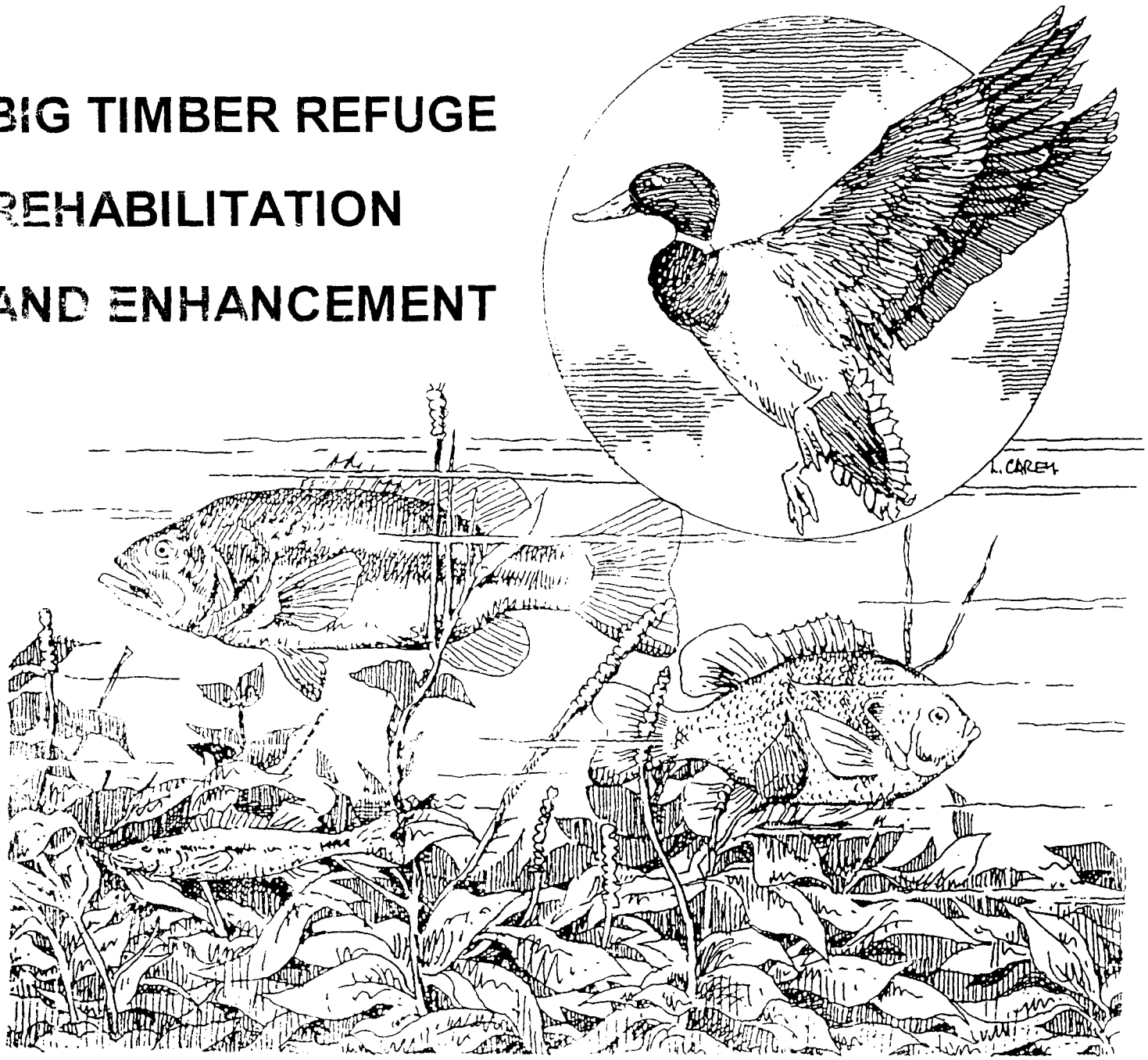
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE
EVALUATION REPORT (PER5F)

BIG TIMBER REFUGE REHABILITATION AND ENHANCEMENT



FEBRUARY 1996

US Army Corps
of Engineers
Rock Island District

POOL 17
UPPER MISSISSIPPI RIVER
MILE 443-445
LOUISA COUNTY, IOWA

ACKNOWLEDGMENT

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POOL 17, MISSISSIPPI RIVER MILES 443.5 - 445.0
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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

List of Tables

TABLE OF CONTENTS (Cont'd)

List of Plates

List of Appendices

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT (PER5F)

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1. INTRODUCTION

The Big Timber Refuge Rehabilitation and Enhancement project, hereafter referred to as "the Big Timber project," is an ongoing part of the Upper Mississippi River System (UMRS) Environmental Management Program (EMP). The Big Timber Project is a U.S. Fish and Wildlife Service (USFWS) management unit of the Louisa Division of the Mark Twain National Wildlife Refuge.

a. Purpose. The purposes of this report are as follows:

(1) Summarize the performance of the Big Timber project, based on the project goals and objectives;

(2) Review the monitoring plan for possible revision;

(3) Summarize project operation and maintenance efforts to date; and

(4) Review engineering performance criteria to aid in the design of future projects.

b. Scope. This report summarizes available project monitoring data, inspection records, and observations made by the U.S. Army Corps of Engineers (Corps), the USFWS, and the Iowa Department of Natural Resources (IADNR) for the period from July 1991 through January 1996.

c. Project References. Published reports which relate to the Big Timber project or which were used as references in the production of this document are presented below.

(1) *Definite Project Report with Integrated Environmental Assessment (R-5), Big Timber Refuge Rehabilitation and Enhancement, Pool 17, Upper Mississippi River, Louisa County, Iowa*, July 1989 (DPR). This report presents a detailed proposal to dredge a channel from Coolegar Slough into Big and Little Denny (isolated backwater ponds) with sidecasting of mechanically excavated material, confined placement of hydraulically dredged material, planting mast trees, and blasting of potholes in the mudflats of the Big

Timber Refuge. The report marks the conclusion of the planning process and serves as a basis for approval of the preparation of final plans and specifications and subsequent project construction.

(2) *Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 17, River Miles 443-445, Big Timber Refuge*, November 1989, Contract No. DACW25-90-C-0040. This document was prepared to provide sufficient detail of project features to allow construction of the dredged channel, sidecasting mechanically excavated material, confined placement of hydraulically dredged material, and blasting of open water holes by a contractor.

(3) *Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 17, River Miles 443-445, Big Timber Refuge*, March 1993, Contract No. DACW25-93-C-0034. This document was prepared to provide sufficient detail of project features to allow planting of mast trees by a contractor.

(4) *Operation and Maintenance Manual, Big Timber Refuge Rehabilitation and Enhancement, Upper Mississippi River Environmental Management Program, Pool 17, River Miles 443-445, Louisa County, Iowa*, June 1994. This manual was prepared to serve as a guide for the operation and maintenance of the Big Timber project. Operation and maintenance instructions for major features of the project are presented.

(5) *Big Timber Habitat Rehabilitation and Enhancement Project, Great Flood of 1993 Damage Assessment*, March 1994. This document was prepared to provide a summary describing the Flood of 1993 damage, proposed corrective action, and estimated cost for repairs.

(6) Letter from Mr. Robert Kelley, Corps, to Mr. William Hartwig, USFWS, August 1995. This letter transmits shop drawings and formally transfers the Big Timber project to the USFWS.

(7) Letter from Mr. William F Hartwig, USFWS to Colonel Cox, Corps, September 1995, accepting the transfer of the Big Timber project from the Corps to USFWS.

2. PROJECT GOALS, OBJECTIVES, AND MANAGEMENT PLAN

a. General. As stated in the DPR, the Big Timber project was initiated in response to the quantitative and qualitative losses of off-channel aquatic and wetland habitat due to sedimentation.

b. Goals and Objectives. Goals and objectives were formulated during the project design phase and are summarized in Table 2-1.

TABLE 2-1
Project Goals and Objectives

Goals	Objectives	Project Features
Enhance Aquatic Habitat	Restore deep (>6 feet) aquatic habitat	Hydraulic Dredging
	Restore shallow (2-3 feet) aquatic habitat	Mechanical Excavation
	Improve levels of dissolved oxygen during critical seasonal stress periods	Dredging & Excavation
	Provide year-round habitat access (cross-sectional area)	Dredging & Excavation
Enhance Terrestrial Habitat	Produce mast tree dominated areas	Revegetation
Enhance Migratory Waterfowl Habitat	Increase reliable resting and feeding water area	Pothole Creation and Dredging/Excavation
	Provide isolated resting, feeding, and brooding pools	Pothole Creation

c. Management Plan. A formalized management plan was not required for this project. The Big Timber project is operated as generally outlined in the Operation and Maintenance Manual.

3. PROJECT DESCRIPTION

a. Project Features. Plate 1 shows a general site plan, and plate 2 shows project features. The constructed project includes:

(1) Creation of Deep Channels. Hydraulic dredging of approximately 74,000 cubic yards to create a 50-foot-wide channel from the mouth of Round Pond to the mouth of Timber Chute (1,120 feet long), and the head end of Timber Chute to the mouth of Big Denny (3,950 feet long). Minimum dredging depth was to elevation 528 (8 feet below Pool 17 flat pool of elevation 536). Hydraulically dredged material was placed in a confined dredged material placement site (CPS) between the Mississippi River and Big and Little Denny. In addition, approximately 5,500 cubic yards was mechanically excavated from Timber Chute to provide a 35-foot-wide by 327-foot-long channel through Timber Chute. Timber Chute minimum excavated depth was to elevation 528 (8 feet below Pool 17 flat pool). Mechanically excavated material was sidecast on both banks of Timber Chute;

(2) Shallow Habitat Excavation. Mechanical excavation of approximately 63,500 cubic yards from the mouth of the Willow Chute area to the heads of Big and Little Denny to provide a 40- to 50-foot-wide by 9,400-foot-long shallower area (located immediately adjacent to the hydraulically dredged channel in Willow Chute). Minimum excavated depth was to elevation 532.5 (3.5 feet below Pool 17 flat pool);

(3) Check Dams. Construction of three check dams from mechanically excavated material at those locations where overland flows are depositing sediment at the project site;

(4) Potholes. Creation of 10 potholes by blasting openings in the mudflats where willows were encroaching;

(5) Boater Access Control. Creation of boater access control by the placement of cleared timber at several locations in the dredged channel; and

(6) Mast Tree Planting. Revegetation by planting 900 trees consisting of 11 mast-producing species on the CPS containment dike.

The deep dredging was designed to restore over-winter and summer thermal refuge areas for fish. The shallower areas will increase fish spawning and nursery habitat. Planting mast trees will enhance terrestrial habitat value. The increase in acreage of year-round open water will increase habitat available to wood duck broods, and the creation of potholes in the mudflat area will provide protected areas for wood ducks.

b. Construction and Operation. Following award of the first contract on May 22, 1990, dredging began during late summer and was essentially completed in the fall of 1991. Final inspection of the vegetation at the dredged material placement site was

accomplished following the first growing season. This time allowed concerns to be addressed that seeding or earthwork could be needed in sandy areas to induce sufficient vegetative growth. However, adequate vegetation established itself and additional work was not needed. Final inspection of project construction was made in the summer of 1992. Following award of the second contract on June 2, 1993, mast trees were planted during the fall and follow-up maintenance was completed in the spring of 1995. The project requires no operational activities.

4. OPERATION, MAINTENANCE, AND PROJECT MONITORING

a. General. Appendix A presents the Post-Construction Evaluation Plan. This plan was developed during the design phase and serves as a guide to measure and document project performance. Appendix B contains the Monitoring and Performance Evaluation Matrix and Resource Monitoring and Data Collection Summary. This schedule presents the types and frequency of data that have been collected to meet the requirements of the Performance Evaluation Plan.

b. Corps of Engineers. The physical locations of the sampling stations referenced in the Post-Construction Evaluation Plan and the Resource Monitoring and Data Collection Schedule are presented on plate 3. As part of the Flood of 1993 Damage Assessment, soundings (sedimentation transects) were taken by the Corps on January 12, 1994, at the 11 Big Timber project dredged channel sedimentation transects. The sedimentation transect data are shown on plates 4 through 10. The Corps has also collected water quality data at one station located near the mouth of Round Pond. A second water quality station, located near the mouth of Little Denny, was added in November 1995. The Corps surveyed pothole sedimentation transects in September 1995. The 10 pothole sedimentation transects are shown on plates 11 through 14. The success of the project relative to original project objectives will be measured using this data along with other data, field observations, and project inspections performed by the USFWS and the IADNR. The Corps has overall responsibility to measure and document project performance.

c. U.S. Fish and Wildlife Service. The USFWS is responsible for operating and maintaining the Big Timber project. The USFWS does not have project-specific monitoring responsibilities. This is a Corps responsibility as identified in the 6th Annual Addendum for the UMRS-EMP. The USFWS Wapello District Manager of the Mark Twain National Wildlife Refuge (USFWS Site Manager) is required to conduct annual inspections of the project and to participate in periodic joint inspections of the project with the Corps.

d. Iowa Department of Natural Resources. The IADNR has collected fish data at the Big Timber project (currently not identified as a project monitoring requirement). The data was not available in time for inclusion in this report.

5. EVALUATION OF AQUATIC HABITAT OBJECTIVES

a. Restore Deep (>6 Feet) Aquatic Habitat.

(1) Monitoring Results. Dredged channel sedimentation transects for Round Pond, Timber Chute and Willow Chute are shown on plates 4 through 7. As shown in Appendix A, Table A-1, the Big Timber project was designed so that 100 acre-feet of deep aquatic habitat would remain at year 50. Changes in project scope between the DPR and construction eliminated the deep dredging in Big and Little Denny described in the DPR. As built, about 78 acre-feet of deep aquatic habitat was constructed (see Table 5-1 and Appendix D, Table D-1). At year 4, nearly 70 acre-feet of deep water habitat remains available. Sounding data presented in the Corps of Engineers Great Flood of 1993 Damage Assessment (Damage Assessment) for the Big Timber project indicates that sedimentation was generally less than 4 inches but up to 2 feet may have accumulated in the reach known as Timber Chute. The Damage Assessment stated no corrective action was anticipated.

The June 1995 USFWS Site Manager's project inspection report noted bank sloughing (approximately 3 feet) was evident throughout Timber Chute along the east bank (see Appendix C). The report also noted that the trees placed in the water for additional fish structure have remained in place and that aquatic vegetation, such as pondweed (*Potamageton* sp.), has begun to inhabit the deep aquatic habitat.

TABLE 5-1

Average Annual Sediment Accretion
Deep Aquatic Habitat, Acre-Feet

Year	Expected	Actual
0	55.6	77.7
4	54.5	69.6
50	42.4	

(2) Conclusions. Based on the final design section, and projecting 0.5 inch/year sediment accretion referenced in the DPR, the Big Timber project should have approximately 55 acre-feet of deep aquatic habitat at year 4 and more than 42 acre-feet of deep habitat at year 50 (see Table 5-1 and Appendix D, Table D-2). Where applicable, sedimentation transects will be extended to include the mechanically dredged material placement sites (Timber Chute, Willow Chute, and Big and Little Denny). The inclusion of the mechanically dredged material placement sites as part of the sedimentation transect monitoring will be used to better determine long-term sedimentation and degradation rates and patterns.

Verbal communication with USFWS and IADNR personnel indicated a positive fisheries response to the Big Timber project.

b. Restore Shallow (2-3 Feet) Aquatic Habitat.

(1) Monitoring Results. Dredged channel sedimentation transects for Willow Chute, Big Denny, and Little Denny are shown on plates 5 through 10. As shown in Appendix A, Table A-1, the Big Timber project was designed so that 30 acre-feet of shallow aquatic habitat would remain at year 50. Changes in project scope between the DPR and construction also included a decrease in the width of shallow dredging for Willow Chute, which affected the quantity of shallow habitat. As built, more than 44 acre-feet of shallow aquatic habitat was constructed (see Table 5-2 and Appendix D, Table D-1). At year 4, approximately 39 acre-feet of shallow water habitat is available.

The June 1995 USFWS Site Manager's project inspection report noted pondweed was present at the Big Denny dredging site and occupied approximately 20% of the surface area. Pondweed also was present at the Little Denny dredging site and occupied approximately 5% of the surface area. In addition, arrowhead (*Sagittaria* spp.) and an unknown grass species were observed adjacent to the Little Denny dredge cut, occupying approximately 5% of the surface area. Bank sloughing (approximately 2 feet) was evident along the east bank of the Little Denny dredging site. The boat access control and the trees placed in the water for additional fish structure remain in place.

TABLE 5-2

Average Annual Sediment Accretion
Shallow Aquatic Habitat, Acre-Feet

Year	Expected	Actual
0	40.0	44.0
4	37.9	38.9
50	15.8	

(2) Conclusions. Based on the final design and projecting 0.5 inch/year sediment accretion referenced in the DPR, the Big Timber project would have almost 38 acre-feet of shallow aquatic habitat at year 4 and nearly 16 acre-feet of shallow aquatic habitat at year 50 (see Table 5-2 and Appendix D, Table D-2). Sedimentation transects will be extended to include the mechanically dredged material placement sites (Timber Chute, Willow Chute, and Big and Little Denny). The inclusion of the mechanically dredged material placement sites as part of the sedimentation transect monitoring will be used to better determine long-term sedimentation rates and patterns.

The USFWS Site Manager's report noted that pondweed and arrowhead are preferred waterfowl submergents. Quality and quantity of aquatic vegetation will be monitored in the future.

c. Improve Levels of Dissolved Oxygen During Critical Seasonal Stress Periods.

(1) Monitoring Results. As shown in Appendix A, Table A-1, the Big Timber project was designed to maintain a minimum of 5 mg/l dissolved oxygen at year 50. At year 4, dissolved oxygen levels have occasionally fallen below 5 mg/l. Baseline water quality monitoring at site W-M443.6G (see plate 3 and Table B-2) commenced on May 6, 1989, and is currently ongoing. Water quality monitoring at site W-M444.4H commenced on November 7, 1995. The project's original fact sheet identified several resource problems. Severe summer and winter fish kills attributable to low dissolved oxygen levels and freeze outs, respectively, were reported. The water quality objective of the project was to increase levels of dissolved oxygen during critical seasonal stress periods to a minimum concentration of 5 mg/l. The purpose of the monitoring program was to determine baseline water quality conditions by measuring dissolved oxygen and related parameters and then to perform post-construction monitoring to determine the project's impact.

The water quality monitoring results from samples collected at site W-M443.6G are found in Appendix E. Pre-project monitoring was performed from May 6, 1989, through September 29, 1990. Post-project monitoring was performed from September 24, 1991, to the present. Corps sampling was not performed during project construction or during the summer of 1993. Water quality monitoring was performed by the construction contractor during the construction phase to meet permit requirements.

At site W-M443.6G, pre-project dissolved oxygen measurements were taken on 24 occasions. The minimum, maximum, and average concentrations of these measurements were 0.6 mg/l, 19.70 mg/l and 10.45 mg/l, respectively. Post-project dissolved oxygen measurements were taken on 48 occasions. The minimum, maximum, and average concentrations of these measurements were 1.74 mg/l, 16.61 mg/l and 9.18 mg/l, respectively. Dissolved oxygen concentrations are shown graphically in Appendix E. The pre-project minimum dissolved oxygen concentration was less than the post-project minimum, while maximum and average values were higher. The differences in the observed pre- and post-project minimum and maximum values could be due to plant respiration and photosynthesis. Prior to the project, aquatic macrophytes were present and there was a greater abundance of phytoplankton (as indicated by the chlorophyll a data). The presence of these plants resulted in higher dissolved oxygen concentrations during periods of photosynthesis and lower concentrations when photosynthesis was not occurring. Therefore, it is hypothesized that the removal of the macrophytes during dredging resulted in a narrower range of dissolved oxygen concentrations. The post-project average dissolved oxygen concentration (9.18 mg/l) was lower than the pre-project average (10.45 mg/l). The reasons for this could be twofold: first, the pre-project monitoring period was only 17 months long, which is a relatively short duration for determining a long-term average; and second, all measurements were made during daytime

hours when dissolved oxygen concentrations are affected by plant photosynthesis. If measurements were taken at night (when photosynthesis is not occurring) the post-project average dissolved oxygen concentration might have exceeded the pre-project average.

Two pre-project and eight post-project dissolved oxygen concentrations were less than the target level of 5 mg/l at site W-M443.6G. None of the eight post-project measurements occurred during the winter.

In addition to routine monitoring, a YSI 6000 in situ dissolved oxygen monitor was placed at site M-M443.6G on December 13, 1995, and removed on January 10, 1996. This instrument recorded dissolved oxygen concentrations every 2 hours. As shown graphically in Appendix E, all dissolved oxygen concentrations were well above the 5 mg/l target level.

Water quality monitoring commenced at site W-M444.4H on November 7, 1995. To date, only one routine sampling has been performed here; however, a YSI 6000 unit was placed at this site during the same period as at site W-M443.6G. As shown graphically in Appendix E, the dissolved oxygen concentration fell below 5 mg/l on several occasions at site W-M444.4H. All excursions below 5 mg/l from December 16, 1995, through January 8, 1996, occurred between, and inclusive of, the hours of midnight to noon. The dissolved oxygen concentration was never below 5 mg/l for an entire day. In fact, each full day that was monitored had at least five readings which were greater than 5 mg/l.

(2) Conclusions. The project has been successful in attaining the target dissolved oxygen level (5 mg/l) at site W-M443.6G during the critical winter period. On occasion, during the remainder of the year, dissolved oxygen levels have fallen below the target level; however, the post-project minimum value (1.74 mg/l) is higher than the pre-project minimum (0.60 mg/l). At site W-M444.4H, YSI 6000 monitor data indicate that dissolved oxygen concentrations do occasionally fall below the target level of 5 mg/l. This is probably a result of being farther removed from flowing water than site W-M443.6G, and also the depth here is not as great as at site W-M443.6G.

Another indication of the project's success is that USFWS and IADNR personnel have not observed any fish kills since project completion. Apparently, post-project dissolved oxygen concentrations have not been at a level detrimental to the fishery, or perhaps the dredged channels have allowed for fish egress from the area during periods of low dissolved oxygen.

d. Provide Year-Round Habitat Access (Cross-Sectional Area).

(1) Monitoring Results. Dredged channel sedimentation transects for Round Pond, Timber Chute, and Willow Chute are shown on plates 4 through 7. As shown in Appendix A, Table A-1, the Big Timber project was designed to have 500 square feet cross-sectional area of year-round habitat access (cross-sectional area) remaining at year 50. As built, a minimum of 523 square feet of year-round habitat access was created in

Round Pond and Willow Chute, and 381 square feet of year-round habitat access was created in Timber Chute (see Table 5-3 and Appendix D, Table D-1). At year 4, a minimum of 427 square feet of year-round habitat access is available in Round Pond and Willow Chute. Timber Chute has 168 square feet of year-round habitat access at year 4.

The June 1995 USFWS Site Manager's project inspection report observed bank sloughing (approximately 3 feet) throughout the east bank of Timber Chute (see Appendix C).

TABLE 5-3

Average Annual Sediment Accretion

	Timber Chute Year-Round Habitat Access (Cross-Sectional Area), Square Feet		Round Pond and Willow Chute Year-Round Habitat Access (Cross-Sectional Area), Square Feet	
Year	**Expected**	**Actual**	**Expected**	**Actual** [1/]
0	336.0	381.2	456.0	523.1
4	329.8	168.1	447.4	426.5
14	314.2		425.8	
50	258.0		348.0	
80	168.0			

[1/] Re: Sedimentation Transect with Minimum Cross-Sectional Area

(2) Conclusions. The year-round habitat access (cross-sectional area) was overestimated in the DPR and did not take into consideration the different cross-sectional areas in Round Pond and Willow Chute versus Timber Chute.

Based on the final design and assuming 0.5 inch/year sediment accretion referenced in the DPR, Round Pond and Willow Chute should have more than 447 square feet of year-round habitat access at year 4 and 348 square feet of deep habitat at year 50 (see Table 5-3 and Appendix D, Table D-2). The 427 square feet of year-round habitat in Round Pond and Willow Chute approaches 14 years of sediment deposition at a uniform 0.5 inch/year and is based on the sedimentation transect with the minimum area. This transect is located towards the head end of Willow Chute. For comparison, Table 5-4 shows the square footage for all of the Round Pond and Willow Chute transects. Nearly all of the sedimentation transects exceed the expected cross-sectional area for year 4.

TABLE 5-4

Round Pond and Willow Chute Sedimentation Transects

	Provide Year-Round Habitat Access (Cross-Sectional Area), Square Feet	
	As Built (1991)	Year 4 (1994)
Round Pond		
S-M443.7F to S-M443.6G	769.5	682.9
S-M443.7G to S-M443.5H	563.2	653.7
Willow Chute		
S-M443.7J to S-M443.7K	616.1	535.4
S-M443.8J to S-M443.8K	685.6	629.7
S-M444.0J to S-M444.0K	621.1	649.3
S-M444.2J to S-M444.2K	538.9	443.8
S-M444.3I to S-M444.4K (S1)	523.1	426.5
Average:	616.8	574.5

Timber Chute should have almost 330 square feet of year-round habitat access at year 4 and 258 square feet of year-round habitat access at year 50 (see Table 5-3 and Appendix D, Table D-2). The current 168 square feet of year-round habitat in Timber Chute is equivalent to 80 years of sediment deposition at a uniform 0.5 inch/year. The Corps of Engineers Great Flood of 1993 Damage Assessment for the Big Timber project indicated that sedimentation was generally less than 4 inches, but up to 2 feet may have accumulated in the reach known as Timber Chute. The Damage Assessment stated no corrective action was anticipated. Examination of as-built cross sections through Timber Chute indicated that a steeper slope was constructed on the east bank than the west, which would be consistent with the bank sloughing observed by the USFWS Site Manager. Overland flows during the Great Flood of 1993 also may have contributed to the observed sloughing of the east bank and subsequent sediment accumulation in Timber Chute, particularly if vegetation was not sufficiently established prior to inundation.

Sedimentation transects will be extended to include the mechanically dredged material placement sites (Timber Chute, Willow Chute, and Big and Little Denny). The inclusion of the mechanically dredged material placement sites as part of the sedimentation transect monitoring will be used to better determine long-term sedimentation rates and patterns.

6. EVALUATION OF TERRESTRIAL HABITAT OBJECTIVES

a. Produce Mast Tree Dominated Area.

(1) Monitoring Results. As shown in Appendix A, Table A-2, the Big Timber project was designed to include 204 acres of mast trees at year 50. At year 2, 354 acres of mast trees exist. Eleven species of mast-producing trees and shrubs were planted on the containment dike in November 1993 (Table 6-1). Because the site was inundated by floodwaters during the 1993 flood, the planting site was totally free of vegetation at the time of planting. A survey of tree survival in November 1994 indicated some tree mortality. This resulted in the replacement of 50 trees at that time. An influx of wild cucumber vine (*Sicyos angulatus*) during the 1994 growing season had completely overtopped many of the planted trees and shrubs and severely threatened their survival. An additional herbicide treatment, not specified in the original plans and specifications, was conducted in June 1995 to control wild cucumber vine.

During the June 1995 Site Manager's project inspection, an estimated 80% or greater seedling survival was noted. An additional inspection in September 1995 indicated that cucumber vine, while still present on the site, did not threaten the survival of the planted trees and shrubs. Tree heights in September 1995 ranged from 2 to 8 feet. Table 6-1 lists the relative survival and growth rates noted at that time.

TABLE 6-1

Tree and Shrub Plantings
Relative Survival and Growth Rates

Species	Number Planted	Survival	Growth Rate
northern red oak	82	good	excellent
pin oak	82	good	good
bur oak	50	fair	fair
swamp white oak	96	excellent	good
northern pecan	50	fair	poor
black walnut	50	poor	poor
butternut	150	good	good
sycamore	50	good	excellent
serviceberry	75	poor	fair
red osier dogwood	75	fair	good
gray dogwood	75	fair	good
highbush cranberry	75	good	excellent

(2) Conclusions. Survival and growth rates of the planted black walnuts were poor. This species is not recommended to be planted in significant numbers on similar sites in the future until more is known about the factors affecting tree survival. Northern red oak, serviceberry, cranberry, and the dogwood species planted are not typically found in the Mississippi River floodplain and are not recommended to be implemented on future projects until long-term survival information is collected from monitoring. Northern red oak, for example, exhibited an excellent growth rate but is classed as a flood-intolerant tree. Future monitoring will help to determine the flood tolerance of the species planted before final conclusions on acceptability are made.

It was found that the contract specifications were inadequate for the control of competing vegetation by herbicide applications within 4 feet of each planted seedling. Changed site conditions brought about by the Flood of 1993 were contributory to the weed problems that threatened tree and shrub survival during the 1994 growing season. Flood-induced tree mortality in the adjacent forest transformed the planting site from partial shade to a full sun condition. The additional sunlight allowed wild cucumber vine and other weeds to establish and grow aggressively throughout the project area. Although the 4-foot area treated with herbicide around each seedling was evident, the encroachment of cucumber vines from the forest edge had entangled many trees. For this reason, an additional herbicide application covering the entire area within 20 feet of each tree or shrub was conducted in June 1995.

7. EVALUATION OF MIGRATORY WATERFOWL HABITAT OBJECTIVES

a. Increase Reliable Resting and Feeding Water Area.

(1) Monitoring Results. As shown in Appendix A, Table A-1, the Big Timber project was designed to increase reliable resting and feeding water areas by 21 acres at year 50 (11 acres deep aquatic habitat, 10 acres shallow aquatic bed, reference DPR, page 19). Pre-project conditions (plate 15) show that most of the project area was silted in and vegetated with willows, lotus, and mixed grasses. Plate 16 shows the post-construction project in 1994. As-built, reliable resting and feeding water areas were increased by more than 27 acres (see Appendix D, Table D-3). Currently, more than 30 acres of reliable resting and feeding water areas exist for waterfowl in the project area. Migratory waterfowl peak populations are shown in Table 7-1.

Recent observations by the USFWS and Corps indicate that preferred waterfowl foods are available such as buttonbush, acorns, duckweed, and invertebrates (see Appendix C).

TABLE 7-1

Big Timber Peak Fall Populations

Year	Ducks	Geese
Pre-Project		
1985	5,219	550
1986	2,305	276
1987	4,095	1,100
1988	1,095	280
1989[1/]	626	65
1990[1/]	400	0
Post-Project		
1991[1/]	341	9
1992	1,337	41
1993	N/A (Flood)	N/A (Flood)
1994	276	177

(USFWS, 95)
[1/] Project construction period

(2) Conclusions. Opening up silted-in backwaters has attracted waterfowl use. Vegetation response to the project has been slow because of the 1993 flood. However, in 1994 and 1995, vegetation response has improved, and sustainable and productive vegetation has provided excellent forage and invertebrate forage for waterfowl.

USFWS review of the Draft Post-Construction Performance Evaluation Report (see Appendix C) noted that "even with good baseline data on waterfowl production and use of the Big Timber Division prior to construction, it is difficult to determine whether short-term increases or decreases in waterfowl use are in response to the project or in response to other factors. Nongame, particularly marsh and water birds such as the great blue herons, have adapted well to the project and are seen in abundance. In general, it is still to early to make biological conclusions about the overall project, but we concur that the early signs are encouraging."

b. Provide Isolated Resting, Feeding, and Brooding Pools.

(1) Monitoring Results. Pothole sedimentation transects are shown on plates 11 through 14. As shown in Appendix A, Table A-1, the Big Timber project was designed to include 10 isolated resting, feeding, and brooding pools (a.k.a. potholes) at year 50. Following construction in the fall of 1991, the USFWS summarized pothole depths and dimensions, shown in Table 7-2 along with Corps 1995 survey data. The Corps Great Flood of 1993 Damage Assessment states that, although no soundings of the potholes were obtained, an accumulation similar to that noted on the surface of the dredged material placement site (approximately 4 to 6 inches of new sediment) could be expected in the potholes. While the potholes provide excellent habitat for waterfowl broods, extensive surveys of the potholes to determine waterfowl use have not been completed. With-project conditions are beginning to show positive waterfowl use for the overall Big Timber site, which may be attributed to the project. Waterfowl production (fledged) for the area is shown in Table 7-3.

TABLE 7-2

Big Timber Pothole Data

Dimension, Feet	1991 (USFWS)	1995 (Corps)	Change, Percent
Depth			
Average	3.9	3.2	-18
Minimum	1.4	0.8	-43
Maximum	6.8	5.5	-19
Width			
Average	39	36	-8
Minimum	24	24	0
Maximum	50	51	+2
Length			
Average	67	80	+19
Minimum	55	69	+25
Maximum	80	88	+10

TABLE 7-3

Big Timber Waterfowl Production

Year	Waterfowl Production (Fledged)
Pre-Project	
1985	165
1986	240
1987	400
1988	420
1989[1/]	438
1990[1/]	461
Post-Project	
1991[1/]	470
1992	690
1993	N/A (Flood)
1994	541
1995	608

(USFWS, 95)
[1/] Project construction period

(2) Conclusions. Pothole habitat is providing resting and feeding opportunity for waterfowl. General increases in waterfowl production have occurred with the project.

Although nongame and nonwaterfowl species were not the emphasis of the Big Timber HREP, these species have benefited greatly. Species such as Great Blue Herons have begun feeding and resting along the dredged channels. The potholes have seen great response from invertebrates, amphibians, and small fish. While these benefits were assumed to occur when waterfowl was highlighted in the DPR, it is important to recognize the overall benefit of the project to a host of wildlife species. The USFWS sampled one randomly selected pothole (#8) on October 17, 1995, to obtain water quality, vegetation, invertebrate, and seine data. Wildlife observations during sampling confirmed use of the pothole by amphibians, mammals, and wading birds. Detailed results of this sampling effort are contained in a letter to the Corps dated November 21, 1995 (Appendix C). USFWS staff reported low species diversity and overall abundance, but noted this was not unexpected given the time of year sampling was conducted. They also noted that while the potholes are a unique feature of the Big Timber landscape and are used by a variety of wildlife species, direct benefits can be difficult to quantify. Exact information on pothole use by waterfowl is not available, and the potholes are not included in the surveys of Big Timber waterfowl populations conducted by Mark Twain refuge staff.

Differences between USFWS and Corps pothole dimensional data are most likely due to taking measurements at different locations on the pothole perimeter. To eliminate this discrepancy, pothole sediment transect control points will be established in 1996. The pothole sediment transects will be added to the Resource Monitoring and Data Collection Summary, and data collected at 5-year intervals, starting in 1996.

8. OPERATION AND MAINTENANCE SUMMARY

a. Operation. The project requires no operational activities.

b. Maintenance.

(1) Inspections. Inspections of the Big Timber Project are to be made by the USFWS Wapello District Manager of the Mark Twain National Wildlife Refuge (Site Manager) at least annually and will follow inspection guidance presented in the Operation and Maintenance Manual. Other project inspections should occur as necessary after high water events or as scheduled by the Site Manager. Joint inspections of the Big Timber Project are to be conducted periodically by the USFWS and the Corps. These inspections are necessary to determine maintenance needs.

(2) Maintenance Based on Inspections. Herbicide treatment for the mast tree revegetation was completed June 12, 1995.

9. CONCLUSIONS AND RECOMMENDATIONS

a. Project Goals, Objectives, and Management Plan. Data and observations collected since project completion suggest that the stated goals and objectives are being met. Further data collection will better define sedimentation rates, survival of mast trees in/on/near dredged material placement sites, and project utilization by migratory waterfowl and other wildlife.

b. Post-Construction Evaluation and Monitoring Schedules. In general, project monitoring efforts have been performed according to the Post-Construction Performance Evaluation Plan in Appendix A and the Resource Monitoring and Data Collection Summary in Appendix B. The next Post-Construction Performance Evaluation will be completed in 1996 following collection of data for the first 5-year interval. A Performance Evaluation Supplement will be prepared annually.

(1) Post-Construction Evaluation. The Post-Construction Evaluation Plan Year 50 Targets were based on the project as proposed in the DPR, which included deep dredging in Big and Little Denny (an additional ±5,000 linear feet of deep dredging) and a greater quantity of shallow dredging in Willow Chute. Consequently, the year 50 targets of 4 objectives have been revised to reflect as-built conditions. The year 0 acreage of mast trees also will be revised to reflect pre-project forest inventory in the project area.

(a) Restore Deep (>6 Feet) Aquatic Habitat. Based on the as-constructed dimensions, the expected deep aquatic habitat (year 0) was 55.6 acre-feet (see Table D-2 and plate 3). The year 50 target with alternative will be revised to 42.4 acre-feet for this objective. Actual deep aquatic habitat at year 4 is nearly 70 acre-feet.

(b) Restore Shallow (2-3 Feet) Aquatic Habitat. Based on the as-constructed dimensions, the expected shallow aquatic habitat (year 0) was 40 acre-feet (see Table D-2 and plate 3). The year 50 target with alternative will be revised to 15.8 acre-feet for this objective. Actual shallow aquatic habitat at year 4 is nearly 39 acre-feet.

(c) Improve Levels of Dissolved Oxygen During Critical Seasonal Stress Periods. The project has been successful in attaining the target dissolved oxygen level (5 mg/l) during the critical winter period. A second water quality monitoring station, located near the near the mouth of Little Denny, was added in November 1995.

(d) Provide Year-Round Habitat Access (Cross-Sectional Area). The expected year-round habitat cross-sectional area (year 0) for this objective is 456 square feet for Round Pond and Willow Chute and 336 square feet for Timber Chute (see Table D-2). The year 50 target with alternative will be revised to 348 square feet for Round Pond and Willow Chute and 258 square feet for Timber Chute. At year 4, a minimum of 427 square feet of year-round habitat exists in Round Pond and Willow Chute. However, nearly all of the Round Pond and Willow Chute sedimentation transects exceed the expected cross-

sectional area for year 4. The cross-sectional area of Timber Chute (168 square feet) is less than the year 50 target for this objective.

(e) Produce Mast Tree Dominated Areas. A pre-project forest inventory delineated 348 acres within the project area with an overstory dominated by mast-producing tree species. This acreage is not expected to remain constant, since the dominance of oak, pecan, or walnut is only a temporal stage in the life cycle of a bottomland forest. As the current forest ages, natural succession will bring about a gradual attrition of these species to be replaced by more shade-tolerant species such as silver maple and ash. Therefore, a gradual reduction in mast-producing acreage is expected over the life of the project.

In addition to the 348 acres previously available, the project added an additional 6 acres of mast-producing species. More importantly, the tree and shrub plantings introduced a diverse mixture of mast species in a linear strip traversing a large portion of the project area. By locating the new plantings on the containment dike above the surrounding floodplain, they are protected from damage by most flood events. This feature helps to assure the availability of these species as a seed source for the future. Silvicultural practices will be performed within the project life span to provide for the regeneration of mast-producing species in the project area. Through proper forest management, a minimum of 204 acres of mast dominated forest stands will be available at year 50. The Year 0 Without Alternative will be revised to reflect the pre-project forest inventory of 348 acres.

(f) Increase Reliable Resting and Feeding Water Areas. More than 30 acres of reliable resting and feeding water areas exist for waterfowl in the project area, an increase over the as-constructed 27 acres. Nongame, particularly marsh and water birds such as the great blue herons, have adapted well to the project and are seen in abundance.

(g) Provide Isolated Resting, Feeding, and Brooding Pools. Pothole habitat is providing resting and feeding opportunity for waterfowl, and has seen great response from invertebrates, amphibians, and small fish. General increases in waterfowl production have occurred with the project.

(2) Resource Monitoring and Data Collection Schedules. The monitoring schedule will be revised to include pothole monitoring at a 5-year interval. Control points for sedimentation and pothole transects will be field surveyed in the spring of 1996 before leaf-out. Sedimentation transects will be extended to include the mechanically dredged material placement sites (Timber Chute, Willow Chute, and Big and Little Denny) to better determine long-term sedimentation rates and patterns. The USFWS will provide pothole vegetation, invertebrate, and seine data during the fall of 1996.

c. Project Operation and Maintenance. Operation and maintenance has been conducted in accordance with the Operation and Maintenance Manual. There are no

operational requirements attached to this project. The maintenance of project features has been adequate.

d. Project Design Enhancement. Discussions with Corps personnel have resulted in the following general conclusions regarding project features which may affect future project design:

(1) Provide Year-Round Habitat Access (Cross-Sectional Area). Sediment has accumulated in Timber Chute to the point where it is no longer classified as deep habitat ($D \geq 6$ feet; current depth is 5.5 feet), which is used to determine year-round habitat access cross-sectional area. While the present depth of Timber Chute should continue to provide year-round habitat access to Willow Chute and Big and Little Denny, sediment removal should be scheduled when water depth approaches 4 feet. If continued monitoring indicates overland flow contributed to erosion of the east bank excavated material and subsequent sediment deposition in Timber Chute, future mechanical excavation projects should consider placement of sidecast material on the downstream bank.

(2) Produce Mast Tree Dominated Areas. Measures utilized to control competing vegetation by herbicide applications within 4 feet of each planted seedling were inadequate. The encroachment of wild cucumber vine on the planting sites necessitated additional vegetation control measures. Future projects that are expected to experience similar vegetation problems should include more intensive weed control measures within 15 to 20 feet of each planted tree or shrub.

Survival and growth rates of the planted black walnuts were poor. Planting this species in significant numbers on similar sites is not recommended until more is known about the factors affecting tree survival. Post-Construction Performance Evaluation Information will include collection of information on the survival of planted trees and shrubs in 1996. Future monitoring will be performed to determine the flood tolerance and growth characteristics for each of the 11 species planted.

APPENDIX A

POST-CONSTRUCTION EVALUATION PLAN

TABLE A-1

Big Timber Refuge Rehabilitation & Enhancement Project
Post-Construction Evaluation Plan [1/]

Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 (1991) With Alternative (As-Built)	Year 4 With Alternative	Year 50 Target With Alternative [2/]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Aquatic Habitat	Restore deep (>6 feet) aquatic habitat	Big Timber dredging	Hydraulic dredging	AC-FT	0	77.7	69.6	100 - DPR 42.4 - As-built	Perform hydrographic soundings of transects [3]	Development of emergent vegetation within deep dredged area
	Restore shallow (2-3 feet) aquatic habitat	Big Timber dredging	Mechanical excavation	AC-FT	0	44	39	30 - DPR 15.8 - As-built	Perform hydrographic soundings of transects [4]	Encroachment of bank or obvious shoaling in shallow dredged areas
	Improve levels of dissolved oxygen during critical seasonal stress periods	Big Timber dredging excavation	Dredging/ excavation	Mg/l	0	> 5	> 5	5	Perform water quality tests [5]	Fish stress (at surface) or fish kills
	Provide year-round habitat access (cross-sectional area) [6]	Big Timber dredging/ excavation	Dredging/ excavation	Sq. Ft.	0	Round Pond - Willow Chute: 523 Timber Chute: 381	Round Pond - Willow Chute: 427 Timber Chute: 168	500 - DPR **Round Pond - Willow Chute: 348 - As-built** **Timber Chute: 258 - As-built**	Perform hydrographic soundings of transects [4]	Development of emergent vegetation within access area
Enhance Terrestrial Habitat	Produce mast tree dominated areas	Mast tree plantings on dredged material placement site	Revegetation	Acres of mast treet	170 DPR **348 Pre-project** [6/ 8/]	354	354 [8/]	204	Perform vegetation transects in mast tree area [7/]	Seedling survival

TABLE A-1 (Continued)

Big Timber Refuge Rehabilitation & Enhancement Project
Post-Construction Evaluation Plan [1]

Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 (1991) With Alternative (As-Built)	Year 4 With Alternative	Year 50 Target With Alternative [2]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Migratory Waterfowl Habitat	Increase reliable resting and feeding water areas	Blasting of potholes and dredging excavation with constructed access limitation	Pothole creation and dredging/ excavation	AC	0	27.3	30.5	21	Perform hydrographic soundings of transects [4]	Waterfowl presence or absence
	Provide isolated resting, feeding and brooding pools	Blasting of potholes	Pothole creation	EA	0	10	10	10	Perform areal survey of project area [5]	Waterfowl presence or absence

TABLE A-1 FOOTNOTES

[1/] See Plate 3, Monitoring Plan for active monitoring sites.

[2/] Highlighted text is revised Year 50 with alternative to reflect as-built conditions.

[3/] Water Quality Stations

W-M443.6G
W-M444.4 H

[4/] Sedimentation Transects (See Table A-2)

[5/] Measured at Sedimentation Transect with Minimum Cross-Sectional Area

[6/] Highlighted text reflects pre-preject forest inventory.

[7/] Vegetation Transects (Post-Construction Phase)
V-M444.5J to V-M444.5M
V-M444.7I to V-M444.7M

Mast tree survey of hardwood trees planted in the dredged material confined placement site.

Sampling locations will be at equal 1/3 increments on each vegetative range. Excluding range end points, sampling will be every 300 feet on the upstream range and every 200 feet on the downstream range for a total of 6 points, 3 on each range.

[8/] For terrestrial habitat enhancement, year 0 is 1993 and the with-alternative is year 2.

[9/] Mapping

April 17, 1994, Color Aerial Photography

Areal survey of the project area will be performed to determine the amount of waterfowl resting and feeding water areas and to inventory potholes.

TABLE A-2

Big Timber Refuge Rehabilitation and Enhancement Project
Sedimentation Transect Project Objectives Evaluation

Transect	Project Objectives to Be Evaluated			
	Restore Deep Aquatic Habitat	Restore Shallow Aquatic Habitat	Provide Year-Round Habitat Across Cross-Sectional Area	Increase Reliable Resting and Feeding Water Areas
Round Pond -Timber Chute - Willow Chute - Big Denny				
S-M443.7F to S-M443.6G	X		X	X
S-M443.7G to S-M443.5H	X		X	X
S-M443.7J to S-M443.6J	X		X	X
S-M443.7J to S-M443.7K	X	X	X	X
S-M443.8J to S-M443.8K	X	X	X	X
S-M444.0J to S-M444.0K	X	X	X	X
S-M444.2J to S-M444.2K	X	X	X	X
S-M444.3I to S-M444.4K (S1)	X	X	X	X
S-M444.4H to S-M444.5H		X		X
S-M444.7G to S-M444.7H		X		X
S-M444.8H to S-M444.8I		X		X
Little Denny				
S-M444.3I to S-M444.4K (S2)		X		X
S-M444.3I to S-M444.4K (S3)		X		X
Potholes				
1				X
2				X
3				X
4				X
5				X
6				X
7				X
8				X
9				X
10				X

APPENDIX B

MONITORING AND PERFORMANCE EVALUATION MATRIX
AND
RESOURCE MONITORING AND DATA COLLECTION SUMMARY

TABLE B-1

Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions.	USFWS	USFWS (EMTC)	LTRMP 1/	--
	Pre-Project Monitoring	Identifies and defines problems at HREP site. Establishes need of proposed project features.	USFWS	USFWS	USFWS	--
	Baseline Monitoring	Establishes baselines for performance evaluation.	Corps	Corps	LTRMP	See Table A-2
Design	Data Collection for Design	Includes quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP 2/	See Table A-2
Construction	Construction Monitoring	Assesses construction impacts; assures permit conditions are met.	Corps	Corps	HREP	See State Section 401 Stipulations
Post-Construction	Performance Evaluation Monitoring	Determines success of project as related to objectives.	Corps (quantitative) Sponsor (field observation)	Corps USFWS	HREP	See Table A-2
	Analysis of Biological Responses to Projects	Evaluates predictions and assumptions of habitat unit analysis. Studies beyond scope of performance evaluation, or if projects do not have desired biological results.	Corps	USFWS (EMTC)	HREP	--

1/ Long-Term Resource Monitoring Program is a component of the UMRS-EMP.
2/ Habitat Rehabilitation and Enhancement Projects

TABLE B-2

Resource Monitoring and Data Collection Summary [1/]

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
POINT MEASUREMENTS														
Water Quality Stations [2/]													Corps	
Turbidity	2W		2W		2W	M								
Secchi Disk Transparency	2W		2W		2W	M								
Suspended Solids	2W		2W		2W	M								
Dissolved Oxygen	2W		2W		2W	M								
Specific Conductance	2W		2W		2W	M								
Water Temperature	2W		2W		2W	M								
pH	2W		2W		2W	M								
Total Alkalinity	--		--		2W	M								
Chlorophyll	2W		2W		2W	M								
Velocity	--		--		2W	M								
Water Depth	2W		2W		2W	M								
Water Elevation	2W		2W		2W	M								
Percent Ice Cover						M								
Ice Depth						M								
Percent Snow Cover						M								
Snow Depth						M								
Wind Direction					2W	M								
Wind Velocity					2W	M								
Wave Height					2W	M								
Air Temperature					2W	M								
Percent Cloud Cover					2W	M								

TABLE B-2 (Cont'd)

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
POINT MEASUREMENTS (Cont'd)														
Sediment Test Stations [1]													Corps	
Elutriate			1											
Bulk Sediment			1											
Column Settling Stations [2]													Corps	
Column Settling Analysis								1						
Boring Stations [3]													Corps	
Geotechnical Borings								1						
TRANSECT MEASUREMENTS														
Sedimentation Transects [4]													Corps	
Hydrographic Soundings							1		5Y					
Vegetation Transects [5]													Corps	
Mast Tree Survey												Y	Corps	
AREA MEASUREMENTS														
Mapping [6]														
Aerial Photography										1		5Y	Corps	

Legend

W = Weekly
M = Monthly
Y = Yearly
nW = n-Week interval
nY = n-Year Interval
1,2,3,.... = Number of times data was collected within designated project phase

TABLE B-2 (Cont'd)

1/ See Plate 3, Monitoring Plan for active monitoring sites. See DPR for Pre-Project and Design Phase station locations.

2/ Water Quality Stations

Design Phase

W-M443.6G DPR D-1

Post-Construction Phase

W-M443.6G
W-M444.4H

3/ Sediment Test Stations (Design Phase)

DPR-BT-1
DPR-BT-2
DPR-BT-3
DPR-BT-4

4/ Column Settling Analysis (Design Phase)

DPR-BT-88-2-1
DPR-BT-88-2-2

5/ Geotechnical Borings (Design Phase)

DPR BT-88-1 through BT-88-9

6/ Sedimentation Transects

Pre-Project Phase

DPR Traverse with 27 cross sections

Post-Construction Phase (Pothole transects added 1995) - See Table B-3

7/ Vegetation Transects (Post-Construction Phase)

V-M444.5J to V-M444.5M
V-M444.7I to V-M444.7M

Mast tree survey of hardwood trees planted in the dredged material confined placement site.

Sampling locations will be at equal 1/3 increments on each vegetative range. Excluding range end points, sampling will be every 300 feet on the upstream range and every 200 feet on the downstream range for a total of 6 points, 3 on each range.

8/ Mapping (Post-Construction Phase)

Aerial Photography

Areal survey of the project area will be performed to determine the amount of waterfowl resting and feeding habitat and to inventory potholes.

TABLE B-2 (Cont'd)

The following monitoring was performed by the construction contractor during the construction phase for the purpose of meeting permit requirements.

Station	Frequency
Outlet Weir	
Suspended Solids	Daily
Temperature	Daily
pH	Daily
Ammonia Nitrogen	Daily
Upstream of Outlet Weir	
Suspended Solids	Daily
Temperature	Daily
pH	Daily
Ammonia Nitrogen	Daily
100 Feet Downstream of Above Point	
Suspended Solids	Daily
Temperature	Daily
pH	Daily
Ammonia Nitrogen	Daily

TABLE B-3

Big Timber Refuge Rehabilitation and Enhancement Project
Sedimentation Transect Project Objectives Evaluation

	Project Objectives to Be Evaluated			
Transect	Restore Deep Aquatic Habitat	Restore Shallow Aquatic Habitat	Provide Year-Round Habitat Across Cross-Sectional Area	Increase Reliable Resting and Feeding Water Areas
Round Pond -Timber Chute - Willow Chute - Big Denny				
S-M443.7F to S-M443.6G	X		X	X
S-M443.7G to S-M443.5H	X		X	X
S-M443.7J to S-M443.6J	X		X	X
S-M443.7J to S-M443.7K	X	X	X	X
S-M443.8J to S-M443.8K	X	X	X	X
S-M444.0J to S-M444.0K	X	X	X	X
S-M444.2J to S-M444.2K	X	X	X	X
S-M444.3I to S-M444.4K (S1)	X	X	X	X
S-M444.4H to S-M444.5H		X		X
S-M444.7G to S-M444.7H		X		X
S-M444.8H to S-M444.8I		X		X
Little Denny				
S-M444.3I to S-M444.4K (S2)		X		X
S-M444.3I to S-M444.4K (S3)		X		X
Potholes				
1				X
2				X
3				X
4				X
5				X
6				X
7				X
8				X
9				X
10				X

APPENDIX C

COOPERATING AGENCY CORRESPONDENCE

BIG TIMBER REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILE 443 THROUGH 445
LOUISA COUNTY, IOWA
SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by: Michael Bornstein, EMP Coordinator Date: 6/16/95

Type of Inspection: Performance Monitoring

1. PROJECT INSPECTION

a. Confined Dredged Material Placement Site

No waste materials or unauthorized structures.

b. Hydraulic Dredging

Little Denny entrance access control remains in place.
No waste materials or unauthorized structures.

c. Mechanical Excavation

Little Denny entrance access control remains in place.
No waste materials or unauthorized structures.

d. Check Dams

No waste materials or unauthorized structures.

e. Pothole Creation

No waste materials or unauthorized structures.

f. Revegetation

Seedling condition very good.
Herbicide treatment scheduled.

2. PROJECT MONITORING (Observations and Project Evaluation)

a. Hydraulic Dredging

The area of hydraulic dredging, from Round Pond through Timber Chute and Big Denny, appears to have depths approaching original dredged depths. Rough measurements were taken throughout these areas, with the observation of little sediment deposition, approximately 3-6". At the site of the Big Denny dredging, pondweed (Potamageton Spp.), a preferred waterfowl submergent, was present and occupied approximately 20% of the surface area. No information has been received from the project co-sponsor, the Iowa Department of Natural Resources (IDNR), regarding fish stress or kills, and field observation does not indicate this has occurred. Verbal communication with IDNR fisheries biologists indicated a positive fisheries response to the HREP, but a report is not available at this time. Waterfowl production and peak fall population estimates for the Big Timber Division are attached (See Attachment). Bank sloughing (approximately 3') was evident throughout the Timber Chute area along the east bank. The trees placed in the water for additional fish structure remain in place.

b. Mechanical Excavation

The area of mechanical dredging, throughout Little Denny, appears to have depths approaching original dredged depths, consistent with rates of sediment deposition of 3-6" found in the hydraulically dredged areas. Approximately 2' of sloughing was evident along the east bank throughout Little Denny. At the site of the Little Denny dredging, pondweed (Potamageton Spp.) was present, occupying approximately 5% of the surface area. An additional preferred waterfowl food, Arrowhead (Sagittaria latifolia), and an unknown grass species also occurred adjacent to the dredge cut, also occupying approximately 5% of the surface area. Field observation has not determined there were any fish kills. Waterfowl production and peak fall population estimates for the Big Timber Division are attached (see attachment). The boat access control remains in place, and trees placed in the water for additional fish structure also remain.

c. Pothole Creation

Potholes remain at the site. Extensive descriptive and water quality data were provided to the Corps of Engineers in a 1991 report. We anticipate follow-up monitoring for dissolved oxygen and temperature in July 1995, and will provide that information as soon as possible. At the time of this performance monitoring, sheet water remained over the potholes constructed in the Big Denny area. The potholes to the west of Timber Chute had duckweed (Lemna Spp.) on approximately 5% of the surface area. Field observations have noted waterfowl leaving the area, and a high abundance of leopard frogs occupying the potholes.

d. Revegetation

Examination of mast tree revegetation within the hydraulic dredge disposal site determined an estimated 80% or greater seedling survival. Sycamores were estimated to be approximately 7-10' tall, while pin oaks exhibited lesser growth rates, currently about 5-6' tall. Small amounts of pin oak mortality were evident, although the entire site was not analyzed. A herbicide treatment is scheduled this summer.

ATTACHMENT

BIG TIMBER WATERFOWL PRODUCTION AND PEAK FALL POPULATIONS*

	Waterfowl Production	Peak Fall Populations
Pre-project		
1985	165	5,219 ducks; 550 geese
1986	240	2,305 ducks; 276 geese
1987	400	4,095 ducks; 1,100 geese
1988	420	1,095 ducks; 280 geese
1989	438	626 ducks; 65 geese
1990	461	400 ducks; 0 geese
Post-project		
1991	470	341 ducks; 9 geese
1992	690	1,337 ducks; 41 geese
1993	N/A (Flood)	N/A (Flood)
1994	541	276 ducks; 177 geese

* All data were obtained from the Mark Twain National Wildlife Refuge Annual Narrative Reports, 1985-1994.

United States Department of the Interior

Fish and Wildlife Service
Mark Twain National Wildlife Refuge
Wapello District
10728 County Road X61
Wapello, Iowa 52653

11/21/95

Memorandum

To: Joe Jordan, U.S. Army COE, Rock Island District

From: Biological Science Technician, Mark Twain NWR, Wapello District

Contaminants Biologist, Ecological Services, Rock Island Field Office

Subject: Big Timber Pothole Sampling

We randomly selected three potholes created as part of the Big Timber Habitat Rehabilitation and Enhancement Project (HREP) for analysis. Unfortunately, due to limited staff time and weather conditions, only one visit was made to one pothole (#8) on October 17, 1995. While our sampling cannot be assumed to be completely representative of all the potholes, similar conditions likely existed during this particular time period. Our findings on water quality and the plant and animal community are listed here.

Comments on the draft Post-Construction Performance Evaluation Report will be mailed under separate cover. All questions regarding the Big Timber HREP should be addressed to Ross Adams, EMP Coordinator, effective December 10, 1995 (217/224-8580).

Water quality sampling was conducted for pothole #8. Parameters sampled were Depth, Temperature at one foot of depth, Temperature at one foot off bottom, Redox, Dissolved Oxygen (DO) at one foot off bottom, DO at one foot of depth, Turbidity, Conductivity, Secchi Disk reading, and Nitrate-Nitrogen. Results of the water quality sampling are as follows:

	Pothole # 8
Depth	4.0ft.
pH	7.6
Temp 1' depth	10.2 degrees celsius
Temp 1' off bottom	10.0 degrees celsius

Redox	-28.7mV
DO 1' depth	1.4
DO 1' off bottom	1.6
Turbidity	30.4 ntu
Conductivity	529.2
Secchi Disk	42mm
NO_3-N	.78

Intensive observations and sampling of the plant and wildlife community at the pothole was conducted during the visit. Results for pothole #8 are as follows:

Vegetation
Duckweed (Lemna sp.) covered 100% of the pothole surface. No submergent vegetation was observed. Silver maple (Acer saccharinum) and black willow (Salix nigra) were the co-dominate tree species surrounding the pothole. Beggerticks (Bidens sp.) and Bur-Cucumber (Sicyos angulatus) made up the majority of the ground cover.

Wildlife Observations
Twelve northern leopard frogs (Rana pipiens) were flushed from the edge of the pothole. Numerous tracks in the soft soil surrounding the pothole indicated use by white-tailed deer (Odocoileus virginianus), beaver (Castor canadensis), muskrat (Ondatra zibethicus) and great blue heron (Ardea herodias). No waterfowl were observed using the pothole.

Seine
A small seine was pulled through sections of the pothole and contents identified. Little diversity or biomass was recorded. One small hybrid sunfish (family Centratchidae) was collected along with small numbers of amphipods (scuds) and gastropods (snails).

Kicknet
Three kicknet replicates were conducted in the pothole. All material in the net was rinsed three times to concentrate and condense organisms. Crawling water beetles (family Halipidae) made up almost the entire sample for each replicate, and were very abundant in the pothole. Amphipods and gastropods were also collected in very small numbers.

Conclusions
Give the time of year that we sampled the pothole, the results were not unexpected: Species diversity and overall abundance was low. Water quality data should be further analyzed by comparing our findings to those from previous sampling efforts. While these

potholes are a unique feature of the Big Timber landscape and are used by a variety of wildlife species, direct benefits can be difficult to quantify.

Because enhancing habitat for migratory waterfowl was a prime goal for the pothole features, further study of waterfowl use may be warranted. Due to their small size, the potholes are generally regarded as providing potential habitat for very limited numbers of waterfowl, including broods. However, exact information on pothole use is unavailable, and the potholes are not included in the surveys of Big Timber waterfowl populations conducted by Mark Twain refuge staff. Monitoring the potholes would require a technique such as establishing a concealed stationary survey point at several selected potholes and then observing waterfowl use during peak activity periods. This is expensive and beyond the scope of current refuge manpower.

James Quinlivan

Michael Coffey

United States Department of the Interior

Fish and Wildlife Service
Mark Twain National Wildlife Refuge
1704 N. 24th Street
Quincy, Illinois 62301

January 22, 1996

Dudley M. Hanson , P.E.
Chief, Planning Division
Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Chief Hanson:

I have reviewed the October 1995 Post-Construction Performance Evaluation Report for the Big Timber Refuge Rehabilitation and Enhancement Project and would like to pass along a few comments on the Project.

I am concerned that siltation (especially in the Timber Chute transect) has occurred much more rapidly than predicted in the planning of the project. The report states that continued monitoring will determine if the siltation is a result of "the Great Flood of 1993 or from higher than estimated average annual sedimentation rates." If this excessive siltation is due to higher than estimated siltation rates, is there a fix to the problem? Can this be corrected as part of the EMP project? We can not in the long run be burdened with substantially higher maintenance cost as a result of a design deficiency. On the other hand, if the problem exists due to the flood I would appreciate any assistance possible in addressing this situation that was not corrected during the past two years of the Corps construction phase. Please provide me with your assessment of this problem when a conclusion has been reached.

Even with good baseline data on waterfowl production and use of the Big Timber Division prior to construction, it is difficult to determine whether short-term increases or decreases in waterfowl use are in response to the project or in response to other factors. Nongame, particularly marsh and water birds such as the great blue herons, have adapted well to the project and are seen in abundance. In general, it is still too early to make biological conclusions about the overall project, but we concur that early signs are encouraging.

Annual inspections will continue to be made by the Wapello District Manager of the Mark Twain National Wildlife Refuge, not the "Upper Mississippi River Wildlife Refuge Manager."

Waterfowl production totals are now available for 1995, and may be included in the final report. Production estimates for 1995 on Big Timber (# of fledged ducks) are 554 wood ducks, 50 mallards, 4 hooded mergansers.

Ross Adams has replaced Michael Bornstein as EMP Coordinator and is now located in the Mark Twain Office at Quincy, Illinois. The telephone number is 217-224-8580. Ross will be working with the Wapello staff on the appropriate levels of monitoring necessary to determine the biological results of this project.

We appreciate your efforts on this important refuge project and look forward to continued cooperation in enhancing habitat for fish and wildlife on the Mississippi River. If you have any questions or comments, please contact me or Ross at this office.

Sincerely,

Richard Steinbach
Refuge Complex Manager

APPENDIX D

TECHNICAL COMPUTATION SHEETS

TABLE D-1

Big Timber Sedimentation Transects

Round Pond - Timber Chute - Willow Chute - Big Denny	Scaled Distance	Provide Year-Round Habitat Access (Cross-Sectional Area) Deep Habitat, Square Feet[1]		Shallow Habitat, Square Feet		Total		Sedimentation		Restore Deep (>6') Aquatic Habitat		Restore Shallow Aquatic Habitat	
								Scour, SF	Accretion, SF	Deep Habitat, Acre-Feet[1]		Shallow Habitat, Acre-Feet	
		As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)	91 to 94 (Cut)	91 to 94 (Fill)	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)
Start Dredging		769.5	682.9										
Round Pond	460									8.1	7.2		
S-M443.7F to S-M443.5G		769.5	682.9			769.5	682.9	5.2	97.8				
	360									5.5	5.5		
S-M443.7G to S-M443.5H		563.2	653.7			563.2	653.7	83.9	29.4				
Timber Chute	610									6.6	5.8		
S-M443.7J to S-M443.6J		381.2	168.1			381.2	168.1	0.0	205.7				
Willow Chute	280									3.2	2.3		
S-M443.7J to S-M443.7K		616.1	535.4	208.7	157.0	824.8	692.4	25.3	73.8				
	510									7.6	6.8	2.5	2.1
S-M443.8J to S-M443.8K		685.6	629.7	214.2	198.0	899.9	827.7	25.1	77.7				
	1060									15.9	15.6	5.0	4.5
S-M444.0J to S-M444.0K		621.1	649.3	195.1	175.4	816.2	824.7	43.0	19.9				
	850									11.3	10.7	3.7	3.2
S-M444.2J to S-M444.2K		538.9	443.8	186.5	156.8	725.4	600.6	34.0	82.3				
	380									4.6	3.8	2.0	1.7
S-M444.3I to S-M444.4K (S1)		523.1	426.5	265.8	228.2	789.0	654.7	11.0	62.7				
Big Denny	1230			Avg	214.1					14.8	12.0	7.5	6.1
S-M444.4H to S-M444.5H		523.1	426.5	262.0	205.0	785.1	631.5	21.7	63.5				
	1430											6.8	6.0
S-M444.7G to S-M444.7H				149.6	157.7	149.6	157.7	17.7	38.6				
	780											2.8	2.8
S-M444.8H to S-M444.8				161.0	160.0	161.0	160.0	27.7	36.1				
	1070											4.0	3.9
Finish Dredging				161.0	160.0	161.0	160.0						
				Avg	192.5								
	Average[2]	616.8	574.5	205.4	179.7	624.1	550.4		Total	77.7	69.6		
Little Denny													
S-M444.3I to S-M444.4K (S2)				243.5	202.1	243.5	202.1	6.54	67.21				
	1850											9.9	8.5
S-M444.3I to S-M444.4K (S3)				221.1	199.7	221.1	199.7	14.5	41.25				
			Average	232.3	200.9						Total	44.0	38.9

[1] Cross-sectional area of deep habitat = W_{bottom} * D(≥6')

[2] Average Deep Habitat Cross-sectional area excludes Timber Chute

TABLE D-2

Average Annual Sediment Accretion[1]								
	Deep Aquatic Habitat, Acre-Feet		Shallow Aquatic Habitat, Acre-Feet		Timber Chute Year-Round Habitat Access (Cross-Sectional Area), Square Feet		Round Pond and Willow Chute Year-Round Habitat Access (Cross-Sectional Area), Square Feet	
Year	Expected[2]	Actual[4]	Expected[3]	Actual[4]	Expected[2]	Actual[4]	Expected[2]	Actual (Minimum)[4, 5]
0	55.6	0.0	40.0	0.0	336.0	321.2 0.0	456.0	523.1
4	54.5	0.0	37.9	0.0	329.8	168.1 0.0	447.4	426.5
14	51.9		32.9		314.2		425.8	
50	42.4		15.8		258.0		348.0	
80					168	S = 1.8"/yr		S = 5.8"/yr

[1] Assumes an annual sedimentation rate of 0.5 inch (0.04 foot)/year

[2] =(A*L)/43560; A=($W_{B.C.W.}$ * D(>6')) (Includes side slope areas ≥6'D)

[3] =(A*L)/43560 (Includes side slope areas)

[4] See Table D-1

[5] Minimum Cross-Sectional Area

TABLE D-3

Big Timber Sedimentation Transects											
								Increase Reliable Resting and Feeding Water Areas			
		Width, Feet						Area, Acres			
		Deep Habitat		Shallow Habitat		Total		Deep Habitat		Shallow Habitat	
Transect Along Dredge Cut	Scaled Distance Feet	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)	As Built (1991)	Year 4 (1994)
Round Pond - Timber Chute - Willow Chute - Big Denny											
Start of Dredge Cut		130.0	120.0			130.0	120.0				
	460							1.4	1.3		
S-M443.7F to S-M443.6G		130.0	120.0			130.0	120.0				
	360							1.0	1.1		
S-M443.7G to S-M443.5H		119.0	140.0			119.0	140.0				
	610							1.3	1.5		
S-M443.7J to S-M443.6J[1]		72.0	70.0			72.0	70.0				
	280							0.5	0.5		
S-M443.7J to S-M443.7K		85.0	86.0	46.0	50.0	131.0	136.0				
	510							1.0	1.1	0.6	0.6
S-M443.8J to S-M443.8K		90.0	94.0	50.0	50.0	140.0	144.0				
	1060							2.3	2.5	1.2	1.2
S-M444.0J to S-M444.0K		100.0	110.0	50.0	50.0	150.0	160.0				
	850							1.8	2.0	1.1	1.0
S-M444.2J to S-M444.2K		80.0	90.0	60.0	50.0	140.0	140.0				
	380							0.7	0.8	0.5	0.4
S-M444.3I to S-M444.4K (S1)		80.0	100.0	60.0	50.0	140.0	150.0				
	1230							2.3	2.8	1.8	1.7
S-M444.4H to S-M444.5H		80.0	100.0	70.0	70.0	150.0	170.0				
	1430							1.3	1.6	2.1	2.6
S-M444.7G to S-M444.7H				60.0	90.0	60.0	90.0				
	780									1.1	1.5
S-M444.8H to S-M444.8I				60.0	80.0	60.0	80.0				
	1070									1.5	2.0
End of Dredge Cut	4890			60.0	80.0	60.0	80.0				
	Average	104.5	113.8	57.0	61.3	117.5	127.3				
Little Denny											
Start of Dredge Cut											
S-M444.3I to S-M444.4K (S2)				80.0	94.0	80.0	94.0				
	1850									3.4	3.9
S-M444.3I to S-M444.4K (S3)				80.0	90.0	80.0	90.0				
End of Dredge Cut			Average	80.0	92.0		Total	13.6	15.1	13.3	14.9

TABLE D-3 (continued)

Potholes		Long Chord, Feet		Short Chord, Feet			Increase Reliable Resting and Feeding Water Areas Area, Acres (Cont'd)[2/]	
		As Built (1991)[3/]	Year 4 (1994)	As Built (1991)[3/]	Year 4 (1994)		As Built (1991)[3/]	Year 4 (1994)
1		70	81	27	24		0.04	0.04
2		72	82	24	28		0.04	0.05
3		65	81	26	25		0.04	0.05
4		67	78	28	29		0.04	0.05
5		55	69	42	36		0.05	0.06
6		60	73	50	38		0.07	0.06
7		75	80	50	39		0.09	0.07
8		65	81	48	43		0.07	0.08
9		60	88	45	51		0.06	0.10
10		80	86	50	47		0.09	0.09
	Average	67	80	39	36	$Total_{Pothole}$	0.44	0.47
						Total	27.3	30.5

1/ Timber Chute

2/ Pothole area (approximate) = Long Chord * Short Chord

3/ USFWS, 1991

APPENDIX E

WATER QUALITY DATA

Pre-project water quality monitoring results from samples collected at site W-M443.6G

DATE	CHLOROPHYLL a (MG/M3)	CHLOROPHYLL b (MG/M3)	CHLOROPHYLL c (MG/M3)	PHEOPHYTIN a (MG/M3)
5/6/89	160.0	5.0	28.0	141.0
5/20/89	125.0	7.0	19.0	158.0
6/3/89	76.0	4.0	5.0	58.0
6/17/89	130.0	4.0	10.0	66.0
7/1/89	195.0	1.0	1.0	1.0
7/15/89	60.0	5.0	3.0	50.0
7/29/89	26.0	2.0	2.0	26.0
8/12/89	46.0	12.0	3.0	53.0
8/26/89	28.0	2.0	2.0	23.0
9/9/89	160.0	1.0	24.0	173.0
9/23/89	33.0	3.0	1.0	43.0
10/14/89	15.0	3.0	3.0	15.0
10/28/89	21.0	2.0	2.0	26.0
4/14/90	35.0	1.0	9.0	65.0
5/8/90	26.0	1.0	7.0	56.0
5/26/90	17.0	8.0	6.0	15.0
6/9/90	6.0	2.0	3.0	3.0
6/30/90	34.0	11.0	7.0	5.0
7/20/90	84.0	21.0	12.0	38.0
8/4/90	81.0	10.0	9.0	23.0
8/18/90	129.0	20.0	12.0	24.0
9/1/90	13.0	5.0	5.0	2.0
9/15/90	69.0	21.0	2.0	34.0
9/29/90	49.0	22.0	20.0	53.0

MIN.	6.0	1.0	1.0	1.0
MAX.	195.0	22.0	28.0	173.0
AVG.	67.4	7.2	8.1	48.0

Pre-project water quality monitoring results from samples collected at site W-M443.6G

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (FT)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
5/6/89	240	0.98	19	32.0
5/20/89	320	1.18	16	35.0
6/3/89	250	1.18	19	34.0
6/17/89	240	1.18	28	32.0
7/1/89	307	0.75	33	18.0
7/15/89	330	1.44	19	39.0
7/29/89	338	1.51	29	36.0
8/12/89	355	1.08	27	54.0
8/26/89	321	1.61	14	15.0
9/9/89	368	1.18	20	41.0
9/23/89	352	1.74	13	19.0
10/14/89	352	1.51	14	20.0
10/28/89	377	1.35	20	28.0
4/14/90	335	1.18	26	34.0
5/8/90	322	1.51	13	21.0
5/26/90	330	1.25	22	24.0
6/9/90	332	2.26	6	9.0
6/30/90	335	3.02	6	5.0
7/20/90	438	0.69	72	93.0
8/4/90	399	0.75	49	72.0
8/18/90	420	0.59	62	93.0
9/1/90	413	-	5	14.0
9/15/90	421	0.92	30	38.0
9/29/90	390	0.85	42	64.0

MIN.	240	0.59	5	5.0
MAX.	438	3.02	72	93.0
AVG.	345	1.29	25	36.3

Pre-project water quality monitoring results from samples collected at site W-M443.6G

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO3)
5/6/89	-	12.0	12.40	8.80	134
5/20/89	-	22.0	13.10	8.90	144
6/3/89	-	25.0	11.60	8.70	118
6/17/89	-	25.0	17.30	9.00	120
7/1/89	-	31.0	19.70	9.20	124
7/15/89	-	21.0	7.10	7.90	124
7/29/89	-	29.0	9.00	8.10	124
8/12/89	-	29.0	11.70	8.60	130
8/26/89	-	27.0	7.90	8.40	120
9/9/89	-	22.0	12.20	8.60	128
9/23/89	-	16.0	9.40	8.30	136
10/14/89	-	20.0	10.90	8.60	148
10/28/89	-	16.0	10.40	8.10	154
4/14/90	SW	9.0	11.50	8.60	122
5/8/90	-	22.0	0.60	9.20	110
5/26/90	-	17.0	7.70	7.60	112
6/9/90	-	22.0	3.80	7.60	120
6/30/90	W	27.0	8.00	7.70	118
7/20/90	-	30.0	13.90	8.30	188
8/4/90	N	27.0	8.80	7.90	146
8/18/90	S	32.0	12.60	8.20	162
9/1/90	-	30.0	9.30	8.00	148
9/15/90	W	25.0	10.10	8.10	158
9/29/90	-	19.0	11.90	8.50	140

MIN.	-	9.0	0.60	7.60	110
MAX.	-	32.0	19.70	9.20	188
AVG.	-	23.1	10.45	-	135

Pre-project water quality monitoring results from samples collected at site W-M443.6G

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
5/6/89	1.64	-	-	9	-	-
5/20/89	2.69	-	-	20	-	-
6/3/89	2.26	-	-	22	-	-
6/17/89	1.67	-	-	24	-	-
7/1/89	2.03	-	-	28	-	-
7/15/89	2.03	-	-	27	-	-
7/29/89	1.51	-	-	25	-	-
8/12/89	1.94	-	-	27	-	-
8/26/89	1.61	-	-	27	-	-
9/9/89	2.85	-	-	18	-	-
9/23/89	2.26	-	-	11	-	-
10/14/89	1.51	-	-	21	-	-
10/28/89	2.00	-	-	16	-	-
4/14/90	1.97	-	0.1	9	70	2
5/8/90	1.97	<.250	0.0	24	85	0
5/26/90	3.94	<.250	0.0	16	100	0
6/9/90	2.26	<.113	0.0	20	0	0
6/30/90	3.35	<.113	0.0	32	10	1
7/20/90	1.51	<.113	0.0	27	70	0
8/4/90	2.00	<.113	0.1	28	10	7
8/18/90	2.20	<.113	0.1	32	5	4
9/1/90	-	-	-	30	20	0
9/15/90	4.72	<.113	0.1	24	0	3
9/29/90	4.53	<.113	0.1	18	100	0

MIN.	1.51	<.113	0.0	9	0	0
MAX.	4.72	<.250	0.1	32	100	7
AVG.	2.37	-	0.1	22	43	2

Post-project water quality monitoring results from samples collected at site W-M443.6G

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
9/24/91	10.00	0.163	0.1	13	60	10
10/10/91	9.10	0.102	0.0	9	10	0
10/22/91	8.80	0.108	0.2	24	20	12
11/5/91	10.10	0.058	0.0	4	100	10
11/26/91	12.00	0.073	0.0	-4	100	12
12/13/91	12.15	0.073	**	-2	0	0
2/3/92	8.80	0.000	**	3	95	0
4/7/92	11.55	*	0.2	17	75	5
5/12/92	10.00	0.093	0.0	17.5	100	0
6/4/92	9.00	0.000	0.0	22	100	0
6/16/92	8.50	0.202	0.1	24	100	5
7/10/92	9.08	0.133	0.0	31	25	5
7/22/92	10.50	0.000	0.0	23.5	100	0
7/27/92	9.60	0.000	0.0	28.5	0	0
8/12/92	9.25	0.113	0.2	19.4	100	5
8/25/92	8.50	0.080	0.6	32	30	15
8/31/92	6.10	0.000	0.0	24	0	0
9/15/92	9.50	0.000	0.0	27.5	90	0
9/28/92	10.60	0.280	0.6	14	0	10
10/13/92	9.40	0.000	0.0	17.5	0	0
11/24/92	12.55	0.068	0.0	6	100	4
1/25/93	10.90	0.000	**	-7	5	5
11/10/93	8.30	0.075	0.0	3	5	3
1/10/94	9.00	0.000	**	-3	100	10
2/24/94	12.40	0.040	**	-9	15	5
3/9/94	11.75	0.000	**	-2	15	5
4/19/94	9.00	0.088	0.1	14	0	7
5/10/94	12.70	0.125	0.0	17	2	1
5/24/94	9.05	0.037	0.0	23	95	2
6/14/94	8.35	0.140	0.2	28	25	6
7/7/94	8.55	0.000	0.1	26	20	3
7/19/94	8.00	0.202	0.2	24	85	7
8/9/94	7.50	*	0.1	71	90	3
8/30/94	7.70	0.041	0.0	18	100	0
9/13/94	7.00	0.107	0.0	23	10	3
10/4/94	8.30	0.042	0.1	14	100	3
10/25/94	7.80	0.119	0.1	6	95	3
12/6/94	8.00	0.072	0.1	-2	100	5
2/14/95	8.42	0.070	**	-4	100	6
3/14/95	7.15	0.000	0.0	14	75	0
4/11/95	10.00	0.081	0.1	9	100	4
6/13/95	9.70	0.044	0.0	19	30	1
6/27/95	8.15	0.000	0.0	22	100	2
7/11/95	6.40	0.070	0.0	27	15	1
7/25/95	7.80	0.000	0.0	26	10	0
8/29/95	8.20	0.000	0.0	26	80	1
9/12/95	7.50	0.000	0.0	16	100	2
9/27/95	6.90	0.021	0.0	13	0	3
10/10/95	8.80	0.000	0.0	11	15	1
10/24/95	7.65	***	0.3	7	98	4
11/7/95	9.25	0.223	0.2	1	5	5
MIN.	6.10	0.000	0.0	-9	0	0
MAX.	12.70	0.280	0.6	71	100	15
AVG.	9.12	0.065	0.1	15	55	4

* Meter malfunction
** Not applicable, ice cover
*** Too windy to take measurement
**** Field/Laboratory accident

Post-project water quality monitoring results from samples collected at site W-M443.6G

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO3)
9/24/91	S	16.0	10.30	8.94	145
10/10/91	-	14.7	9.18	8.64	156
10/22/91	S	15.2	13.95	8.60	149
11/5/91	SW	2.7	11.50	8.18	156
11/26/91	SE	2.9	12.60	*	143
12/13/91	-	2.0	11.72	7.64	138
2/3/92	-	3.3	13.72	7.52	163
4/7/92	NW	14.2	15.82	8.80	140
5/12/92	-	19.0	16.61	4.53	95
6/4/92	-	22.5	*	8.60	120
6/16/92	SE	25.0	3.06	7.85	150
7/10/92	NW	15.0	7.82	8.27	150
7/22/92	-	24.0	7.51	7.70	100
7/27/92	-	27.5	8.01	8.70	110
8/12/92	NW	24.5	7.83	8.32	125
8/25/92	S	28.0	8.66	8.40	135
8/31/92	-	25.5	9.75	9.00	125
9/15/92	-	24.0	7.95	8.49	135
9/28/92	W	17.5	9.44	8.00	130
10/13/92	-	13.0	8.88	8.12	140
11/24/92	NE	4.8	*	8.00	162
1/25/93	E	0.7	12.40	8.19	181
11/10/93	NW	4.9	13.74	8.94	210
1/10/94	SE	1.5	11.30	8.24	189
2/24/94	W	-0.3	11.62	7.78	142
3/9/94	N	2.6	9.92	7.91	146
4/19/94	NW	15.8	8.29	8.31	166
5/10/94	W	16.0	14.72	8.70	139
5/24/94	S	22.8	2.91	7.47	170
6/14/94	S	26.7	3.84	7.64	175
7/7/94	S	28.4	6.67	7.98	165
7/19/94	SE	27.3	4.95	7.97	177
8/9/94	E	25.0	4.88	8.28	176
8/30/94	-	23.3	7.17	8.40	172
9/13/94	SE	24.0	6.83	8.51	196
10/4/94	N	16.9	7.86	8.34	165
10/25/94	NW	12.0	10.22	9.23	170
12/6/94	N	4.2	11.80	8.57	178
2/14/95	SE	2.9	12.30	8.15	183
3/14/95	-	9.6	16.44	8.88	140
4/11/95	SE	7.9	12.75	9.47	122
6/13/95	W	22.2	*	7.95	178
6/27/95	NW	26.3	1.74	7.72	163
7/11/95	SE	28.2	3.82	7.97	171
7/25/95	-	28.2	5.20	8.29	194
8/29/95	NE	29.2	4.71	8.15	175
9/12/95	SE	20.4	6.02	7.89	182
9/27/95	S	15.9	6.92	*	153
10/10/95	SE	15.7	8.39	8.17	204
10/24/95	NW	9.2	8.89	8.40	190
11/7/95	NW	4.2	10.01	7.80	175

MIN.	-	-0.3	1.74	4.53	95
MAX.	-	29.2	16.61	9.47	210
AVG.	-	15.9	9.18	8.20	157

* Meter malfunction
** Not applicable, ice cover
*** Too windy to take measurement
**** Field/Laboratory accident

Post-project water quality monitoring results from samples collected at site W-M443.6G

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (FT)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
9/24/91	408	1.30	12	25.0
10/10/91	398	1.00	14	24.0
10/22/91	388	1.20	16	26.0
11/5/91	343	2.05	6	5.0
11/26/91	311	1.95	7	7.0
12/13/91	326	2.45	5	<6
2/3/92	357	**	2	<10
4/7/92	327	1.25	14	30.0
5/12/92	346	1.18	23	21.0
6/4/92	368	1.08	30	26.0
6/16/92	393	0.49	56	56.0
7/10/92	490	0.49	95	121.0
7/22/92	404	1.41	19	22.0
7/27/92	448	0.89	17	51.0
8/12/92	402	0.82	37	38.0
8/25/92	412	1.21	22	25.0
8/31/92	410	1.20	18	19.0
9/15/92	421	0.89	22	24.0
9/28/92	423	0.89	19	19.0
10/13/92	400	1.10	26	38.0
11/24/92	379	1.71	12	14.4
1/25/93	401	**	4	7.5
11/10/93	406	1.00	20	6.6
1/10/94	417	**	6	5.1
2/24/94	300	**	32	36.9
3/9/94	351	**	5	8.8
4/19/94	371	0.50	52	110.0
5/10/94	330	2.25	7	9.0
5/24/94	422	0.70	28	51.0
6/14/94	448	0.45	48	80.0
7/7/94	455	0.85	30	53.0
7/19/94	437	0.55	30	60.0
8/9/94	449	0.65	29	46.0
8/30/94	422	0.95	25	38.0
9/13/94	436	1.00	10	23.0
10/4/94	395	1.20	15	27.0
10/25/94	374	1.10	17	28.0
12/6/94	338	1.55	13	18.0
2/14/95	352	**	9	7.0
3/14/95	335	1.15	14	35.0
4/11/95	254	1.40	14	30.0
6/13/95	424	0.95	19	35.0
6/27/95	472	1.10	24	32.0
7/11/95	462	0.70	48	83.0
7/25/95	484	1.00	24	32.0
8/29/95	474	0.85	23	53.0
9/12/95	438	0.90	27	44.0
9/27/95	401	0.80	24	38.0
10/10/95	368	0.90	18	38.0
10/24/95	367	1.00	24	44.0
11/7/95	313	2.00	16	26.0

MIN.	254	0.45	2	5.0
MAX.	490	2.45	95	121.0
AVG.	393	1.11	22	-

* Meter malfunction
** Not applicable, ice cover
*** Too windy to take measurement
**** Field/Laboratory accident

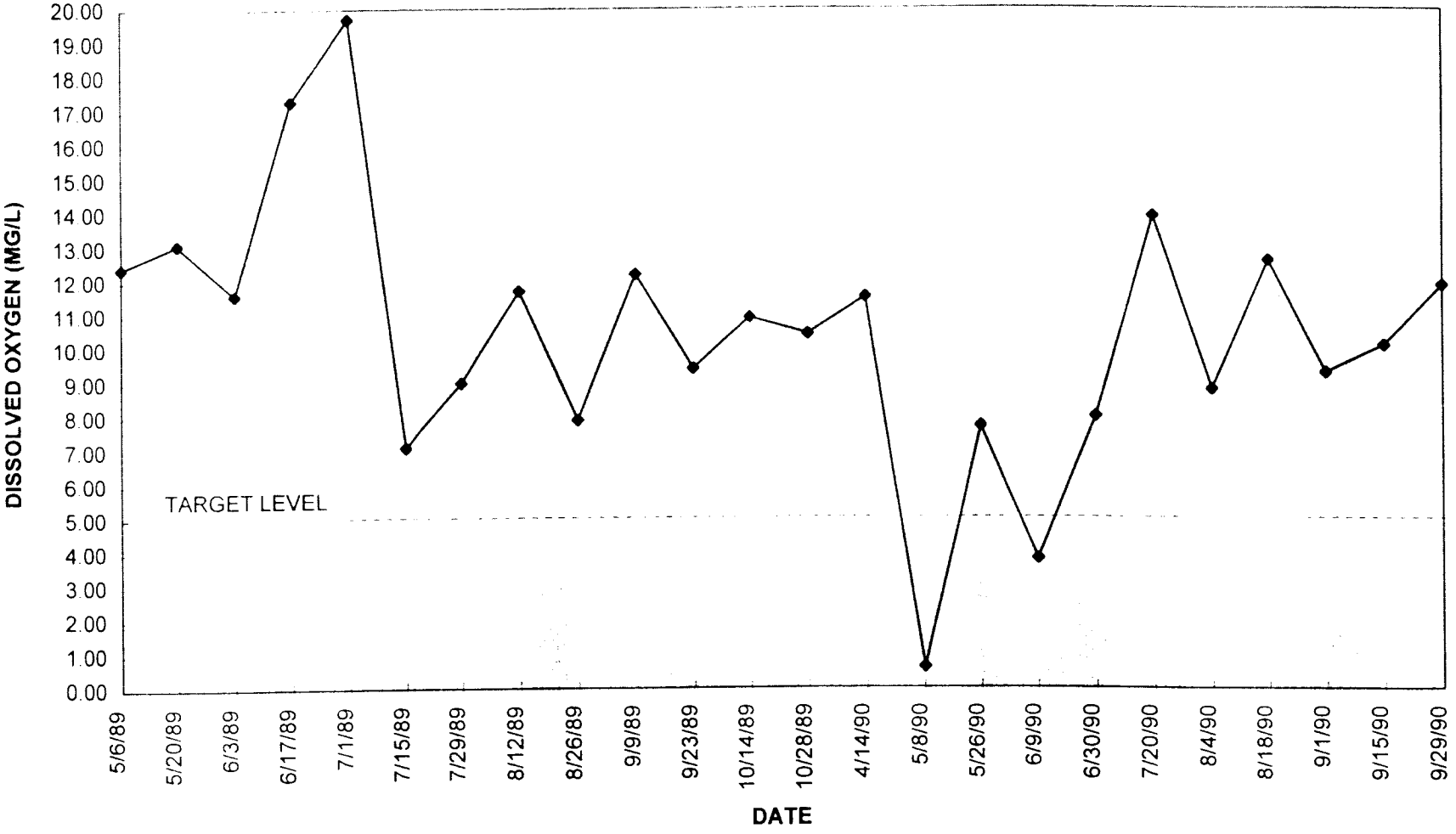
Post-project water quality monitoring results from samples collected at site W-M443.6G

DATE	CHLOROPHYLL a (MG/M3)	CHLOROPHYLL b (MG/M3)	CHLOROPHYLL c (MG/M3)	PHEOPHYTIN a (MG/M3)
9/24/91	23.8	0.6	3.3	7.2
10/10/91	20.2	1.2	2.8	9.3
10/22/91	48.5	5.1	6.7	<0.2
11/5/91	12.2	1.2	1.1	9.2
11/26/91	6.1	0.6	0.9	4.7
12/13/91	3.1	<1	<1	<1
2/3/92	21.0	<1	16.0	34.0
4/7/92	40.0	<1.6	6.2	15.0
5/12/92	54.4	23.0	7.7	12.0
6/4/92	34.5	5.3	5.3	45.5
6/16/92	29.6	8.9	10.9	<0.2
7/10/92	69.3	11.4	6.1	38.2
7/22/92	42.1	4.9	4.7	5.0
7/27/92	76.7	15.1	8.5	10.5
8/12/92	58.4	1.5	6.6	29.2
8/25/92	19.6	4.8	1.9	26.4
8/31/92	24.6	4.1	4.1	<0.2
9/15/92	95.9	27.1	9.9	13.6
9/28/92	33.3	2.5	4.0	0.5
10/13/92	11.8	<0.2	1.6	4.1
11/24/92	9.5	4.4	4.3	<2
1/25/93	22.0	<1.2	18.5	80.3
11/10/93	35.5	6.5	8.8	<2.7
1/10/94	12.1	<1.3	<1.6	10.9
2/24/94	6.1	7.5	11.6	<2.7
3/9/94	-	-	-	-
4/19/94	67.0	<1	6.0	13.0
5/10/94	60.0	3.9	6.2	7.8
5/24/94	21.0	1.9	<1	13.0
6/14/94	26.0	2.0	1.7	10.0
7/7/94	40.0	2.6	2.3	15.0
7/19/94	32.0	<1	<1	6.3
8/9/94	46.0	1.3	3.0	3.2
8/30/94	27.0	<1	<1	2.9
9/13/94	57.0	<1	<1	<1
10/4/94	36.0	<1	<1	11.0
10/25/94	39.0	<1	6.1	3.8
12/6/94	9.2	<1	<1	9.0
2/14/95	20.0	<1	1.1	7.8
3/14/95	57.0	<1	6.5	5.9
4/11/95	140.0	<1	17.0	<1
6/13/95	58.0	<1	<1	<1
6/27/95	43.0	6.1	3.1	<1
7/11/95	100.0	<1	<1	21.0
7/25/95	82.0	<1	3.5	43.0
8/29/95	33.0	2.8	4.2	<1
9/12/95	32.0	<1	<1	26.0
9/27/95	23.0	8.8	17.0	13.0
10/10/95	****	****	****	****
10/24/95	27.0	2.0	5.2	15.0
11/7/95	58.0	<1	8.7	14.0

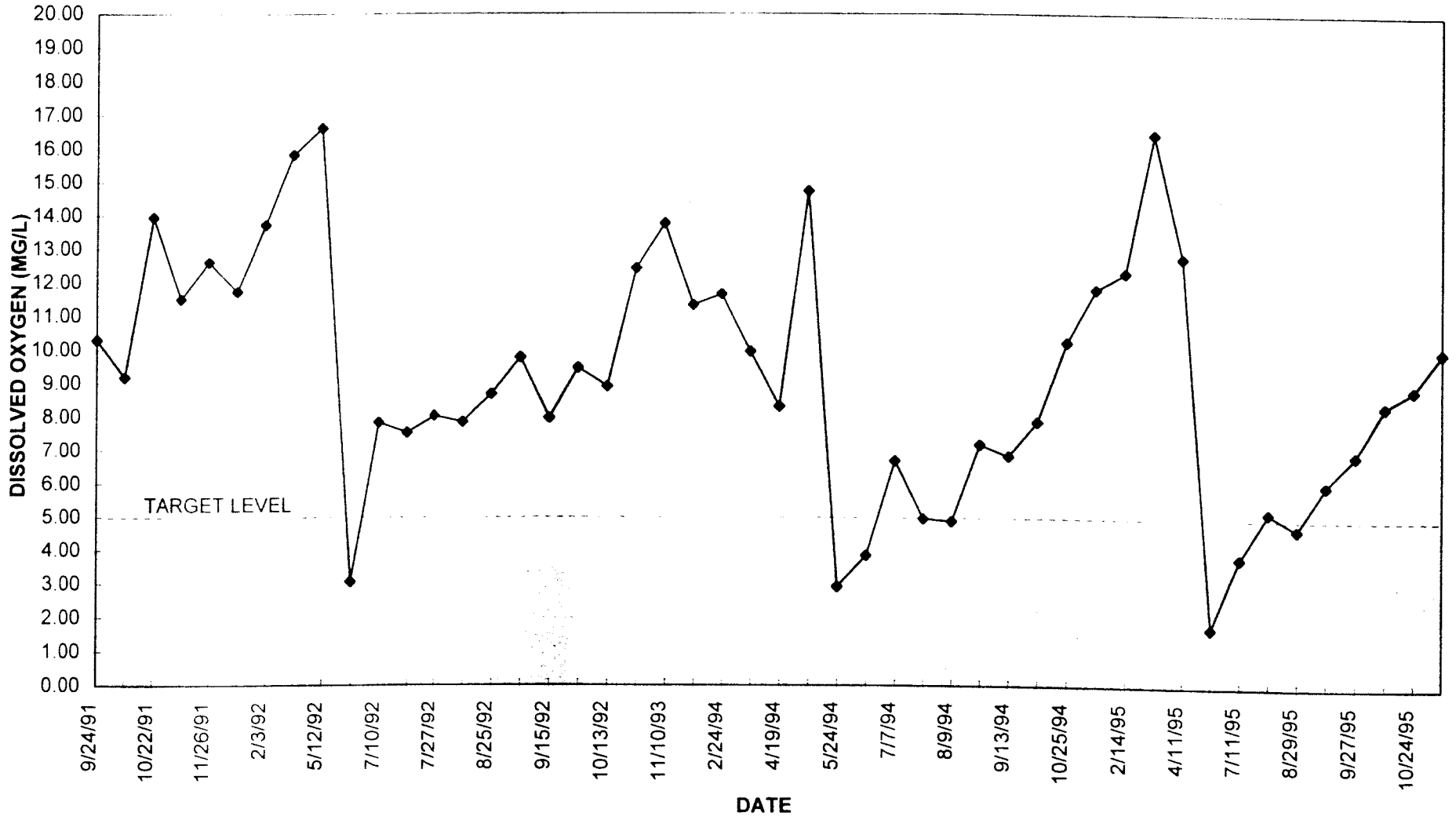
MIN.	3.1	<0.2	0.9	<0.2
MAX.	140.0	27.1	18.5	80.3
AVG.	39.7	-	-	-

* Meter malfunction
** Not applicable, ice cover
*** Too windy to take measurement
**** Field/Laboratory accident

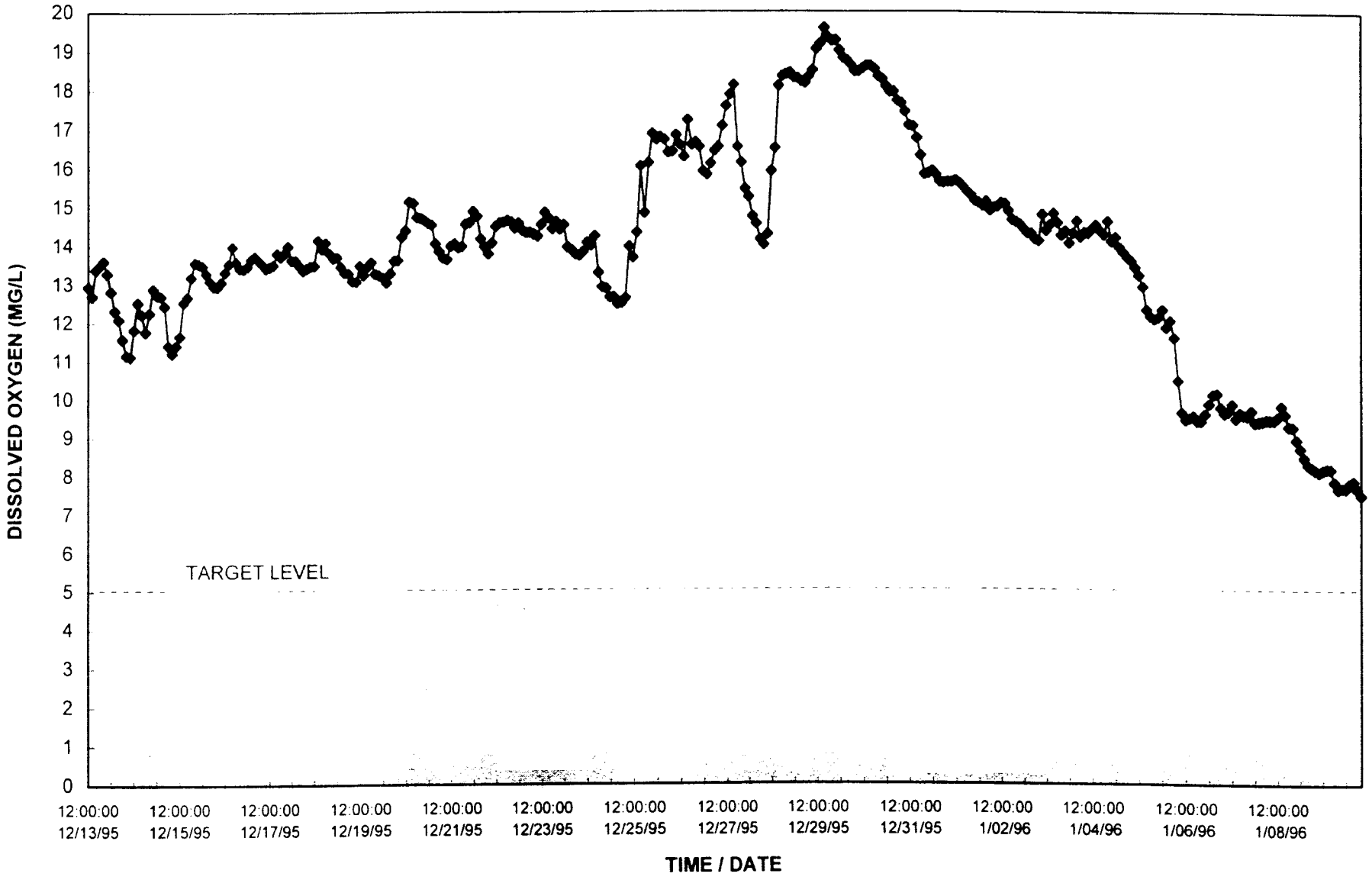
PRE-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M443.6G



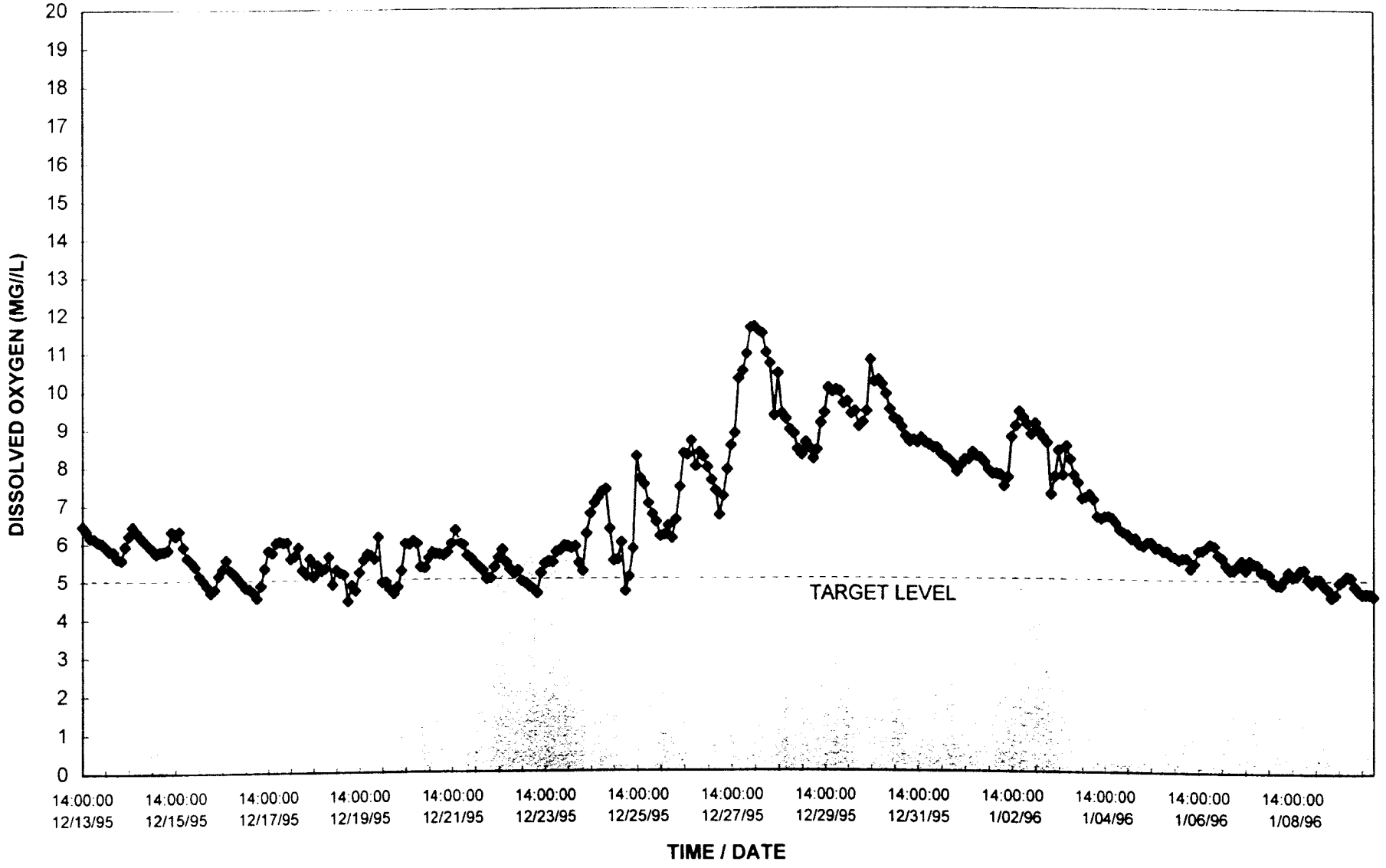
POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M443.6G



YSI 6000 POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M443.6G



YSI 6000 POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M444.4H



APPENDIX F

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Mr. Richard Nelson Field Supervisor U.S. Fish and Wildlife Service 4469 48th Avenue Court Rock Island, IL 61201	1	1
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Ms. Holly Stoerker Upper Mississippi River Basin Association 415 Hamm Building 408 St. Peter Street St. Paul, MN 55111		1
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Mr. Harlan Hirt 1
U.S. Environmental Protection Agency, Region V
77 West Jackson Blvd.
Chicago, IL 60604

Mr. Donald Powell 2
U.S. Army Engineer District, St. Paul
Planning Division (CENCS-PE-P)
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CENCD-PE-PD-PL
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE
51 E. Fourth Street - Room 101
Winona, Minnesota 55987

IN REPLY REFER TO:

TAKE PRIDE IN AMERICA

September 5, 1991

Colonel John R. Brown
Department of the Army
Rock Island District, Corps of
Clock Tower Building
P. O. Box 2004
Rock Island, Illinois 61204

LETTER OF AGREEMENT

This letter is to state the understanding between the U.S. Fish and Wildlife Service (Service) and the Army Corps of Engineers (CORPS) to utilize Contract DACW25-90-C-0020 between the CORPS and J.F. Brennan Company, Incorporated, to accomplish additional work within the bounds of the agreement reached between the Service, CORPS and State of Wisconsin. The CORPS agrees to amend said contract to include removal of 450 cubic yards of material from the Far Nuf boat landing and place it within the disposal island, incorporating it with the top soil. Exact engineering specifications will be furnished by the Service before work commences. The Service will participate by funding $16,000 toward the accomplishment of this work.

U.S. Department of the Interior
U.S. Fish and Wildlife Service

By: James R. Lennartson

James R. Lennartson
Title: Refuge Manager

Date: 9/5/91

U.S. Department of Defense
U.S. Corps of Engineers

By: John R. Brown

John R. Brown
Title: Colonel, EN--Commanding

Date: 9 Sep 91

Standard Form 1080
Revised May 1970
2 Treasury FRM 2500
1080-108

VOUCHER FOR TRANSFERS BETWEEN APPROPRIATIONS AND/OR FUNDS

VOUCHER NO.

SCHEDULE NO.

BILL NO.

PAID BY

Department, establishment, bureau, or office billing

Department of the Army
Rock Island, Corps of Engineers

Clock Tower Building
P. O. Box 2004
Rock Island, IL 61204-2003

Department, establishment, bureau, or office billed

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Upper Mississippi River NW & FR
51 East 4th Street, Room 101
Winona, Minnesota 55987

ORDER NO.	DATE OF DELIVERY	ARTICLES OR SERVICES	QUANTITY	UNIT PRICE COST	UNIT PRICE PER	AMOUNT DOLLARS AND CENTS
	09-91	Amend Contract #DACW25-90-C-0020 to include dredging 450 yd^3 of spoil and place on disposal island, incorporated as top soil.				16,000.00
					TOTAL,	16,000.00

Remittance in payment hereof should be sent to-

Department of the Army, Rock Island District, Corps of Engineers
Box 2004, Rock Island, IL 61204-2004 ATTN: Resource Management

ACCOUNTING CLASSIFICATION—*Billing Office*

CERTIFICATE OF OFFICE BILLED

I certify that the above articles were received and accepted or the services performed as stated and should be charged to the appropriation(s) and or fund(s) as indicated below; or that the advance payment requested is approved and should be paid as indicated.

(Date)

(Authorized administrative or certifying officer)

(Title)

ACCOUNTING CLASSIFICATION—*Office Billed*

32579-1262 = $6000
32595-1261 = $10000

Paid by Check No.

☆ U.S.GPO:1990-0-311-153/81,100

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

REPLY TO
ATTENTION OF

March 13, 1996

Planning Division

SEE REPORT DISTRIBUTION LIST (APPENDIX E)

The Rock Island District of the U.S. Army Corps of Engineers has enclosed the final Performance Evaluation Report for the Big Timber, Iowa, Habitat Rehabilitation and Enhancement Project (HREP). This project was implemented as part of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

Performance Evaluation Reports such as this one are the primary vehicle for communicating project effectiveness and will be essential for assessing the overall success or failure of the UMRS-EMP's HREP element.

The Big Timber HREP included the hydraulic dredging of a channel 5,070 feet long, 50 feet wide, and 8 feet deep from Coolegar Slough, through Round Pond, to the mouth of Timber Chute, and from the head end of Timber Chute to the mouth of Big Denny; the mechanical dredging of a channel 327 feet long, 35 feet wide, and 8 feet deep through Timber Chute; the mechanical dredging of a channel about 9,400 feet long, 40-50 feet wide, and 3.5 feet deep adjacent to the hydraulically dredged channel; the creation of 10 potholes in areas of willow thickets; and the placement of barriers to prevent boat access to Little Denny.

Hydraulically dredged material was placed in a containment area ringed by existing natural levees connected by a low dike that was constructed along the banks of Big and Little Denny. Mechanically dredged material was placed along the banks of encroaching mudflats and the riverside banks, creating low level check dams. The combination of hydraulic and mechanical dredging maximized aquatic habitat enhancement benefits while minimizing actual dredging costs. The placement site dike has been replanted with mast trees and button bush. The project's construction contract was awarded in May 1990, and construction was completed in January 1993.

United States Department of the Interior

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

IN REPLY REFER TO:

FWS/ABA-CGS

March 29, 1995

Mr. Robert W. Kelley, P.E.
Chief
Engineering Division
U.S. Army Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Kelley:

Enclosed is a fully-executed copy of modification number 5 (your work order number 4) to Agreement number 14-48-0003-94-1065 between the Army Corps of Engineers, Rock Island, and the U.S. Fish and Wildlife Service. Please retain this copy for your records.

If you have any questions regarding this document, please contact Ms. Susan Kozarek at (612) 725-3580, Extension 274. If you have any questions regarding the administration of the agreement, please contact Mr. Keith Beseke at (507) 452-4232.

Sincerely,

Susan F. Kozarek

Susan F. Kozarek
Contracting Officer

Enclosure

mod 5
DON: 30181-5-0699
AMOUNT: $355,000.00

U.S. ARMY CORPS OF ENGINEERS
INTERAGENCY AGREEMENT
(ER 1140-1-211)

1. AGREEMENT NO.
14-48-0003-94-1065

2. [ ] INITIAL AGREEMENT
[X] AMENDMENT NO, 4

3. PROJECT TITLE
Flood Damage Habitat Restoration Project

4. EFFECTIVE DATE
06 March 1995

5. COMPLETION DATE
30 September 1996

6. NAME AND ADDRESS OF USACE ORGANIZATION
U.S. Army Engineer District, Rock Island
P.O. Box 2004
Clock Tower Building
Rock Island, IL 61204-2004

7. NAME AND ADDRESS OF OTHER AGENCY
U.S. Department of the Interior, F&W Service
Upper Miss Riv Nat'l Wildlife & Fish Refuge
51 E. 4th Street, Room 101
Winona, MN 55987

8. SCOPE OF WORK (Additional pages may be used as needed)

See Attached Scope of Work.

This scope summarizes the work to be completed by the Rock Island District Corps of Engineers for Region 3 of the U.S, Department of the Interior, Fish and Wildlife Service under Work Order No. 3 of the referenced Memorandum of Agreement.

POC's: Barbara Kimler
309/794-5643

Dan Holmes
309/794-5480

9. SPECIAL PROVISIONS (Additional pages may be used as needed)

Funds to be provided by 31 May 1995.

10. USACE PROJECT OFFICER	TELEPHONE	11. OTHER AGENCY PROJECT OFFICER	TELEPHONE
ROBERT W. KELLEY, P.E. Chief, Engineering Division	309/794-5226	JIM FISHER	507/452-4232
ADDRESS Clock Tower Bldg., P.O. Box 2004 Rock Island, IL 61204-2004		ADDRESS 51 E. Fourth Street, Room 101 Winona, MN 55987	

ENG FORM 4914-R, Jan 88

Corps of Engineers
Rock Island District
ATTN: CENCR-ED-DN
P.O. Box 2004
Rock Island, IL 61204-2004

SCOPE OF WORK FOR DESIGN AND CONSTRUCTION SERVICES WORK ORDER NO. 4

1. INTRODUCTION:

a. Purpose: The purpose of this work order is for Rock Island District to provide Design and Construction Services for two projects in Mississippi River Pools 11 and 13 to the USFWS, Region 3.

b. Reference: Memorandum of Agreement between the U.S. Department of the Interior, Fish and Wildlife Service (USFWS), Region 3 and the U.S. Department of the Army, Corps of Engineers (COE), dated 6 June 1994.

2. SCOPE OF SERVICES:

For each project, the COE will provide the following services:

a. Preparation of plans, specifications and contract documents and performance of field survey as required.

b. Construction contract procurement and administration.

c. Construction management and inspection.

d. Engineering during construction.

3. **PROPOSED PROJECTS:**

Table 3-1 provides a summary of proposed projects.

TABLE 3-1
PROPOSED PROJECTS

PROJECT NO	POOL	TITLE AND DESCRIPTION
1	11	**Pool 11 Riprap:** Riprap island bank at RM's 610.3 and 613.0; Stabilize Wetland at RM 601.5; Riprap Causeway at RM 604.0.
2	13	**Pool 13 Riprap:** Riprap heads of islands at RM's 551.8, 544.0, and 555.2; Riprap shoreline at RM 548.7

4. **COST ESTIMATE**

TABLE 3-1
COST ESTIMATE

Item	Cost
Construction:	
Pool 11 Riprap	137,700
Pool 13 Riprap	144,400
Total Construction	**$282,100**
Planning, Engineering & Design	30,400
Construction Management	42,500
Total Project Cost	**$355,000**

5. **SCHEDULE**

Table 5-1 provides a schedule of the work.

TABLE 5-1
SCHEDULE OF WORK

Contract	Submit Plans & Specs for USFWS Review	Final Plans & Specs Complete 1/	Advertise for Bids	Award Contract	Construc-tion Complete
Pool 11 Riprap	Apr 95	Jun 95	Jul 95	Sep 95	Sep 96
Pool 13 Riprap	Mar 95	May 95	Jun 95	Aug 95	Aug 96

1/ Includes NEPA and permit actions to be completed by USFWS

APPROVAL

U.S. FISH AND WILDLIFE SERVICE
Department of the Interior

James R. Fisher

Jim Fisher
Project Leader
Upper Mississippi River Wildlife
and Fish Refuge

DATE: 3/13/95

U.S. ARMY CORPS OF ENGINEERS
Department of the Army

Robert W. Kelley

Robert W. Kelley, P.E.
Chief, Engineering Division
Rock Island District

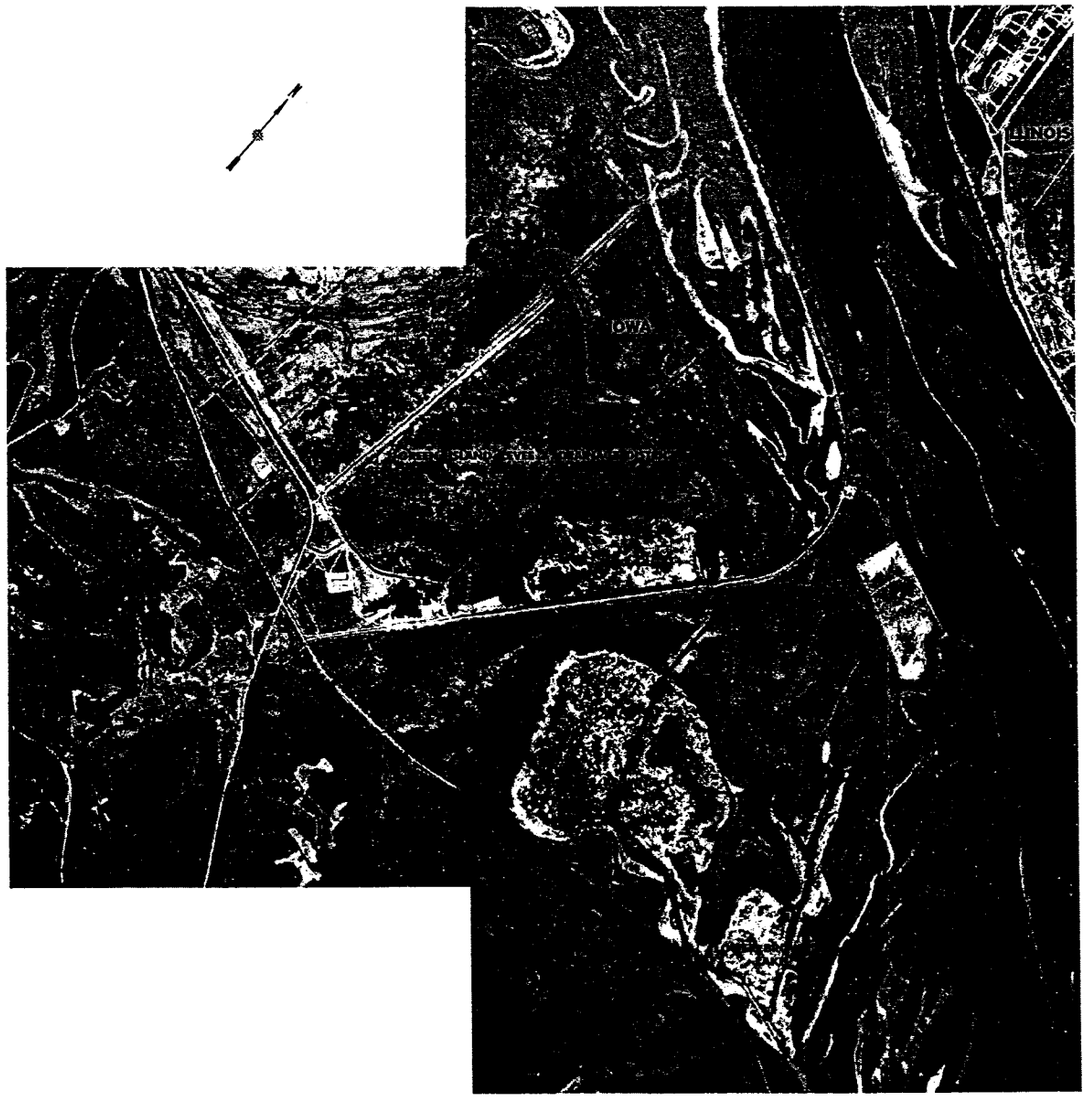
DATE: March 6, 1995

Timber Chute Sedimentation Transects (For Estimating Dredging Quantities)							
		Provide Year-Round Habitat Access (Cross-Sectional Area)[4]			Restore Deep (>6') Aquatic Habitat		
Round Pond - Timber Chute - Willow Chute	Scaled Distance	Timber Chute Restoration, CY (Round Pond - Timber Chute - Willow Chute)			Timber Chute Restoration, CY (Round Pond - Timber Chute - Willow Chute)		
		As Built (1991)	Year 4 (1994)	Year 4 - Restore 8' Depth	As Built (1991)	Year 4 (1994)	Year 4 - Restore
S-M443.7J to S-M443.6J[2]	165	381.2	168.1	336.0	2329.4	1027.3	2053.3
S-M443.7J to S-M443.6J[2]	165	381.2	168.1	336.0	3047.1	2149.6	2662.6
S-M443.7J to S-M443.7K[3]		616.1	535.4	535.4			
				Total	5376.5	3176.8	4715.9
					Quantity to be dredged		1539.1

[1] Round Pond
[2] Timber Chute
[3] Willow Chute
[4] Cross-sectional area of deep habitat = W_{bottom} * D(≥6')

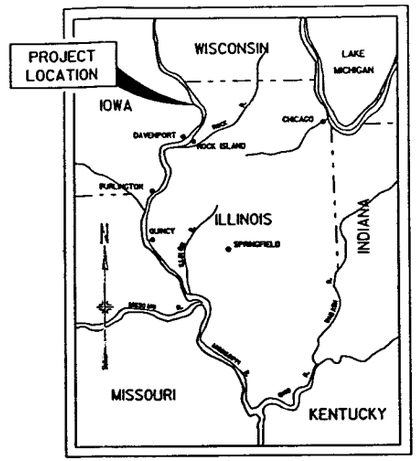
Code	Item	Quantity	Unit	Unit Price	Amount	Contingenc	Con %	Reasons
06.	**FISH AND WILDLIFE FACILITIES**							
06. **Timber Chute Restoration (Round Pond - Timber Chute - Willow Chute)**	**CHANNEL DREDGING**							
06.	DREDGING	1,539	CY	$ 7.20	$ 11,081	$ 2,216	20.0%	
				TOTAL	$ 13,298			

PLATES



800 400 0 800 1600
SCALE

DATE OF AERIAL PHOTO NOV.20,1995



VICINITY MAP

25 0 25 50 75
SCALE IN MILES

US Army Corps of Engineers Rock Island District

Symbol	Date	Approved	Description
			Revisions

U.S. ARMY ENGINEER DISTRICT ROCK ISLAND, ILLINOIS	Designed by	CCK	Dated 8 MARCH '96
	Drawn by	SDH	Scale: AS SHOWN
	Checked by	CCK	Drawing Code: XXXXX
	Approved by	DJJ	Solicitation number: DACW25-XX-B-XXXX

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM
PROJECT NO. BROWNS LAKE REHAB ILLINOIS COUNTY, ENHANCEMENT JACKSON COUNTY, IOWA

GENERAL PLAN AND VICINITY MAP

Sheet Reference Number:

Sheet of XX

PLATE 1

LEGEND

NOTES:

1. MAST TREES PLANTED ON THE CONTAINMENT DIKE.
2. DATE OF AERIAL PHOTOGRAGHY: 4-17-94

- SHALLOW AQUATIC HABITAT
- COMBINATION SHALLOW/DEEP AQUATIC HABITAT
- DEEP AQUATIC HABITAT
- EXCAVATED SIDECAST MATERIAL
- CHECK DAM

Revisions			
Symbol	Description	Date	Approved

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

UPPER MISSISSIPPI RIVER SYSTEM
BIG TIMBER PERFORMANCE EVALUATION
POOL 17, RIVER MILES 443.5-445

PROJECT FEATURES

Designed by:	MDC
Drawn by:	SDH
Checked by:	BLK
Reviewed by:	DJH
Approved by:	CHARLES S. COX COL., CORPS OF ENGINEERS
Scale:	AS SHOWN
Date:	3 APRIL '95
Drawing Code:	
Sheet reference number:	
Solicitation Number:	DACW25-9 -B-
Sheet	of

PLATE 2

LEGEND

SHALLOW AQUATIC HABITAT

COMBINATION SHALLOW/DEEP AQUATIC HABITAT

DEEP AQUATIC HABITAT

CHECK DAM

(A) START OR END POINT OF REACH. SEE AS-BUILT TABLE

NOTES:

1. DATE OF AERIAL PHOTOGRAPHY: 4-17-94

600 300 0 600 1200FT
SCALE: 1"= 600'

SEDIMENTATION TRANSECT ALIGNMENT ROUND POND-TIMBER CHUTE-WILLOW CHUTE-BIG DENNY	SCALED DISTANCE
START DREDGE CUT	
	460
S-M443.7F TO S-M443.6G	
	360
SM443.7G TO S-M443.5H	
	610
S-M443.7J TO S-M443.6J	
	280
S-M443.7J TO S-M443.7K	
	510
S-M443.8J TO S-M443.8K	
	1060
S-M444.0J TO S-M444.0K	
	850
S-M444.2J TO S-M444.2K	
	380
S-M444.3I TO S-M444.4K (S1)	
	1230
S-M444.4H TO S-M444.5H	
	1450
S-M444.7G TO S-M444.7H	
	780
S-M444.8H TO S-M444.8I	
	1070
END DREDGE CUT	

SEDIMENTATION TRANSECT ALIGNMENT LITTLE DENNY	SCALED DISTANCE
START DREDGE CUT (D)	
S-M444.3I TO S-M444.4K (S2)	1850
SM444.3I TO S-M444.4K (S3)	
END DREDGE CUT (G)	

		AS BUILT DREDGING AND EXCAVATION CHANNEL OCT. 21, 1991					
LOCATION	REACH	LENGTH IN FEET	BOTTOM WIDTH IN FEET		BOTTOM ELEVATION		SIDE SLOPES
			HYDRAULIC	MECHANICAL	HYDRAULIC	MECHANICAL	
ROUND POND	A-B	1120	50	-	528	-	2H:1V
TIMBER CHUTE	B-C	327	35	-	528	-	2H:1V
WILLOW CHUTE	C-D	3200	50	40	528	532.5	2H:1V
WILLOW CHUTE	D-E	750	50	40	528	532.5	2H:1V
BIG DENNY	E-F	3625	-	50	-	532.5	2H:1V
LITTLE DENNY	D-G	1850	-	50	-	532.5	2H:1V
TOTALS		10,872					

TYPE OF MEASUREMENT

POINT

E = BULK SEDIMENT ANALYSIS
W = WATER QUALITY
C = COLUMN SETTLINGS ANALYSIS
B = BORING

TRANSECT

S = SEDIMENTATION
V = VEGETATION
1938, 1977 EXISTING DATA

LOCATION CODE

- M ... = MISSISSIPPI RIVER
- 545.8 = RIVER MILE
- ...H = ALPHA DESIGNATOR
Z = LEFT DECENDING BANK
A = RIGHT DECENDING BANK

Revisions			
Symbol	Description	Date	Approved

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

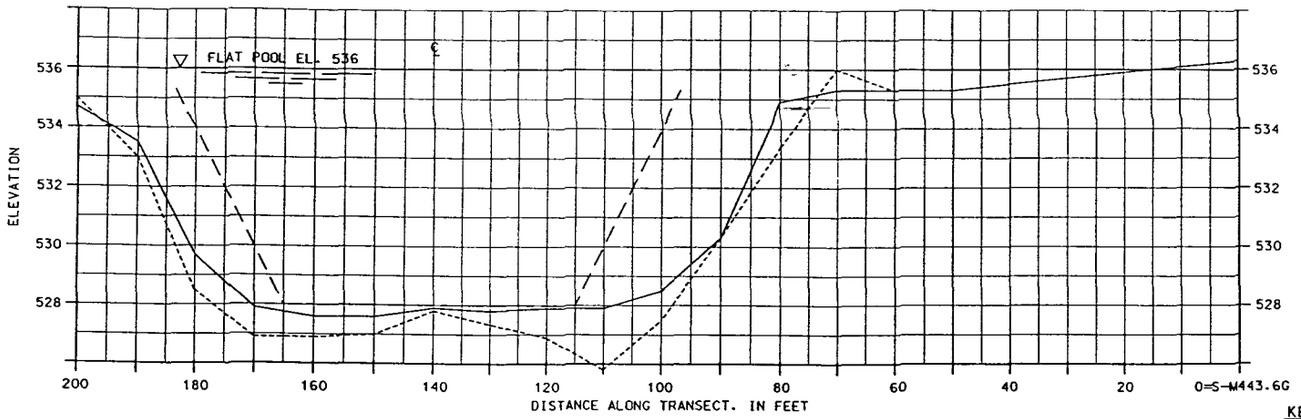
UPPER MISSISSIPPI RIVER SYSTEM
BIG TIMBER PERFORMANCE EVALUATION
POOL 17, RIVER MILES 443.5-445

MONITORING PLAN

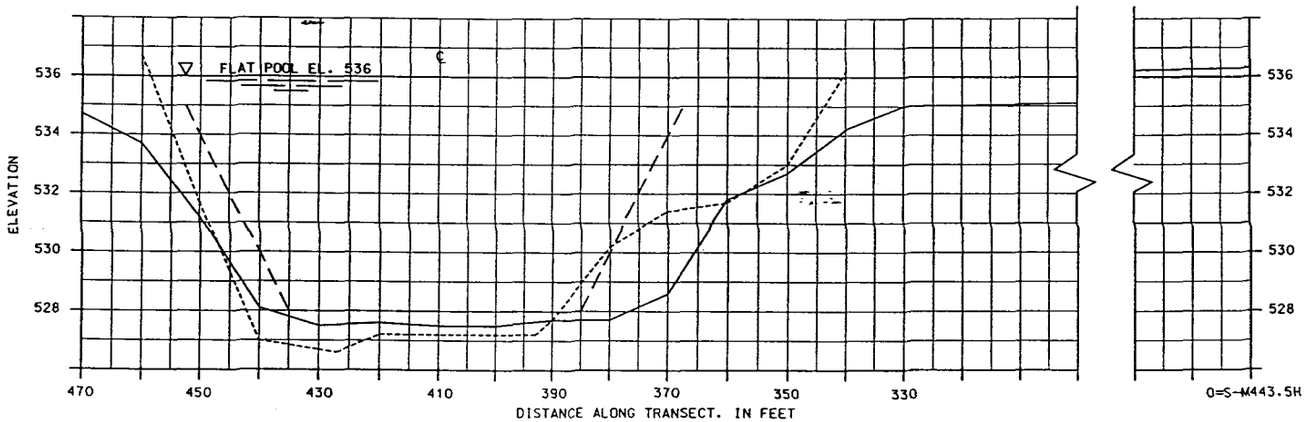
Designed by: MDC
Drawn by: SDH
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 3 APRIL '95
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9 -0-
Sheet of

PLATE 3



SEDIMENTATION TRANSECT S-M443.7F to S-M443.6G (STA. 0+00)



SEDIMENTATION TRANSECT S-M443.7G to S-M443.5H (STA. 0+00)

KEY

— — — — CHANNEL SECTION, AS DESIGNED

---------- CHANNEL SECTION, AS COMPLETED IN JULY 1991

———— CHANNEL SECTION, AS SOUNDED IN JANUARY 1994

℄ CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTE : THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3

Revisions		
Symbol	Description	Date Approved

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

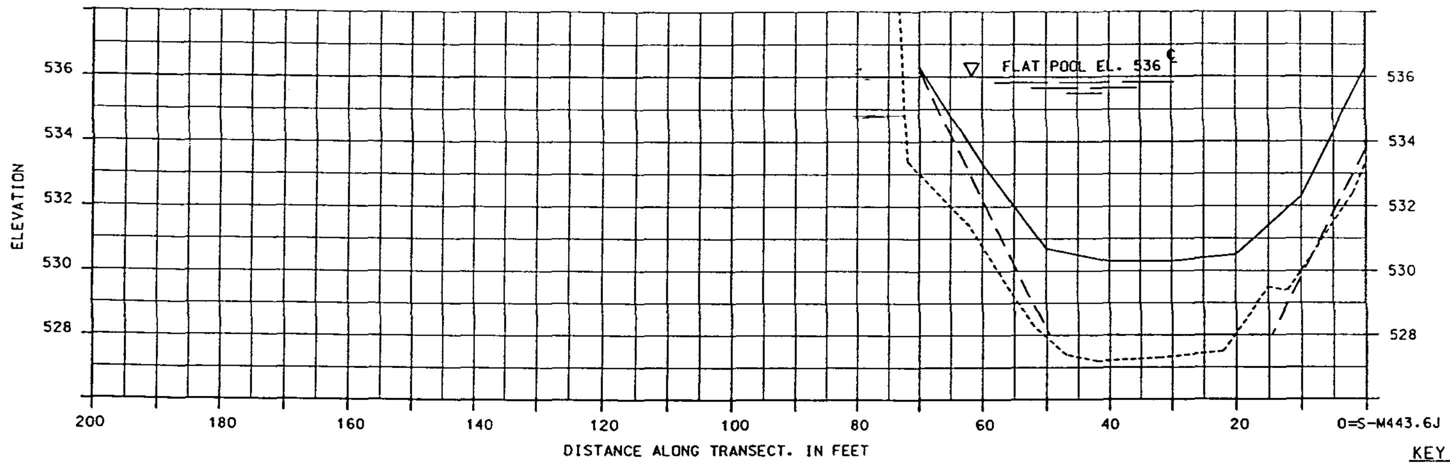
Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX, COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17.
RIVER MILES 443.5 - 445

DREDGED CHANNEL SEDIMENTATION TRANSECTS ROUND POND

Scales:
Dates:
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9 -0-
Sheet of

PLATE 4

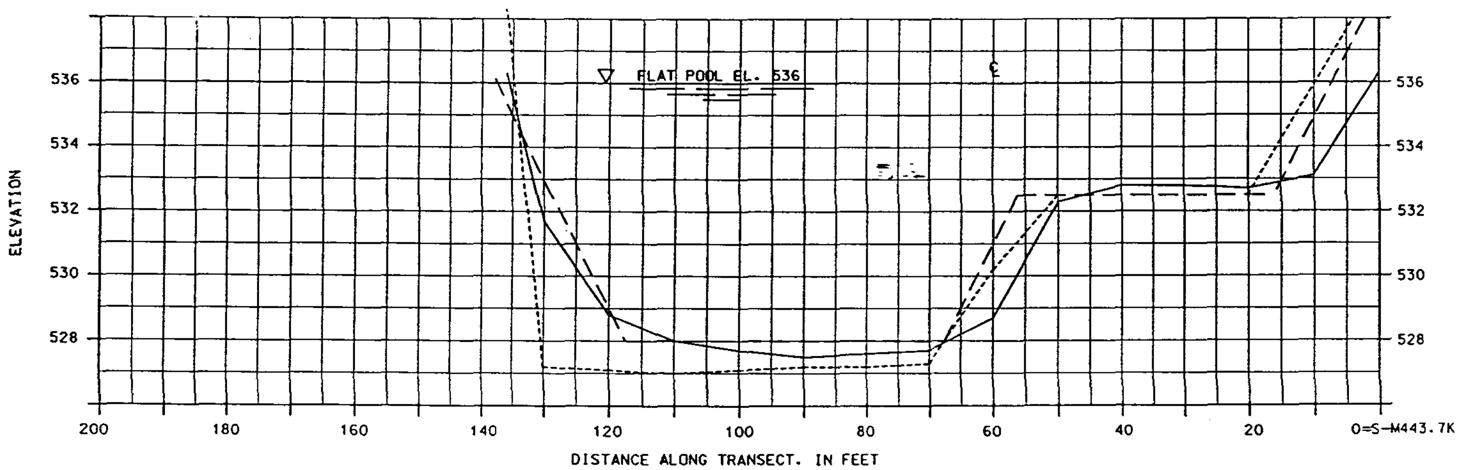


SEDIMENTATION TRANSECT S-M443.7J to S-M443.6J (STA. 0+00)

KEY

— — — —	CHANNEL SECTION, AS DESIGNED
------------	CHANNEL SECTION, AS COMPLETED IN JULY 1991
————	CHANNEL SECTION, AS SOUNDED IN JANUARY 1994
℄	CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTE : THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3



SEDIMENTATION TRANSECT S-M443.7J to S-M443.7K (STA. 0+00)

Revisions			
Symbol	Description	Date	Approved

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

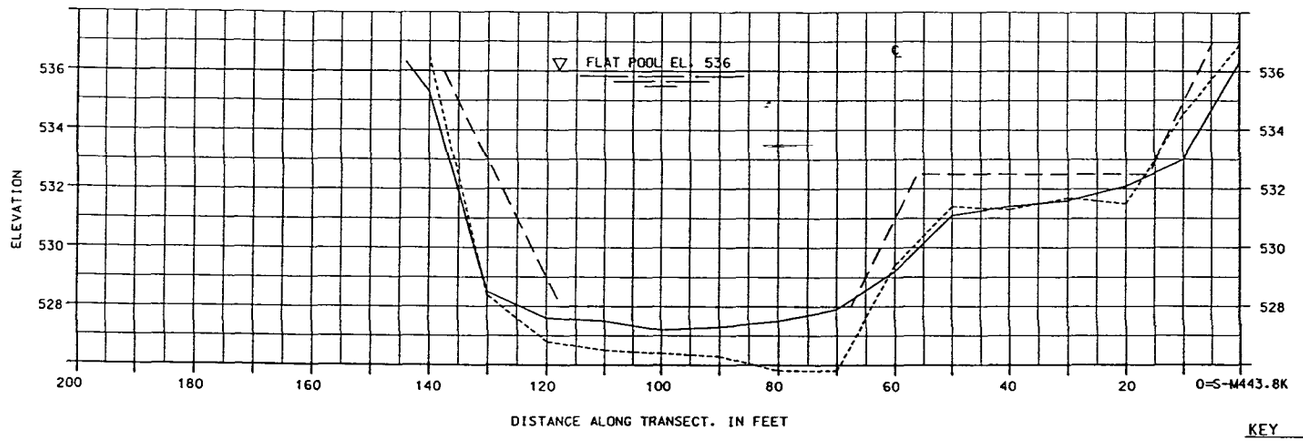
UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 - 445

DREDGED CHANNEL SEDIMENTATION TRANSECTS TIMBER CHUTE-WILLOW CHUTE

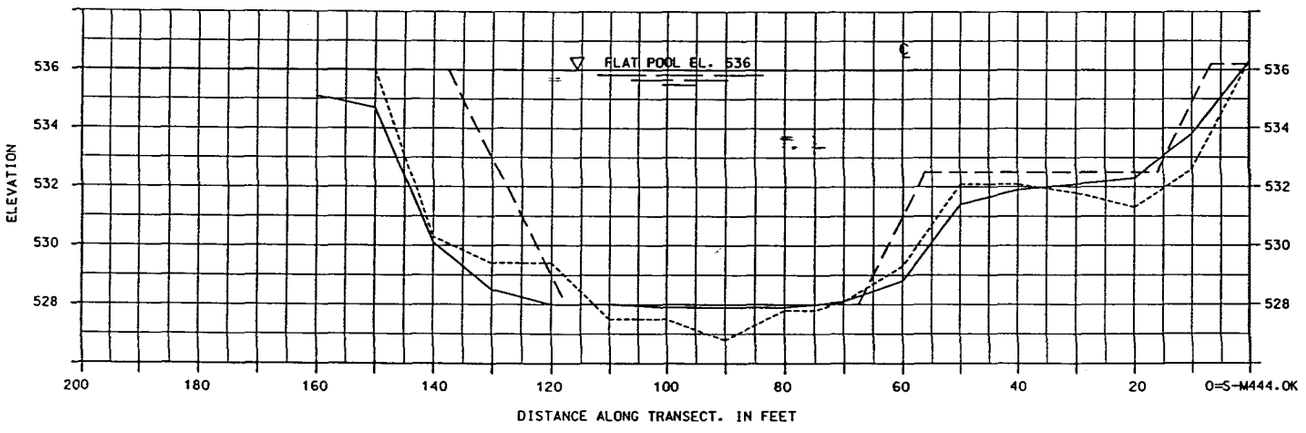
Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale:
Date:
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 5



SEDIMENTATION TRANSECT S-M443.8J to S-M443.8K (STA. 0+00)



SEDIMENTATION TRANSECT S-M444.0J to S-M444.0K (STA. 0+00)

KEY

— — — — CHANNEL SECTION, AS DESIGNED

---------- CHANNEL SECTION, AS COMPLETED IN JULY 1991

———— CHANNEL SECTION, AS SOUNDED IN JANUARY 1994

℄ CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTE : THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3

Revisions			
Symbol	Description	Date	Approved

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

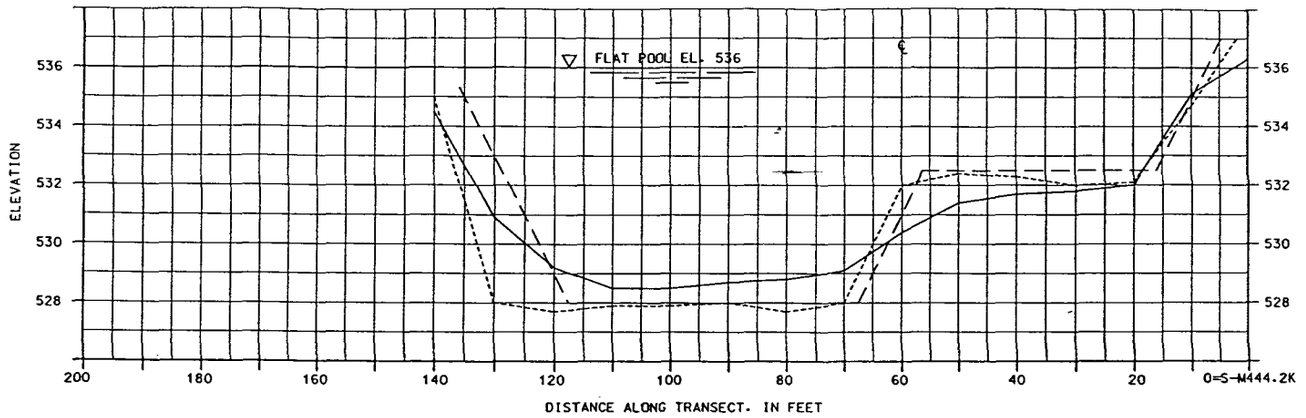
Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES J. COX, COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 - 445

DREDGED CHANNEL SEDIMENTATION TRANSECTS WILLOW CHUTE

Scale:
Date:
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9_-B-____
Sheet of

PLATE 6



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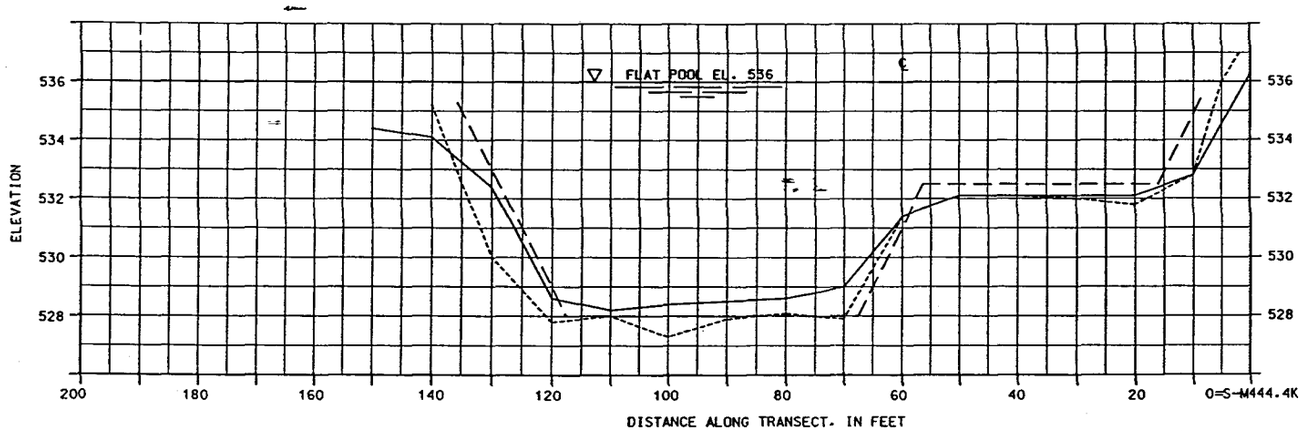


SEDIMENTATION TRANSECT S-M444.3I to S-M444.4K (SEGMENT 1) - SEE NOTE 2

KEY

- — — — — CHANNEL SECTION, AS DESIGNED
- ---------- CHANNEL SECTION, AS COMPLETED IN JULY 1991
- ———— CHANNEL SECTION, AS SOUNDED IN JANUARY 1994
- ℄ CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

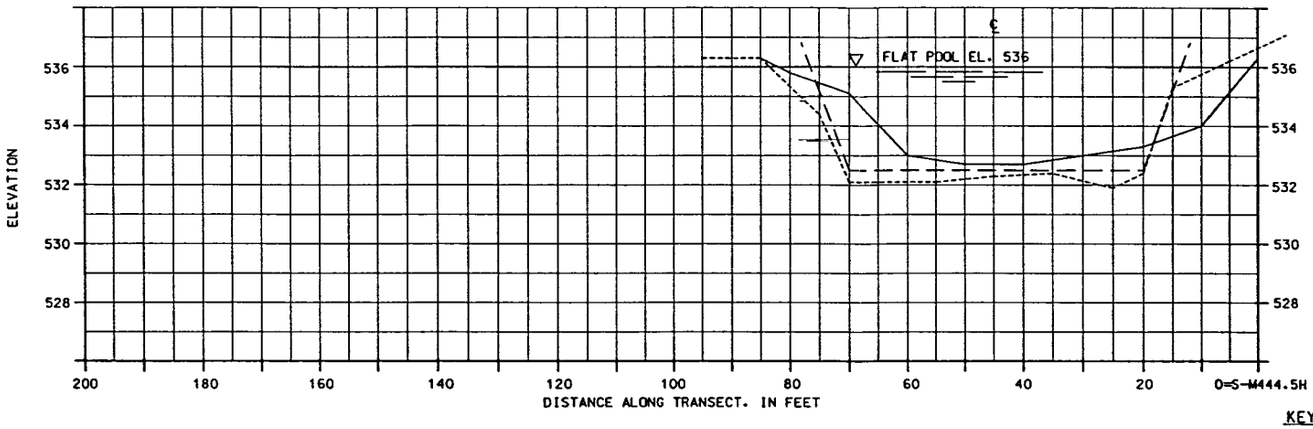
NOTES :
1. THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3
2. THIS TRANSECT WAS SOUNDED IN 3 SEGMENTS SEGMENT 1 IS SOUTHERN MOST (FURTHEST FROM RIVER)

Revisions			
Symbol	Description	Date	Approved

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

Designed by: CCK	UPPER MISSISSIPPI SYSTEM BIG TIMBER PERFORMANCE EVALUATION POOL 17, RIVER MILES 443.5 - 445
Drawn by: SDH	DREDGED CHANNEL SEDIMENTATION TRANSECTS WILLOW CHUTE
Checked by: CCK	
Reviewed by: DJJ	Scales / Sheet reference number / Solicitation Number: DACW25-9 -C-
Approved by: CHARLES S. COX, COL., CORPS OF ENGINEERS	Dates / Drawing Codes / Sheet of

PLATE 7

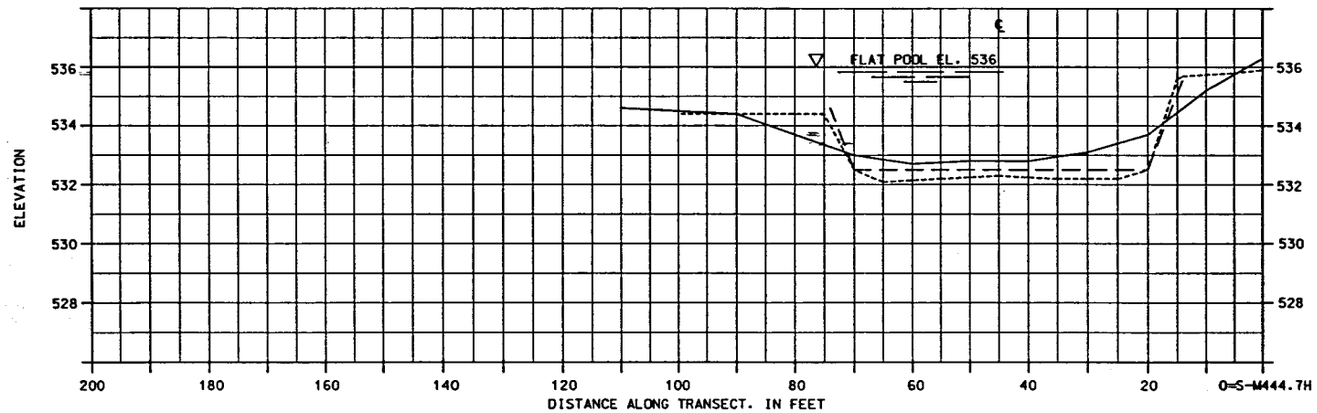


SEDIMENTATION TRANSECT S-M444.4H to S-M444.5H (STA. 0+00)

KEY

- — — — — CHANNEL SECTION. AS DESIGNED
- ---------- CHANNEL SECTION. AS COMPLETED IN JULY 1991
- ———— CHANNEL SECTION. AS SOUNDED IN JANUARY 1994
- ℄ CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTE : THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3



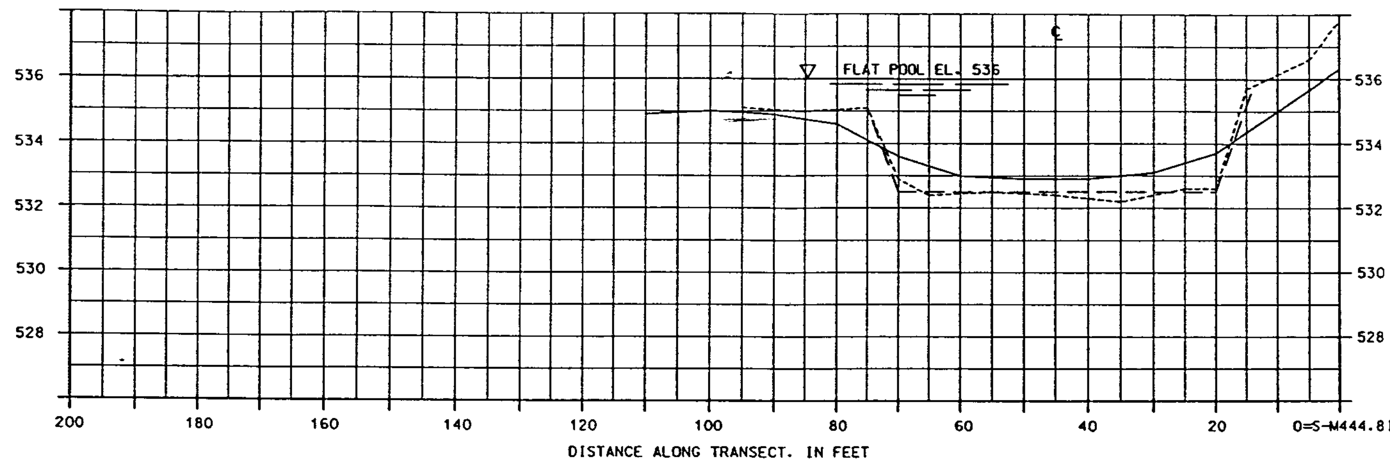
SEDIMENTATION TRANSECT S-M444.7G to S-M444.7H (STA. 0+00)

Revisions			
Symbol	Description	Date	Approved

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

Designed by: CCK	UPPER MISSISSIPPI SYSTEM
Drawn by: SDH	BIG TIMBER PERFORMANCE EVALUATION POOL 17.
Checked by: CCK	RIVER MILES 443.5 - 445
Reviewed by: DJJ	DREDGED CHANNEL SEDIMENTATION TRANSECTS
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	BIG DENNY
Scale:	Sheet reference number:
Dated:	Solicitation Number: DACW25-94-B-
Drawing Code:	Sheet of

PLATE 8



SEDIMENTATION TRANSECT S-M444.8H to S-M444.8I (STA. 0+00)

KEY

— — — — CHANNEL SECTION, AS DESIGNED

------------- CHANNEL SECTION, AS COMPLETED IN JULY 1991

———— CHANNEL SECTION, AS SOUNDED IN JANUARY 1994

℄ CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTE : THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3

Revisions			
Symbol	Description	Date	Approved

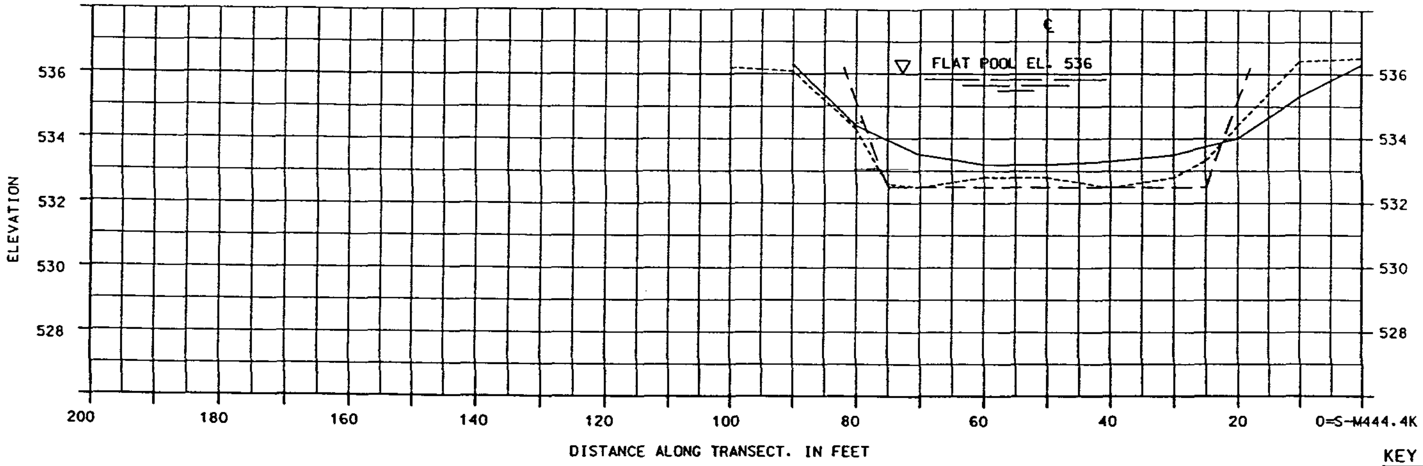
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 – 445

DREDGED CHANNEL
SEDIMENTATION TRANSECTS
BIG DENNY

Scale:
Date:
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9 -8-
Sheet of

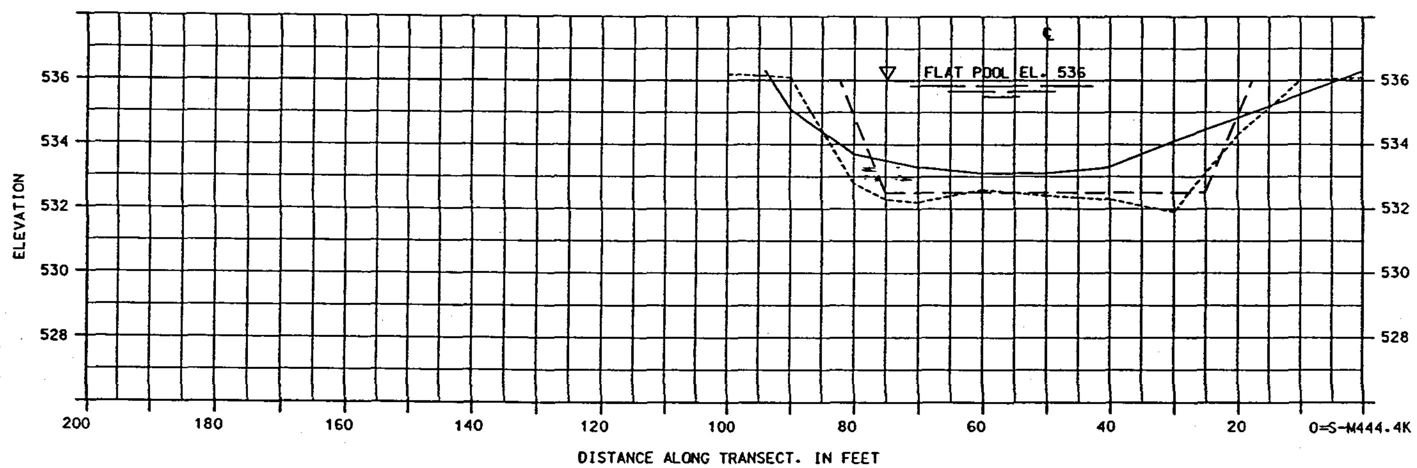


SEDIMENTATION TRANSECT S-M444.3I to S-M444.4K (SEGMENT 3) - SEE NOTE 2

KEY

— — — —	CHANNEL SECTION, AS DESIGNED
-------------	CHANNEL SECTION, AS COMPLETED IN JULY 1991
————	CHANNEL SECTION, AS SOUNDED IN JANUARY 1994
℄	CENTER LINE OF AS-DESIGNED AND AS-COMPLETED SECTIONS

NOTES :
1. THE WATER SURFACE AT THE TIME OF THE JANUARY 1994 SOUNDING WAS 536.3
2. THIS TRANSECT WAS SOUNDED IN 3 SEGMENTS
SEGMENT 2 IS BETWEEN SEGMENTS 1 & 3.
SEGMENT 3 IS NORTHERN MOST (CLOSEST TO RIVER)



SEDIMENTATION TRANSECT S-M444.3I to S-M444.4K (SEGMENT 2) - SEE NOTE 2

Revisions			
Symbol	Description	Date	Approved

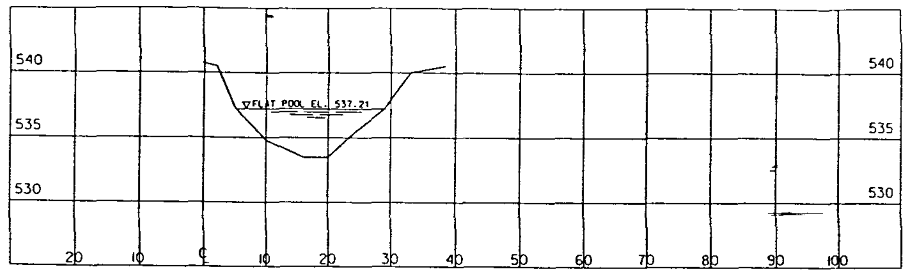
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

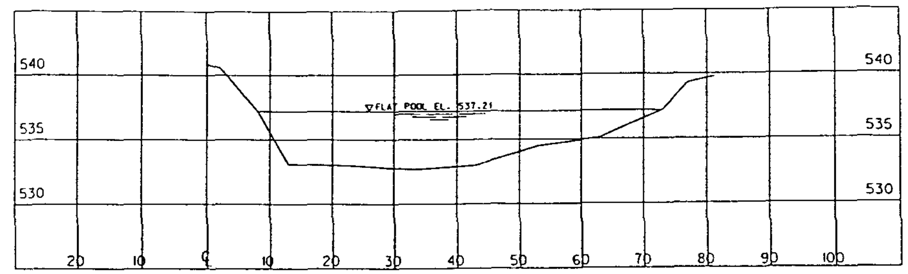
UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 - 445

DREDGED CHANNEL
SEDIMENTATION TRANSECTS
LITTLE DENNY

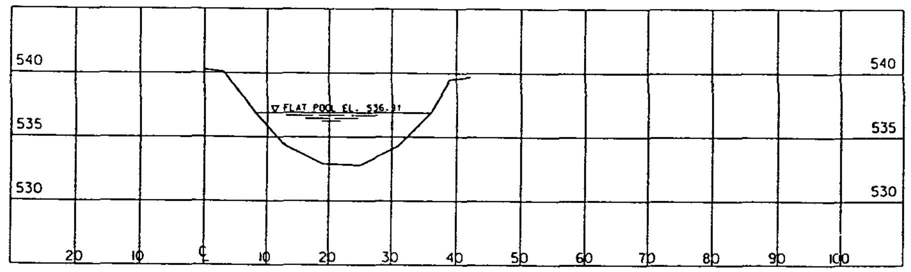
Scale:
Date:
Drawing Code:
Sheet reference number:
Solicitation Number: DACW25-9 -6-
Sheet of



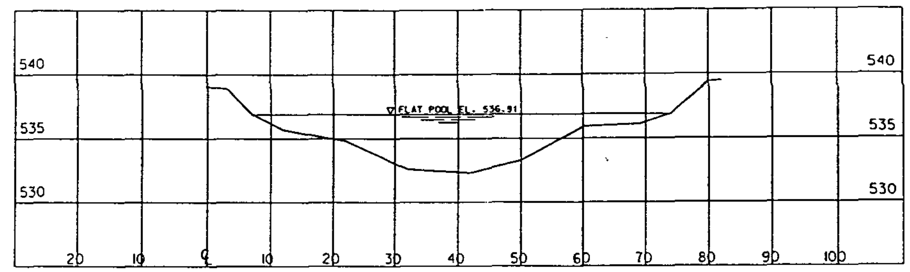
POTHOLE #1 - SHORT CHORD



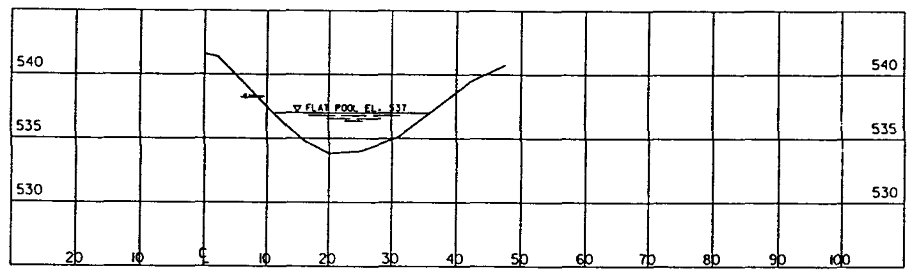
POTHOLE #1 - LONG CHORD



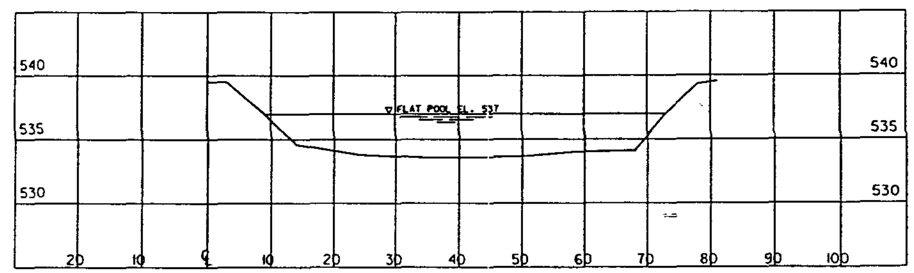
POTHOLE #2 - SHORT CHORD



POTHOLE #2 - LONG CHORD



POTHOLE #3 - SHORT CHORD



POTHOLE #3 - LONG CHORD

LEGEND:

——— 13 SEPT.1995: FIELD BOOK FC-95-6

Revisions			
Symbol	Description	Date	Approved

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

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 - 445

SEDIMENTATION TRANSECTS
POTHOLES 1-3

Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX, COL., CORPS OF ENGINEERS

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Solicitation Number: DACW25-9 -B-
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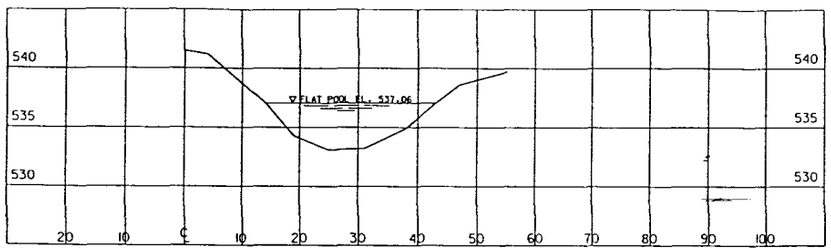
PLATE 11



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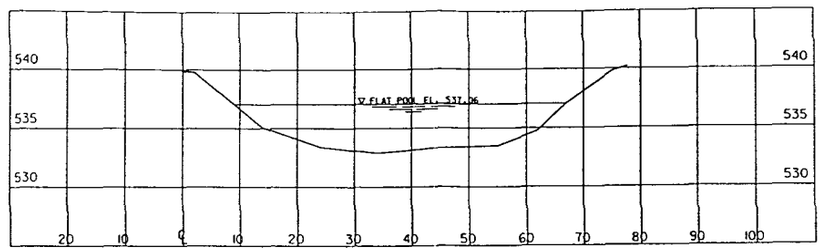

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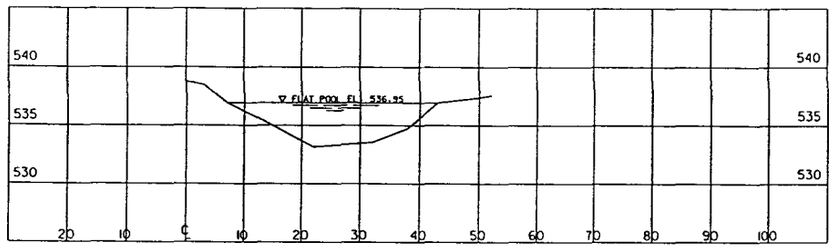

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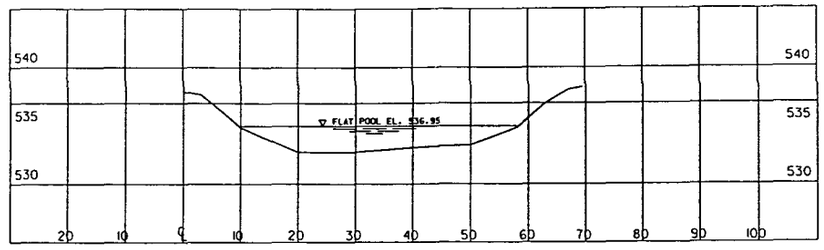

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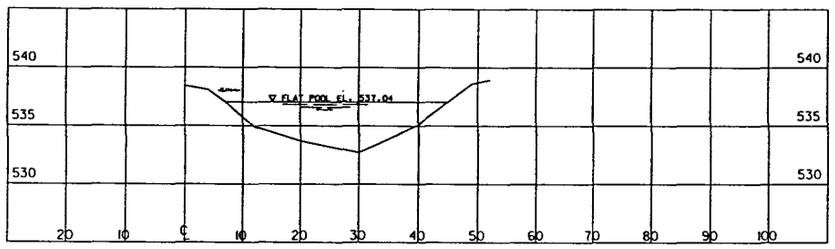

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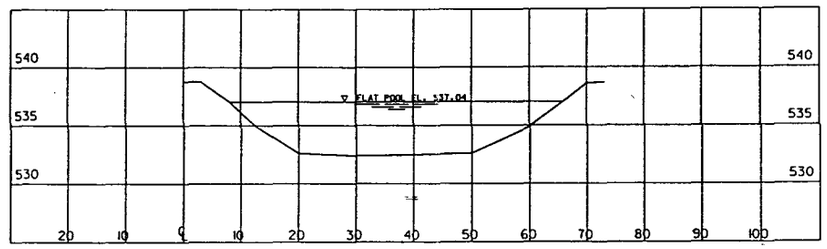

POTHOLE #6 - LONG CHORD

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Revisions			
Symbol	Description	Date	Approved

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

Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

US Army Corps of Engineers

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE EVALUATION POOL 17, RIVER MILES 443.5 - 445

SEDIMENTATION TRANSECTS POTHOLES 4-6

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Drawing Codes
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Solicitation Number: DACW25-9 -C-
Sheet of

PLATE 12

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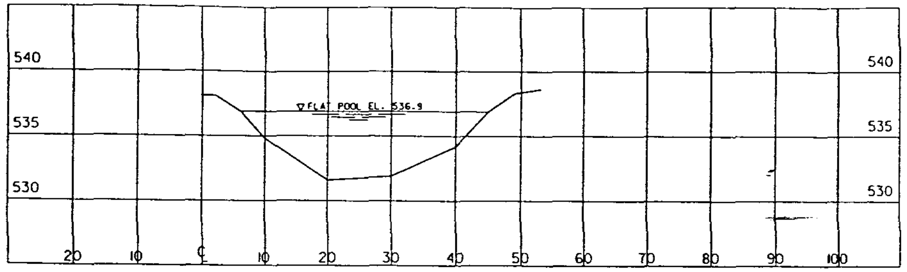

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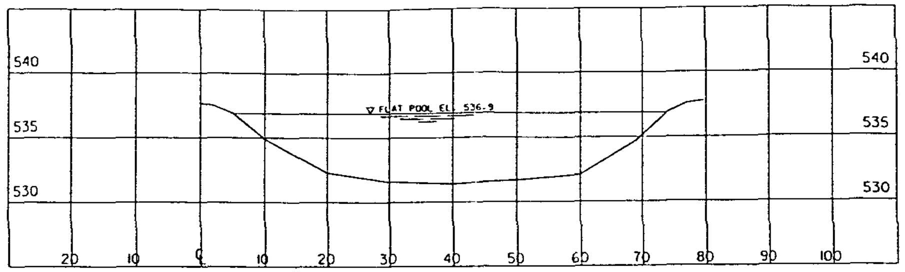

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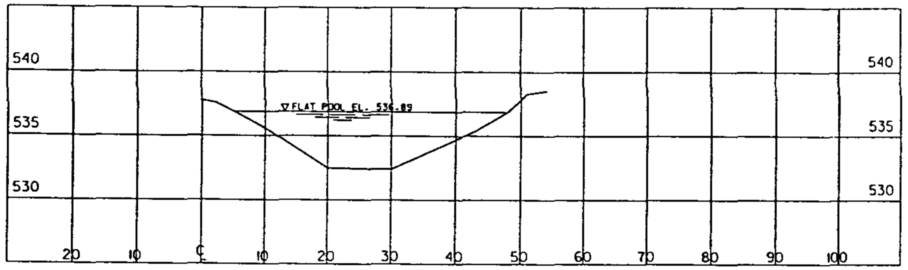

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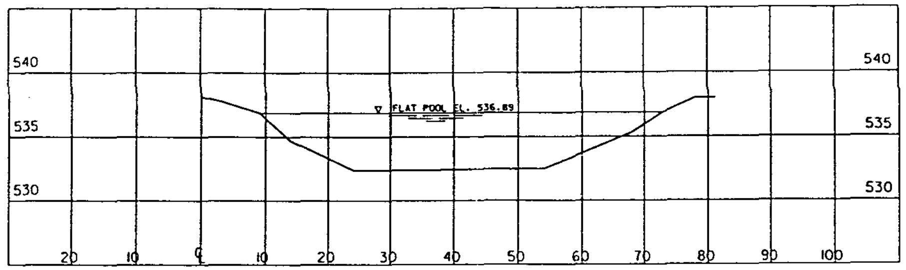

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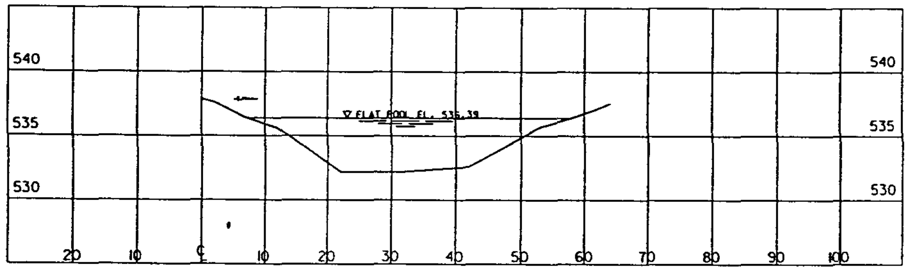

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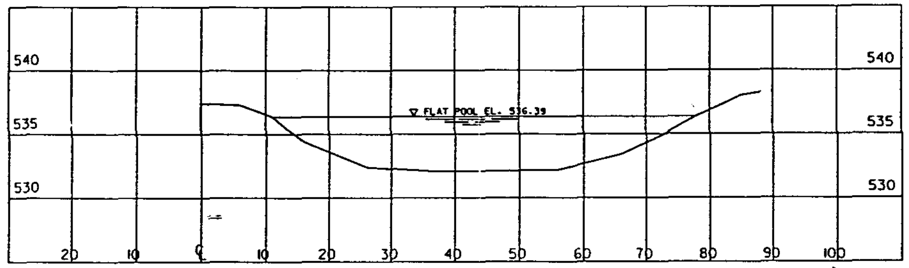

POTHOLE #9 - LONG CHORD

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Revisions			
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U.S. ARMY ENGINEER DISTRICT
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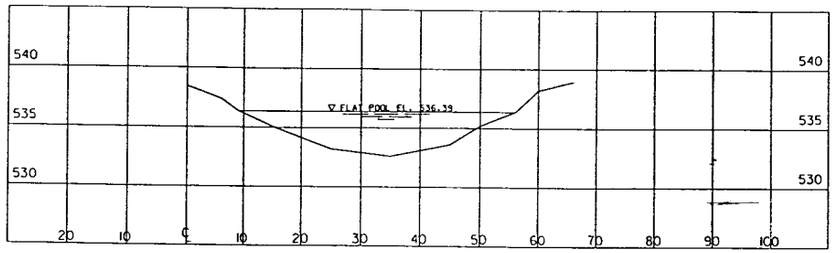
ROCK ISLAND, ILLINOIS

Designed by: CCK	US Army Corps of Engineers Rock Island District — UPPER MISSISSIPPI SYSTEM BIG TIMBER PERFORMANCE EVALUATION POOL 17, RIVER MILES 443.5 - 445
Drawn by: SDH	**SEDIMENTATION TRANSECTS POTHOLES 7-9**
Checked by: CCK	
Reviewed by: DJJ	Scale: / Date: / Sheet reference number: / Solicitation Number: DACW25-9 -8-
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Drawing Code: / Sheet of

PLATE 13



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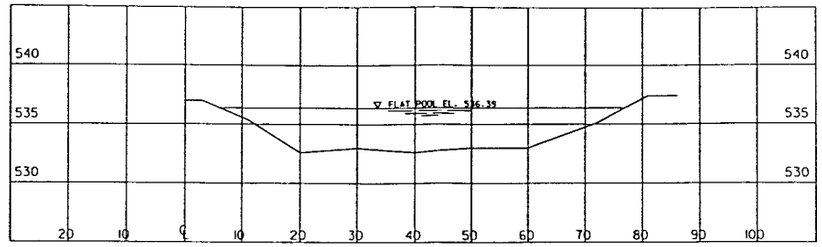

POTHOLE #10 - LONG CHORD

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

Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Approved by: CHARLES S. COX
COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI SYSTEM
BIG TIMBER PERFORMANCE
EVALUATION POOL 17,
RIVER MILES 443.5 - 445

SEDIMENTATION TRANSECTS
POTHOLE 10

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Solicitation Number: DACW25-9 -B-
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PLATE 14

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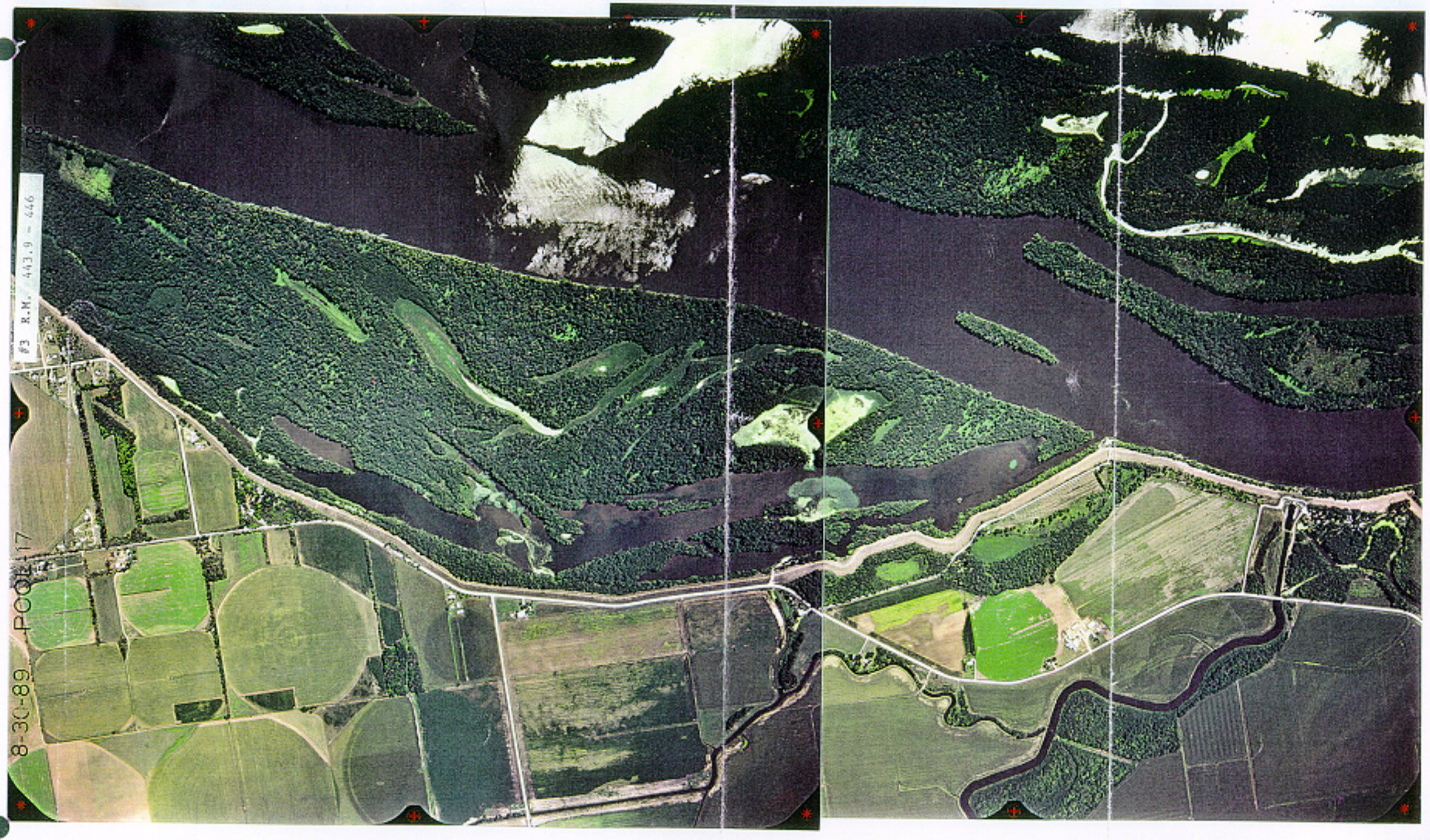

PLATE 15 - 1989 Aerial Photo - Pre-Project Conditions

Big Timber, Iowa EMP-HREP
Pool 17, Mississippi River Mile 444

PLATE 16 - 1994 Aerial Photo - Post Project Conditions

Big Timber, Iowa EMP-HREP
Pool 17, Mississippi River Mile 444