pool 2

	Alternative A1	Alternative B	Alternative C1	Alternative C2	Alternative C3	Alternative D	Alternative E
COSTS	$8,424,825	$7,103,800	$7,129,500	$7,129,500	$8,177,900	$7,683,075	$7,300,275
BENEFICIAL USE	901,500 CY active 0 CY passive	0 CY active 0 CY passive	522,000 CY active 379,500 CY passive	0 CY active 1,357,500 CY passive	0 CY active 1,357,500 CY passive	1,357,500 CY active 0 CY passive	901,500 CY active 0 CY passive
FISH AND WILDLIFE	18 acres impacted 396 average annual habitat units lost	43 acres impacted 831 average annual habitat units lost	47.5 acres impacted ** average annual habitat units lost	73.5 acres impacted ** average annual habitat units lost	75.7 acres impacted ** average annual habitat units lost	6 acres impacted 272 average annual habitat units lost	20 acres impacted 668 average annual habitat units lost
WATER QUALITY	100% mechanical dredging and rehandling	100% mechanical dredging and rehandling	100% mechanical dredging and rehandling. Water quality benefit to Spring Lake.	100% mechanical dredging and rehandling. Water quality benefit to Spring Lake.	100% mechanical dredging and rehandling. Water quality benefit to Spring Lake.	100% mechanical dredging and rehandling	100% mechanical dredging and rehandling
CULTURAL RESOURCES	No identified impacts. Site 2.35 requires survey.	No identified impacts	No identified impacts. Site 2.35 requires survey.	No identified impacts	No identified impacts	No identified impacts	No identified impacts. Site 2.35 requires survey.
RECREATION	Negligible impacts on recreation	Negligible impacts on recreation	Some potential for recreational enhancement of Spring Lake Park Reserve	Some potential for recreational enhancement of Spring Lake Park Reserve	Significant potential for recreational enhancement in Spring Lake Park Reserve	Negligible impacts on recreation	Negligible impacts on recreation
VISUAL	Minor visual impacts at site 2.10 and 2.35	Major adverse visual impacts at sites 2.25, 2.27, 2.31 and 2.75	Negligible visual impacts at sites 2.05 and 2.24A. Minor impacts at site 2.35.	Negligible visual impacts at sites 2.24A and 2.24B.	Negligible visual impacts at sites 2.24A, 2.24B, and 2.24C	Negligible visual impacts at site 2.05	Negligible visual impacts at site 2.05. Minor impacts at site 2.35.
SOCIAL							

** HEP evaluation was not performed for this alternative.

THALWEG DISPOSAL

Thalweg disposal is not recommended in lower pool 2 at this time. Predictive capability for sediment transport is not sufficiently quantifiable to permit analysis of the effects downstream. In addition, the bottom sediments in this reach of pool 2 are classified as contaminated. Should these two problems be resolved, the possibility of thalweg disposal in the future would be reevaluated.

POTENTIAL GEOTECHNICAL IMPACTS

The impacts of dredged material placement on underground utilities, groundwater, subsurface foundations and existing embankment structures were not considered necessary to distinguish viable alternative plans in the reconnaissance level investigation. However, the following discussion of potential geotechnical impacts relates to the kind of information that will be addressed prior to implementation.

It has been proposed that existing structures, such as roads, railroad and dam embankments, act as dredge disposal containment dikes or as containment boundaries on one or more sides. At a minimum, fill will be placed to the embankment top elevation, with the option of increasing the fill a number of feet above that elevation. The impacts of placing fill adjacent to existing embankments depends on many variables. For example, existing embankment materials range from pervious to impervious or some combination. If the existing embankments are pervious, they may become unstable if water is ponded and seepage occurs through the embankment. Calculations show that uncompacted sand slopes will be stable during seepage if they are 1V on 5H or flatter. In most instances, existing embankments are compacted with 1V on 2H to 1V on 3H side slopes. Calculations show that compacted embankments have increased stability but only slightly. On the other hand, if the existing embankments are impervious, ponded water will pass through the foundation under the embankment. If the head is great enough, piping could result, which could cause failure of the embankment. If the water is allowed to flow back into the river or surrounding area without ponding, seepage problems would be less likely; however, the additional weight of the fill on the structure foundation could cause an unstable structure or settlement of the structure. Embankments may experience differential settlements, or settlement which would require annual maintenance.

The construction of containment dikes near streams or rivers could cause unstable dike and/or river side slopes, depending on foundation characteristics and the total height of dike. In addition, there is the potential that abandoned gravel pits may be a source of groundwater recharge. Thus, groundwater contamination could result from disposal at these sites.

MATRIX EVALUATION

The dredged material placement evaluation matrix (see table 7), developed during the Upper Mississippi River Basin Commission Study, is used here, with some modifications, to compare alternatives. Although the matrix has recognized limitations, it is a useful tool for comparing different channel maintenance plan alternatives with multi-faceted impacts. The evaluation criteria used in assigning values to the various matrix components are discussed in Appendix F.

DISCUSSION

Based on the total matrix evaluation scores, alternative C3 is the best overall dredged material placement plan, while alternative C2 ranks a very close second. Alternative C1 and D rank third and fourth respectively with somewhat lower matrix scores. Alternatives E, A1, and B rank fifth, sixth, and seventh respectively with significantly lower matrix scores. From a site availability standpoint, alternatives B, C2, and C3 rank highest since all of the DMP sites for these alternatives are federally owned. Alternatives A1, C1, and E rank last in this category. In terms of dredging costs, alternative B ranks highest with the lowest overall cost and alternative A1 ranks last with the highest cost. Alternative C3 has the second highest cost of all the alternatives. Alternative D has the highest active beneficial use ranking with 100 percent of the material placed scheduled for use. Alternative B ranks last since beneficial use is not feasible with the placement sites used in this alternative. Water quality impacts are minor for all of the alternatives since all dredging would be done by mechanical methods. Alternatives A1, C1, and E would have no water quality impact. Alternatives C2 and C3 would have a positive impact on water quality at Spring Lake. Alternative B has the greatest negative impact on the aquatic/terrestrial ecosystem followed by alternatives E, C1, A1, and D respectively. Alternatives C2 and C3, however, would have a positive impact in the Spring Lake enhancement area. Cultural resources would not be impacted under alternatives B, C2, C3, and D. Alternatives A1, C1, and E involve the use of site 2.35 and a survey would be required at this site. In terms of recreational, visual, and social impacts, all of the alternatives are closely ranked. Alternative C3 has the highest recreational ranking because of potential recreational enhancement in the Spring Lake Park Reserve area.

TABLE 7
DREDGED MATERIAL PLACEMENT EVALUATION MATRIX

ALTERNATIVE	ECONOMIC			ENVIRONMENTAL		CULTURAL	SOCIAL			TOTAL
	Site Availability R x 6 = S	Dredging Costs R x 15 = S	Benefits R x 9 = S	Water Quality R x 8 = S	Aquatic/ Terr. Ecosystem R x 22 = S	Cultural Resources R x 5 = S	Recreation R x 5 = S	Visual Impacts R x 1 = S	Social Impacts R x 4 = S	
A1	-1.25 / -7.5	-2.25 / -33.75	2.25 / 20.25	0 / 0	-1.25 / -27.5	-0.4 / -2.0	0.2 / 1.0	-2.2 / -2.2	-1.8 / -7.2	-58.9
B	0 / 0	0 / 0	0 / 0	-1.0 / -8.0	-2.50 / -55.0	0 / 0	-0.3 / -1.5	-2.5 / -2.5	-1.4 / -5.6	-72.6
C1	-1.25 / -7.5	-0.25 / -3.75	2.0 / 18.0	0 / 0	-1.0 / -22.0	-0.4 / -2.0	0.8 / 4.0	-2.2 / -2.2	-1.5 / -6.0	-21.45
C2	0 / 0	-0.25 / -3.75	2.75 / 24.75	-0.75 / -6.0	0.25 / 5.5	0 / 0	1.3 / 6.5	-1.7 / -1.7	-1.6 / -6.4	18.9
C3	0 / 0	-1.75 / -26.25	2.75 / 24.75	-0.5 / -4.0	1.0 / 22.0	0 / 0	2.0 / 10.0	-1.7 / -1.7	-1.6 / -6.4	18.4
D	-0.5 / -3.0	-1.0 / -15.0	3.0 / 27.0	-1.0 / -8.0	-0.75 / -16.5	0 / 0	0.2 / 1.0	-0.75 / -0.75	-1.9 / -7.6	-22.85
E	-1.25 / -7.5	-0.5 / -7.5	2.25 / 20.25	0 / 0	-2.0 / -44.0	-0.4 / -2.0	0.2 / 1.0	-2.2 / -2.2	-1.7 / -6.8	-48.75

RECOMMENDED DREDGED MATERIAL PLACEMENT PLAN

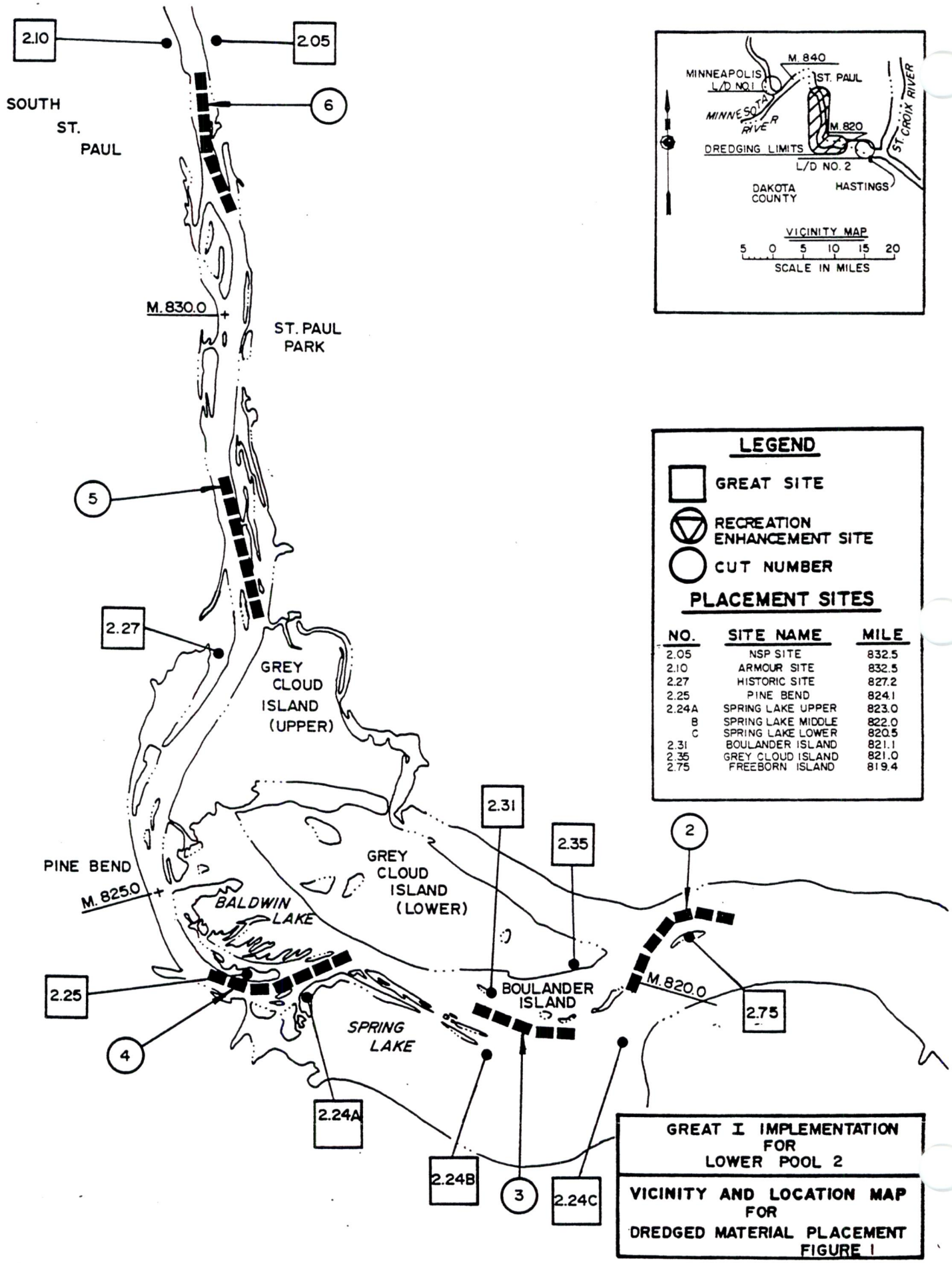
The purpose of the previous alternative evaluation and discussion in the technical appendixes is to provide a rationale for recommending a dredging material placement plan for lower pool 2 that is economical, reflects sound engineering judgment, minimizes adverse environmental impacts, and is operationally implementable. It should be noted that the following recommended plan for dredged material placement in lower pool 2 is based on survey information of expected beneficial use and historic dredge cut depths modified by estimates of Most Probable Future with GREAT (MPFWG) conditions. It is intended as a guide for management of the St. Paul District's channel maintenance program involving permanent dredged material placement sites over the 40-year plan period from 1986 to 2025. It is expected that as additional information becomes known (i.e., beneficial use, secondary movement, etc.), appropriate changes will be made to the plan.

PROPOSAL AND RATIONALE

The recommended plan for dredged material disposal for lower pool 2 is alternative C3 as described in this report. Implementation of this alternative would cost $8,177,900 or $1,074,100 more than the least costly alternative. All of the dredged material under this plan would be placed in a dike configuration to provide complete closure of Spring Lake to main channel flows. The dike would be constructed to a 17-year level of flood protection. This action would improve water quality in Spring Lake and enhance recreational potential in this area. In addition, the sediment transport capabilities of the main channel may be increased thereby reducing the amount of dredging in the Boulanger Bend area of the river. All of the material placed under this alternative would serve a passive beneficial use. The DMP sites are federally owned and would not require acquisition. Benefits to recreation and the aquatic/terrestrial ecosystem are higher for this alternative than for the other alternatives.

IMPLEMENTATION SCHEDULE

Following completion of the review and approval process for this report, the Corps will immediately initiate the actions necessary for implementing the recommended plan. Appropriate state and federal permits will be requested. Formal permission will be obtained from the landowners involved or, if necessary, site acquisition measures will begin. The recommended placement sites will initially be prepared and used within existing equipment capability and funding allocations. Specific funds for implementing the plan will be requested in the next formal budget submittal. Required equipment improvements and modifications will be scheduled through the normal Plant Replacement and Improvement Program (PRIP). If necessary, existing equipment will be supplemented with contract capability as funding allows.


2.10
2.05
SOUTH ST. PAUL
6
M. 830.0
ST. PAUL PARK
5
2.27
GREY CLOUD ISLAND (UPPER)
2.31
2.35
2
PINE BEND
M. 825.0
GREY CLOUD ISLAND (LOWER)
BALDWIN LAKE
2.25
BOULANDER ISLAND
M. 820.0
2.75
4
SPRING LAKE
2.24A
2.24B
3
2.24C
MINNEAPOLIS L/D NO. 1
M. 840
ST. PAUL
MINNESOTA RIVER
M. 820
ST. CROIX RIVER
DREDGING LIMITS
L/D NO. 2
DAKOTA COUNTY
HASTINGS
VICINITY MAP
5 0 5 10 15 20
SCALE IN MILES
LEGEND
GREAT SITE
RECREATION ENHANCEMENT SITE
CUT NUMBER
PLACEMENT SITES
NO. SITE NAME MILE
2.05 NSP SITE 832.5
2.10 ARMOUR SITE 832.5
2.27 HISTORIC SITE 827.2
2.25 PINE BEND 824.1
2.24A SPRING LAKE UPPER 823.0
B SPRING LAKE MIDDLE 822.0
C SPRING LAKE LOWER 820.5
2.31 BOULANDER ISLAND 821.1
2.35 GREY CLOUD ISLAND 821.0
2.75 FREEBORN ISLAND 819.4
GREAT I IMPLEMENTATION FOR LOWER POOL 2
VICINITY AND LOCATION MAP FOR DREDGED MATERIAL PLACEMENT
FIGURE 1

APPENDIX F

SPRING LAKE EVALUATIONS

PROBLEM APPRAISAL REPORT

CHANNEL MAINTENANCE PLAN FOR LOWER POOL 2 MISSISSIPPI RIVER AND SPRING LAKE REHABILITATION

Department of the Army
St. Paul District, Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

January 1991

TABLE OF CONTENTS

	Page
1.00 Introduction	1
Authority	1
Purpose	1
Planning Process	1
Project Planning Team	2
2.00 Project Area	2
3.00 Existing Conditions	5
Geomorphology	5
Hydrology	5
Sediment Transport	7
Water Quality	9
Eutrophication	11
Dissolved Oxygen	11
Water Temperature	12
Light Penetration	12
Contaminants	13
Pathogens	13
Vegetation	13
Aquatic and Wetland Vegetation	13
Terrestrial and Floodplain Vegetation	17
Fish and Wildlife	17
Terrestrial Wildlife	17
Waterfowl	17
Benthos	20
Fish	20
Threatened and Endangered Species	20
Habitat Types and Distribution in Spring Lake	20
Aquatic Habitat	21
Wetland Habitat	21
Island Habitat	23
Cultural Resources	23
Recreational Use	23
4.00 Future Conditions Without the Project	23
Sediment Transport and Future Geomorphic Changes	24
Future Hydrologic Conditions	24
Water Quality	24
Vegetation	24
Future Habitat Types and Distribution	25
Future Fish and Wildlife Use of Spring Lake	25
Future Recreational Use	25
5.00 Resource Management Goals for the Project Area	26
Corps of Engineers	26
Dakota County and Metropolitan Council	26
Washington County	26
Minnesota Department of Natural Resources	27
Minnesota Pollution Control Agency	27
U.S. Fish and Wildlife Service	27
National Park Service	27
C.F. Industries	27

TABLE OF CONTENTS (continued)

	Page
6.00 Habitat Improvement Goals	28
Aquatic Habitat	28
Wildlife Habitat	28
7.00 Planning Opportunities	28
Availability of Channel Maintenance Dredged Material	28
Availability of a Numerical Hydraulic Model	29
Development of the Spring Lake Regional Park Reserve	29
Upper Mississippi River Environmental Management Program	30
Pool 2 Beach Development Plan	30
Water Control Capability	30
8.00 Planning Constraints	30
Hydrologic Constraints	30
Engineering Constraints	31
Ecological Constraints	31
Legal Constraints	31
Navigation Constraints	32
Economic Constraints	32
9.00 Conceptual Alternative Plans	32
Early Proposals	32
Corps of Engineers Recent Channel Maintenance Activities	32
Corps 1984 Draft Channel Maintenance Plans	33
10.00 Proposed Conceptual Plan	35
Sources of Dredged Material	35
Phased Construction	37
Structural Features	37
Dike System	37
Islands	38
Wetland Development	38
Beaches	38
Habitat Improvement Features	38
11.00 Information Needed for Further Project Planning and Design	39
Bathymetric/Topographic Survey	39
Substrate Survey	39
Hydraulic Model	39
Water Quality Predictive Analyses	39
Dredge Cut and Placement Site Material Testing	39
Survey of Historic Dredged Material Placement Sites	40
Habitat Analyses	40
12.00 Steps Prior to Project Construction	40

LIST OF TABLES

Table Number	Title	Page
1	Physical characteristics of surficial sediment from Spring Lake	14
2	Aquatic vegetation in Spring Lake, 1981	18
3	Area of habitat types in Spring Lake	22

LIST OF FIGURES

Figure Number	Title	Page
1	Lower pool 2 and historic dredge cuts	3
2	Spring Lake location map	4
3	Spring Lake bathymetry	6
4	Computed backwater curves, pool 2	8
5	Sediment types in Spring Lake	10
6	Aquatic vegetation in Spring Lake	19
7	Dredged material placement alternatives from Draft Reconnaissance Report for Lower Pool 2	34
8	Conceptual plan for Spring Lake rehabilitation	36

INTRODUCTION

1.00 The U.S. Army Corps of Engineers, St. Paul District, is implementing a long-term Channel Maintenance Plan (CMP) for the Upper Mississippi River. The CMP consists of a series of recommended dredged material placement sites for the maintenance of the 9-foot navigation channel during the 40-year period from 1986 to 2025. This problem appraisal report addresses the feasibility of using channel maintenance dredged material to rehabilitate Spring Lake. This report addresses the dredge cuts and dredged material placement sites for lower pool 2, river miles 815.2 to 828.3.

Authority

1.01 This study is conducted under the operation and maintenance authorities of the Corps of Engineers. Authority for construction, operation and maintenance of the Upper Mississippi River 9-Foot Channel project was provided by the River and Harbor Acts of July 3, 1930; February 24, 1932; and August 30, 1935; and in the Resolution of the House Committee on Flood Control, September 18, 1944.

Purpose

1.02 The St. Paul District needs to develop a long-term channel maintenance plan for lower pool 2 of the Mississippi River. The plan will involve the use of dredged material to improve the condition of Spring Lake. The project will provide for long-term placement of dredged material from lower pool 2 and should contribute to:

- Reduced long-term channel maintenance dredging requirements
- Reduced long-term channel maintenance costs
- Full development of the Spring Lake Park Reserve
- Improvement of Spring Lake water quality
- Improvement of Spring Lake fish and wildlife habitat

Planning Process

1.03 The channel maintenance plan for lower pool 2 and Spring Lake rehabilitation is being systematically planned to meet a number of different objectives. This planning effort is being conducted in close coordination with the agencies having management responsibilities for the lower pool 2 reach of the Mississippi River. This Problem Appraisal report is intended to document the extent of the project area, describe existing and probable future conditions in Spring Lake, identify the resource management goals for the project area, identify planning constraints and opportunities, identify habitat objectives for the project area, and describe various alternative plans for long-term channel maintenance in lower pool 2 and Spring Lake rehabilitation.

1.04 Following completion and approval of this Problem Appraisal report, alternative plans will be compared; a public meeting will be held; a proposed plan will be selected, developed in detail, and designed; and a Project Design report will be prepared. A National Environmental Policy Act document will be prepared for the project and coordinated with interested agencies and the public. After completion and approval of the Project Design report, plans and specifications will be prepared, and construction will proceed. The plan will guide future channel maintenance and dredged material placement actions.

Project Planning Team

1.05 Coordination was carried on through a series of agency meetings starting in March 1989. The agencies involved and principal study team contacts are:

Metropolitan Council	Jack Mauritz
Dakota County Parks, Minnesota	Chuck Lowry
U.S. Fish and Wildlife Service	Gary Wege
Minnesota Pollution Control Agency	Louis Flynn
Minnesota Department of Natural Resources	Steve Johnson
Wisconsin Department of Natural Resources	John Sullivan
Washington County, Minnesota	Jim Luger
National Park Service	Alan Hutchings
U.S. Army Corps of Engineers	Mark Lisney

PROJECT AREA

2.00 Lock and dam 2 is located at river mile 815.2 near Hastings, Minnesota. Pool 2, which is located entirely within Minnesota, extends upstream through St. Paul and Minneapolis, Minnesota. Upper pool 2 upstream from river mile 829 is largely confined by high bluffs and is heavily developed with residential, commercial, and industrial establishments. The Minnesota River enters pool 2 near Fort Snelling. Downstream from river mile 829 to lock and dam 2, the pool broadens and is considerably less developed.

2.01 This report addresses channel maintenance requirements for lower pool 2, including five river reaches where maintenance dredging has historically been necessary, between river miles 815.5 and 828.3 (figure 1).

2.02 Spring Lake is a backwater area and is the dominant open water feature of lower pool 2. Spring Lake covers about 1,850 acres between river miles 820.3 and 823.3. The boundaries of the Spring Lake project area are defined by a series of former natural riverbank levees that, following closure of lock and dam 2, formed a chain of islands around most of the perimeter of Spring Lake (figure 2.)

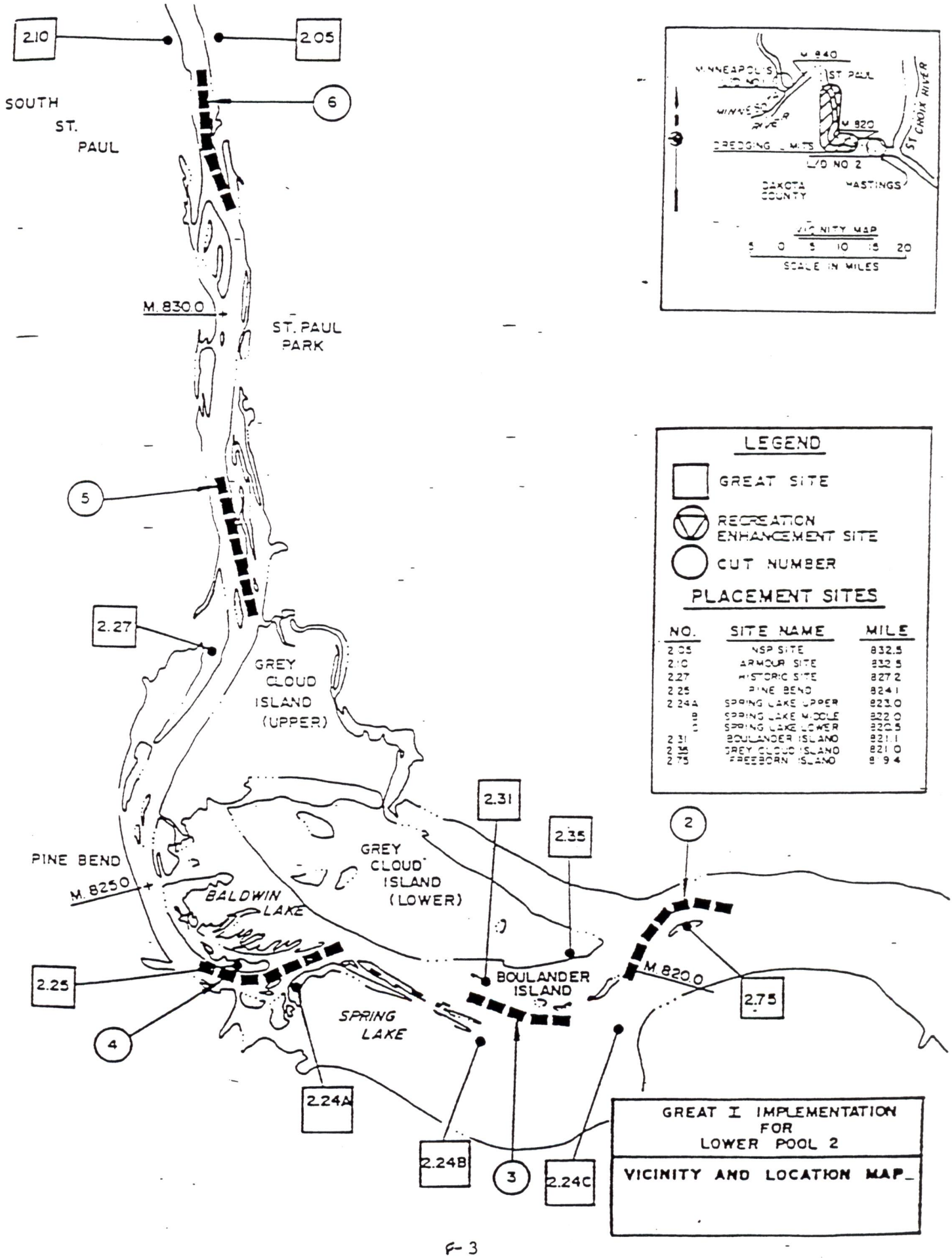


Figure 1. Lower pool 2 and historic dredge cuts.

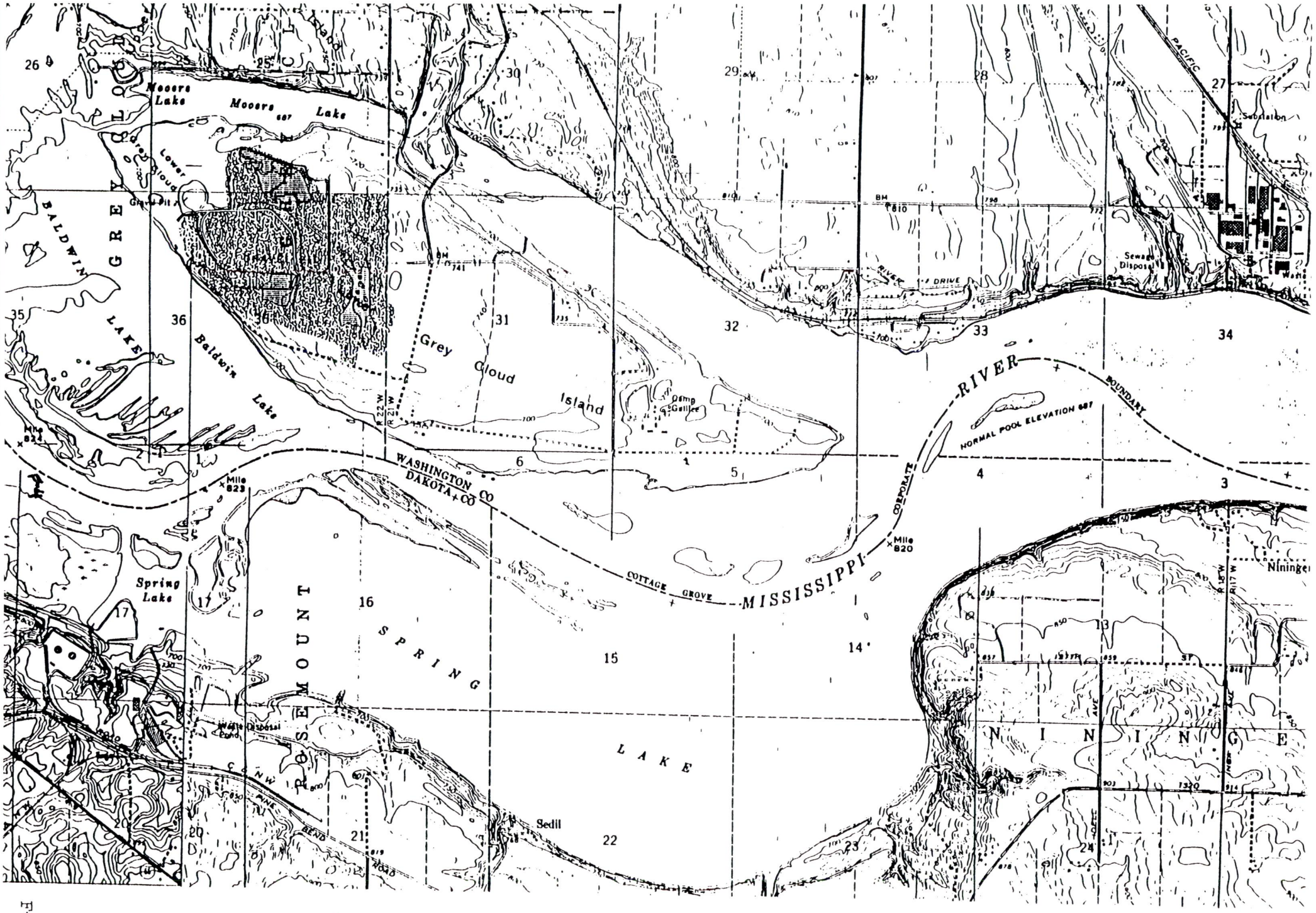


Figure 2. Spring Lake Location Map.

EXISTING CONDITIONS

Geomorphology

3.00 The Spring Lake project area is located in the valley of the Mississippi River which was enlarged during glacial times by drainage from glacial Lake Agassiz. The valley is flanked by river terraces and limestone bluffs. Before construction of lock and dam 2, the Spring Lake area was floodplain forest and marsh, with an abandoned channel lake along the south side. A series of natural river levee islands separated the Spring Lake area from the main channel of the river.

3.01 Since closure of lock and dam 2 in 1931, the natural river levee islands have been increased in size by additions of dredged material from channel maintenance actions.

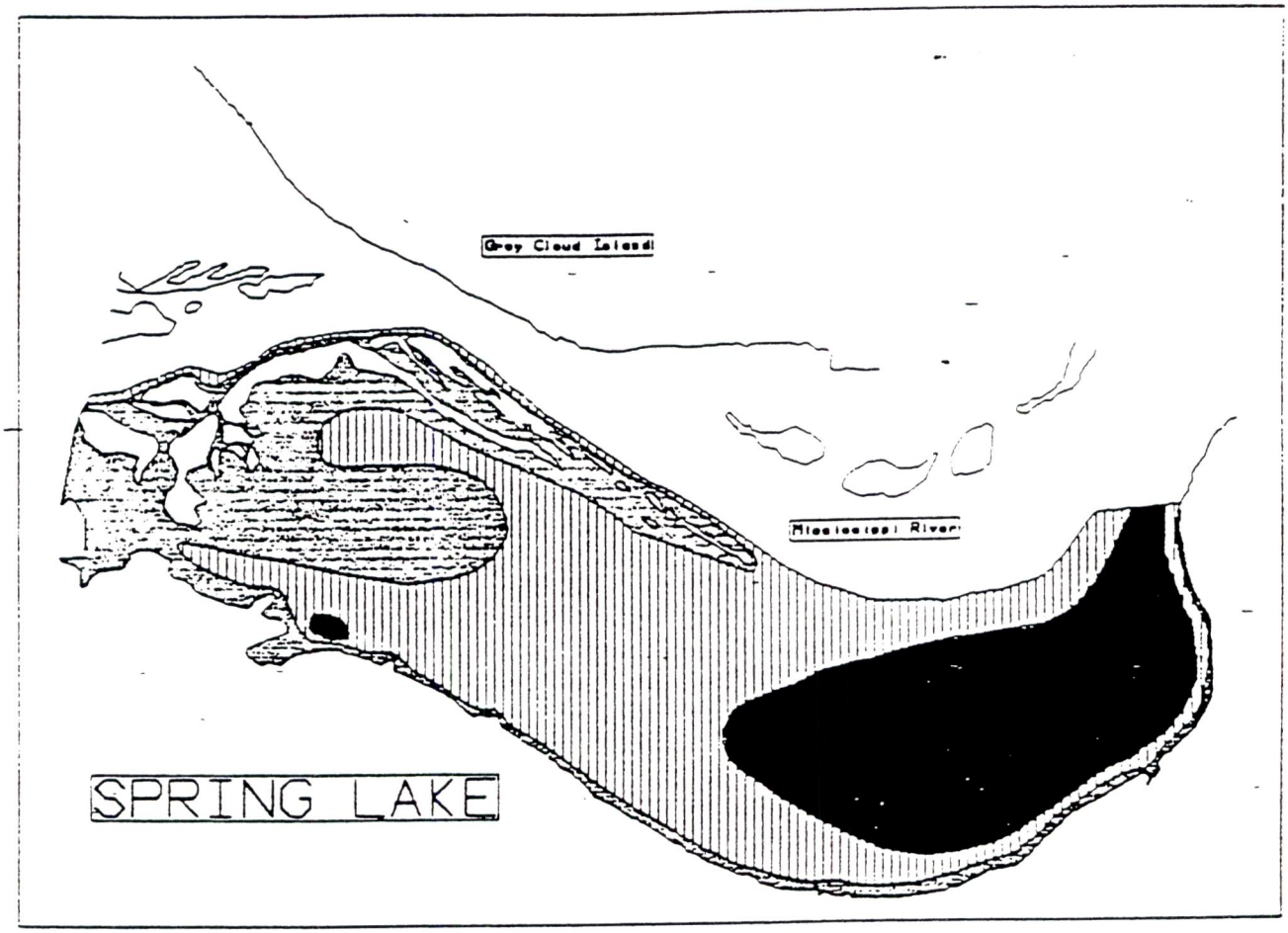
3.02 Spring Lake is shallow, with a median depth of 4.4 feet and a maximum depth of 15 feet (figure 3). Most of the bed of Spring Lake is formed of silty vertical accretion deposits over sand and clay (E.A. Hickok and Associates in: Metropolitan Council 1974). The former ridge-and-swale floodplain topography that supported floodplain forest along the river side of the former Spring Lake marsh prior to inundation has been reworked since inundation, leaving a relatively shallow, flat lake bottom with accumulations of woody debris.

3.03 The limestone bluffs along the south side of Spring Lake have been eroded by intermittent streams that have carved ravines into the bluff face and formed small alluvial deltas which extend into Spring Lake.

Hydrology

3.04 Pool 2 extends 32.5 river miles upstream on the Mississippi River to Lock and Dam 1 in St. Paul, and 25 miles up the Minnesota River. The Mississippi River portion of pool 2 covers 9,652 acres.

3.05 The drainage area upstream of lock and dam 2 is approximately 37,000 square miles. River discharge has ranged from a low of approximately 632 cubic feet per second (cfs) in 1932 to 171,000 cfs in 1965. Average river discharge is about 11,000 cfs. Peak annual runoff usually occurs in the spring from snowmelt and early rains. Summer thunderstorms cause temporary increases in discharge. Low river discharge usually occurs in late summer, followed by increases from fall rains. Winter discharge during ice conditions is usually quite constant in the 7,000 to 9,000 cfs range.





1 < 2 feet
2 2 - 5 feet
3 > 5 feet

Figure 3. Spring Lake bathymetry.

3.06 Lock and dam 2 is operated to maintain the 9-foot navigation channel, according to regulation strategy described in a Reservoir Regulation Manual. A control point for pool elevation has been established at South St. Paul, Minnesota, where the project pool elevation of 687.2 feet NGVD (National Geodetic Vertical Datum) is maintained by operation of lock and dam 2 until river discharge exceeds 12,000 cfs. At this discharge, a maximum allowable drawdown of the pool at the upstream face of the dam is 0.7 foot to elevation 686.5. As river discharge increases above 12,000 cfs, the pool elevation at the dam is held at 686.5, and the stage at all other points in the pool rises. When river discharge exceeds 40,000 cfs, all the operable dam gates are opened and open river conditions prevail.

3.07 Because of the river gradient, surface elevations in pool 2 increase with distance upstream. This tilted plane of water surface elevation varies with river discharge and dam operation. Figure 4 illustrates water surface elevations in the main channel by river mile upstream from lock and dam 2. Water surface elevations of Spring Lake closely follow elevations in the main channel, except during periods of rapidly changing river discharge or strong wind events. At such times, the water surface elevation in Spring Lake can be expected to differ from the main channel by up to about 1 foot.

3.08 Ice usually forms across most of Spring Lake in the winter, to a thickness of up to 2 feet. Ice-free areas at the upstream end of the lake and at places along the south shore remain open due to inflowing current and groundwater discharge from springs. Wind-driven ice scours the shorelines of Spring Lake during breakup.

Sediment Transport

3.09 Sediment transport through pool 2 is greatly influenced by sediment yield of the Minnesota River. Draining over 16,000 square miles of intensively farmed watershed, the Minnesota River has been estimated to yield 0.24 ton of fine-grained sediment per square mile of drainage area annually. The median suspended solids concentration of the Minnesota River at Jordan was 137 mg/l, the highest measured in Minnesota rivers (Tornes 1986). Sediment contribution to pool 2 from the Mississippi River is minimal in comparison.

3.10 Bed load sediment transport through lower pool 2 has not been estimated. Dredging records from 1970 through 1989 indicate that an average of 56,700 cubic yards has been dredged annually from lower pool 2. There is movement of river bed load material into Spring Lake, mostly through the inflowing channels at the upstream end of the lake. Sand deltas have formed where this bed load material is deposited where the channels enter the lake. The delta area at the upstream end of Spring Lake consists of shallow, sparsely-vegetated sand flats and supports some stands of emergent aquatic vegetation.

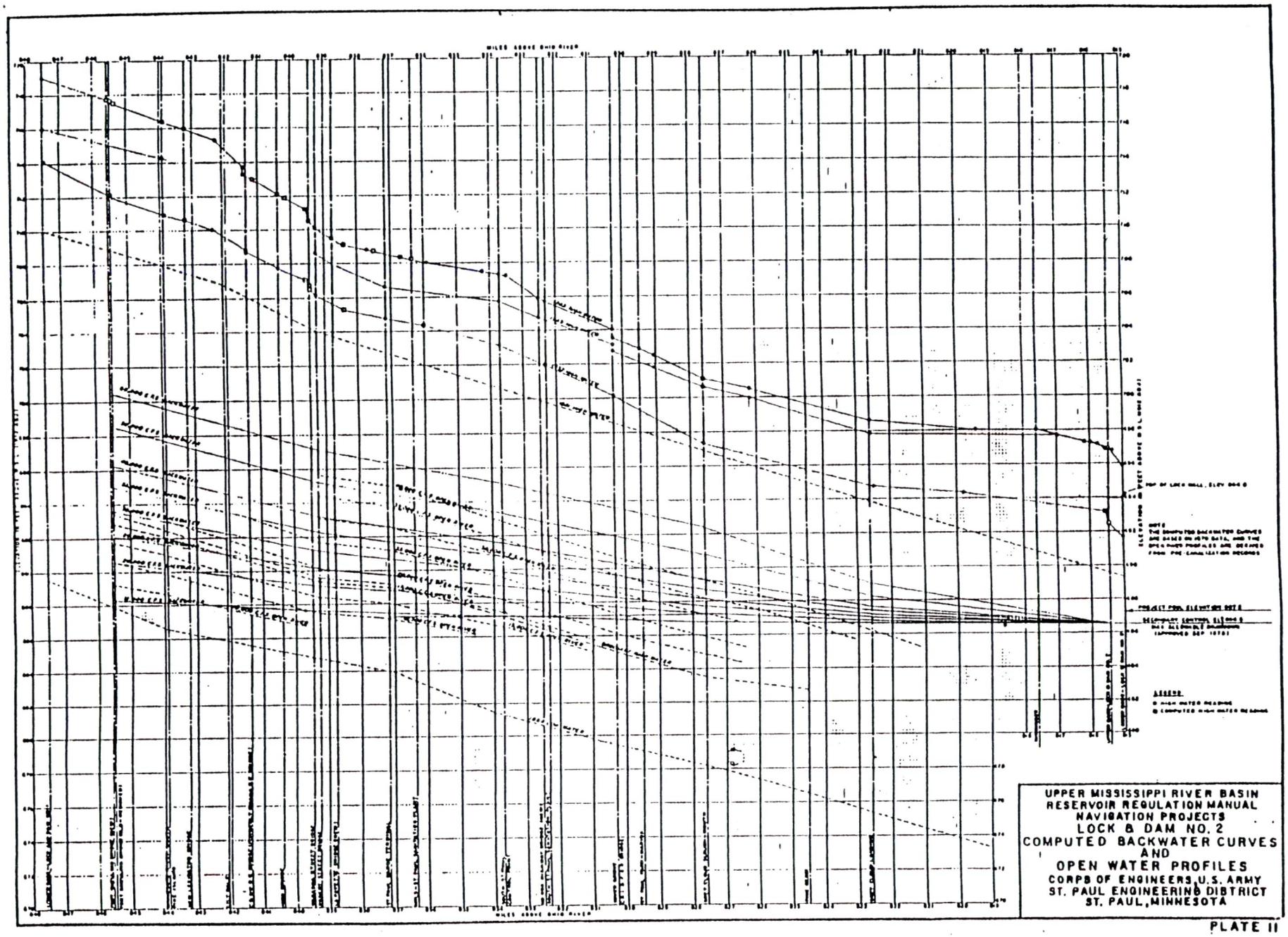


Fig. 4. Computed backwater curves, pool 2

3.11 Suspended solids concentrations in Spring Lake are normally high during the open water season, due to high suspended solids concentrations of inflowing Mississippi River water, and resuspension of lake bed sediments by wind-driven waves and bottom-feeding fish. The accumulation rate of sediment in Spring Lake has not been measured. There appears to have been a general leveling of bed elevation in Spring Lake since closure of lock and dam 2, due to sediment deposition and wind-induced resuspension and redistribution of material. There does not appear to be a high rate of sediment accumulation in Spring Lake. Extensive areas remain 3 to 5 feet deep.

3.12 Bed material in Spring Lake is mostly fine-grained silt and clay, with a fairly high water content and relatively little organic matter. Table 1 shows the physical characteristics of material collected from Spring Lake in November 1988. A survey conducted by E.A. Hickok and Associates in 1973 revealed that most of the lake bed is fine-grained silt, and a strip of sandy substrate exists along the south shore of the lake (figure 5). The substrate type distribution illustrated on figure 5 is only approximate, based on borings made on widely-spaced transects. Sandy substrate in Spring Lake is restricted to a fairly narrow strip along the south shore, where wave action scours the lake bottom free of silt. Minor coastal features (small points and bars) exist along the south shore of the lake where alluvial deposits from the intermittent streams have been reworked by wave action. Some sandy substrate areas exist in the inflowing channels and in bed load deposits at the upstream end of the lake. Woody debris accumulations that are remnants of former wooded floodplain areas exist in the upper third of the lake. Woody debris contributed from the Minnesota River may be a continuing source of logs and stumps in the shallow areas at the upper end of Spring Lake.

Water Quality

3.13 The water quality of Spring Lake is characterized by moderately hard water, high concentrations of plant nutrients, high concentrations of suspended solids and nuisance blue-green algae blooms during the open water season. Spring Lake has a wind fetch of nearly 3 miles and an east-west orientation. Wave action readily resuspends the fine-grained bottom sediment.

3.14 Pool 2 of the Mississippi River is classified by the Minnesota Pollution Control Agency as a Class 2C water body, suitable for fisheries and recreation, but not suitable for body contact recreation such as swimming.

3.15 Considerable water quality data is available for pool 2, collected by the Metropolitan Waste Control Commission, the Minnesota Pollution Control Agency, several investigators from the University of Minnesota, the Minnesota Department of Natural Resources, the Corps of Engineers, and the U.S. Environmental Protection Agency. Water quality in pool 2 has historically been

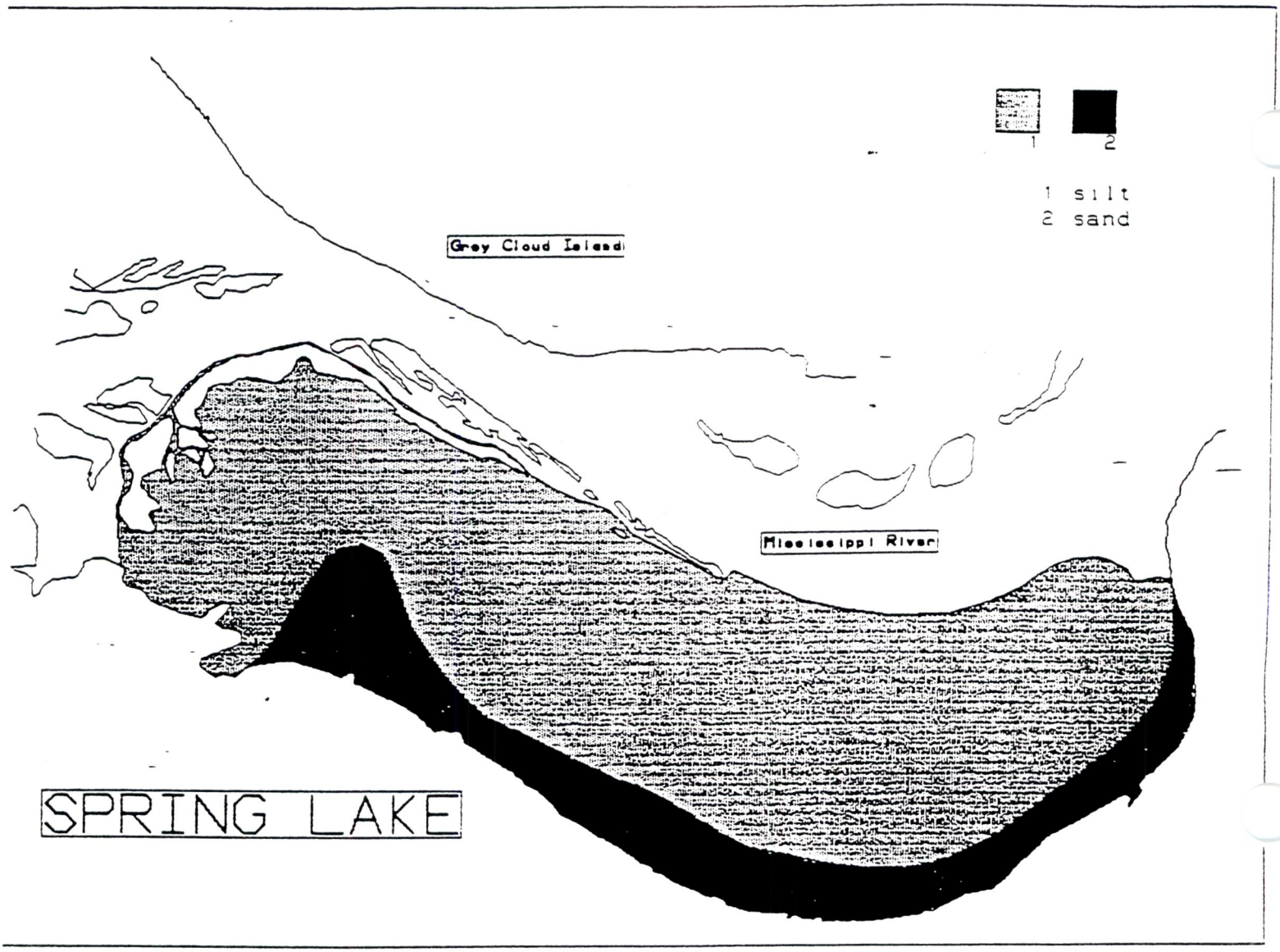


Figure 5. Sediment types in Spring Lake.

poor, with excessive loadings of sediment and plant nutrients from the Minnesota River, and loadings of oxygen-demanding materials, plant nutrients, and contaminants from the metropolitan area upstream. Improvements in waste treatment, primarily at the Metropolitan Waste Control Commission Metro Plant, have resulted in greatly improved water quality in recent years.

Eutrophication

3.16 Loadings of nitrogen and phosphorus to the Spring Lake reach of the Mississippi River are very high. EPA (1975) estimated that annual loading was 5,650,550 pounds of phosphorus and 67,483,870 pounds of nitrogen in 1972. About half of the phosphorus loading was estimated to come from non-point sources. EPA concluded that Spring Lake received an excessive annual load of phosphorus. They also concluded that complete removal of phosphorus loading from point sources would still leave sufficient phosphorus loading to sustain eutrophic conditions in the lake. Internal loading of phosphorus from the lake sediments probably occurs. During the summer, windless periods probably allow development of anoxic conditions at the sediment surface and mobilization of phosphorus from the sediments into the water column.

3.17 Unionized ammonia concentrations may occur at concentrations toxic to aquatic life at times during the summer months when rapid organic decomposition coincides with periods of high algal activity and high pH.

3.18 The algal community in Spring Lake is characteristic of north temperate eutrophic lakes, with spring diatom blooms rapidly giving way to nuisance blue-green algae blooms. Several factors limit algal densities in the lake despite the high nutrient loading rates. The hydraulic residence time is estimated to be only 2.5 days (at 9,895 cfs river discharge)(EPA 1975). Also, the high suspended solids concentrations limit light penetration into the water. Megard et al. (1979) found mean chlorophyll concentrations of 246 ug/l in Spring Lake. They concluded that the shallow (<1m) mixed layer in Spring Lake during periods of low flow and temporary stratification allowed the high concentrations of algae to develop by concentrating the algae above a shallow thermocline. They also concluded that algae in the water column attenuated an average 67% of the subsurface light when chlorophyll a concentrations were at 200 ug/l.

Dissolved Oxygen

3.19 Dissolved oxygen in Spring Lake is no longer directly affected by loading of oxygen demanding materials from the waste treatment plants upstream. Dissolved oxygen concentrations in the main channel now only rarely are less than the stream standard of 5 mg/l. Oxygen concentrations in Spring Lake and lower pool 2 are greatly affected by algal activity during summer low flow periods, however. Megard, et al. (1979) measured oxygen production and respiration rates by algae in the lake. They demonstrated that

algal photosynthesis and respiration can exert a considerable influence on dissolved oxygen which results in marked diel swings in oxygen concentration.

3.20 Stefan and Wood (1976) developed a hydrodynamic model of lower pool 2 and investigated factors affecting dissolved oxygen concentration. They observed high daytime dissolved oxygen concentrations in Spring Lake that are the result of surface aeration by wind and algal photosynthesis. They concluded that dissolved oxygen in lower pool 2 is greatly affected by algal activity and mixing between the main channel and backwater areas. Daily oxygen contribution from these backwater areas to the main channel can be expected to vary, by time of day, with algal activity and degree of wind and convective mixing between the backwater areas and the main channel. Wide diel fluctuations in dissolved oxygen in the backwaters could result in nighttime depression of dissolved oxygen concentration in the main channel as well as daytime contribution. These effects are most critical during summer extreme low flow conditions.

3.21 Critical (below 5 mg/l) dissolved oxygen concentrations in Spring Lake occur at night during the summer, due to algal respiration. There have been no reports of low winter dissolved oxygen or fish kills in Spring Lake. Flow through Spring Lake is probably sufficient to maintain winter dissolved oxygen.

Water Temperature

3.22 The seasonal temperature regime of Spring Lake is influenced by ambient temperature of inflowing Mississippi River water, wind, air temperature, cloud cover, groundwater inflow, ice cover, and heat transfer from the bottom. Maximum water temperatures in Spring Lake occur in the summer in shallow water on sunny days and may exceed 27 degrees C. Winter temperatures in Spring Lake have not been measured, but may be in excess of 2 degrees C in areas protected from current and in areas with groundwater inflow. Winter water temperatures in areas with discernible current are probably close to 0 degrees C.

3.23 Stefan and Wood (1976) concluded that temporary stratification develops in the summer months in Spring Lake, that is disrupted by wind-induced water movement and convective mixing caused by nighttime cooling.

Light Penetration

3.24 The high suspended solids concentrations common in Spring Lake attenuate light, limiting depth of penetration into the water. Megard (1980a) found Secchi transparency to be less than 0.5 m in Spring Lake when algal concentrations were at 200 ug/l chlorophyll a. Megard et al. (1979) found a strong correlation between chlorophyll a and suspended particulate matter in lower pool 2. Algae in Spring Lake contribute greatly to attenuation of light, and limit light penetration to a very thin surface layer during the summer months.

3.25 Light penetration in the water column is limited by suspended inorganic materials during periods of higher river discharge and strong wind.

Contaminants

3.26 Loadings of toxic metals, chlorinated hydrocarbons, and pesticides have deteriorated water quality in pool 2. Although concentrations of these substances in the water are very low, PCB's and mercury have accumulated in the system and occur in unacceptable concentrations in fish. Bulk chemical analyses of dredge cut sediments are available that show that pool 2 main channel sediments are among the more contaminated on the Upper Mississippi River. Bulk chemical results of a limited sampling of Spring Lake sediment (table 1) revealed that concentrations of cadmium, copper, mercury, lead, and zinc were somewhat higher than those for other Mississippi River backwater sediments. Chlorinated hydrocarbons, pesticides, and PCB's were not detected in these samples.

3.27 Most contaminants in rivers are associated with the silt and clay size fractions of the sediment. Transport and accumulation of contaminants in lower pool 2 is closely tied to the sediment transport regime. There has been no investigation of the mass transport of contaminants through the study reach. Of the total amount of sediment and associated contaminants that enter the study reach, only a small fraction may permanently accumulate in Spring Lake.

3.28 The Minnesota State Health Department has issued a fish consumption advisory that recommends not to eat fish taken from the Mississippi River downstream of St. Anthony Falls more than once per month because of contamination by PCB's and mercury.

Pathogens

3.29 Fecal coliform concentrations have improved steadily in lower pool 2 from zero percent compliance with the State water quality standard in 1978 to infrequent exceedences in recent years (Terry O'Day pers. comm. 1991). The highest concentration of fecal coliform bacteria found in the main channel at river mile 821.8 adjacent to Spring Lake in 1990 was 85/ml. The State water quality standard during March through October is a monthly geometric mean not to exceed 250/ml, with no sample exceeding 2,000/ml. The Spring Lake reach of the river is still classified by the State as a 2C stream, that does not have sufficient quality for swimming.

Vegetation

Aquatic and Wetland Vegetation

3.30 Aquatic vegetation in Spring Lake is limited in species composition, density, and areal extent (Minnesota DNR 1981), (EA

Table 1. Results of bulk chemical analysis of surficial sediment from Spring Lake Pool 2, Mississippi River, taken November 14, 1988.

Parameter	Unit	Detection Limit	Sample 1	2	3
Total solids	%	0.1%	45.1	46.2	53.9
Volatile solids	%	0.1%	13.8	13.1	11.2
Total organic carbon	mg/kg	1.00	11100	12100	31100
Sand	%	0.1%	3.8	4.3	8.2
Silt + clay	%	0.1%	96.2	95.7	91.2
Ammonia N	mg/kg	0.200	18.9	22.7	13.5
Cyanide	mg/kg	0.500	<0.500	<0.500	<0.500
Arsenic	mg/kg	0.820	5.67	4.94	3.95
Cadmium	mg/kg	0.800	1.67	1.14	0.54
Total Chromium	mg/kg	0.600	23.8	19.0	16.1
Copper	mg/kg	0.600	32.4	20.6	14.3
Mercury	mg/kg	0.02	0.18	0.17	0.12
Manganese	mg/kg	0.200	712	622	629
Nickel	mg/kg	4.40	16.8	15.0	13.5
Lead	mg/kg	6.80	31.5	25.9	22.6
Selenium	mg/kg	0.600	<0.340	<0.350	<0.320
Zinc	mg/kg	0.400	84.8	75.9	64.1
Methoxychlor	ug/kg	0.040	<0.040	<0.040	<0.040
Aldrin	ug/kg	0.006	<0.006	<0.006	<0.006
a-BHC	ug/kg	0.002	<0.002	<0.002	<0.002
b-BHC	ug/kg	0.006	<0.006	<0.006	<0.006

Table 1. (cont.)

Parameter	Unit	Detection Limit	Sample 1	2	3
g-BHC (Lindane)	ug/kg	0.006	<0.006	<0.006	<0.006
d-BHC	ug/kg	0.48	<0.48	<0.48	<0.48
Chlordane	ug/kg	0.040	<0.040	<0.040	<0.040
4,4'DDD	ug/kg	0.010	<0.010	<0.010	<0.010
4,4'DDE	ug/kg	0.010	<0.010	<0.010	<0.010
4,4'DDT	ug/kg	0.010	<0.010	<0.010	<0.010
Dieldrin	ug/kg	0.010	<0.010	<0.010	<0.010
Endosulfan I	ug/kg	0.010	<0.010	<0.010	<0.010
Endosulfan II	ug/kg	0.020	<0.020	<0.020	<0.020
Endosulfan sulfate	ug/kg	0.020	<0.020	<0.020	<0.020
Endrin	ug/kg	0.020	<0.020	<0.020	<0.020
Endrin aldehyde	ug/kg	0.020	<0.020	<0.020	<0.020
Heptachlor	ug/kg	0.006	<0.006	<0.006	<0.006
Heptachlor epoxide	ug/kg	0.010	<0.010	<0.010	<0.010
Toxaphene	ug/kg	0.050	<0.050	<0.050	<0.050
PCB 1016	ug/kg	0.150	<0.150	<0.150	<0.150
PCB 1221	ug/kg	0.150	<0.150	<0.150	<0.150
PCB 1232	ug/kg	0.150	<0.150	<0.150	<0.150
PCB 1242	ug/kg	0.150	<0.150	<0.150	<0.150
PCB 1248	ug/kg	0.150	<0.150	28	52
PCB 1254	ug/kg	0.250	96.0	98.0	53.0

Table 1. (cont.)

Parameter	Unit	Detection Limit	Sample 1	2	3
PCB 1260	ug/kg	0.250	<0.250	<0.250	<0.250
2,4-D	ug/kg	0.050	<0.050	<0.050	<0.050
2,4,5-T	ug/kg	0.030	<0.030	<0.030	<0.030
2,4,5-TP (Silvex)	ug/kg	0.020	<0.020	<0.020	<0.020

1986). A 1981 lake survey by the Minnesota Department of Natural Resources found sparse submerged aquatic vegetation and a limited number of species (table 2).

3.31 A vegetation map of Spring Lake was prepared from aerial photographs taken in May 1985 (EA 1986) (figure 6). Only 35 acres of submersed vegetation and 38 acres of emergent marsh were present in the approximately 1,637 acres of Spring Lake. Aquatic and wetland vegetation cover at the time consisted of 33 acres of submersed macrophytes, 38 acres of emergent species (mostly cattail), and 2 acres of water lily. Aquatic plants in Spring Lake are undoubtedly limited by shading caused by high suspended solids concentrations, wave action, and fluctuating water levels in pool 2.

Terrestrial and Floodplain Vegetation

3.32 The islands and shoreline of Spring Lake are subject to periodic flooding by the Mississippi River. Elm, cottonwood, and silver maple are found on drier sites farther from the water. Willow occur in the wetter areas, usually at the river's edge. There are approximately 76 acres of island in the Spring Lake study area. Floodplain forest vegetation covered 67 acres of the islands, with about 7 acres of willow brush and 2 acres of unvegetated dredged material deposit.

3.33 Terrestrial vegetation communities and habitat along the southern periphery of Spring Lake are quite diverse with river terrace, blufftop uplands, ravines, and rock outcrops. The terrestrial vegetation of the Spring Lake Park Reserve area is described in detail in the Spring Lake Park Reserve Master Plan (Dakota County 1983).

Fish and Wildlife

Terrestrial Wildlife

3.34 The terrestrial areas adjacent to Spring Lake support a rich variety of birds and mammals. White-tailed deer are abundant. Hawks and eagles are present along the bluffs. Hunting is not allowed in the upland portions of the Spring Lake Park Reserve. Muskrat, beaver, and mink are present at the upper end of Spring Lake. The limited extent of wetland vegetation limits the abundance of furbearers.

Waterfowl

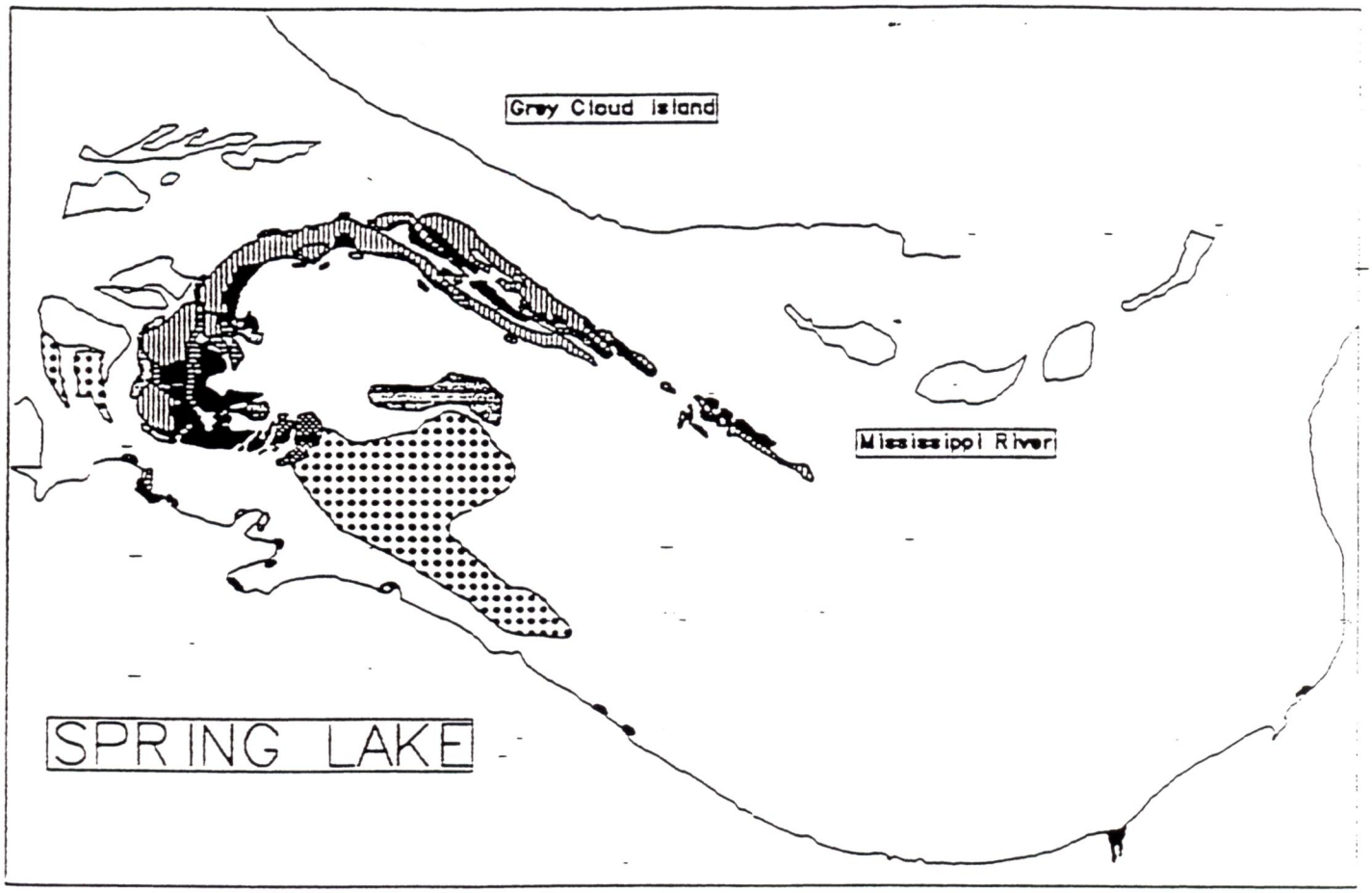
3.35 Spring Lake was once renowned as a waterfowl migration stop that afforded excellent hunting opportunities. Some waterfowl use the lake during migration, but the limited food available does not attract many birds. Only very limited numbers of breeding birds use Spring Lake. Some waterfowl hunting occurs on Spring Lake, because of the island and emergent marsh habitat in the upper end of the lake and because of proximity to the Minneapolis-St. Paul metropolitan area.

Table 2. Aquatic vegetation of Spring Lake, 1981, surveyed by the Minnesota Department of Natural Resources.

Common Name	Occurrence	Common Name	Occurrence
Curly leaf pondweed (S) *Potamogeton crispus*	C	Narrow leaf cattail (E) *Typha angustifolia*	O
Narrow leaf pondweed (S) *Potamogeton spp.*	P	Common cattail (E) *Typha latifolia*	O
River pondweed (S) *Potamogeton nodosus*	R	Spike rush (E) *Eleocharis palustris*	O
White water lily (E) *Nymphaea tuberosa*	P	Water hemlock (E) *Cicuta maculata*	C
Lesser duckweed (F) *Lemna minor*	O	Touch-me-not (E) *Impatiens biflora*	C
Greater duckweed (F) *Spirodela polyrhiza*	O	Water smartweed (E) *Polygonum amphibium*	P
Arrowhead (E) *Sagittaria latifolia*	C	Mountain watercress (E) *Cardamine rotundifolia*	P

Key: (S) submerged
(E) emergent
(F) floating

A - Abundant
C - Common
O - Occasional
R - Rare
P - Present





1 Logs and Stumps
2 Water Lily
3 Emergent Marsh
4 Mixed Macrophytes
5 Sand Flats
6 Bottomland Forest
7 Brush and Willow
8 Old Dredged Material

Figure 6. Aquatic vegetation in Spring Lake.

Benthos

3.36 Aquatic macroinvertebrates in Spring Lake were sampled in 1984 at four locations (EA 1985). Tubificid worms were the most numerically abundant animals. At one near-shore (probably sandier substrate) location, Chironomid midges were the most abundant. Hexagenia mayflies were present at all four locations in modest numbers, an encouraging sign indicating that water quality conditions are improving. Fingernail clams were present in low numbers at three locations. Benthic organism numbers ranged from 1,981 to 7,523/square meter. These densities are similar to densities reported for other fine substrates in the Mississippi River. Most other silt substrate locations in the Mississippi River had higher numbers of larger benthic organisms, especially Hexagenia.

Fish

3.37 The Minnesota Department of Natural Resources has conducted a series of fish surveys of Spring Lake. Carp and gizzard shad are the most abundant species by numbers and biomass. Panfish, mostly crappies and bluegills, are fairly common. Largemouth and smallmouth bass have been increasing in abundance in recent years. Northern pike, channel catfish, walleye and sauger are present. The abundance of sport fish species is expected to increase as water quality improves.

3.38 Some sport fishing occurs on Spring Lake, but limited fish stocks, limited access, and the windswept nature of the lake keep angling effort low.

Threatened and Endangered Species

3.39 The bald eagle and peregrine falcon are the only Federally-listed threatened and endangered species known to occur in the lower pool 2 area. Only a few eagles make use of the Spring Lake area during winter because most of the river is normally frozen. However, some eagles are regularly sighted along the lower pool 2 reach in winter. A pair of peregrine falcons have nested on a bluff near lock and dam 2 (J. Galle pers. comm. 1990). Although within its known range, the Federally-listed endangered mussel, Lampsilis higginsi, has not been reported in the Spring Lake area or anywhere in pool 2. With improved water quality, there is potential for recolonization in pool 2 by Lampsilis higginsi.

Habitat Types and Distribution in Spring Lake

3.40 The total area of water, wetlands and islands in the Spring Lake project area is approximately 1,637 acres. The list of habitats and approximate acreages in table 3 corresponds to figures 2, 3, 5, and 6. These figures and acreages are only approximate, and are based on a survey conducted for the Corps of Engineers in 1985 (EA 1986).

Aquatic Habitat

3.41 Most of Spring Lake is shallow open water with silt bottom and no vegetation. These conditions provide habitat for turbidity-tolerant fish, but relatively little available food in comparison to similar aquatic habitats with aquatic vegetation present. Densities of benthic invertebrates are probably improving, but most invertebrates in Spring Lake are burrowing animals which are not readily available prey for fish.

3.42 There is relatively little acreage in Spring Lake that can be considered good habitat for panfish; protected from current with clear water and submersed macrophytes. Spawning habitat for many fish species is almost nonexistent due to lack of coarse bottom substrate, high turbidity, and sparse aquatic vegetation.

3.43 The stumpfields could provide good habitat for walleyes, largemouth bass and channel catfish, which are attracted to woody debris cover. Presence of aquatic macrophytes would provide additional underwater structure and cover that would greatly improve the value of the stumpfield habitat for fish.

3.44 There is a fairly large (431 acres) area of deeper water (>5 feet deep) in Spring Lake. This area has silt bottom and is not close to any shallow areas that support aquatic macrophytes. There is no structure or irregularities in the lake bottom in this deep water aquatic habitat. This lack of proximity to any cover or physical structure and a lack of shelter from current limits the suitability of the area for panfish. The deeper areas are probably used for overwintering habitat by fish, but suitability for winter fish habitat is very limited by lack of shelter from river current and cold water temperature.

Wetland Habitat

3.45 Shallow areas with submersed and floating-leaved aquatic macrophytes cover only about 35 acres, almost entirely in the upstream end of Spring Lake (table 3). Density of the submersed macrophytes is not high, and the depth of macrophyte colonization is limited to about 1 foot below low control pool elevation, thereby greatly limiting total biomass and volume of habitat. Aquatic macrophytes appear to occur only downstream of islands or woody debris accumulations that afford protection from waves and river current. The species composition of the submersed macrophyte community is limited. Notably scarce is Valisneria, an important food item for migrating waterfowl.

3.46 Wetland areas with emergent herbaceous vegetation in Spring Lake are dominated by cattail.

3.47 Willow brush habitat covers the zone between the emergent wetland habitat and the floodplain forest islands. Sandbar willow is the dominant species.

Table 3. Area of habitat types in Spring Lake.

Habitat Type	Acreage
Aquatic	1561
Open water	1488
sand bottom	244
0-2ft deep	54
2-5ft deep	153
5+ft deep	37
silt bottom	1080
0-2ft deep	178
2-5ft deep	508
5+ft deep	394
stumpfield	111
0-2ft deep	57
2-5ft deep	54
Wetland	73
submersed macrophytes	33
water lily	2
emergent macrophytes	38
Island terrestrial	76
willow brush	7
floodplain forest	67
dredged material	2

Island Habitat

3.48 The islands along the periphery of Spring Lake are forested with a typical late successional stage floodplain forest with silver maple, cottonwood, American elm and green ash. Wood nettles and poison ivy grow on the ground. The islands are generally low, only rising to several feet above low control pool elevation, and are subject to extended periods of inundation. Dredged material deposits on the islands near the main channel provide areas of higher elevation. The dredged material deposits that have revegetated are more typical of xeric uplands, with grasses, box elder, and green ash. The more recent dredged material deposits are unvegetated.

Cultural Resources

3.49 The Spring Lake Park Reserve Master Plan (Dakota County 1983) reports that there are several archaeological sites within the park boundaries. These sites were excavated by the St. Paul Science Museum in the 1950's. The areas excavated include a small rock shelter on the bluff on the south side of Spring Lake and two Indian burial mounds and two Indian village sites on the south and east shores of Spring Lake. No historical sites listed on the National Register are located in the Park Reserve.

Recreational Use

3.50 Recreational use of the land around Spring Lake is presently limited by lack of facilities, a history of private ownership, and limited access. An aerial survey of recreation use was conducted during the summer of 1989 by the Minnesota-Wisconsin Boundary Area Commission, the Corps of Engineers, and the Minnesota Department of Natural Resources (Minnesota-Wisconsin Boundary Area Commission, 1990). The survey documented considerable use of main channel beaches by boaters in lower pool 2. In 1989, 15,682 recreational boats passed through lock and dam 2, and 12,211 locked through in 1990. There has been a marked increase in recreational boating activity in lower pool 2 since 1985. River-oriented recreational use in the lower pool 2 reach is expected to increase.

3.51 Spring Lake itself provides limited aquatic-oriented recreational opportunities, because of limited land access, the open wind-swept nature of most of the lake, shallow depth, turbid water, low fish catch per effort, and limited hunting opportunities.

FUTURE CONDITIONS WITHOUT THE PROJECT

4.00 The following section is a prediction of conditions in the study area over the next 40 years without any project to rehabilitate Spring Lake.

Sediment Transport and Future Geomorphic Changes

4.01 Bed load sediment transport through lower pool 2 is expected to continue to vary from one year to the next with annual differences in river discharge. The average annual dredging requirement in lower pool 2 is expected to remain roughly the same over the next 40 years. The delta area at the upstream end of Spring Lake is expected to increase in size in a downstream direction. Fine sediment deposition will continue, and the depth and volume of Spring Lake may decrease. Most deposition of fine material will occur in the deeper areas, where unconsolidated fine material is focused by wave action. Spring Lake may have already reached some equilibrium with respect to sedimentation and bed elevation.

Future Hydrologic Conditions

4.02 No significant changes in the hydrology of Spring Lake are expected. The gradual rise in bed elevation within Spring Lake will gradually decrease residence time for water within the lake.

Water Quality

4.03 Water quality in lower pool 2 is expected to gradually improve. Fewer periods of low dissolved oxygen will occur, especially if the quality of inflowing Minnesota River water improves. Contaminant loading is expected to decrease. In-place pollutants will gradually become sequestered in buried sediment. Concentration of contaminants in fish flesh will probably decline. Water quality will remain poor with regard to suspended solids concentration, an excess of plant nutrients, and continued nuisance algae blooms. Once sanitary and storm sewer separation is complete in the metropolitan area, pathogens and indicator bacterial concentrations should meet State water quality standards all of the time. The threat of a chemical or petroleum spill will continue to exist, and may increase with future increases in river traffic.

Vegetation

4.04 Submersed aquatic vegetation should increase slightly in extent as the islands in the upper end of Spring Lake expand. High suspended solids and algal concentrations will continue to limit the distribution, composition, and abundance of submersed macrophytes.

4.05 Emergent aquatic vegetation, mostly cattail, and willow brush will probably expand in acreage along with the gradual growth in the islands. Some purple loosestrife exists in the stands of emergent vegetation in the upper end of Spring Lake.

4.06 The floodplain forest community on the islands will probably not change significantly. Most of the floodplain forest on the islands is already in a later successional stage. Dredged material deposits will gradually become vegetated.

Future Habitat Types and Distribution

4.07 Although no map of expected future conditions has been prepared, the distribution and quality of fish and wildlife habitat in Spring Lake in the year 2030 will probably not differ much from table 3 and figure 6. Most of the lake will remain shallow, open water aquatic habitat with silt bottom and no vegetation. Only slight increases in the extent of vegetated wetland habitat are expected. Habitat quality is not expected to change.

Future Fish and Wildlife Use of Spring Lake

4.08 Fish will probably increase in abundance with the gradual improvements in water quality, but will still be greatly limited by turbidity, lack of spawning habitat, limited bottom structure and macrophyte cover. More eagles and other fish-eating birds will probably use the Spring Lake area, encouraged by any increased abundance of fish. Turbidity will continue to limit bird species that must see their prey in the water. There may be some slight increase in waterfowl use of Spring Lake associated with any increased acreage of vegetated shallow areas.

4.09 Despite growing demand, fishing and hunting opportunities on Spring Lake will probably remain limited by relatively low numbers of sport fish and waterfowl. Trapping opportunities will remain limited by low numbers of furbearers.

Future Recreational Use

4.10 Development of the Spring Lake Park Reserve is proceeding, and recreational use of the land area in the park is expected to increase dramatically as the park development is completed. With no project to improve the condition of Spring Lake, many water-oriented recreational opportunities will not be realized. Facilities for swimming could be provided by swimming pools or specially designed beach areas in Spring Lake. Sport fishing, wildlife viewing, small-craft boating, and hunting opportunities will remain limited. Full development of the Spring Lake Park Reserve, with potentially valuable water- and wildlife-oriented recreation, will not occur.

RESOURCE MANAGEMENT GOALS FOR THE PROJECT AREA

5.00 Agency goals for the Spring Lake area were discussed in a meeting in March 1989.

Corps of Engineers

5.01 The St. Paul District, Corps of Engineers has been planning long-term channel maintenance for lower pool 2. A preliminary report (Corps of Engineers 1984) describes future channel maintenance requirements and conceptual alternatives for material placement involving Spring Lake.

- o Develop a long-term channel maintenance plan for lower pool 2
- o Reduce dredging requirements in lower pool 2
- o Maximize beneficial use of dredged material
- o Minimize cost of dredging and material placement
- o Improve fish and wildlife habitat and water quality conditions

Dakota County and Metropolitan Council

5.02 Dakota County, with assistance from the Metropolitan Council, is developing the Spring Lake Regional Park Reserve. General objectives for Park Reserve development are outlined in the Master Plan (Dakota County 1983).

- o Full development of the Spring Lake Regional Park Reserve
- o Preserve representative examples of the native ecosystems and landscape features of the Spring Lake area, including floodplain forest, the wooded ravines and deltas, north- and east-facing bluffs and their characteristic plant communities, plus some upland features
- o Provide two swimming beaches
- o Provide conditions suitable for small-craft boating
- o Provide conditions and facilities suitable for land-based recreation along the shore of Spring Lake
- o Improve aesthetic appeal of area
- o Improve sport fishing opportunity
- o Improve fish and wildlife habitat conditions
- o Promote recreational and industrial use of the river

Washington County

5.03 Washington County has completed a park system plan which includes some studies of the Grey Cloud Island area. The County is considering further studies of park development at Grey Cloud Island. If park development is feasible, a master plan would be prepared. The master plan would address how a Grey Cloud Island Park Reserve would complement the Spring Lake Park Reserve and the Mississippi River National Recreation Area.

Minnesota Department of Natural Resources

5.04 The Minnesota DNR has a longstanding interest in improving Spring Lake for fish and wildlife habitat, and for encouraging appropriate recreational use of the river.

- o Improve water quality
- o Improve fish and wildlife habitat conditions
- o Improve sport fishing opportunity
- o Improve hunting and furbearer trapping opportunities
- o Improve small-craft boating opportunities
- o Limit redistribution of in-place pollutants
- o Avoid increases in flood stages

Minnesota Pollution Control Agency

5.05 The MPCA regulates discharges to the Mississippi River with the primary objectives of maintaining and improving water quality.

- o Improve water quality
- o Limit redistribution of in-place pollutants
- o Regulate the Rosemount treatment plant and Oxbo Industries to protect river water quality

U.S. Fish and Wildlife Service

5.06 The U.S. Fish and Wildlife Service has a mandate to improve habitat conditions, maintain populations of fish and migrating waterfowl, and protect endangered species.

- o Improve fish and wildlife habitat conditions
- o Improve water quality
- o Limit redistribution of in-place contaminants

National Park Service

5.07 The National Park Service will administer the recently designated Mississippi National River and Recreation Area which includes the river corridor through the Minneapolis-St. Paul metropolitan area.

- o Full development of Spring Lake Park Reserve
- o Improve fish and wildlife habitat
- o Improve water quality
- o Limit redistribution of in-place contaminants
- o Promote recreational and industrial use of the river

C.F. Industries

5.08 C.F. Industries operates a port facility adjacent to the upstream end of Spring Lake. Maintaining safe navigable access to the port facility is necessary to their business.

- o Maintain commercial harbor and safe navigation access

HABITAT IMPROVEMENT GOALS

6.00 Target species and associated habitat needs for the Spring Lake area are as follows:

Aquatic Habitat

6.01 Target species for management are panfish (bluegill, crappie), sauger, northern pike, largemouth bass, and channel catfish. Habitat improvements to increase abundance of these species are needed.

- o Increase the areal extent and depth of macrophyte beds
- o Increase the extent of deep water sheltered from river current in proximity to macrophyte beds, and with adequate dissolved oxygen (D.O.) and sufficiently high water temperature for winter habitat
- o Increase macrophytes in stumpfield areas
- o Decrease suspended solids concentration
- o Maintain adequate dissolved oxygen (>5 mg/l) at all times

Wildlife Habitat

6.02 Target wildlife species for management are migrating waterfowl, breeding mallards, teal and wood ducks, wading birds, fish-eating birds, passerine birds and muskrats. Habitat improvements for wildlife management purposes are needed.

- o Increase the areal extent of submersed and emergent macrophytes, including species of value as waterfowl food
- o Increase interspersion of emergent wetland, macrophyte beds, and open water
- o Provide and maintain a variety of successional stages of floodplain forest island habitats
- o Maintain large cottonwoods for eagle nesting and roost sites
- o Save large snags for cavity-nesting birds
- o Provide islands with herbaceous and brushy vegetation adjacent to macrophyte beds for waterfowl nesting
- o Provide low sandy islands for wading bird use

PLANNING OPPORTUNITIES

Availability of Channel Maintenance Dredged Material

7.00 Dredged material from Corps of Engineers channel maintenance activities over the next 40 years is projected to average 33,925 cubic yards annually, a total of 1,357,000 cubic yards (Corps of Engineers 1984). This estimate appears to be conservatively low, based on the recent history of dredging requirements, especially at the Pine Bend dredge cut. Material would be dredged from four historic cuts: Boulanger Bend Lower Light, Boulanger Bend, Pine Bend Foot Light, and Grey Cloud Slough (figure 1). These four dredge cuts are sufficiently close to Spring Lake that material could be economically transported for construction of Spring Lake improvement features.

7.01 Dredged material could be used to build fill structures such as channel closures, islands, island extensions, dikes, and beaches as part of Spring Lake improvement.

7.02 Opportunity exists for dredging out historic placement sites to obtain material for construction, provided the dredging creates capacity for future placement of material in locations close to the historic dredge cuts. This type of advance dredging for long-term placement site preparation can be cost-effective for channel maintenance purposes and make larger amounts of material available for construction at one time. No analysis of opportunities for this kind of dredging in lower pool 2 has been conducted. Hydraulic excavation and placement of historically dredged material poses few water quality problems, because the material was essentially washed free of contaminant-bearing fine materials when it was initially dredged. Dredging of any material underlying the historic dredged material deposits would require testing and evaluation of the underlying material to determine suitability for use and water quality effects.

7.03 Careful hydraulic design of dredged material placement in the Spring Lake area, especially channel closures and extension of the chain of barrier islands around the lake, could improve bed sediment transport competence of the main channel and reduce dredging requirements in the Boulanger Bend reach of the river. Reduced dredging requirements could represent significant long-term cost savings for the Government.

Availability of a Numerical Hydraulic Model for Lower Pool 2

7.04 The Corps of Engineers has developed a two-dimensional numeric hydraulic model of the Spring Lake reach of the river. This model can be used for simulating hydraulic conditions resulting from alternative channel geometries.

Development of the Spring Lake Regional Park Reserve

7.05 Dakota County and the Metropolitan Council are committed to development of the Spring Lake Regional Park Reserve. Dakota County is in the process of acquiring the real estate around Spring Lake. Public ownership of the land areas would greatly simplify real estate arrangements for dredged material placement. The park development provides an opportunity for beneficial use of dredged material in addition to features designed for habitat and water quality improvement. Any improvements in fish and wildlife habitat and water quality would complement the park and improve recreational opportunities. Details of material placement design could complement Dakota County plans for physical development of the park.

Upper Mississippi River Environmental Management Program

7.06 The Upper Mississippi River Environmental Management Program, authorized by the Water Resources Development Act of 1986, has as one of its main elements, a program of habitat rehabilitation and enhancement (HREP) projects. Federal cost-share funding is available for habitat improvement projects in partnership with State natural resource management agencies. The Spring Lake project has been nominated by the Minnesota Department of Natural Resources as a future HREP project. The project has been selected and approved for planning starting in 1991. Features of Spring Lake habitat improvement that cannot be justified as part of the Lower Pool 2 Channel Maintenance Plan could be funded through the HREP program. The planning process for development of the Channel Maintenance Plan is closely following the procedures used in planning HREP projects to minimize duplication of effort and to ensure compatibility with the eventual HREP project design.

Pool 2 Beach Development Plan

7.07 The Corps of Engineers is conducting an analysis of potential sites for recreational beach development in pool 2. This plan is near completion. The plan will include consideration of channel maintenance requirements in lower pool 2 and Spring Lake area improvements.

Water Control Capability

7.08 The Corps of Engineers operates lock and dam 2, 6 miles downstream from Spring Lake. Operation of the navigation dam provides fairly predictable water surface elevations in the project area. Improvements in the stream gaging and water regulation system that are being implemented should improve future habitat conditions by reducing the frequency and magnitude of water level fluctuations.

PLANNING CONSTRAINTS

8.00 The plan for long-term channel maintenance for lower pool 2 and Spring Lake improvement must be compatible with a number of hydrologic, engineering, ecological, legal, and economic constraints.

Hydrologic Constraints

o Any Spring Lake structures must have a neutral or positive effect on bed sediment transport in the main channel so that long-term maintenance dredging requirements are reduced.

o Any Spring Lake structures must be designed with consideration of the hydrologic regime and water regulation of pool 2.

o Any Spring Lake structures must not induce increased flood elevations of more than 0.5 foot during a 100-year recurrence interval event.

o Pool 2 will continue to be regulated to provide a nine-foot channel for navigation. This constraint on river regulation prevents intentional drawdown of the pool for habitat management purposes.

Engineering Constraints

o Physical characteristics of lower pool 2 dredged material and sediments in potential placement locations in the Spring Lake area.

o Material handling capabilities of dredging equipment.

Ecological Constraints

o Any modifications to Spring Lake should not result in water quality degradation in the lake or the Mississippi River.

o Dredging and material placement should not result in water quality degradation in excess of State and Federal water quality standards.

o Fish passage between Spring Lake and the main channel should be maintained.

o Construction of any Spring Lake improvements should be conducted to minimize redistribution of in-place contaminants.

o Plans for Spring Lake improvement should maximize the areal extent and quality of vegetated wetland habitat.

Legal Constraints

o All features of the plan for long-term channel maintenance and Spring Lake improvement must be justifiable under Corps of Engineers channel maintenance authorities.

o Dredged material placed by the Corps of Engineers becomes property of the landowner.

o Dredged material placement sites at Spring Lake must be provided at no cost to the Federal Government.

o The plan must comply with all Federal and State laws and regulations.

o A local cooperation agreement may be required with Dakota County for project construction within the Spring Lake Park Reserve, and perhaps with the Minnesota Department of Natural Resources for the operation and maintenance of any structures associated with the project.

Navigation Constraints

o Small-craft access between Spring Lake and the main channel should be maintained.

Economic Constraints

o The cost of long-term channel maintenance for lower pool 2 with Spring Lake improvements must be equal to or less than the long-term cost for channel maintenance without Spring Lake improvements.

CONCEPTUAL ALTERNATIVES FOR LOWER POOL 2 CHANNEL MAINTENANCE AND SPRING LAKE REHABILITATION

Early Proposals

9.00 Structural alternatives for improving water quality and habitat conditions have been proposed since shortly after closure of lock and dam 2 (Schilling 1984). An early proposal (letter dated September 9, 1940 from Mrs. Minnie Lee, Nininger, Minnesota, to the Minnesota Conservation Department) proposed a dike to sequester Spring Lake from the main channel of the river.

9.01 In an analysis of water quality problems in Spring Lake, E.A Hickok and Associates (in Metropolitan Council 1974) proposed a set of four different structural alternatives which involved various degrees of separation of Spring Lake from the river by construction of a dike system. The intent was to reduce loading of sediment and nutrients from the river, allowing some restoration of water quality.

9.02 The Corps of Engineers contracted for a literature review and impact analysis of the various proposals for Spring Lake improvement. Schilling (1984) posed four alternatives, three being similar to the three closure alternatives proposed by E.A. Hickok and Associates, but with provision for flow through the barrier dike to prevent winter dissolved oxygen depletion and to allow flushing of the lake (in a full closure alternative) by groundwater. The fourth alternative proposed by Schilling included a partial closure dike, a water control structure at the upstream end, and islands to break up wind fetch in the lake.

Corps of Engineers Recent Channel Maintenance Activities

9.03 Since completion of the GREAT I report, the District has been following the guidelines of that study. The guidelines are to use the recommended dredged material placement sites, if possible, or other sites coordinated through the On Site Inspection Team (OSIT) process with an emphasis on beneficial use. Since 1981, material has been placed for beneficial use at Packer Terminal, mile 831.0, and C.F. Industries, mile 823.8. Material has also been placed on islands in lower pool 2 to enhance recreational opportunities.

Material has been recently placed on an island in Boulanger Bend (that had been previously used for material placement), in anticipation of use for the Spring Lake project. The sites being used during this interim period have limited capacity, and therefore the need for implementing a long-range dredged material placement plan continues to increase.

Corps of Engineers Draft Proposals for Lower Pool 2 - 1984

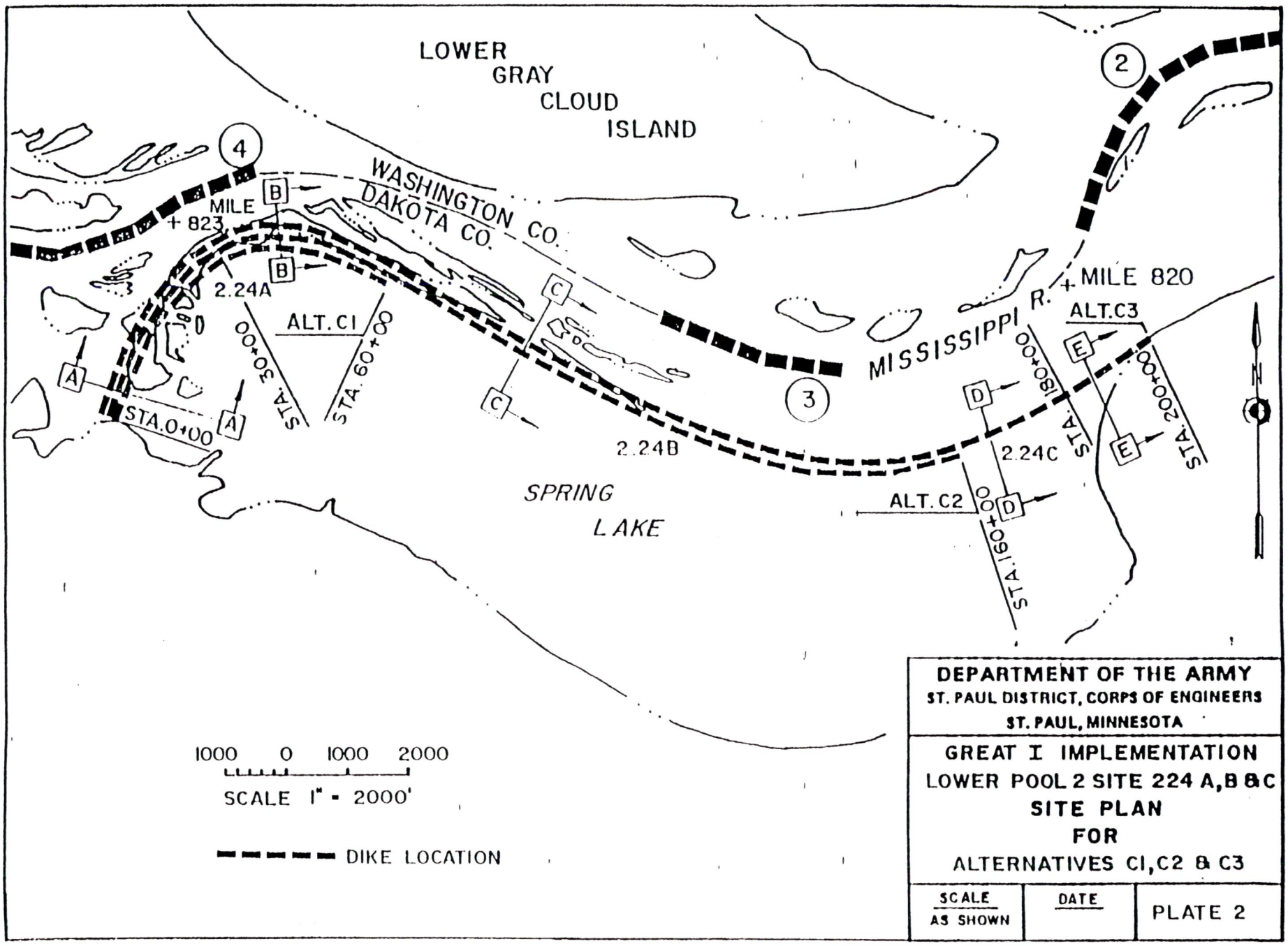
9.04 A draft Dredged Material Placement Reconnaissance Report For Lower Pool 2 was prepared by the St. Paul District (Corps of Engineers 1984). Eight alternatives were considered, including three alternatives involving various degrees of closure of Spring Lake. The GREAT-recommended alternative was changed due to elimination of two dredge cuts (1 and 6) from further consideration, and because of availability of disposal sites. Alternative plan A-1 was substituted for the GREAT-recommended plan and was used as a basis for comparison of the other alternatives.

9.05 Three alternative plans (C-1, C-2, and C-3)(figure 7) were essentially more developed designs of the three alternatives for Spring Lake dike closure proposed by E.A. Hickok and Associates (in Metropolitan Council 1974). The other alternatives considered a combination of seven placement sites between river miles 832.5 and 819.4 (GREAT sites 2.05, 2.10, 2.25, 2.27, 2.31, 2.35, and 2.75) (figure 1) . Sites 2.05 and 2.31 were identified as having potential as stockpile sites for use in conjunction with a project to improve Spring Lake.

9.06 Alternative A-1 is the GREAT I CMP for lower pool 2 modified to reflect the revisions in placement site dimensions and the deletion of cuts 1 and 6. Under this plan, 696,000 cubic yards of material from cuts 2 and 3 would be mechanically placed at site 2.35 and 661,500 cubic yards of material from cuts 4 and 5 would be mechanically placed at site 2.10. Of this material, 240,000 cubic yards at site 2.35 and all of the material at site 2.10 would be removed for active beneficial use. This alternative was used as the "probable future without Spring Lake improvements" as a basis for comparison with the other alternatives.

9.07 Alternative C-1 was to mechanically place 379,500 cubic yards from the Boulanger Bend dredge cut to form a 6,000-foot-long closure dike at the upstream end of Spring Lake with a 3,000-foot-long riprapped overflow spillway. Material from cuts 2 and 3 would be mechanically placed at site 2.05. Approximately 240,000 cubic yards of material from site 2.35 and all of the material from site 2.05 (282,000 cubic yards) would be removed for beneficial use.

9.08 Alternative C-2 involves placement of 978,000 cubic yards of material from cuts 2, 3, and 5 to form a 16,000-foot-long dike that would more completely isolate Spring Lake from the main channel. A 3,000-foot-long riprapped overflow spillway would be constructed at the upper end of the dike system. The remaining 379,500 cubic yards of material from cut 4 would be placed at site 2.24A. None of the material would be removed for active beneficial use.



Figur Dredged material placement alternatives from D Reconnaissance Report for Lower pool 2.

9.09 Alternative C-3 involves the placement of all material from cuts 2, 3, 4, and 5 (1,379,500 cubic yards) along the riverward side of Spring Lake to form a continuous 20,000-foot-long dike. The dike would completely isolate Spring Lake from the main channel. The dike would be constructed to a 17-year occurrence flood protection elevation. A 3,000-foot-long riprapped overflow spillway would be constructed at the upstream end of the dike system, and a 2,000-foot-long spillway would be built at the lower end. None of the material would be removed from the floodplain for active beneficial use.

9.10 The three alternatives C-1, C-2, and C-3 are concepts, and detailed additional features were not developed in the 1984 report. Alternative C-3, complete closure, was the recommended plan in the 1985 report. However, plan C-3 presents a number of problems and questions which have not been resolved or answered to date. These questions deal with:

- Water quality effects in Spring Lake
- Water quality effects on river
- Potential winter kill of fish
- Limited fish passage between Spring Lake and river
- No small-craft boating access between Spring Lake and main channel
- Effects on flood water surface elevations
- Effects on sediment transport and dredging requirements
- Need for rerouting Rosemount waste treatment plant and Oxbo Industries effluents
- Phasing of construction, availability of material
- Effects on fish and wildlife habitat in Spring Lake
- Compatibility with design of Spring Lake Park Reserve

PROPOSED CONCEPTUAL PLAN

10.00 An alternative plan exists that should meet the agency objectives, habitat improvement goals, and planning opportunities and constraints described above. The alternative is a combination of previously proposed features and closely resembles the alternative 4 proposed by Schilling (1984). This combined alternative is conceptually illustrated on figure 8. Features of the plan are described below.

Sources of Dredged Material

10.01 Material from historic dredged material placement sites close to Spring Lake would be used, along with immediate channel dredging requirements from cuts 2, 3, 4, and 5, for initial construction. Approximately 400,000 to 600,000 cubic yards could be available for initial construction. The historic placement sites would be dredged to a depth of about 5 to 8 feet below low control pool elevation, leaving a perimeter island emergent. Portions of the sites could be dredged quite deep (provided suitable material is present) to provide capacity for future dredged material placement. These sites

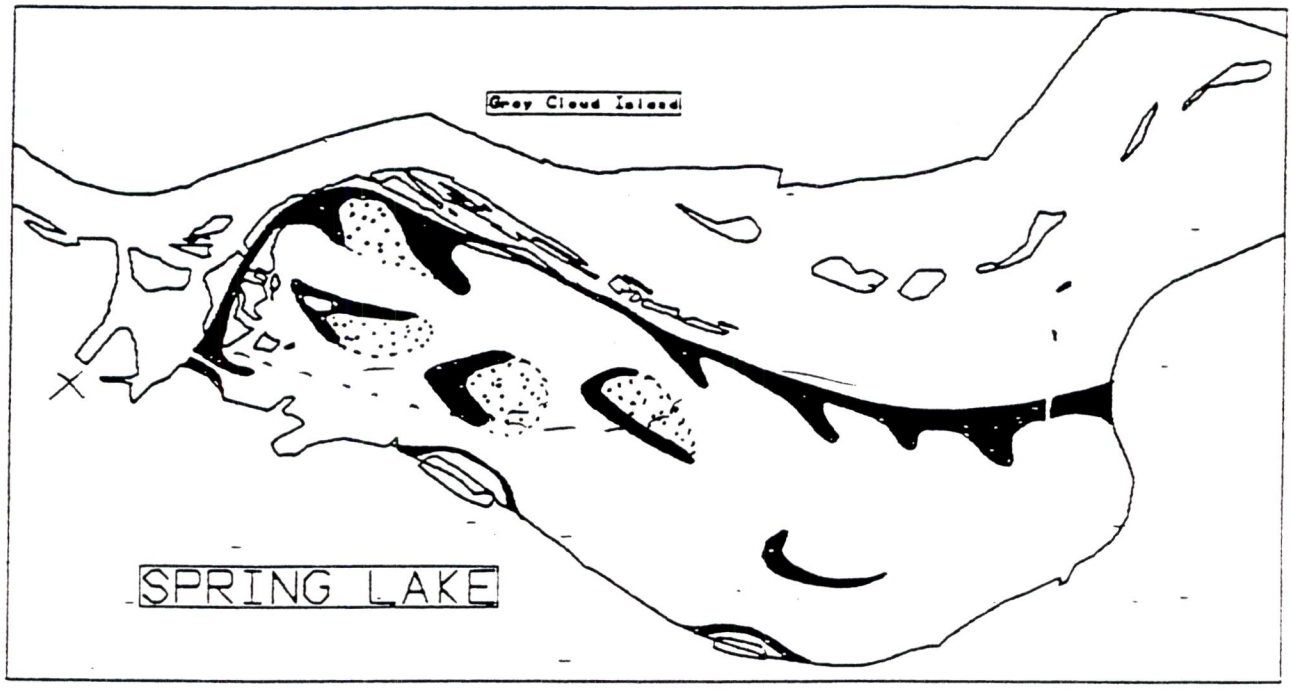


Figure 8. Conceptual plan for Spring Lake rehabilitation.

would be used for future placement of material. The deep aquatic areas formed would be connected to the main channel to provide habitat for fish and recreational opportunities for boaters along the main channel for a time until the sites would be used again for channel maintenance.

Phased Construction

10.02 Following initial construction dredging and material placement, material from routine channel maintenance dredging would be placed to sequentially complete structural features for some years. For example, approximately another 250,000 cubic yards of material could be available over a 5-year period. Following completion of the structural features at Spring Lake, material from routine maintenance dredging would be directed to the sites used as borrow areas for construction dredging. Monitoring of water quality conditions in Spring Lake and the Mississippi River would be conducted to sequentially assess the effects of each project phase.

Structural Features:
Dike System

10.03 A dike system, or extension of the chain of barrier islands, that would sequester Spring Lake from the river for the purpose of water quality improvement is desirable. A dike system should be designed to provide small-craft boating access and fish passage opportunity between the lake and the main channel. An overflow section at the upstream end is necessary to allow flood flows into Spring Lake. Low parts of existing islands could serve as overflow sections, because they are already stabilized with trees and other vegetation. The rest of the dike, or built peninsula, would not need to be much higher than the existing islands. Height of the dike system need not be considerably higher than the existing islands to achieve some improvements in water quality. Design height will depend on material available, flood water surface hydraulic predictions, selected width, and level of river discharge selected to exclude from Spring Lake. Most of the dike system could be stabilized with vegetation to provide resistance to erosion. One or more low flow inlet culverts with operable gates would provide for sufficient inflow to maintain winter dissolved oxygen. An outlet structure would be needed that would provide for exit of flood flows from the lake. One or more smaller outlets with lower bottom elevations would allow small-craft access and opportunity for fish passage between the lake and the river. The dike system could be designed to visually resemble a series of riverine islands, rather than a monolithic levee. Low peninsulas and embayments could be incorporated into the design of the dike system to provide wetland and shallow aquatic habitat.

Islands

10.04 Islands within the open water area of Spring Lake would be desirable for water quality and habitat improvement purposes. The islands would be designed using coastal engineering technology to most optimally reduce wind fetch and wave action within the lake with the material available. Islands would reduce wind-induced resuspension of lake bed sediment. The islands would be designed to visually resemble a series of riverine islands, with peninsulas and shallow embayments that would allow development of wetland habitat. Areas at the upstream end of Spring Lake could be filled to provide shallow area for more marsh development. Some of the islands could be built to higher elevations, and top-dressed with finer material to allow for ready revegetation and tree growth. Other islands could be built lower and left in a less vegetated condition to provide shorebird habitat and possibly (on other islands) beaching areas for recreational boaters. Geotechnical analyses will be necessary to determine feasibility of island construction.

Wetland Development

10.05 Wetland areas could be developed in shallow areas at the upstream end of Spring Lake through careful placement of material to provide shallow flooded areas that would allow development of wetland vegetation. These areas could be designed in conjunction with islands and the dike system.

Beaches

10.06 Dakota County has expressed interest in providing two swimming beaches on Spring Lake as part of the Spring Lake Park Reserve. The beach substrate and shore could be built of dredged material. Floating curtain or enclosure dikes built of dredged material could sequester the beach areas from the rest of Spring Lake, to allow water quality maintenance in the swimming areas.

Habitat Improvement Features

10.07 A number of fish and wildlife habitat improvements could be conducted that are beyond the Corps of Engineers channel maintenance authorities. These improvements could be conducted by Dakota County in cooperation with the Minnesota Department of Natural Resources and conservation groups, and some could be features of an HREP project at Spring Lake. Habitat improvement features such as provision of coarse spawning substrate for panfish, artificial aeration devices if needed, vegetation management on the islands to provide a variety of successional stages, artificial nesting structures, etc. could be included in the project.

INFORMATION NEEDED FOR FURTHER PROJECT PLANNING AND DESIGN

Bathymetric/Topographic Survey

11.00 A more detailed survey of riverbed elevation in the Spring Lake project area is needed for water quality predictions, hydraulic analyses, and engineering design of project features. Some recent survey data along the potential dike alignment is available and should be expanded upon. Soundings on 200-foot centers would provide adequate detail for project design purposes.

Substrate Survey

11.01 A more detailed survey of sediment type in Spring Lake is needed to plan habitat improvements and for geotechnical design of any fills. Visual observations of substrate type could be conducted in conjunction with the bathymetric survey. In addition to characterization of surficial substrate type, borings will be needed for engineering analyses.

Hydraulic Model

11.02 A 2-dimensional numerical hydraulic model has been developed for the Spring Lake reach of the river. The model, once calibrated, should allow simulation of the hydraulic effects of proposed structural changes to the riverbed geometry. Effects of the proposed project on sediment transport may be indicated by the model results.

Water Quality Predictive Analyses

11.03 Water quality analyses will be performed to predict future water quality conditions within Spring Lake and in the Mississippi River that could result from the project. The technical approach for making these predictions will involve use of water quality monitoring data collected from Spring Lake, the adjacent main channel and from River Lake. River Lake is an abandoned channel floodplain lake several miles upstream of Spring Lake that is more hydraulically isolated from the main channel than is Spring Lake. River Lake may serve as a model of with-project conditions in Spring Lake. Sediment samples of Spring Lake and River Lake will be analyzed to evaluate the potential for internal loading of phosphorus. The Metropolitan Waste Control Commission numerical water quality model of lower pool 2 may also be used to predict the effects of a Spring Lake project on river dissolved oxygen during summer low flow conditions.

Dredge Cut and Placement Site Material Testing

11.04 Particle size and bulk chemistry of material proposed for dredging will be needed to predict water quality effects of dredging and to identify any potential problems with contaminants. Sampling requirements will be determined as the sources of dredged

material for the project are more specifically identified. Geotechnical analyses of placement site and structure stability will be needed. Some testing of materials obtained from borings may be necessary.

Survey of Historic Dredged Material Placement Sites

11.05 An elevation survey of historic placement sites near Spring Lake is needed to quantify material available for construction dredging. An inventory of habitat at the sites is also needed to quantify impacts of dredging the sites.

Habitat Analyses

11.06 An analysis of existing habitat and an incremental analysis of proposed future habitat conditions in Spring Lake should be conducted to provide for systematic design of habitat improvement features.

STEPS PRIOR TO PROJECT CONSTRUCTION

12.00 The following are steps necessary prior to project construction.

Task	Date
o Completion and approval of this problem appraisal	Feb 1991
o Hold public information and NEPA scoping meeting	May 1991
o Complete design report	Dec 1991
o Prepare and coordinate NEPA document	Dec 1991
o Acquisition of Spring Lake islands by Dakota County	Dec 1991
o Begin plans and specifications	1992
o Obtain all necessary permits and approvals	1992
o Complete cooperative agreements	1992
o Advertise for bids	1992
o Begin construction	1992

A local cooperation agreement (LCA) will be made between the Corps of Engineers and Dakota County prior to construction. Another local cooperation agreement may be needed with the Minnesota Department of Natural Resources for operation and maintenance of any water control structures.

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Spring Lake

Hydraulic Evaluation of

"Lake within the Lake" Alternatives

Hydraulic Appendix
Dredged Material Placement
Reconnaissance Report
Lower Pool 2

Introduction

The Lower Pool 2 reconnaissance study examined various alternatives for disposing dredged material. The study area, drede cuts, and potential placement sites can be seen in Plate 1. One of the focuses of the Lower Pool 2 study, and the primary focus of this appendix, is to determine the impacts of a "Lake within a Lake" alternatives. The TABS 2-dimensional model was used for this analysis. The purpose of the 2 dimensional model is to determine the impacts of the "Lake Within a Lake" alternatives on the 100 year flood elevations. The model was developed for large flood conditions only. Conditions where there is significant overtopping of the floodplain and floodplain islands. Model extends from Dam 2 upstream to R.M. 830 at the Rock Island Line Railroad Bridge.

Bathymetric sources

Bathymetric data used in the construction of the RMA2 finite element grid was obtained from several sources. HEC-2 cross sections were obtained from the models developed for the flood insurance program by the Minnesota Department of Natural Resources in 1972. Detailed maps were available showing the exact locations of the cross sections. Plate 2 shows the coverage of this data. It was possible to determine the state plane coordinates of the endpoints and the azimuth of the line. An outline of the shoreline was digitized from USGS 7.5 minute quadrangle maps. This data was used to define the 689 ft contour just below the normal pool elevation.

Surveyed cross sections of the island separating Spring Lake from the navigation channel were obtained in 1991. The points in these cross sections were converted to state plane coordinates. Plate 3 shows the location of these cross sections.

Soundings of the navigation channel in the vicinity of Spring Lake were also available. These navigation channel soundings ran from River Mile 818.0 to River Mile 824.7.

Contour maps of Lower Spring Lake and the upper entrance channels to Spring Lake were also used in constructing the grid. The points from these various sources were converted to Minnesota South state plane coordinates and used in the grid construction. Plate 4 shows the coverage of this data. Plate 5 shows the final mesh used for the existing condition model. The resulting bathymetry can be seen in an elevation map shown in Plate 6.

Calibration

Calibration was accomplished using the 1965 and 1969 flood conditions. No discharge measurements were available within lower pool 2 during these floods. Downstream starting water surface elevations and discharges were obtained from the records at Dam 2. Table 1 shows the starting elevations and discharges used in the RMA2 modeling.

Table 1 Boundary Conditions

Condition	Discharge	Starting Elevation
1965 flood	171,000	697.00
1969 flood	156,000	697.00*
1 percent chance flood	150,000	694.75

* = The elevation at dam 2 was the same for both the 1965 and 1969 flood. Inspection of aerial photos of the dam during the 1969 flood showed that there was significant blockage due to ice and debris. This explains why the 1969 elevation at Dam 2 is not lower than it was in 1965.

High water marks recorded during the floods were used to accomplish the calibration. These high water marks are found in "Reservoir Regulation Manual; Appendix 2, Locks & Dam No.2" dated 1973 by the St. Paul District. Turbulent exchange coefficients of 25 lb-sec/sq ft were used in the modeling. Manning's n coefficients were used to calibrate the model. Table 2 shows the high water marks locations and elevations for the 1965 flood, and the final calibration elevations given by the model. Table 3 gives the same information for the 1969 calibration event.

Table 2 1965 flood calibration data

Location		High Water Mark Elevation	Model Computed Elevation	Difference
R.M. 815.4	Upper Gage L/D2	697.0	697.0	0.0
R.M. 817.6	Ninninger	698.0	697.9	-0.1
R.M. 822.6	Grey Cloud Landing	698.8	698.7	-0.1
R.M. 826.2		700.5	700.1	-0.4
R.M. 829.1		702.5	703.0	0.5
R.M. 830.3	C R I & P Railroad	703.5	703.5	0.0

Table 3 1969 flood calibration data

Location		High Water Mark Elevation	Model Computed Elevation	Difference
R.M. 815.4	Upper Gage L/D2	697.0	697.0	0.0
R.M. 817.6	Ninninger	698.0	697.7	-0.3
R.M. 822.6	Grey Cloud Landing	697.8	698.4	+0.6
R.M. 826.2		700.5	699.7	-0.8
R.M. 829.1		701.8	702.3	0.5
R.M. 830.3	C R I & P Railroad	702.8	702.8	0.0

Plate 7 shows the material type designation of the grid and the final manning coefficients used for the various material types. The final manning coefficients are all reasonable for the physical characteristics of the elements.

It is important to understand that the current grid is only calibrated for high flow conditions where most islands are overtopped. Additional work would need to be done to develop a lower flow condition model. This is due to the greater blocking effect of islands and the greater impact small channels have on flows through backwater areas.

Alternatives

Three different "Lake within a Lake" alternatives were chosen to show a range of stage impacts for different size projects. Plates 8, 9, and 10 show "Lake within a Lake" alternatives 0, 1, and 2 respectively. Typical cross section of the assumed barrier segment can be seen in Plate 11. Preliminary sand volumes for the 3 alternatives are shown in Table 4. Sand volumes are shown for low control pool water depths of 2 and 4 feet. The mean volume of materia 1 was also calculated. This value can be used in cost estimates. The barrier segments were modeled in the RMA2 grid by raising the elevation of nodes along the alignment.

Table 4 Sand volumes for sand island alternatives

Alternative	2 ft. water depth	4 ft. water depth	Mean
0	89,500 cuyd	143,000 cuyd	101,250 cuyd
1	158,400 cuyd	253,000 cuyd	205,700 cuyd
2	383,000 cuyd	611,600 cuyd	497,300 cuyd

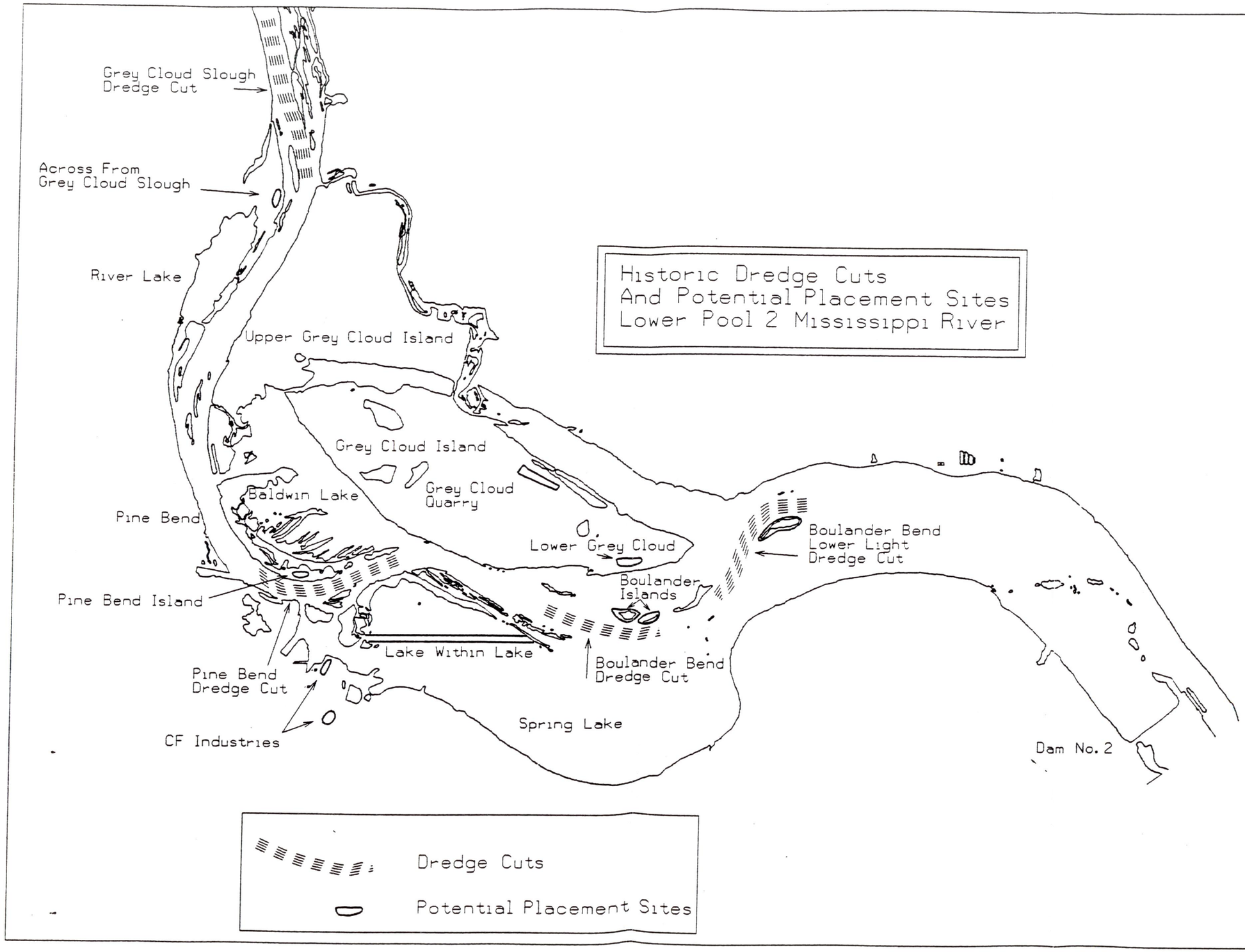
Table 5 shows the stage increases at the upstream terminus of the model caused by the three "Lake within a Lake" alternatives. It was assumed that stage increases occurring at the upper end of the model would propagate upstream to the city of St. Paul. This is a conservative assumption. It is likely that the stage increases would dissipate with additional distance upstream.

Table 5 Stage Increases at Upstream End of Model

Alternative	Stage Increase at R.M. 830
0	0.006 feet
1	0.011 feet
2	0.017 feet

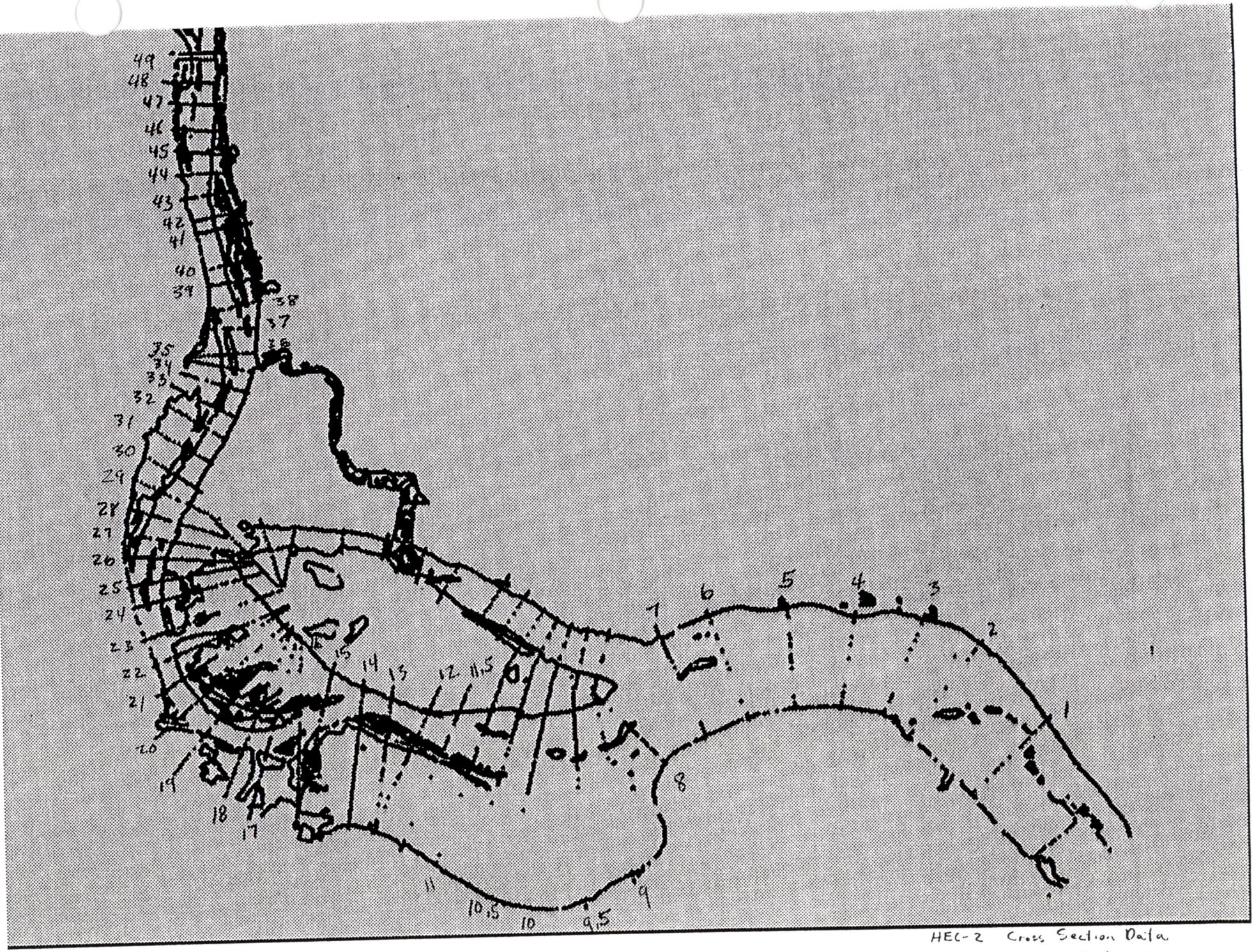
Baldwin Lake

One of the current dredge material placement options is to unload sediment on Lower Grey Cloud Island via an enlarged channel through the Baldwin Lake Area. Enlarging a channel into this area could mean an increase in navigation channel flows passing out through the Baldwin Lake area. Currently the navigation channel downstream of this location is a problem dredging site. If flows are reduced through this section of navigation channel dredging problems will likely worsen. If this alternative is to gain further consideration, several additional alternatives should be considered. The first is to consider access from the downstream end of Baldwin lake without deepening the inlet channel. The second is to restrict the downstream outlet with a structure in response to deepening the inlet channel.



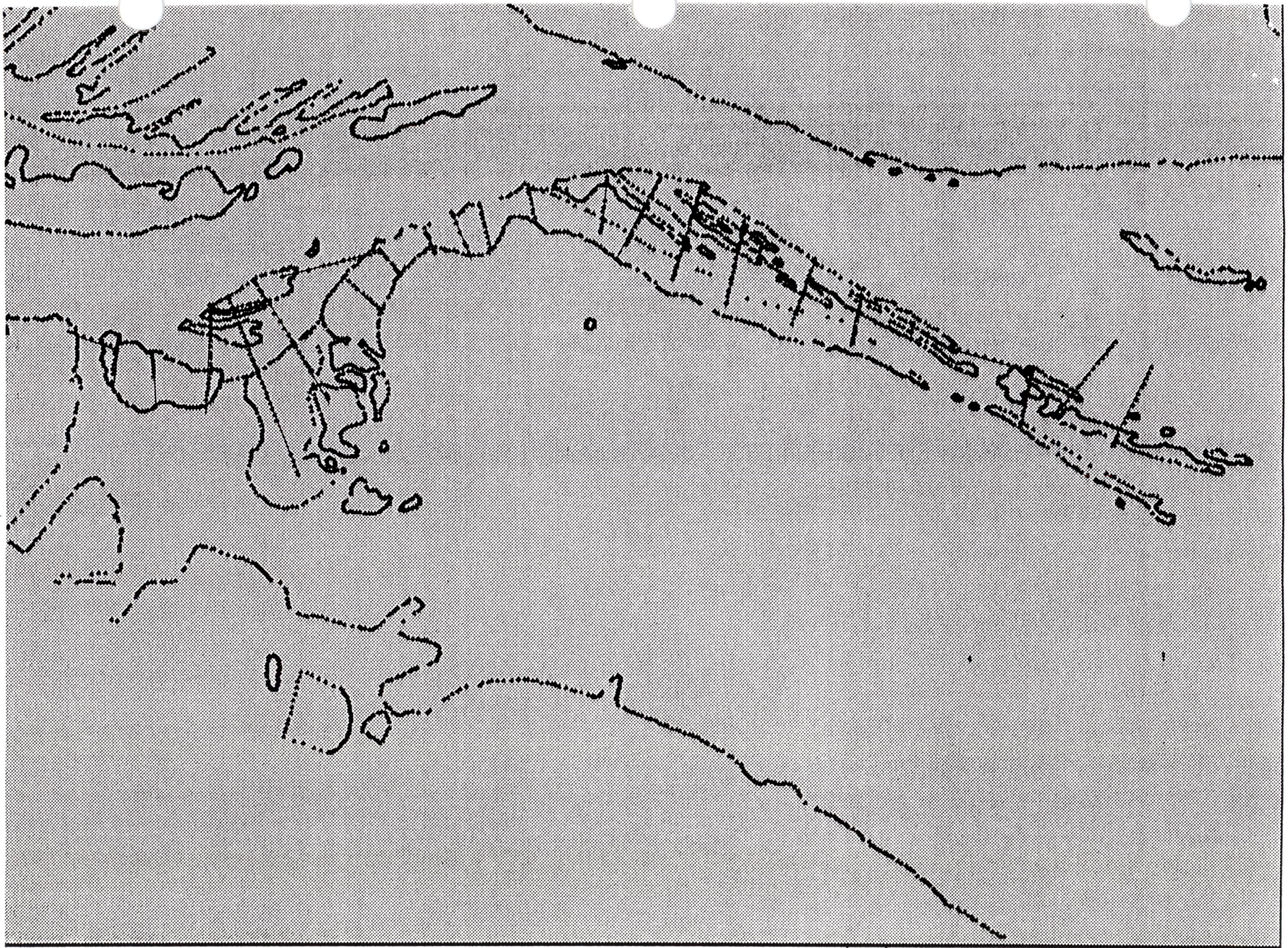
./p23d.dgn Dec. 5, 1994 11:26:14 1 inch = 4000 feet

Plate 1
Study Area

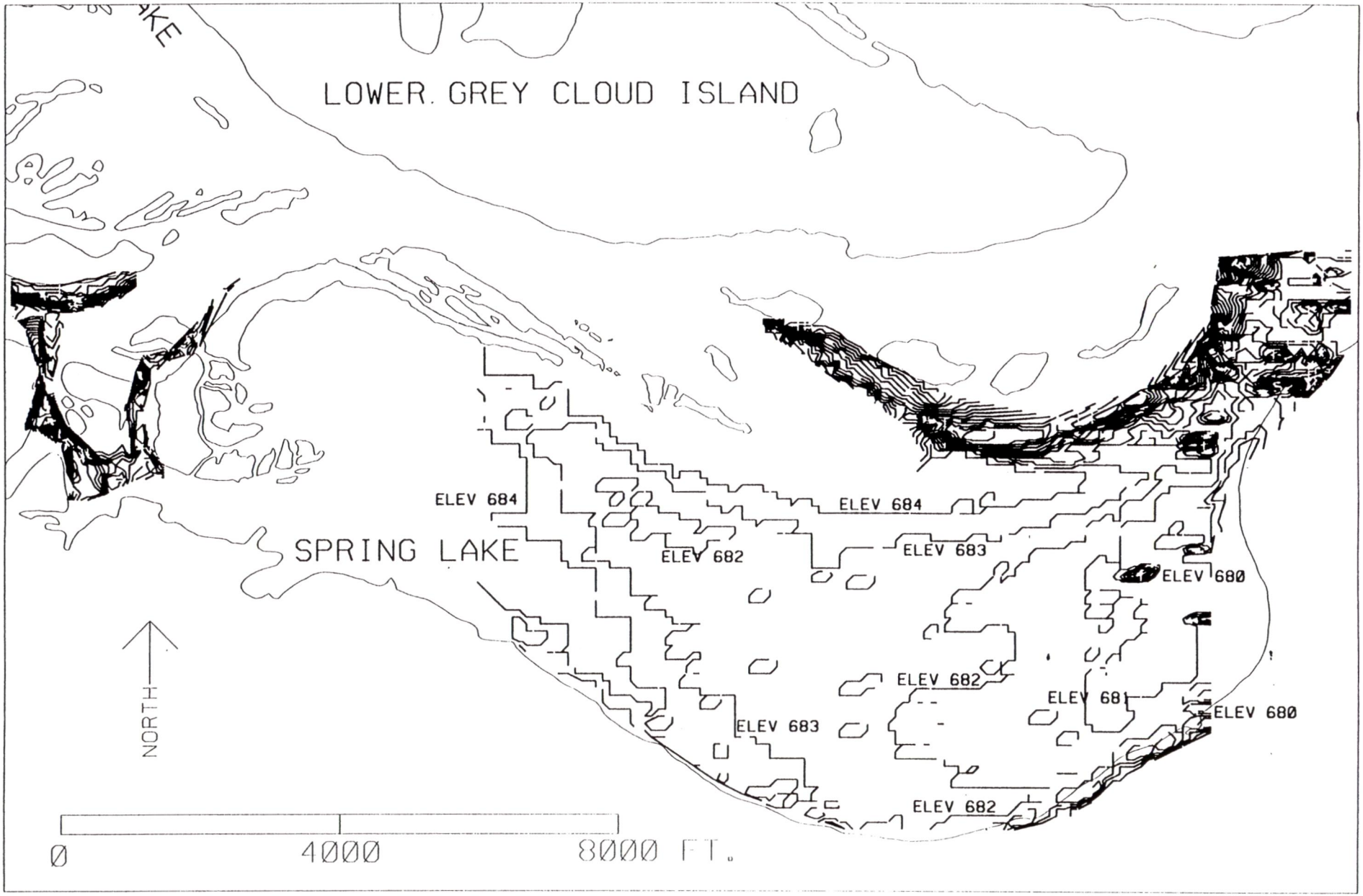


HEC-2 Cross Section Data

Plate 2



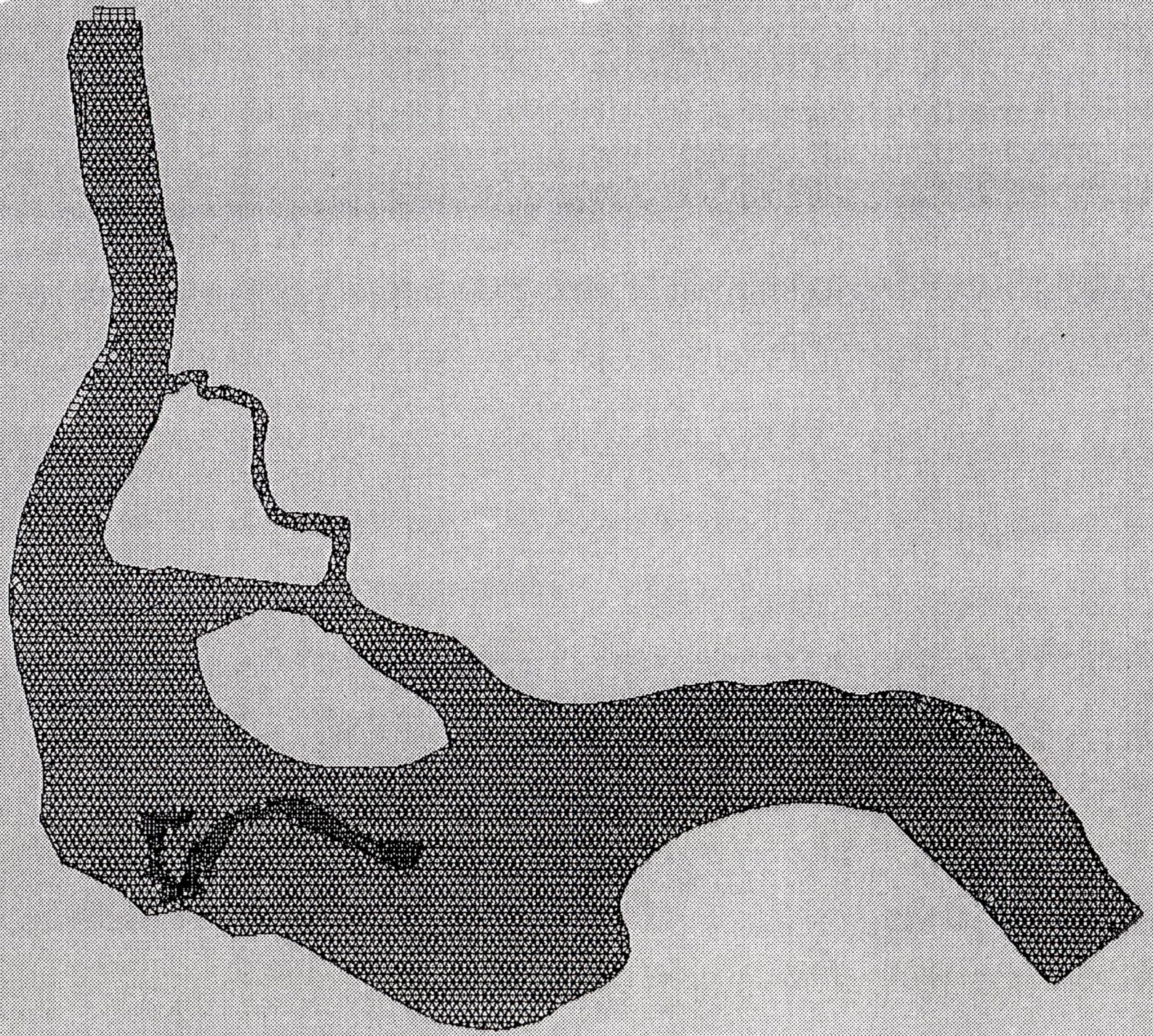
Spring Lake Island Survey Cross Sections
PLATE 3



/usr2/smg/sprlkmn/bathdat/pool2in. Jun. 13, 1995 07:34:33 1 inch = 2000 feet

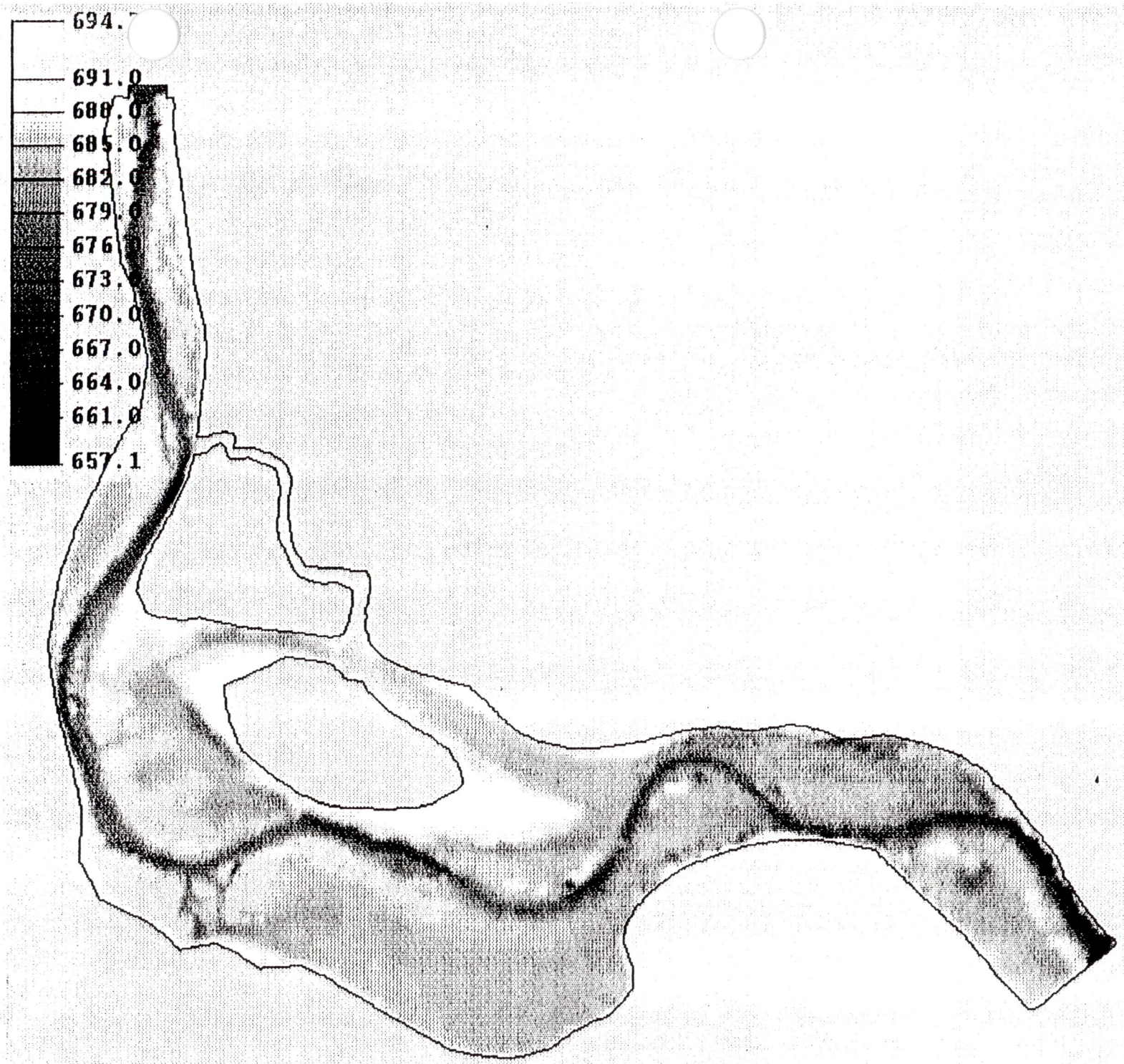
Hydrographic Surveys

Plate 4



Lower Pool 2 Grid

Plate 5



Existing Cond.

Plate 6

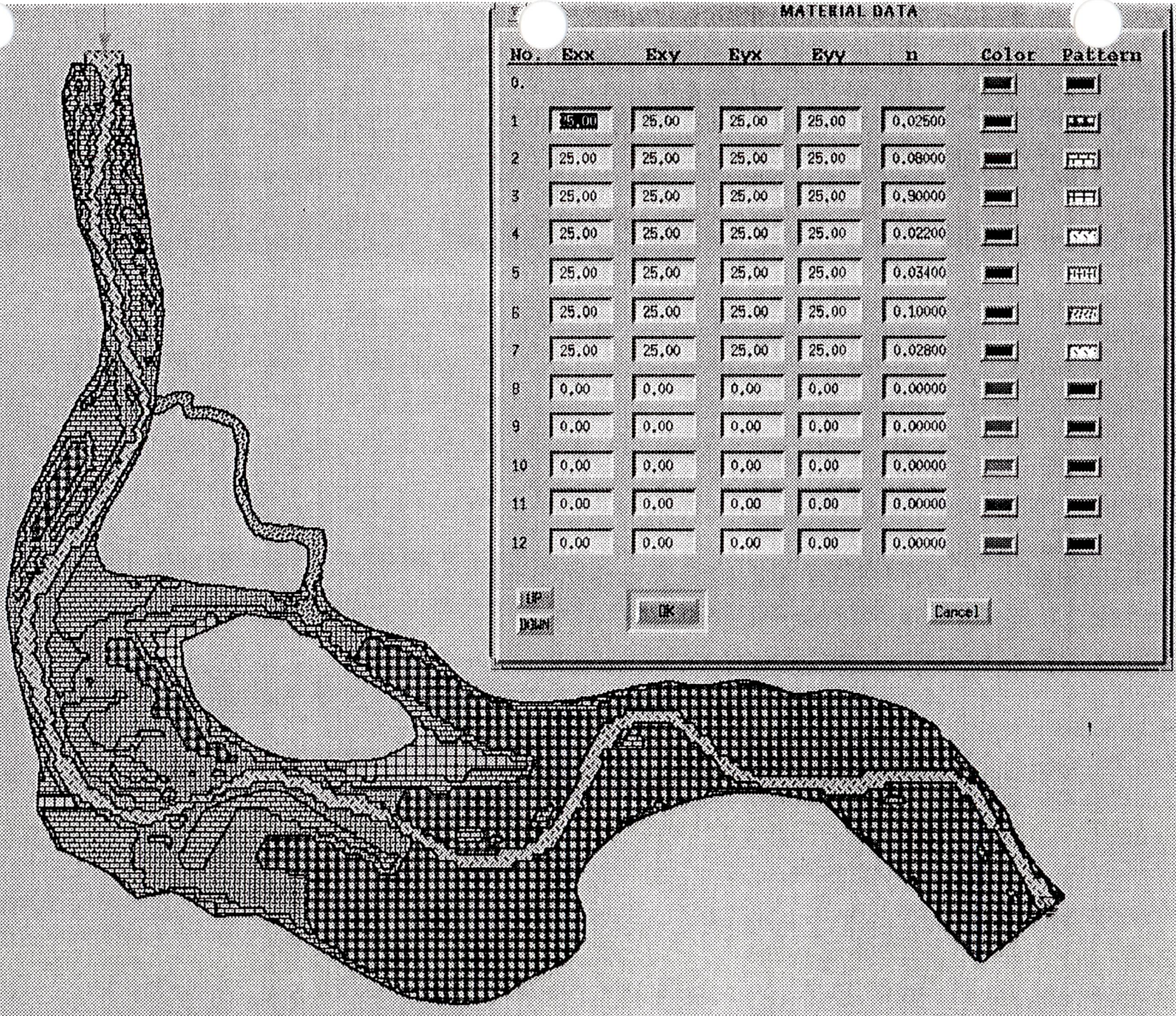
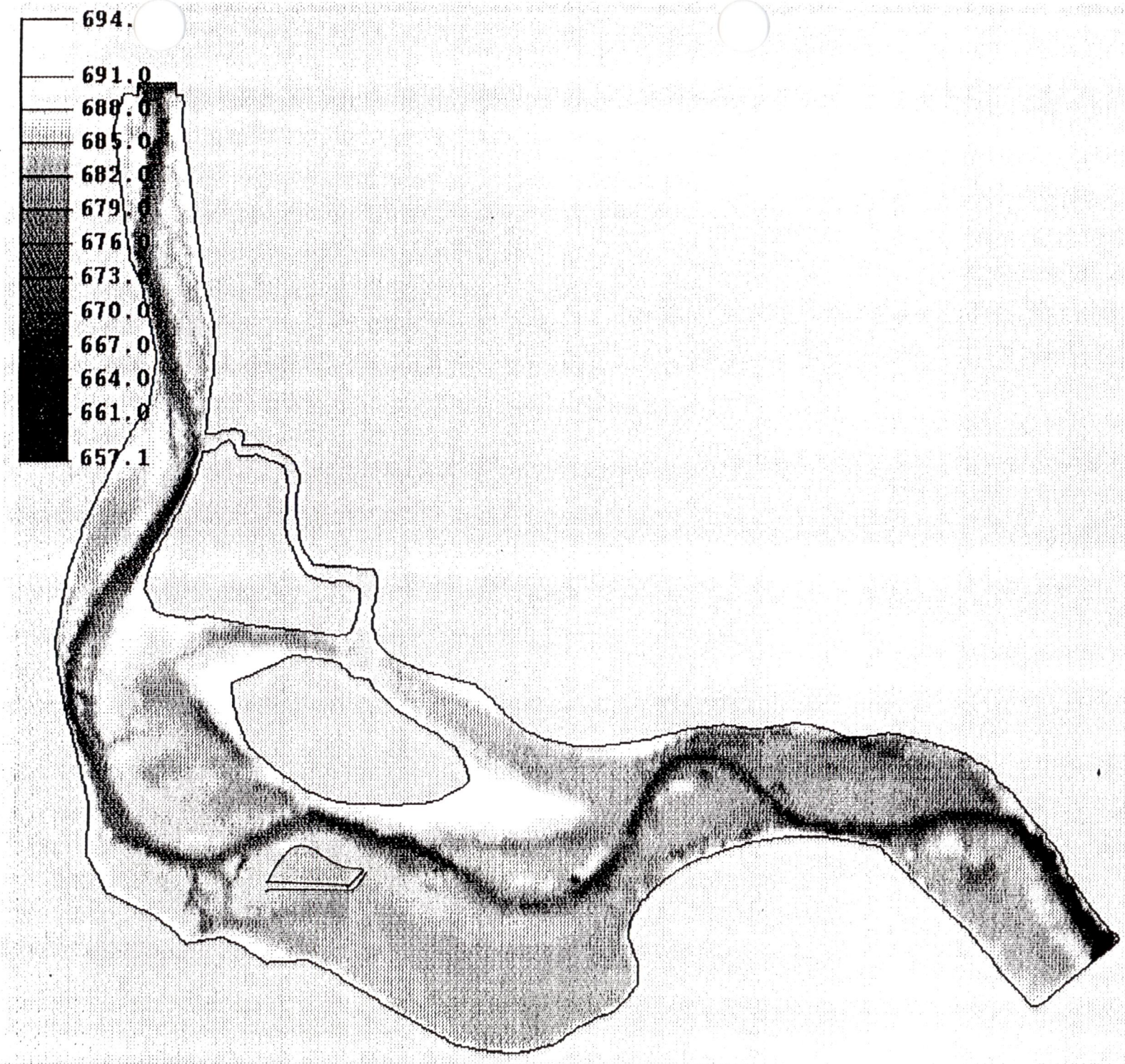

MATERIAL DATA
No. Exx Exy Eyx Eyy n Color Pattern
0.
1 25.00 25.00 25.00 25.00 0.02500
2 25.00 25.00 25.00 25.00 0.08000
3 25.00 25.00 25.00 25.00 0.90000
4 25.00 25.00 25.00 25.00 0.02200
5 25.00 25.00 25.00 25.00 0.03400
6 25.00 25.00 25.00 25.00 0.10000
7 25.00 25.00 25.00 25.00 0.02800
8 0.00 0.00 0.00 0.00 0.00000
9 0.00 0.00 0.00 0.00 0.00000
10 0.00 0.00 0.00 0.00 0.00000
11 0.00 0.00 0.00 0.00 0.00000
12 0.00 0.00 0.00 0.00 0.00000
UP
DOWN
OK
Cancel

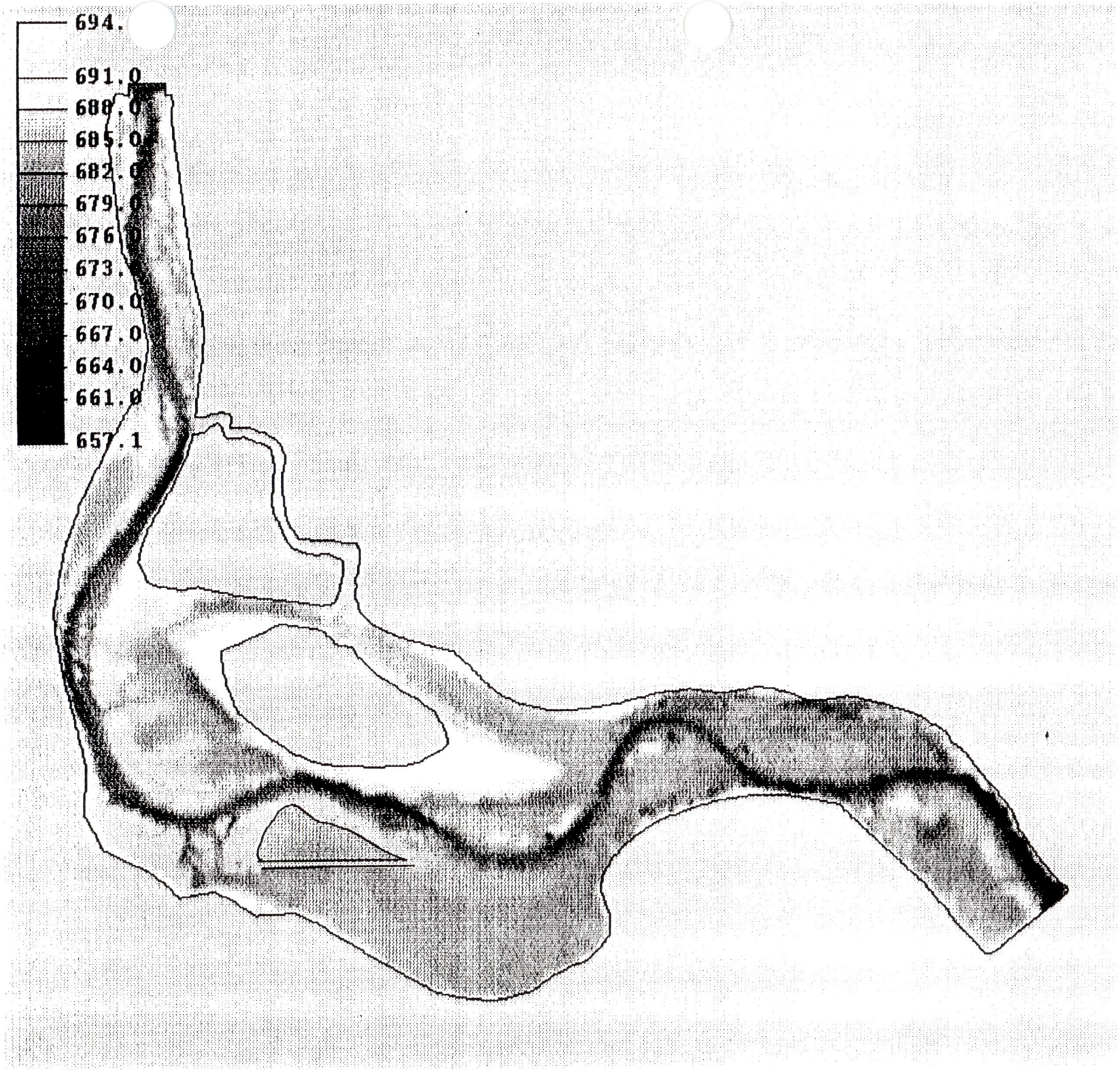
Plate 3



Alternative 0

0.006 ft stage increase at upper end of model.

Plate 8

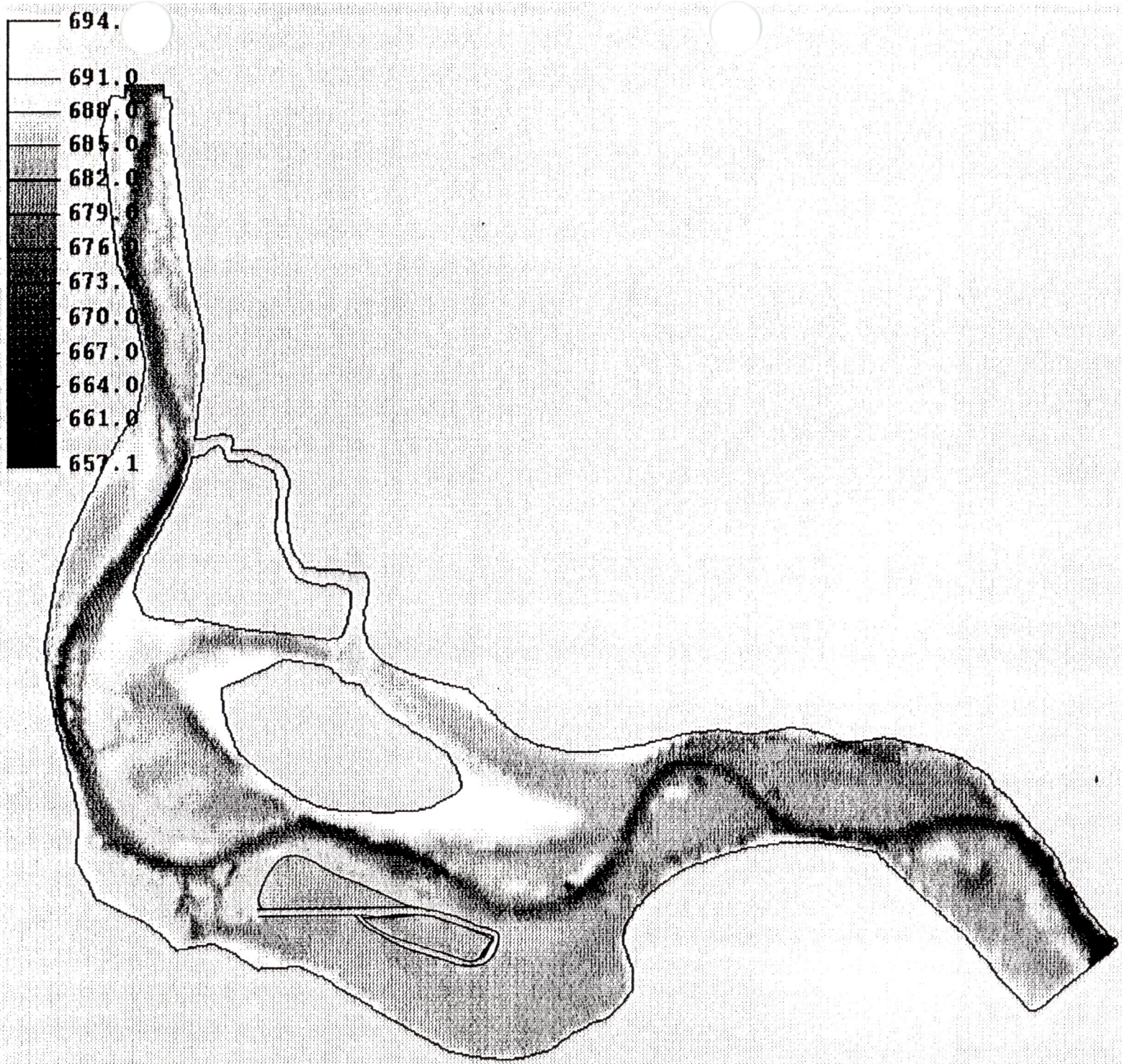


Alternative 1

0.011 ft

stage increase at upper end of model.

Plate 9



Alternative 2

0,017 ft.

stage increase at upper end of model

Plate 10

SPRING LAKE MINNESOTA ISLAND DESIGN

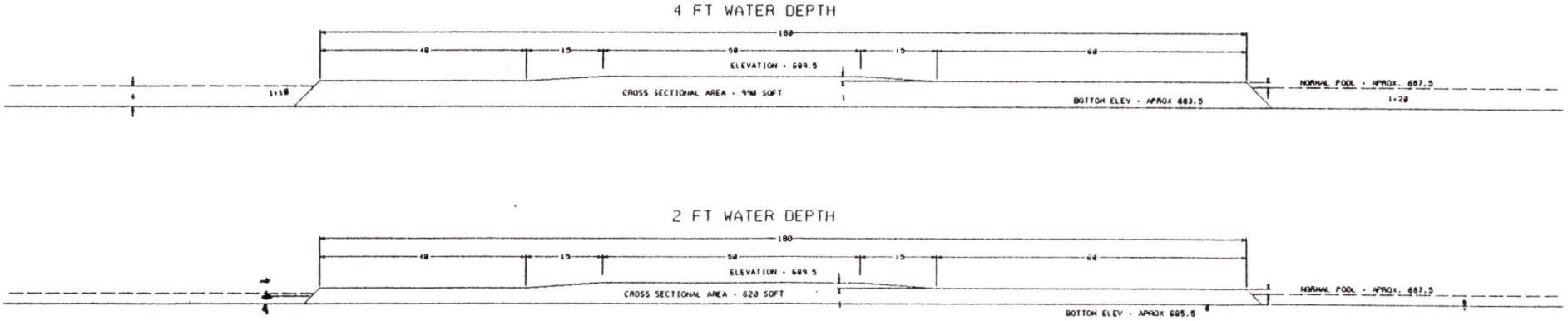


Plate 11

APPENDIX G

CORRESPONDENCE

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

October 10, 1995

REPLY TO
ATTENTION OF

Management and Evaluation Branch
Engineering and Planning Division

Enclosed for review and comment is the Draft Dredged Material Placement Reconnaissance Report for Lower Pool 2. The report recommends the preexcavation of three historic dredged material placement sites with the material to be placed in the Shiely sand and gravel pits on Lower Grey Cloud Island. The three sites would then be used for the placement of dredged material from cuts 2-5 in lower pool 2. Two of the sites would have to be reexcavated approximately one-half way through the 40-year planning period to provide the necessary containment capacity.

This report also addresses the removal of dredged material placed on these sites since 1989.

We request that you provide any comments you may have on this report by November 10, 1995. If there are any questions concerning the enclosed report, please contact Gary Palesh, (612) 290-5282, or Steve Tapp, (608) 687-3011.

Sincerely,

Charles E. Crist

Encl

Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 East 80th Street
Bloomington, Minnesota 55425-1665

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
FWS/AFWE-TCFO

OCT 25 1995

Mr. Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Crist:

This replies to your September 21, 1995, letter requesting U.S. Fish and Wildlife Service (Service) comments on the Draft Dredged Material Placement Reconnaissance Report for Lower Pool 2 on the Upper Mississippi River. The following preliminary recommendations are provided for use by the District in finalizing the reconnaissance report.

1. At this time, the Service supports implementation of Alternatives I1 and H2 subject to the following recommendations and actions by the District. Both of these alternatives rely on use of Sites 2-821.1-LM and 2-822.5-LM (Shiely Pits), 2-821.1-LM and 2-823.8-LM, all of which are currently private property. We strongly recommend that the District initiate land acquisition (fee title or perpetual easements) of these properties as soon as possible to facilitate dredged material disposal both short-and long-term. The Shiely Site is critical to future channel maintenance in Lower Pool 2 and we strongly urge the District to initiate appropriate discussions with the landowner.

2. Transfer sites used in Alternatives I1 and H2 should be restored once they are no longer used by the District for channel maintenance purposes (i.e. abandoned). While we assume that abandonment will not occur for many years, restoration of abandoned disposal sites should be part of the Channel Maintenance Management Plan. Restoration would likely include removal of existing dredged material to the elevation of adjacent habitat, such as bottomland hardwoods, and revegetation.

Additional comments on Lower Pool 2 may be provided at the River Resources Forum meeting and future comments on the overall Channel Maintenance Management Plan. We appreciate the opportunity to provide comments at this time. Please contact Mr. Gary Wege at 612/725-3548 if you have any questions on this letter and its contents.

Sincerely,

Lynn M. Lewis

Lynn M. Lewis
Field Supervisor

cc: River Resources Forum (Terry Moe, Kevin Szcodronski, Steve Johnson)

Responses to U.S. Fish and Wildlife Service
Comments of October 25, 1995

1. We concur as to the critical nature of the Shiely site and plan to initiate discussions with the owner(s) concerning use of the site as early as possible.

2. It is expected that once the riverine transfer sites are no longer used, some site restoration measures will be required. However, as noted, any restoration is likely to occur at some distant time in the future. The Corps of Engineers and the resource management agencies will have to determine at that time what measures are required.

Minnesota Department of Natural Resources

500 Lafayette Road
St. Paul, Minnesota 55155-40__
Division of Waters, Box 32
(612) 296-4802
Fax: (612) 296-0445
Internet: steve.johnson@dnr.state.mn.us

November 3, 1995

Gary Palesh
Management and Evaluation Branch
Engineering and Planning Division
St. Paul District
Corps of Engineers
190 Fifth St. E.
St. Paul, MN 55101-1638

Re: Lower Pool 2 Dredged Material Placement Reconnaissance Report

Dear Gary:

The Minnesota Department of Natural Resources has reviewed the September 1995 Draft Dredged Material Placement Reconnaissance Report for Lower Pool 2. We have the following comments.

1. In general, the document is clumsily written and contains numerous missing words and incomplete sentences. We assume those will be cleaned up in a final version, since the report as it exists is often confusing to read. Adding a lot to the confusion is the fact that the Shiely site is referred to in Plate 1 as 822.0 and everywhere else in the report as 822.5, and that the Pine Bend site is 824.1 in Plate 1 and 823.8 in the rest of the report. Plate 1 is consistent with the 1984 report, but the rest of the 1995 report is different. We assume we're discussing the same sites, and you have simply renumbered them.

2. Under the recent agreements related to development of the CMMP, Pine Bend, Upper Boulanger and Lower Boulanger would be classified as "transfer sites". It is our understanding that when transfer sites are abandoned and no longer used (not likely to occur in the near future, of course), they are to be unloaded and revegetated. The cost of this work should be included in the economic analysis and subsequently in the matrix analysis.

3. The same natural resources matrix value table issue identified in our review of the Lower Pool 3 plan occurs in this document.The table runs from <200 to >1101 on a scale of 1-10. A more appropriate scale, as discussed in our comments on the Lower Pool 3 report, would be a scale of <200 to >601.

4. The alternatives anaysis should be reconducted in light of the changes we recommend in our comments 2 and 3, above, to determine if Alternatives I1 and H2 still surface. If so, we could endorse this plan, provided a long-term lease is in-place for the Shiely property. Without a lease on the Shiely property, this plan doesn't have much value. To us, a preferred alternative might be to select the Shiely site as the preferred placement site for all dredge cuts, providing dredging can be done mechanically. In imminent closure and emergency situations where fast action is required, the island sites could be used as described in the plan and the material moved later. This would eliminate the need to double-handle material, except in imminent closure and emergency situations.

5. It adds to the confusing nature of the document that Table 2 on page 3 lists the GREAT I dredge cut summary rather than something modern that uses the experience of the last 20 yeras. If you updated the table, you wouldn't have to explain why you're not dealing with Cuts 1 and 6.

6. We are concerned about sediment quality, and we have urged the Minnesota Pollution Control Agency to take a careful look at this plan.

7. With the island sites pretty much full and the plan anticipating unloading them in 1997, what do we do with dredging needs that may occur in 1996? The agencies should discuss this problem before it becomes urgent sometime next spring or summer.

8. On page 7 you eliminate further consideration of the C.F. Industries site because Shiely is cheaper. I can understand why the Shiely site might prevail in a comparative analysis, but this may be the first time we've seen a plan decide not to **evaluate** a site because another is cheaper. What if the Corps cannot negotiate a long-term lease with Shiely? What if nothing is in place in 1996? It would seem the C.F. Industries site should continue to be analyzed and may in fact be seriously considered for interim dredging in 1996.

9. The discussion on page 8 makes little sense without reading the 1984 report. Either some descriptive text from the 1984 report should be included here, or at the very least there should be reference to the fact that the 1984 report can be found in Appendix E. An evaluation of the 1984 report would show, for example, that your statement about the infeasibility of Alternative C1 is incomplete. Alternative C1 proposed that only one of the four dredge cuts go to the site referenced; the other three would go to Spring Lake (also infeasible, as noted in the discussion of Alternative C2).

10. Your description of Alternative B1 on page 15 is confusing. In one sentence at the top of the page you state that material will be placed permanently at site 2-821.1-LM with no beneficial

use removal. In the next sentence, you state the material in that site would be removed to Shiely, where it all is beneficially used.

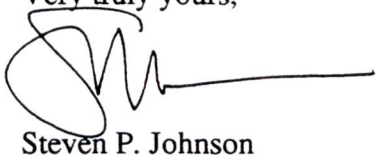
11. At the bottom of page 22 you state that placement of material at Shiely may require dredging the old entrance channel from the west. With a perfectly good channel to Shiely maintained to the south, there doesn't seem to be any logical reason to dredge the west channel; the cost of dredging would outweigh the time saved in reaching the site from Cut 5 (and only Cut 5 would see any time saving by using the western entrance). The same statement is repeated on page 39.

12 The discussion on page 23 of fish and wildlife impacts neglects to mention the beneficial impacts that would occur because the island sites would be permanently revegetated.

13. The cover page for Appendix E describes it as a "June 1994" report rather than July 1984, as noted on the next page.

Thank you for this opportunity to comment.

Very truly yours,



Steven P. Johnson
River Management Supervisor

cc: Lynn Lewis, USFWS
Gretchen Benjamin, WDNR
Larry Zdon, MPCA
John Linc Stine, DOW
Dale Homuth, Region VI
Scot Johnson, Lake City

Responses to Minnesota Department of Natural Resources
Comments of November 3, 1995

1. The site numbers on plate 1 have been corrected.

2. We do not concur. We believe there are so many uncertainties associated with the future disposition of these sites that attempting to predict what may take place in 40 years and what it may cost would be highly speculative and meaningless. Some of the more salient uncertainties are:

a. The Corps and the resource agencies may elect to continue to use these sites as transfer sites if the Shiely pits or other sites are available for use.

b. If the sites are abandoned, the Corps and the resource agencies may elect to remove some or all of the material above the natural topography, or they may decide the best solution would be to leave the sites as they exist at that time.

c. If material is to be removed from these sites at the time they are abandoned, there is no way of predicting how much material would be removed or where it would be taken.

Even if we were to assume some cost for unloading and restoring the sites, this cost would be relatively minor in proportion to the overall cost of the alternatives. The most the dredging cost matrix value would change would be one unit. Because we have used a more detailed alternatives comparison than that provided soley by the matrix, the inclusion of these relatively minor costs would not be expected to have any effect on the decision making process.

3. In hindsight, we believe it was a mistake to adjust the habitat matrix scoring for lower pool 3 to the 200 - 600 habitat units scale. The matrix evaluation criteria should remain constant from all reaches of the river, and not be adjusted on a pool by pool or reach by reach basis. However, we had agreed to use this scale for lower pool 3, and that is the scale we used in the lower pool 3 reconnaissance report.

If we had used the 200 to 600 scale for all of the reconnaissance reports prepared in the past, nearly 2/3 of the alternatives considered in those reports would have received 0 or 10 points. This is not an effective range to evaluate pool plan alternatives. Appendix B provides additional justification for use of the 200 - 1100 scale.

The following is how the matrix scoring would have varied if the 200 - 600 scale had been used in this report.

Alt.	Habitat Score 200-1100	Habitat Score 200-600	Overall Matrix Total 200-1100	Overall Matrix Total 200-600
A1	6	3	592	526
B1	3	1	568	524
F1	3	1	653	609
G1	10	10	780	780
H1	7	5	714	670
I1	8	7	736	714
A2	10	10	775	775
B2	5	1	580	492
F2	9	8	788	766
G2	10	10	750	750
H2	10	10	780	780

As can be seen, using the 200-600 scale for determining the habitat matrix value would not have any effect on which alternatives were selected for the more detailed pair-wise comparison. The only one that may have been questionable would be alternative H1, which was eliminated during the first pair-wise comparison anyway.

4. We believe neither the inclusion of some future site restoration costs, nor the use of the 200-600 habitat scale would change the basic decision that has to be made. There is little question that alternatives I1 and H2 are the best overall choices of the alternatives using riverine transfer sites. The real decision then comes down to using riverine transfer sites vs. direct placement in the Shiely pits (alternatives G1 and G2). As indicated in the report, we do not believe the added costs associated with direct placement in the Shiely site can be justified.

5. We prefer to leave table 2 as is. This provides a link to the GREAT I study. If we updated the cut descriptions and deleted cuts 1 and 6 from the table, we would get comments asking why we are deviating from the GREAT I dredge cut designations.

6. Comment noted.

7. We recognize that the island sites in lower pool 2 are at or near capacity. At present, it appears that funding constraints could preclude unloading these sites in 1996. Unloading Corps Island in lower pool 3 and Grand Encampment Island in lower pool 4 are higher priority at this time.

8. The C.F. Industries pit was not eliminated solely because it was "cheaper" to use the Shiely pit. As indicated in paragraph 4.1.4, the C.F. Industries pit does not have capacity for 40 years of dredged material and the environmental effects of using that site would be comparable to using the Shiely pits. We believe eliminating a site from further evaluation that doesn't have capacity, is more expensive to use, and with environmental effects comparable to a similar alternative is exercising common sense.

We recognize that the whole dredged material placement effort in lower pool 2 hinges on being able to use the Shiely site. If arrangements to use this site can not be made, we will have to re-evaluate other alternatives, including the

C.F. Industries pit. There is nothing to prevent consideration of using the C.F. Industries pit in 1996 as an interim measure, if necessary.

9. On page 4 it was noted that the 1984 reconnaissance report was attached as appendix E. We have added the reference to appendix E on page 8 also. Alternative C1 is not considered a feasible alternative because site 2-832.5-LM is no longer available. If we eliminate this site from this alternative, it is no longer alternative C1.

10. This has been clarified to indicate that material placed at these sites over the next 40 years would not be removed for beneficial use. The material that would be transferred to the Shiely pits is the dredged material placed at some of these sites during 1989-95, which the District has made a committment to remove.

11. We have deleted these statements. The decision on how to access the Shiely pits for directly placed material would have to be made at the time of placement.

12. This is accounted for in the Habitat Evaluation Procedures. Under the future without project condition for all alternatives, it is assumed that none of the sites would be used, and therefore would revegetate and provide habitat benefits. For the future with project condition for each alternative, the habitat effects at each site used are assessed and accounted. The difference between the future without project and future with project habitat unit totals is the impact of that alternative. For alternatives G1 and G2, the habitat effects are considered zero because the future without project and future with project habitat conditions for the riverine sites are the same.

13. The date has been corrected here and elsewhere in the report.

United States Department of the Interior

NATIONAL PARK SERVICE
Mississippi National River and Recreation Area
175 Fifth Street East, Suite 418, Box 41
St. Paul, Minnesota 55101-2901

IN REPLY REFER TO:

L8052(MISS)-2

November 9, 1995

Mr. Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Crist:

The National Park Service (NPS) has reviewed the Draft Dredged Material Placement Reconnaissance Report, Lower Pool 2. The project site is within the boundary of the Mississippi National River and Recreation Area (MNRRA), a unit of the national park system. NPS review of this proposed federal action is required by 16 U.S.C. § 460zz-3(b).

16 U.S.C. § 460zz-3(b) states, in part, that before any department or agency of the United States government begins any undertaking within MNRRA, the NPS (via delegation from the Secretary of the Interior) shall review the undertaking to assess its compatibility with the Area's comprehensive management plan (CMP). In fulfillment of this mandate, we offer the following comments:

1) We have a general concern throughout the document regarding cultural resource issues. It appears that none of the proposed dredge deposition sites have been surveyed for cultural resources. With the exception of the Armour Site and the Shiely Site this is an issue that needs further consideration, particularly for the sites proposed to be pre-excavated. We assume you have contacted the Minnesota Historical Society regarding these sites and any potential impacts which may result from dredge activities.

2) Our preferred alternatives differ from those selected by the Corps. We would prefer alternative G1 for Cuts 2 & 3 and alternative G2 for Cuts 4 & 5. This assumes that the old entrance channel from the west would **not** require dredging because the channel to the south would be used, and that Shiely would agree to give the District a long-term lease or possibly sell the site to the District. The 'G' alternatives were selected because they would have the least impact on the natural and cultural

resources due to direct deposition of material into the Shiely site. In addition, the 'G' alternatives would eliminate the need for double-handling the material. In emergency or imminent closure situations the island sites mentioned in alternatives H2 and I1 could be used as described in the plan, with the material being moved at a later date. We believe the 'G' alternatives most closely comply with the goals and visions of the MNRRA CMP.

3) The information regarding National Park Service goals (page F-27) is outdated. NPS agency goals cited in this section were discussed in 1989. Since that time the Comprehensive Management Plan for the Mississippi National River and Recreation Area has been finalized. The following types of goals should be listed for the NPS in place of those cited:

- Preserve and enhance natural resources.

- Restore significant natural resources that have been adversely impacted in the past.

- Improve water quality in the river and move toward fishable and swimmable goals as defined in state and federal law.

- Recognize the role of the Mississippi River as a nationally significant natural ecosystem and migratory corridor for wildlife in the heart of the midcontinent.

- Recognize the role of the Mississippi River as a working river and as the heart of midcontinent navigation.

- Encourage economic development activities that take advantage of the corridor's attributes in a manner that preserves, protects, and enhances the natural and cultural resources in the corridor.

- Enhance opportunities for public outdoor recreation, education, and scenic enjoyment throughout the MNRRA corridor.

4) The document would be easier to read if the sites were referred to by name rather than by code number. The code number identification results in constant page flipping to determine which sites are being discussed in each alternative.

5) Numerous errors and inconsistencies are scattered throughout the document. Determining which statement(s) are accurate and which are not interferes with efficient document review. Some examples include:

- On page 9 under the descriptions of alternative placement sites, Upper and Lower Boulanger Islands are said to be

ostensibly owned by P.A.S. Associates. However, in the appendices on pages B-7 and B-8 these islands are listed as owned by the Federal Government. In Appendix E it is also states that these islands are federally owned. Which ownership is correct?

o On page 16 in the second to last paragraph it states that both Upper and Lower Boulanger Island have been used for dredge deposition in the past, *the upper island in 1995*. In the description of Lower Boulanger on page 9 of the document it states that this island <u>also</u> was used for deposition in 1995. Which statement is accurate?

o On page 16 under 5.2.2.3 it mentions **four** riverine sites for this alternative. That number should be **two**. This occurs again on page 18, paragraph 1, discussing alternative F1. **Three** historic dredged material placement sites are referred to, then later in the same paragraph it discusses "these **four** sites".

These types of errors, along with numerous typos such as the site code given for Shiely in the site description section on page 10 (RM instead of LM), create confusion when reviewing the draft plan. We assume these types of problems will be corrected in the final plan for Lower Pool 2.

If you have questions on any of these comments, or on the MNRRA, please contact Nancy Duncan at 290-4160.

Sincerely,

JoAnn Kyral
Superintendent

cc: Gary Wege, FWS
Steve Johnson, DNR
Colonel John Wonsik, COE

Responses to National Park Service
Comments of November 9, 1995

1. Coordination with the Minnesota SHPO has taken place. A notation to that effect has been added to table B-17. The riverine sites that are being recommended as dredged material transfer sites have all been used for dredged material placement in the past. This has precluded any surveys of these sites. Based on available information, the potential for cultural resources being present at these sites is considered very low.

2. We concur that alternatives G1 and G2 would have the least potential effect on natural and cultural resources. However, we do not believe these potential effects are substantial enough to justify the added cost of alternatives G1 and G2, approximately $3.35 million more than the recommended alternatives.

All material placed in the Shiely pits will have to be double-handled. If it is taken directly to the site by barge, the material has to be loaded on trucks and trucked to its final location in the pits. The use of riverine transfer sites is less costly because the double handling is done by hydraulic dredge in large volumes which significantly lowers the unit cost.

3. These goals have been added to the report in section 3.

4. Comment noted.

5. We have corrected the errors noted, as well as other editorial errors present in the draft report.

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

State Office Building, Room 1
3550 Mormon Coulee Ro
La Crosse, Wisconsin 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

George E. Meyer
Secretary

November 13, 1995

Mr. Charles E. Crist
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

SUBJECT: Dredged Material Placement Reconnaissance Report
Lower Pool 2

Dear Mr. Crist:

The Dredged Material Placement Reconnaissance Report Lower Pool 2 is north of the Wisconsin border. Accordingly, our comments relate to potential water quality impacts that dredging and disposal may have on Wisconsin waters.

Please find enclosed with this letter a copy of an internal memo written by John Sullivan, the Wisconsin Department of Natural Resources, Mississippi River Water Quality Specialist. His comments reflect Department concerns with respect to water quality impacts from dredging and disposal, in Lower Pool 2.

If you have any questions, please contact Mr. Sullivan directly at the address above or at (608)785-9995.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

c Scot Johnson - MNDNR, Lake City, MN
Steve Johnson - MNDNR, St. Paul, MN
Gary Wege - USFWS, Bloomington, MN
Steve Tapp - USACE, Fountain City, WI

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 8, 1995 FILE REF:

TO: Terry Moe
Gretchen Benjamin

FROM: John Sullivan

SUBJECT: Pool 2 Dredge Material Placement - Comments

Here are my comments. Feel free to pass these on to the Corp for their review and consideration.

Dredging historic dredge spoil sites - Will this result in the re-exposure of elevated contaminants in bed sediments? This is to be expected if these materials contain silty deposits (ie cuts 2 & 3).

Hydraulic dredging of any sediments with PCBs exceeding 50 ng/g (ppb) should be avoided unless the spoils are transferred to a confined disposal facility (CDF) designed to trap fine material. Further, the outlet of the CDF should have a TSS limit designed to avoid serious water quality standards exceedances (ie. metals, PCBs and ammonia). This needs to be coordinated with MPCA.

Mechanical dredging of contaminated sediments may be more desirable. However, transfer of contaminated sediments from a dredge cut to another "in-water disposal site" should be avoided. Instead, contaminated sediments should be placed in an upland site.

I would still like to see recent sediment contaminant data collected in 1995. I would also like someone from the Corp to describe their preferred alternative since the listed options are confusing to me.

Responses to Wisconsin Department of Natural Resources
Comments of November 13, 1995

1. At some point during the pre-excavation of the riverine sites, re-exposure of contaminated sediments may occur. However, these sites would be dredged to 30 feet below normal pool elevation so the vast majority of the sediments that will be exposed will be pre-European settlement and should be uncontaminated.

2. The recommended plan for cut 2 (alternative I1) requires that cut 2 be dredged mechanically. Cuts 3 and 4 would be dredged hydraulically. However, sediment data for these cuts indicate the material is relatively coarse and uncontaminated. Dredge cut 5 (also uncontaminated) would be dredged mechanically.

3. Contaminated sediments from cut 2 would be placed at sites 2-821.1-LM and/or 2-821.5-LM. While these sites may contain open water, they still would be containment sites. Upland placement should not be necessary.

4. The 1995 contaminant data is being included in a report that will be available in the near future.

Minnesota Department of Natural Resources

500 Lafayette Road
St. Paul, Minnesota 55155-40__

Division of Waters, Box 32
(612) 296-4802
Fax: (612) 296-0445

January 19, 1996

Gary Palesh
Management and Evaluation Branch
Engineering and Planning Division
Corps of Engineers
Army Corps of Engineers Centre
190 Fifth St. E.
St. Paul, MN 55101-1638

Re: Lower Pool 2 Dredged Material Placement Reconnaissance Report

Dear Mr. Palesh:

1 Thank you for the opportunity to review the revised version of the above-referenced document, which was discussed at the Mississippi River Resources Forum meeting Dec. 18-19. While we are not fully satisfied with your responses to our previous comments (Appendix G), we don't see much point in belaboring those issues.

2 Since selected alternative I-1 involves placement at site 2-821.5, doesn't the Corps need to acquire that site? The plan discusses acquisition of the other two island placement sites, but not this one.

3 It seems critical that the Corps accelerate discussions with the Shiely company concerning acquisition of the long-term disposal site on Grey Cloud Island. We would be willing to assist with those discussions in any way we could.

Very truly yours,

Steven P. Johnson
River Management Supervisor

cc: Scot Johnson

Responses to Minnesota Department of Natural Resources
Comments of January 19, 1996

1. Comment noted.

2. The referenced discussion has been corrected.

3. The offer of assistance is appreciated. We will contact you if your support is needed to assist the acquisition process.