KIMLER

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE
EVALUATION REPORT SUPPLEMENT (PERS2D)

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

SEPTEMBER 1996

US Army Corps
of Engineers
Rock Island District

POOL 13
UPPER MISSISSIPPI RIVER
MILE 545.8
JACKSON COUNTY, IOWA

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:

CENCR-PD-W

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT
SUPPLEMENT (PERS2D)

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

POOL 13, MISSISSIPPI RIVER MILE 545.8
JACKSON COUNTY, IOWA

SEPTEMBER 1996

ACKNOWLEDGMENT

Many individuals of the Rock Island District of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the Iowa Department of Natural Resources contributed to the development of this supplemental Post-Construction Performance Evaluation Report for the Brown's Lake Rehabilitation and Enhancement Project. These individuals are listed below:

ROCK ISLAND DISTRICT, CORPS OF ENGINEERS

PROJECT ENGINEER:	Celia C. Kool, P.E.
TECHNICAL MANAGER FOR HABITAT PROJECTS:	Darron Niles
ENVIRONMENTAL ANALYSIS:	Charlene Carmack
WATER QUALITY:	Dave Bierl
FORESTRY:	Gary Swenson
CADD SUPPORT:	Sue Brown
REPORT PREPARATION:	Nancy Holling

U.S. FISH AND WILDLIFE SERVICE

EMP COORDINATOR:	Ross Adams
REFUGE MANAGER:	Ed Britton
PROJECT INSPECTION, OPERATION, AND MAINTENANCE:	Bill Davison
SEDIMENT TRANSECTS:	Jim Rogala
WATER QUALITY DATA:	
VEGETATION TRANSECTS:	Theresa Blackburn
LTRM DATA TRANSFER:	Linda Leake

U.S. FISH AND WILDLIFE SERVICE - IOWA COOPERATIVE RESEARCH UNIT

FORESTRY/REVEGETATION:	Erwin Klass

IOWA DEPARTMENT OF NATURAL RESOURCES

SEDIMENT TRANSECTS:	Mike Griffin
FISHERIES:	John Pitlo
	Russ Gent
	Tom Boland

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT
SUPPLEMENT (PERS2D)

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

POOL 13, MISSISSIPPI RIVER MILE 545.8
JACKSON COUNTY, IOWA

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

Section **Page**

List of Tables

TABLE OF CONTENTS (Cont'd)

List of Tables (Cont'd)

List of Plates

List of Appendices

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT
SUPPLEMENT (PERS2D)

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

POOL 13, MISSISSIPPI RIVER MILE 545.8
JACKSON COUNTY, IOWA

1. INTRODUCTION

The Brown's Lake Rehabilitation and Enhancement project, hereafter referred to as "the Brown's Lake project," is an ongoing part of the Upper Mississippi River System (UMRS) Environmental Management Program (EMP). The Brown's Lake project is located within the Upper Mississippi River Wildlife and Fish Refuge.

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

(1) Supplement monitoring results and project operation and maintenance discussed in the May 1993 Post-Construction Evaluation Report;

(2) Summarize the performance of the Brown's Lake project, based on the project goals and objectives;

(3) Review the monitoring plan for possible revision;

(4) Update project operation and maintenance efforts to date; and

(5) 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 U.S Fish and Wildlife Service (USFWS), and the Iowa Department of Natural Resources (IADNR) for the period from June 1987 through February 1996.

c. Project References. Published reports which relate to the Brown's Lake project which supplement those references in the May 1993 Post-Construction Evaluation Report are presented below.

(1) *Post Construction Performance Evaluation Report (Per2F), Brown's Lake Rehabilitation and Enhancement, Pool 13, River Mile 545.8, Upper Mississippi River, Jackson County, Iowa*, May 1993 (93PER). This document was prepared to summarize all

available monitoring data, project inspections, and project observations by the Corps, the USFWS, and the IADNR for the period June 1987 to October 1992.

(2) *Brown's Lake Habitat Rehabilitation and Enhancement Project, Great Flood of 1993 Damage Assessment*, February 1994. This document was prepared to summarize the Flood of 1993 damage, proposed corrective action, and estimated cost for repairs.

(3) *Report on the revegetation of fine-grained dredged material with mast-producing tree species on the Upper Mississippi River in Jackson County, Iowa,* December 1994. This report summarizes the results of efforts to revegetate the fine-grained dredged material deposited in the containment area as a feature of the HREP project. The study was conducted for the Corps by Iowa State University researchers at the direction of the Iowa Cooperative Fish and Wildlife Unit. The objectives of the study were to determine optimal strategies for establishing mast-producing trees on fine-grained dredged material, and to establish a viable stand of mast-producing tree species at the Brown's Lake dredged material placement site.

(4) Letter from Mr. Robert Kelley, Corps, to Mr. William Hartwig, USFWS, June 19, 1995. This letter transmits the final report for the second phase of the project, revegetation of fine-grained dredged material with mast-producing tree species, and formally transfers the Brown's Lake project to the USFWS.

(5) Letter from Mr. William F. Hartwig, USFWS, to Colonel Cox, Corps, July 20, 1995, accepting the transfer of the Brown's Lake project from the Corps to the USFWS. This letter noted that revegetation of the dredged material placement site was not successful and that maintenance to ensure survival of the tree seedlings was not applicable.

(6) Letter from Mr. Robert Kelley, Corps, to Mr. William Hartwig, USFWS, August 10, 1995. This letter formally deletes the paragraph in the O&M Manual describing maintenance of the dredged material placement site.

(7) *Memorandum of Agreement between the USFWS and the Corps*, July 8, 1994, to allow the USFWS and the Corps to work together on a mutually beneficial project known as the Flood Damage Habitat Restoration Project. This project included several work orders, the first of which resulted in Plans and Specifications for the Brown's Lake Inlet Channel Excavation, River Mile 545.8, Pool 13, Upper Mississippi River System, Jackson County, Iowa, June 1995, Contract No. DACW25-95-C-0064. This document was prepared to provide sufficient detail of project features to allow clearing, stripping, and excavation of the inlet channel, and placement of the excavated material on the river bank and levee adjacent to the inlet channel by a contractor. This project was in response to flood damage caused by the Great Flood of 1993, which resulted in large sediment accumulations in the inlet channel, on the water control structure apron, and complete burial of the riprap adjacent to the water control structure.

(8) *National Biological Service, Illinois Natural History Survey, Iowa Department of Natural Resources and Wisconsin Department of Natural Resources. Long-Term Resources Monitoring Program 1993 Flood Observations.* National Biological Service, Environmental Management Technical Center (EMTC), Onalaska, Wisconsin, December 1994. (LTRMP 94-SO11). This publication is a compilation of reports of observations made during the 1993 flood on the Upper Mississippi River. It includes observations of pre- and post-flood aquatic macrophyte abundance in the Brown's Lake complex, field observations of tree mortality in Pool 13 resulting from the 1993 flood, observations of sedimentation along two transects in Brown's Lake, and water quality sampling in Brown's Lake during peak flood levels in July 1993.

(9) *Largemouth Bass Response to Habitat and Water Quality Rehabilitation in a Backwater of the Upper Mississippi River, by Russell Gent, John Pitlo, Jr., and Tom Boland. North American Journal of Fisheries Management 15:784-793,* 1995. This study was identified as reference (4) in the May 1993 Performance Evaluation Report (Per2F) under a different title.

(10) *Site Manager's Project Inspection and Monitoring Results - 6/19/95, 4/9/96.* These reports outline the results of USFWS inspections of the deflection levee, water control structures, inlet channel improvements, side channel excavation, lake dredging and the dredged material placement site.

2. PROJECT GOALS, OBJECTIVES, AND MANAGEMENT PLAN

a. General. As stated in the *93PER*, the Brown's Lake project was initiated primarily because of rapid accumulation of sediment and deterioration of water quality which resulted in significant winter kills in the lake. Although water quality within the lake was adequate to sustain native fisheries during the summer months, ice and snow cover produced periods when dissolved oxygen (DO) became depleted to the point where fish kills occurred.

b. Goals and Objectives. Goals and objectives were formulated during the project design phase and are summarized in Appendix A.

c. Management Plan. The 93PER recommended that a formal Management Plan be developed for the Brown's Lake project, as have been developed for more recently developed EMP projects, such as Potter's Marsh, Illinois (RM 522.5 - 526.0). The Management Plan was developed by the USFWS and is shown in Table 2-1. The Brown's Lake project is operated as generally outlined in the O&M Manual.

TABLE 2-1

Annual Management Plan for Brown's Lake

Time Frame	Management Action	Purpose
Winter	Open one water control structure 10 inches after ice cover.	Increase DO concentrations for overwintering fish in backwaters.
Spring	Close water control structure when turbidity levels reach 40 NTU in the main channel or 100 NTU in the Maquoketa River. All gates will be closed prior to spring runoff.	Improve water quality in important backwater habitat by decreasing suspended sediment concentrations.

3. PROJECT DESCRIPTION

a. Project Features. Plate 1 shows a general plan and vicinity map, and plate 2 shows project features.

b. Construction and Operation. Following award of the levee/dredging construction contract on July 21, 1988, dredging began during late summer and was essentially completed in September 1990. Planting for the revegetation of the dredged material containment area was completed by May 1993. Excavation of the inlet channel to remove sediment deposited as a result of the Great Flood of 1993 began in August 1995 and is scheduled for completion in September 1996. Project operation and maintenance generally consists of: (1) operating the water control structure to ensure sufficient dissolved oxygen levels throughout the Brown's Lake Complex during critical times of the year; (2) maintaining the inlet channel to ensure that it is kept free of silt and debris; (3) maintaining the water control structure gates; (4) mowing and maintaining the sediment deflection levee and related revetment; and (5) maintaining the drainage ditch system in the mast tree planting area.

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 Performance Evaluation Plan and the Resource Monitoring and Data Collection Schedule are presented on plates 3 and 4. The Corps has collected data at 8 sedimentation transects. A ninth sedimentation transect, the Smith's Creek Thalweg, has been eliminated due to difficulties in replicating the 1987 transect and its removed location from Smith's Creek. This transect has been designated as inactive on plate 3. The Corps sedimentation transect data are shown on plates 5 through 7. The sediment transects are surveyed every 5 years at various times during the year, depending on project access and workload. The Corps also has collected water quality data at six stations. Three stations are located within the dredged channel, two are off-channel, and one is in Lainsville Slough. The water quality monitoring stations are shown on plate 4. In addition, three staff gauges were installed during the summer of 1996 to assist in future monitoring efforts. Plates 3 and 4 show the staff gauge locations. 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 Brown's Lake project. The USFWS has collected data at 4 sedimentation transects, 6 water quality stations (contracted to the IADNR), and 20 aquatic vegetation transects in Upper and Lower Brown's Lakes. The three sedimentation transects are surveyed annually during the winter, through the ice. Plate 8 shows USFWS sediment transect data. Data collection and monitoring being done by the USFWS is being performed under the Long-Term Resources Monitoring (LTRM) Program (Public Law 99-662). As part of the Corps Flood of 1993 Damage Assessment, soundings (sedimentation transects) were taken by LTRM representatives at three of the USFWS Brown's Lake project dredged channel sedimentation transects. The USFWS Refuge Manager is required to conduct annual inspections of the project and participate in periodic joint inspections of the project with the Corps. As Refuge Manager, the USFWS is also in a position to make regular field observations which aid in determining the relative success or failure of the Brown's Lake project.

d. Iowa Department of Natural Resources. The IADNR has collected data at 5 sedimentation transects and 4 fish stations. The sedimentation transects are surveyed annually during the summer. Plate 9 shows IADNR sedimentation transect data. As manager of the adjacent Green Island Refuge, the IADNR is in a good position to make regular field observations of the Brown's Lake project which aid in determining the relative success or failure of the project.

5. EVALUATION OF AQUATIC HABITAT OBJECTIVES

a. *Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing* Sedimentation in Upper and Lower Brown's Lakes.

(1) Monitoring Results. Sedimentation transects are shown on plates 5 through 9. The sediment data used to determine the average annual sediment volume consists of the USFWS and IADNR sediment transects and the undisturbed areas of the Corps transects. The undisturbed areas of the Corps transects were used because no as-built information is available for comparison of the dredge cut areas. Sediment transects used to determine sediment reduction are identified in Table A-2.

As shown in Appendix A, Table A-1, the Brown's Lake deflection levee was designed to provide an annual sediment reduction of 21.6 acre-feet at year 50. The without-project expected sediment volume was determined to be 30.8 acre-feet (reference DPR A-2, 3). The annual sediment deposition, based on all sediment transect information available to date, is 19.4 acre-feet (see Table 5-1 and Appendix E, Table E-1), resulting in an actual annual sediment reduction of 11.4 acre-feet.

TABLE 5-1

Brown's Lake Sediment Reduction

Without-Project Expected Annual Sediment Volume, Acre-Feet	30.8
With-Project Average Annual Sediment Volume, Acre-Feet 1/	19.4
Actual Annual Sediment Reduction Due to Project, Acre-Feet	11.4
Designed Annual Sediment Reduction, Acre-Feet 2/	21.6

1/ Based on a weighted average annual sediment deposition rate of 0.3 in/yr
2/ Based on a design annual sediment deposition rate of 0.1 in/yr

The average annual sediment deposition rates varied among the three groups of transects, as shown in Tables 5-2 and E-1. The weighted average annual sediment deposition rate of 0.3 in/year is approximately three times the design sediment deposition rate of 0.1 in/year.

TABLE 5-2

Brown's Lake Average Annual Sediment Deposition

Transects	Years of Transect Data	Average Annual Sediment Deposition Rate, In/Year
IADNR	10	0.2
Corps	65	0.4
USFWS	5	1.0
Weighted Average		0.3
Design Annual Sediment Deposition Rate		0.1

Individual sediment transect deposition rates are shown on plate 3. The Corps and IADNR transects have the lowest annual sediment deposition rate as they utilize or occur at undisturbed areas of the project. The USFWS transects include dredged channels and have a correspondingly higher sediment deposition rate due to tendency of the dredge cuts to act as sediment traps.

The Corps transect with the highest annual sediment rate (545.8H) intersects the IADNR sediment transect with the highest annual sediment deposition rate (545.8E). These transects are the closest to the Smith's Creek outlet, the predominant watershed which directly contributes significant sediment to Upper Brown's Lake. The remaining Corps transects in Upper Brown's Lake (545.7H, 545.3H) experienced similar, lesser sediment deposition than the transect closest to Smith's Creek. The similar sediment deposition rates of the Upper Brown's USFWS transects (545.4A, 545.5A) can be compared to the closest Corps transects (545.7H, 545.3H). The Lower Brown's Lake USFWS transect (544.2A) has the highest annual sediment deposition rate. This may be due to its relatively short length (400 ft), and the inclusion of the dredge cut. Of the three Lower Brown's Lake Corps transects, two were not included in the analysis due to insufficient or questionable data (544.6H , 544.1E). The middle Lower Brown's Lake Corps transect (544.3H) experienced the lowest annual sediment deposition rate of all of the Corps transects.

Measurements of current velocity and turbidity gradients along a transect through Upper Brown's Lake and Scarborough Lake taken by EMTC during the 1993 flood (reference 11) suggest that the deflection levee appears to have been effective in mitigating high turbidity and current velocity at sites along the study transect. Current velocities along the Brown's Lake transect during the 1993 flood were strongly influenced by flooded islands with associated understory and mature tree cover.

The Corps Flood of 1993 Damage Assessment for the Brown's Lake project noted the Green Island levee, which forms the northern boundary of the Brown's Lake complex and serves as an access road to the water control structure and the sediment deflection levee, was overtopped, resulting in the loss of the crushed stone road surface from the top of the levee (Appendix C). The sediment deflection levee was also overtopped at the northern end at the water control structure. Damage to the sediment deflection levee was limited to the loss of the crushed stone road surface from the top of the levee.

The 1996 USFWS Site Manager's project inspection report noted the deflection levee was in satisfactory condition, but needed mowing and had one small hole on the top due to a burrowing animal (Appendix C). The hole will be filled.

(2) Conclusions. The sediment reduction due to construction of the deflection levee is approximately half of the design reduction in sediment volume. The majority of the Upper Brown's Lake transects exhibited a higher annual sedimentation rate than the Lower Brown's Lake transects. This would indicate that the majority of the sediment deposition in Upper Brown's Lake may be due to Smith's Creek.

Although reduced current velocities in Brown's Lake cannot be directly attributed to the diversion levee, it may exert some influence on flow dynamics, as was suggested by the presence of turbidity gradients on the Brown's Lake transect.

The Corps transects were difficult to recover, as they had not been monumented during the design phase. All of the recoverable Corps transects have been monumented for ease of future recovery, and three staff gauges will be installed during the summer of 1996 to assist in future monitoring efforts. Staff gauge locations are shown on plates 3 and 4. The next PERS will evaluate the Corps transects to include data from the dredge cuts for a better comparison with the USFWS transects. Continued monitoring will better determine long-term sedimentation rates and patterns.

b. Improve Water Quality for Upper and Lower Brown's Lakes by Decreasing Suspended Sediment Concentrations and Increasing Winter Dissolved Oxygen Concentrations.

(1) Monitoring Results. The primary water quality objectives of the Brown's Lake project are to decrease sediment input to the lake and to increase winter DO concentrations. As shown in Appendix A, Table A-1, the project was designed to keep suspended solids concentrations at or below 50 mg/l and to maintain DO concentrations at or above 5 mg/l by providing a water inflow of 350 cfs. Although no pre-project water quality data are available, it is presumed that fish kills observed during past winters were likely due to low DO concentrations in conjunction with decreasing water depths due to sedimentation. In an effort to avoid future winter kills, a water control structure was constructed in the inlet channel to Brown's Lake. The gated structure was designed to allow oxygen-rich Mississippi River water to flow into the lake during the critical winter months, while keeping sediment-laden waters from the lake the remainder of the year.

The first Brown's Lake performance evaluation report addressed the results from post-project water quality monitoring performed through early 1993. In this initial performance evaluation summary, DO concentrations during the winter months were reported to be more than sufficient to sustain aquatic life, ranging from 8.47 mg/l to 11.42 mg/l. Additionally, a study performed in 1990/1991 by the IADNR entitled *Largemouth Bass Use of Newly Dredged Canals and Response to Change in Water Quality During the Winter Period in Upper and Lower Brown's Lakes, Pool 13, Upper Mississippi River* showed that DO levels increased rapidly throughout the lake when the water control structure gates were opened. Water quality monitoring is ongoing at Brown's Lake, and the results from measurements taken during 1994 and 1995 are reported herein.

During the study period, water quality monitoring was performed year-round by the Corps at three Brown's Lake sites (W-M545.8F, W-M545.5C and W-M544.2C) and by the USFWS (contracted to the IADNR) at one site (W-M545.5B). Additional winter DO monitoring was performed by the Corps at the following three sites: W-M544.1D, W-M544.6F and W-M544.7F. Sites W-M545.8F, W-M544.2C, W-M545.5B, and W-M544.6F are located within dredged channels. Sites W-M545.5C and W-M544.7F are off-channel sites, while site W-M544.1D is located in Lainsville Slough. Site locations are identified on plate 4.

The results from water quality monitoring at all sites are found in Appendix D. Table D-1 gives the monitoring results for samples collected at site W-M545.8F. This site is located downstream of the water control structure in the inlet channel and is the site most representative of the inflow to the lake. DO concentrations here ranged from 2.58 mg/l - 18.72 mg/l. Seven DO measurements were below 5 mg/l, however, none of these occurred during the winter when the water control structure was open (see Table 5-3, Table D-1 and Figure D-1). One of the four water control structure gates was opened during the following periods to allow oxygen-rich water into the lake: December 27, 1993 - February 21, 1994 (10-inch opening) and December 16, 1994 - March 8, 1995 (8-inch opening). One gate also was opened 5 feet on four occasions during August through September 1994 in an attempt to flush out sediment which had accumulated in the vicinity of the water control structure. Most of the low DO values observed at this site were measured during the summer of 1995 (See Table 5-3). DO concentrations at sites W-M545.5C (see Table D-2 and Figure D-2) and W-M545.5B (see Table D-3 and Figure D-4) paralleled those observed at site W-M545.8F. Of particular interest is the drop in DO concentrations at all three sites following closure of the water control structure on February 21, 1994. Following ice-out, however, the DO concentrations quickly recovered. As shown in Table D-4 and Figure D-3, site W-M544.2C did not experience a drop in DO concentration following the February 21, 1994, closure. Also, the DO concentrations at this site fell below 5 mg/l on only one occasion during the summer of 1995 (4.94 mg/l on July 5, 1995 - See Table 5-3). These observations are likely due to this site's proximity to Lainsville Slough. Apparently, oxygenated Mississippi River water flowing down the slough is "backing up" the lower end of Brown's Lake and impacting water quality here. As shown in Tables D-5 through D-7, DO monitoring was performed only during the winter at sites W-M544.1D, W-M544.6F, and W-M544.7F. Except for a 4.03 mg/l DO concentration at W-M544.6F on January 24, 1995, all measurements exceeded 5 mg/l (see Table 5-3).

TABLE 5-3

DO Concentrations Below 5 mg/l

DO (mg/l)	Date	Location
4.78	3/1/94	W-M545.8F
4.75	6/20/95	W-M545.8F
4.79	7/5/95	W-M545.8F
3.96	7/18/95	W-M545.8F
2.58	8/22/95	W-M545.8F
3.63	9/5/95	W-M545.8F
3.87	9/19/95	W-M545.8F
2.89	7/31/95	W-M545.5C
3.06	9/5/95	W-M545.5C
4.12	9/19/95	W-M545.5C
4.94	7/5/95	W-M544.2C
4.03	1/24/95	W-M544.6F

Total suspended solids (TSS) samples were collected at sites W-M545.8F, W-M545.5C, and W-M544.2C. TSS concentrations were less than or equal to the 50 mg/l objective the majority of the time (see Tables D-1 through D-3). The TSS concentration exceeded 50 mg/l on six occasions, as shown in Table 5-4. Two of the exceedences occurred on days when the maximum wave height for the period was measured, while others may have been related to algal biomass, as indicated by chlorophyll a concentrations. The average TSS concentrations at sites W-M545.8F, W-M545.5C, and W-M544.2C were 24.6 mg/l, 29.2 mg/l, and 30.8 mg/l, respectively.

TABLE 5-4

Total Suspended Solids Concentrations Exceeding 50 mg/l

Suspended Solids (mg/l)	Date	Location
57.0	7/5/95	W-M545.8F
57.0	7/5/95	W-M545.5C
58.0	9/19/95	W-M545.5C
100.0	11/21/95	W-M545.5C
69.0	7/5/95	W-M544.2C
83.0	7/18/95	W-M544.2C

Desired water inflow for the Brown's Lake project was determined during the design phase by performing an oxygen balance analysis. The results of the oxygen balance analysis indicated that approximately 350 cfs of river water would be required to ensure adequate DO throughout the winter in order to prevent winter kills. Design assumptions for the water control structure included a low-flow head of approximately 0.2 foot, which would generate a velocity of 3.5 ft/s, which would require an area of about 100 square feet. Consequently, the structure was designed with four 5-foot by 5-foot box culverts. Experience to date has shown that the size of the structure is more than adequate to supply oxygenated water throughout the lake. Typically, a single gate is opened 10 inches. At a velocity of 3.5 ft/s, this would result in a flow of only 14.6 cfs through the gate. No post-construction measurements of water inflow to Brown's Lake through the water control structure have been collected; however, it is apparent from DO measurements that a single gate opening of only 10 inches allows a sufficient amount of flow through the gates to oxygenate the lake.

The 1996 USFWS Site Manager's project inspection report noted the water control structure was operating satisfactorily, and that the operating mechanisms will be greased. The report also noted that work continues on dredging the inlet channel (Appendix C).

(2) Conclusions. The Brown's Lake project continues to have a positive impact on water quality. During the critical winter months, DO concentrations have remained above the 5 mg/l objective throughout most of the lake. Only once during the 2-year study period did the DO concentration during the winter fall below 5 mg/l, and this occurred at a site located outside of the main basin of the lake. The project also has had a positive impact regarding TSS input to the lake. Only once during the study period did the TSS concentration in the inlet channel exceed the 50 mg/l objective.

To date, the Brown's Lake project has performed well in meeting its water quality objectives. Ongoing DO and TSS monitoring efforts are sufficient, and installation of a monitoring device to measure water inflow at the water control structure does not appear to be justified. Since monitoring efforts reveal oxygenated water can be provided to the Brown's Lake project by partially opening one of the four gates, the oxygen balance method used for design should reflect less conservative values. Consequently, this "lesson learned" was utilized in the design of the inlet structure at the Spring Lake, Illinois (RM 532-536) EMP project. Utilization of less conservative values for sediment oxygen demand (SOD) and biochemical oxygen demand in the Spring Lake design resulted in an optimum inflow (175 cfs), half of that determined to ensure an adequate inflow at the Brown's Lake project (350 cfs).

In addition, a potential for further improvement in water quality was seen. The low DO concentrations observed at several sites during the summer months could be alleviated by allowing Mississippi River water to enter the lake at times of relatively low flows when TSS concentrations are below 50 mg/l. This would require monitoring of TSS concentrations on the Mississippi River near the Brown's Lake inlet channel. The TSS monitoring could be performed by IADNR personnel as part of their biweekly sampling of LTRM sites. Another option would be to determine the relationship between TSS and turbidity at current LTRM sites. A regression analysis was performed in order to determine the turbidity level that corresponded to a TSS concentration of 50 mg/l for two sites: M556.4A (the closest upstream main channel site) and MQ02.1M (Maquoketa River site). The Maquoketa River site is important because it enters the Mississippi just upstream of Brown's Lake. The turbidity values corresponding to a TSS of 50 mg/l were determined to be 34 NTU and 27 NTU, respectively. Therefore, the gates to the inlet structure should only be opened during summer low DO periods if the turbidity levels at M556.4A and MQ02.1M are less than 34 NTU and 27 NTU, respectively.

c. Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths.

(1) Monitoring Results. Dredged channel sedimentation transects are shown on plates 5 through 8. As shown in Appendix A, Table A-1, the Brown's Lake dredging was designed to provide an additional 8 acre-feet of additional lake volume at year 50. The O&M Manual establishes the as-constructed lake volume at 240 acre-feet at year 0. The additional lake volume at year 6 is 169 acre-feet (see Table 5-5 and Appendix E, Table E-2). The additional lake volume was determined using the dredge cut portions of the Corps sediment transects and USFWS transects. These transects are identified in Table A-2.

As-built depth of the dredge cuts at flat pool was 9 feet. The average depth of the dredge cuts at flat pool is 7.2 feet at year 6, as shown in Table 5-5 and Appendix E, Table E-2. Annual sediment deposition used for design was 0.15"/yr (ref. DPR A-5). The dredge cuts have performed somewhat as sediment traps, however, and sediment deposition in the dredged channel averages 4.6"/year, as shown in Table 5-5 and Appendix E, Table E-2.

TABLE 5-5

Acre-Feet of Additional Lake Volume

	Design Conditions	Dredge Cuts
Acre-Feet of Additional Lake Volume Due to Project at Year 6	228	169
Average Depth of Dredge Cuts at Year 6, Ft	8.9	7.2
Sediment Deposition, in/yr	0.15	4.6

Plate 3 shows individual dredge cut sediment deposition rates. The dredge cuts in the southern part of Upper Brown's Lake experienced greater sedimentation than the dredge cuts in the northern part of Upper Brown's Lake and the access channel. This may be due to the proximity of the southern dredge cuts to Smith's Creek. Dredge cuts in the southern part of Lower Brown's Lake also experienced greater sedimentation than the dredge cuts in the northern part of Lower Brown's Lake. This may be due to floodwaters backing up into the project from Lainsville Slough. For the two Lower Brown's Lake transects which included two dredge cuts each, the riverward dredge cut experienced greater sediment deposition than the landward dredge cut. This may be due to overland flow during the Flood of 1993 or the riverward channel may be more susceptible to the backwater effects of Lainsville Slough. As noted before, the Lower Brown's Lake USFWS transect (544.2A) has the highest annual sediment deposition rate.

The Corps Flood of 1993 Damage Assessment for the Brown's Lake project stated that LTRM representatives indicated sediment accumulations of generally less than 6 inches in the dredged channels. A study of sedimentation patterns in Upper Mississippi backwaters before and during the 1993 flood (report contained in reference 11) investigated changes in bed elevation as measured along an established transect in Brown's Lake that traversed one of the dredge cuts (USFWS transect S-M 545.4A). The dredge cut had accumulated an average of 7.4" of sediment/year prior to 1993 but had only 0.5"(1.2 cm) of accumulation in 1993. This is consistent with the 1993 dredge cut area of 544.8 SF and the 1994 dredge cut area of 539.5 SF (1994 data line because USFWS sediment transects are surveyed during the winter. (For additional dredge cut area comparisons, see Appendix E, Table E-2.)

The EMTC took measurements of current velocity and turbidity gradients along a transect through Upper Brown's Lake and Scarborough Lake during the 1993 flood (reference 8). Turbidity measurements recorded on this transect during peak flows and turbidities on the Maquoketa River at its confluence with the Mississippi (just upstream of the project area) showed a marked decrease with lateral distance from the main channel. Current velocities along the Brown's Lake transect also generally declined with distance from the main channel.

Fish habitat is being monitored by observing changes in sedimentation transect depths over time, monitoring water quality, and monitoring aquatic (macrophytic) vegetation. Aquatic plant communities in backwater areas provide an important link to the productivity of Upper Mississippi River backwaters. Fisheries literature has recorded some 84 species of fish that utilize aquatic macrophytes in their life cycle, and 44 of these species utilize plants during spawning activity. Aquatic plants also provide benefits related to chemical balance, oxygen production, hydrology, and food sources.

Aquatic vegetation (submersed and floating-leafed) in backwater areas of Pool 13 is monitored by staff of the LTRMP Field Station at Bellevue, Iowa. A total of 20 transects was established in Upper and Lower Brown's Lakes (Appendix C). Transect sampling is conducted twice during the growing season (spring and summer periods). Historical datasets for the years 1991 through 1995 are available through the EMTC. Review of the monitoring data for the 1991-1995 period generally indicates an increase in submersed aquatic vegetation over time, with post-flood 1993 being an exception. A study that compared pre- and post-flood vegetation communities in Brown's Lake and two other backwater complexes in Pool 13 (reference 8) revealed that nearly all submersed aquatic macrophytes disappeared from monitored transects in Brown's Lake following the July 1993 flood. Increased water depths, turbidity, and current velocities associated with flood conditions were identified as contributing factors to plant mortality. Subsequent review of historical datasets for the 1994 and 1995 monitoring seasons appears to indicate a recovery of the aquatic plant community to levels comparable to pre-flood conditions.

Largemouth bass stock assessments of Lainsville Slough and Lower Brown's Lake, including Scarborough Lake, were conducted annually from 1984 through 1994 (high water levels during 1985 and 1986 prevented data collection during those years). Data collected during stock assessments were used to develop population estimates (Table 5-6).

TABLE 5-6

Largemouth Bass (≥ 9") Population Estimate
Lainsville Slough and Lower Brown's Lake
(including Scarborough Lake)

Year	Population Est.	95% Confidence Interval Lower	Upper
1984	1,665	1,283	3,609
1985*	-------	-------	-------
1986*	-------	-------	-------
1987	3,488	3,374	3,609
1988	1,645	1,390	2,015
1989	2,932	2,900	2,964
1990	3,465	3,293	3,655
1991	3,714	3,128	4,569
1992	1,577	932	2,848
1993	2,710	1,827	5,243
1994	5,908	5,207	6,827

* high water levels prevented data collection

(1984-1991 data contained in reference 12; 1992-1994 data obtained from IADNR files at Bellevue field station)

The 1996 USFWS Site Manager's project inspection report noted some bank erosion in the vicinity of the excavated side channel and two duck blinds which are scheduled to be removed.

(2) Conclusions. Based on the O&M Manual, the as-constructed lake volume at year 0 with project should be 230 acre-feet. Sedimentation data collected to date indicates an average annual sediment deposition in the dredged channels of 4.6"/year. Utilizing the as-constructed lake volume of 230 acre-feet at year 0 and the 4.6"/year sedimentation rate, the dredged channels would be expected to fill in about 22 years, as shown in Table 5-7 and Appendix E, Table E-4. The present depths are within the range of depths for existing side

channels (6 to 8 feet in depth). The majority of the Upper Brown's Lake dredge cuts exhibited a higher annual sedimentation rate than the Lower Brown's Lake dredge cuts, indicating the majority of the sediment deposition in Upper Brown's Lake may be due to Smith's Creek. For a comparison of transect sediment deposition versus dredge cut deposition, see Appendix E, Table E-3. Continued monitoring will better define sedimentation rates and patterns.

TABLE 5-7

Brown's Lake Dredge Cut
Average Annual Sediment Accretion [1/]

	Additional Lake Volume, Acre-Feet [1/]	
Year	**Design**	**Actual**
0	230	230
6	228	169
22	224	5
50	217	

[1/] Assumes an annual sedimentation rate
Design: S = 0.15 inches (0.01 foot)/year. Ref. DPR A-5.
Actual: S =4.6 inches (0.38 foot)/year. See Table 5-5.

Results of post-project monitoring of aquatic habitat parameters indicate that the project has been successful in restoring aquatic habitat values and fulfilling the objectives outlined in Table 2-1. Deep holes and channels created by dredging in the Brown's Lake complex have restored variable water depths that had largely disappeared from the area prior to project construction, and this has increased the diversity of habitat available to fish species that utilize this backwater complex. Local bass fishermen reported that the project has had a positive effect on fisheries resources in the area.

The presence of aquatic vegetation in Upper and Lower Brown's Lakes since project construction, and its recovery in the years following the extreme conditions that prevailed during the summer of 1993, are indicators that may suggest an increase in the availability and diversity of fish habitat. While excessive growth of aquatic vegetation may actually be detrimental to fisheries habitat value under certain conditions, there is no indication that the current (post-project) levels of submersed aquatic macrophytes have limited the recovery of fish habitat in the Brown's Lake complex. The interspersion of the dredged canals and deep holes with shallow, vegetated areas appears to provide a variety of microhabitats that could meet the requirements of numerous fish species at various life cycle stages.

d. Increase Habitat Available for Wintering Fish by Providing Deeper Water Areas.

(1) Monitoring Results. As shown in Appendix A, Table A-1, the Brown's Lake project was designed to provide 8 acre-feet of additional lake volume. The project includes 5 deep holes, 130 feet in diameter, dredged to an elevation of 566 (17 feet below Pool 13 flat pool). As built, the 5 deep holes would increase habitat available for wintering fish by 26 acre-feet. It is expected the deep holes will act as sediment traps and fill more rapidly than the dredged channel or areas undisturbed by project construction. The deep holes were surveyed in august 1996. Preliminary data indicate depths between 13-15 feet.

A study was prepared for the USFWS by the IADNR entitled *Largemouth Bass Use of Newly Dredged Canals and Response to Change in Water Quality During Winter Period in Upper and Lower Brown's Lakes, Pool 13, Upper Mississippi River.* The results of this study conducted in the winter of 1990-1991 were recently published (retitled) in the *North American Journal of Fisheries Management* (reference 12). Water quality variables inside and outside the project area, movement of radio-tagged largemouth bass in response to changing oxygen concentrations, and creel statistics were used to evaluate the success of the improvements. Turbidity was significantly less in the Brown's Lake complex than in the main channel. An increase in DO concentrations at all sampling sites in the Brown's Lake complex was measured within 7 days after opening the inlet structure. Chemical and thermal stratification in the dredged canal water column resulted from colder (32 degrees F.), highly oxygenated water from the main channel moving over denser, warmer (36-38 degrees F.) water in the dredged canals. Stratification in the dredged canals persisted until ice-out, with colder, oxygenated water in the surface stratum; warmer, but anoxic, water in the bottom stratum; and a mixture in the middle stratum.

Movements of radio-tagged largemouth bass balanced use of the dredge canals with DO concentrations, exiting the complex concurrent with oxygen declines and returning when the water control structure was opened and oxygen concentrations increased. Some radio-tagged bass moved as much as 4 miles under ice to return to the complex. Estimated angler effort and catch increased 58% and 117%, respectively, in the Lower Brown's Lake-Lainsville Slough complex following rehabilitation. A 10-fold increase in angler effort and catch was estimated for Upper Brown's Lake after the project was completed. Although angling statistics cannot be considered an absolute index of fish response, the creel surveys did provide information that was useful in assessing fish response to habitat and environmental changes produced by the project.

(2) Conclusions. Sediment deposition in the deep holes will be included for discussion in the final report.

Habitat rehabilitation in Brown's Lake was successful in creating wintering habitat for fish. The results of radio telemetry and creel studies summarized in reference 11 provide evidence that the project was successful in creating wintering habitat for largemouth bass. Oxygenation of the water column in the dredge canal system, by operation of the gated control structure, resulted in the return of radio-tagged largemouth bass to the dredged canal system. Inlet gate openings were reduced from 12 inches to 6 inches to ensure that current velocities would not be detrimental to wintering largemouth bass and other centrarchid species. Closure of the water control structure during high water also effectively protected the Brown's Lake complex from high suspended solid loads in the main channel.

The ability to introduce oxygenated water into the complex during periods of low DO concentrations is a key element in providing year-round habitat for native fisheries. The combination of increased water depths and higher DO levels has provided a viable over-wintering area for fish within Upper and Lower Brown's Lakes. Water quality variables inside and outside the project area, movement of radio-tagged largemouth bass in response to changing oxygen concentrations, and creel statistics all indicated increased use of the area following project construction.

6. EVALUATION OF WETLAND HABITAT OBJECTIVES

Increase Bottomland Hardwood Diversity by Increasing Selected Terrestrial Elevations and Reducing Frequency of Flooding for Such Hardwoods.

(1) Monitoring Results. The increased elevation of the dredged material containment area was expected to provide adequate growing conditions (in terms of water regime) for the establishment of mast-producing tree species. Planting of mast trees within and adjacent to the dredged material containment area was undertaken in two separate efforts. Both of the planting initiatives had experimental objectives in addition to the primary objective of increasing bottomland hardwood diversity in the project.

In May 1990, a 150-foot-wide strip immediately adjacent to the upstream dredge material containment levee was aerially seeded with pin oak acorns. The experimental objective of this effort was to determine the feasibility of this method of planting. Approximately 25,000 acorns were dropped by helicopter onto this 150-foot-wide strip. On May 20, 1991, a strip survey of this area was conducted by the Corps. Strips 3 feet wide and 15 feet apart were surveyed for pin oak seedlings. Based on this survey, it was estimated that 1,200 pin oak seedlings were growing on the site at that time. ISU researchers reported all of these remaining seedlings were lost due to extended inundation during 1992-1993.

The experimental objective of the ISU revegetation effort (reference 6) was to determine optimal strategies for establishing mast-producing trees on fine-grained dredged material placement sites along the Upper Mississippi River. Twelve species of mast-producing trees and shrubs, totaling 1,080 seedlings, were planted in the containment area during 1992 and 1993 (Table 6-1). Extreme wet weather and the 1993 flood hampered the effort and affected the experimental design of plot studies intended to compare species suitability and cultural treatments. All seedlings on more than half (12 of 23) of the original plots were lost due to flooding. ISU researchers determined that 4,081 seedlings were alive in October 1994.

Corps and USFWS staff visited the area in May 1996. Standing water covered much of the west dredged material containment cell. The east cell had much less standing water than the west cell. The predominant woody vegetation observed in the containment area was willow, with some cottonwood. Silver maple seedlings were common throughout the east cell, along with lesser amounts of green ash. Of the planting done by ISU researchers, the only surviving trees observed were in the southeast quarter of the cell and the ridge that extends toward the middle of the cross dike separating the cells. Bur oak, red oak, cottonwood, *Populus spp.*, red-osier dogwood, sycamore, eastern red cedar, and black walnut trees were observed growing in this portion of the containment area.

Table 6-1: Species used in various studies on the Brown's Lake revegetation project listing wildlife food value, tolerance to flooding, tolerance to shade and tolerance to clay (heavy) soils.

Species	Type of Plot[a]			Food[b]	Tolerance to		
	Suit.	Cult.	Oak	Value	Flooding	Shade	Clay
American Sycamore (*Platanus occidentalis*)	X			low	high[d]	low[c]	high [d]
Black Cherry (*Prunus serotina*)	X			high	low[f]	mod.[d]	mod. [f]
N. Red Oak (*Quercus borealis maxima*)	X	X	X	high	mod.[e]	mod.[c]	mod. [g]
Wild Plum (*Prunus americana*)	X			med.	mod.[d]	mod.[d]	mod. [f]
Bur Oak (*Quercus macrocarpa*)	X		X	high	high[e]	mod.[d]	high [g]
Black Walnut (*Juglans nigra*)	X	X		high	low[d]	mod.[d]	mod. [d]
Shagbark Hickory (*Carya ovata*)	X			high	low[d]	high[c]	low [h]
Serviceberry (*Amelanchier alnifolia*)	X			high	mod.[e]	mod.[e]	NA
N. Pin Oak (*Quercus ellipsoidalis*)	X			high	high[c]	low[c]	high [g]
N. Pecan (*Carya Illinoensis*)	X			high	low[d]	high[c]	mod. [e]
White Oak (*Quercus alba*)			X	high	low[d]	mod.[d]	mod. [e]
Swamp White Oak (*Quercus bicolor*)			X	high	high[d]	mod.[d]	high [g]
Red-Osier Dogwood (*Cornus alternifolia*)		X		high	high[e]	low[d]	high [e]
Hybrid Poplar (*Populus sp.*)		X		low	high	low[d]	high [e]

a= Suit.=species suitability study, Cult.=cultural treatment study, Oak=oak vs. oak study
b= food value for wildlife- (Source: Martin, 1951)
c= (Source: Barret, 1980)
d= (Source: Preston, 1980)
e= (Source: Sykes, 1993)
f= (Source: USDA Forest Service, 1971)
g= (Source: Ware, 1983)
h= (U.S.D.A. Forest Service, 1985)

Source: Reference (6)

(2) Conclusions. The technique of aerial pin oak seeding immediately adjacent to the upstream containment levee was somewhat successful. Approximately 5 percent of the acorns dropped produced seedlings after the first year. These seedlings have since died from extended inundation in 1992-1993, however, this seeding effort was undertaken as an adjunct to, rather than a component of, the containment area replanting.

While creation of the dredged material containment area did succeed in raising the elevation of the placement site, much of this area remains too poorly drained to be suitable for regeneration of mast-producing tree species. Mast trees planted as part of the ISU revegetation study are growing on sites in the containment area that are relatively higher in elevation and better drained than the surrounding ground. This mast tree component currently occupies only a small percentage of the replanted area. Persistent poor drainage in much of the containment area limits the likelihood that further active mast tree revegetation efforts would be successful. Natural revegetation of the area by wet-soil adapted tree species such as willow and cottonwood appears to be underway. Over time, further consolidation of the dredged material may provide more favorable conditions for mast tree production. Although some mortality of the mast trees currently established on the site will continue to occur, those that survive to maturity could provide a future seed source for natural mast tree regeneration in the long term.

7. OPERATION AND MAINTENANCE SUMMARY

a. Operation. Project operations are detailed in the O&M Manual and generally consist of: (1) inspecting the sediment deflection levee during flood periods; (2) closing the water control structure during high water periods; (3) opening the water control structure during periods of low DO conditions in Brown's Lake; and (4) inspecting the inlet channel and side channel following each flood event for removal of flood carried debris, repair of sloughing banks, etc.

The project has been operated successfully in this manner since its completion in the fall of 1989. As described in the Annual Management Plan (Table 2-2), one gate of the water control structure should be opened approximately 10 inches after ice cover of Brown's Lake. This will allow water to thermally stratify under the ice before the colder main channel water enters the system later in the winter. This stratification is beneficial as it allows fish to select optimal zones of oxygen, temperature, and current by moving 4 to 6 feet vertically in the water column.

b. Maintenance.

(1) Inspections. Inspections of the Brown's Lake project are to be made by the USFWS Savanna District Manager of the Upper Mississippi River National Wildlife and Fish Refuge (Site Manager) at least annually and will follow inspection guidance presented in the O&M Manual. A copy of the completed project inspection checklist should be furnished to the Corps, attention OD-S. Other project inspections should occur as necessary after high water events or as scheduled by the Site Manager. Joint inspections of the Brown's Lake project are to be conducted periodically by the USFWS and the Corps. These inspections are necessary to determine maintenance needs. The Site Manager's project inspection and monitoring results for 1995 and 1996 can be found at Appendix C.

(2) Maintenance Based on Inspections. In 1995, herbicide treatment was applied to vegetation on the deflection levee road, and the gate mechanism of the water control structure was greased and inspected. The USFWS will detail 1996 maintenance efforts for the final report.

8. CONCLUSIONS AND RECOMMENDATIONS

a. *Project Goals, Objectives, and Management Plan.* Based on data and observations collected since project completion, it appears that the stated goals and objectives are being met, increasing bottomland hardwood diversity excepted. Continued data collection will better define the degree of sedimentation rate reduction, water quality improvement, fish habitat and diversity improvement, and mast tree survival.

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 2001 following collection of data for the second 5-year interval. A Performance Evaluation Supplement will be prepared annually.

(1) Post-Construction Evaluation.

(a) Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper And Lower Brown's Lakes. The annual sediment reduction due to the sediment deflection levee of 11.4 acre-feet is approximately half of the design reduction in sediment volume.

(b) Improve Water Quality for Upper and Lower Brown's Lake by Decreasing Suspended Sediment Concentrations and Increasing Winter Dissolved Oxygen Concentrations. To date, the Brown's Lake project has performed well in meeting its water quality objectives. Upon review of the data, a potential for further improvement in water quality was seen. The low DO concentrations observed at several sites during the summer months could be alleviated by allowing Mississippi River water to enter the lake at times of relatively low flows when TSS concentrations are below 50 mg/l. This would require monitoring of TSS concentrations on the Mississippi River near the Brown's Lake inlet channel. The TSS monitoring could be performed by IADNR personnel as part of their biweekly sampling of LTRM sites. Another option would be to determine the relationship between TSS and turbidity at current LTRM sites. A regression analysis was performed in order to determine the turbidity level that corresponded to a TSS concentration of 50 mg/l for two sites: M556.4A (the closest upstream main channel site) and MQ02.1M (Maquoketa River site). The Maquoketa River site is important because it enters the Mississippi just upstream of Brown's Lake. The turbidity values corresponding to a TSS of 50 mg/l were determined to be 34 NTU and 27 NTU, respectively. Therefore, the gates to the inlet structure should only be opened during summer low DO periods if the turbidity levels at M556.4A and MQ02.1M are less than 34 NTU and 27 NTU, respectively.

This objective also included measurement of cubic feet per second of desired water inflow based on the oxygen balance method used during the design phase. Since the water control structure is not operated to its full capacity, the year 50 target with alternative flow of 350 cfs is excessive. A monitoring device to collect data would cost approximately $10,000.

The positive impacts of the Brown's Lake project on water quality has been documented through measurement of DO and suspended solids. Consequently, measurement of cubic feet per second of desired water inflow will be deleted from the Post-Construction Evaluation Plan.

(c) Increase Fish Habitat in Upper and Lower Brown's Lakes. Of the 20 historic LTRM aquatic vegetation transects in Upper and Lower Brown's Lakes, 15 of these transects will continue to be sampled by LTRM Bellevue Field Station personnel twice yearly during the growing season.

(d) Increase Fish Diversity by Providing Varied Water Depths. Based on sedimentation data collected to date, the average annual sediment deposition in the dredged channels approaches 5"/yr. Utilizing this sedimentation rate and the as-built additional lake volume of 230 acre-feet, the dredged channels would be expected to fill in about 22 years. Although the present depths are within the range of depths for existing side channels (6 to 8 feet in depth), it appears a 50-year life for dredged channels may not achievable. Continued monitoring will better define sedimentation rates and patterns and the expected life of dredged channels in backwater areas.

(e) Increase Habitat Available for Wintering Fish by Providing Deeper Water Areas. Deep hole data analysis will be discussed in the final report.

(f) Increase Bottomland Hardwood Diversity by Increasing Selected Terrestrial Elevations and Reducing Frequency of Flooding for Such Hardwoods. The Corps vegetation transect V-M545.8H will not be included in future monitoring efforts. The persistence of standing water in the west cell of the containment area is expected to prevent regeneration of trees along this transect for the foreseeable future. The 1996 field observations along transect V-M545.3H revealed little presence of woody vegetation, with horsetail (*Equisetum spp.*) being the dominant species. As noted in Section 6a(1), some mast trees survive in the ISU study plots located in the southeast quarter of the containment area. Regeneration of bottomland hardwoods in the dredged material containment area will be monitored at 5-year intervals. The 50-year target with alternative of 35 acres of mast trees will be deleted.

(2) Resource Monitoring and Data Collection Schedules. The monitoring schedule will be revised to include deep hole monitoring at a 5-year interval. Coordinates for the deep holes will be obtained for ease of recovery for continued post-construction monitoring.

c. Project Operation and Maintenance. Project operation and maintenance has been conducted in accordance with the O&M Manual. Annual site inspections by the Refuge Manager have resulted in proper corrective maintenance actions.

d. Project Design Enhancement. Discussions with USFWS and Corps personnel involved with operation, maintenance, and monitoring activities at the Brown's Lake project have resulted in the following general conclusions regarding project features which may affect future project design:

(1) Dredged Channels. In general, the dredged channels appear to be filling at a faster rate than the undisturbed areas. A 50-year design life for dredge cuts may not be an achievable goal. Continued monitoring will better define life expectancies for dredged channels.

(2) Water Control Structure. During the 1993 performance evaluation review, it was recognized that the water control structure has more flow capacity than that required to re-oxygenate Brown's Lake. Oxygenated water can be provided to the Brown's Lake project by partially opening one of the four gates, which suggests the oxygen balance method used for design should utilize less conservative values. Consequently, this "lesson learned" was utilized in the design of the inlet structure at the Spring Lake, Illinois (RM 532-536) EMP project. Utilization of less conservative values for sediment oxygen demand (SOD) and biochemical oxygen demand resulted in an optimum inflow (175 cfs) half of that determined to ensure an adequate inflow at the Brown's Lake project (350 cfs), while oxygenating a greater area (720 acres at Spring Lake vs. 375 acres at Brown's Lake). As a result, the Spring Lake project water control structure has two 5-foot-wide gates.

(3) Entrance Channel. During initial project construction, the entrance channel into the Brown's Lake complex was re-oriented to reduce debris and sediment accumulation problems. Prior to the Great Flood of 1993, debris was still drifting into the entrance channel, requiring removal at least once per year, and sediment had deposited at the mouth of the entrance channel. During the Great Flood of 1993, the water control structure was inundated and overtopped, and large accumulations of sediment were deposited in the channel, completely burying the riprap located adjacent to the water control structure. The contract to remove sediment deposited as a result of the Great Flood of 1993 is completed; however, in order to keep the entrance channel open, periodic removal of accumulated sediment will be required. Operation of the water control structure to provide oxygenated water during the winter months has not been affected by the sediment accumulation in the inlet channel.

(4) Dredged Material Placement Site. An attempt was made to revegetate the dredged material placement site with mast-producing trees. The process of reforestation was severely hindered due to the lack of drainage in the dredged material placement site, which contributed to the minimal survival of the mast-producing trees. This problem was alleviated somewhat by construction of a relatively deep ditch through the site. Future projects which consider dredged material placement sites for reforestation should include remedial working of the material and/or a drainage system for the placement site, based on characteristics of the final in-place dredged materials, or consider alternative approaches such as planting the site with wet-soil adapted species, such as silver maple and cottonwood, to assist in dehydration and consolidation of the site prior to planting with mast trees (reference 6).

APPENDIX A

POST-CONSTRUCTION EVALUATION PLAN

TABLE A-1

Brown's Lake Rehabilitation and Enhancement Project
Post-Construction Evaluation Plan [1/]

Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 With Alternative (As-Built)	Year 6 With Alternative	Year 50 Target With Alternative [2/]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Aquatic Habitat	Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes.	Basic development	Deflection levee	ac-ft of annual sediment reduction	0			20	Evaluate data per Note[5/]. Perform hydrographic soundings of transects	Observe by pole soundings or depth gauges.
	Improve Water Quality for Upper and Lower Brown's Lakes by Decreasing Suspended Sediment Concentrations and Increasing Winter DO Concentrations.	Basic development	Water control structure and inlet channel improvement	mg/l suspended solids	300		≤ 50	50	Evaluate Water Quality per Note [3/]	Observe water clarity differences between blocked river flows and lake water
				mg/l DO	≤5	≥ 5	≥ 5	5	Evaluate Water Quality per Note [3/]	Observe effects of low DO (fish kills)
				~~cubic feet (cfs) of desired water inflow~~				~~350~~		~~Observe effects of opening and closing gates~~

TABLE A-1 (Continued)

Brown's Lake Rehabilitation and Enhancement Project
Post-Construction Evaluation Plan [1/]

Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 With Alternative (As-Built)	Year 6 With Alternative	Year 50 Target With Alternative [2/]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Aquatic Habitat (Continued)	Increase fish habitat in Upper and Lower Brown's Lakes and increase fish diversity by providing varied water depths	Basic development	Dredging	ac-ft of additional lake volume	0	230		~~8~~ TBD	Evaluate data per Note [5/]	Observe/record fish changes and observe by pole soundings or depth gauges sedimentation in excavated channel
	Increase habitat available for wintering fish by providing deeper areas			number of deep holes (D>6')	0	5	TBD summer 1996	5	Evaluate data per Note [5/]	
Enhance Wetland Habitat	Increase bottomland hardwood diversity by increasing selected terrestrial elevations and reducing frequency of flooding for such hardwoods.	Basic development	Mast tree plantings on dredged material placement site	acres of mast trees	0			~~35~~	Evaluate data per Note [7/]	Observe/record planted mast survivability

TABLE A-1 (Cont'd)

Brown's Lake Rehabilitation and Enhancement Project

1/ See plate 3 of this report for active monitoring sites.

2/ Year 50 Target with Alternative are shown as underlined for revised targets and strike outs if deleted from the monitoring program.

3/ Corps/USFWS/LTRM Water Quality Stations	Remarks
W-M545.8 F	Corps site
W-M545.5 B	USFWS/LTRM site
W-M545.5 C	Corps site
W-M544.7 F	Corps winter only site
W-M544.6 F	Corps winter only site
W-M544.1 D	Corps winter only site
W-M544.2 C	Corps site
Corps Suspended Sediment Station	
W-M546.0A	Smith's Creek

4/ IADNR Fish Stations
F-M545.5 C
F-M545.4 B
F-M545.1 J
F-M544.3 C

5/ Sedimentation Transects (See Table A-2)

6/ USFWS/LTRM Vegetation Transect	
V-M545.0 B	Discontinued

7/ COE Vegetation Transects	
V-M545.8 H	Discontinued
V-M545.5 H	

TABLE A-2

Brown's Lake Rehabilitation and Enhancement Project
Sedimentation Transect Project Objectives Evaluation

Transect	Project Objectives to Be Evaluated		
	Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes	**Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths [3/]**	**Increase Habitat Available for Wintering Fish by Providing Deeper Areas [3/]**
Corps			
S-M545.8H (Upper Brown's Lake)	X		
S-M545.7H (Upper Brown's Lake)	X [1/]	X	
S-M545.3H (Upper Brown's Lake)	X [1/]	X	
S-M544.6H (Lower Brown's Lake)	[2/]	X	
S-M544.3H (Lower Brown's Lake)	X [1/]	X	
S-M544.1E (Lower Brown's Lake)	[2/]	X	
S-M545.9H (Access Channel)		[2/]	
S-M546.3H (Inlet Channel)		X	
USFWS			
S-M545.5A (Upper Brown's Lake)	X	X	
S-M545.4 A (Upper Brown's Lake)	X	X	
S-M544.2A (Lower Brown's Lake)	X	X	
S-M544.1D (Lainsville Slough)			
IADNR			
S-M545.8E (Upper Brown's Lake)	X		
S-M545.6B (Upper Brown's Lake)	X		
S-M544.9E (Lower Brown's Lake)	X		
S-M 545.0C (Upper Brown's Lake)	[2/]		
Deep Holes			
To be included in final report			X

[1/] Does not include dredge cut.
[2/] Insufficient or questionable data.
[3/] Dredged channel only.
[4/] Because the area of the dredge cut in Corps transect S-M 545.7H was so much greater than the remaining transects (due to a wider bottom width), it was not used to determine the acre-feet of additional lake volume.

APPENDIX B

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

TABLE B-1

Brown's Lake Rehabilitation & Enhancement Project
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 Resources Monitoring Program is a component of the UMRS-EMP.
2/ Habitat Rehabilitation and Enhancement Projects

TABLE B-2

Brown's Lake Rehabilitation & Enhancement Project
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[1/, 2/, 3/]													Corps/USFWS/ LTRM	
Turbidity						*								
Secchi Disk Transparency						*								
Suspended Solids					*	*								Corps only
Dissolved Oxygen					*	*								
Specific Conductance					*	*								
Water Temperature					*	*								
pH					*	*								
Total Alkalinity					2W	M								
Chlorophyll					*	*								Corps only
Velocity					*	*								
Water Depth					*	*								
Percent Ice Cover						*								USFWS/ LTRM only
Ice Depth						*								
Percent Snow Cover						*								USFWS/ LTRM only
Snow Depth						*								
Substrate Hardness					*	*								USFWS/ LTRM only
Wind Direction					*	*								Corps only
Wind Velocity					*	*								Corps only
Wave Height					*	*								Corps only
Air Temperature					2W	M								
Percent Cloud Cover					2W	M								

TABLE B-2 (Continued)

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
<u>POINT MEASUREMENTS</u> (Cont'd)														
Sediment Test Stations [3/]													Corps	
Suspended Solids				1		D								
Water Depth						D								
Discharge Measurement						D								
Boring Stations													Corps	
Geotechnical Borings - See Construction Drawings								1						
Fish Stations [4/]														
Creel Survey										1	1	6M	IADNR	
Electrofish/netting										1	1	4M		
Radio telemetry										-	1	Y		
<u>TRANSECT MEASUREMENTS</u>														
Sedimentation Transects [5/, 6/, 7/]													Corps	
Hydrographic Soundings							1		**				Corps/USFWS/ LTRM/IADNR	
Vegetation Transects [8/ 9/]													Corps	
Mast Tree Survey												5Y	Corps	

TABLE B-2 (Continued)

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
<u>AREA MEASUREMENTS</u>														
Mapping [10/]														
Aerial Photography										1		5Y	Corps	

<u>**Legend**</u>

* = Sampling performed every other week at the USFWS/LTRM site. At the Corps sites, sampling was performed monthly from October through March, and every other week from April through September.

** = Every 5 years by the Corps, annually by USFWS/LTRM and IADNR

D = Daily

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 (Continued)

Brown's Lake Rehabilitation and Enhancement Project

1/ See plate 3 of this report for locations of post-construction phase sampling points, transects, and area measurements. See DPR for locations of design phase sampling locations.

2/ Corps/USFWS/LTRM Water Quality Stations	Remarks
W-M545.8 F	Corps site
W-M545.5 B	USFWS/LTRM site
W-M545.5 C	Corps site
W-M544.7 F	Corps winter only site
W-M544.6 F	Corps winter only site
W-M544.1 D	Corps winter only site
W-M544.2 C	Corps site
3/ Corps Suspended Sediment Station	
W-M546.0A	Smith's Creek
4/ IADNR Fish Stations	
F-M545.5 C	
F-M545.4 B	
F-M545.1 J	
F-M544.3 C	
5/ USFWS/LTRM Sedimentation Transects	
S-M544.2 A	DPR Transect E
S-M545.5 A	DPR Transect B
S-M545.4 A	
S-M544.1 D	
6/ IADNR Sedimentation Transects	
S-M545.2 I	IADNR Number 11 - Discontinued
S-M544.9 E	IADNR Number 9
S-M545.0 C	IADNR Number 1
S-M545.6 B	IADNR Number 10
S-M545.8 E	IADNR Number 6
7/ COE Sedimentation Transects	
S-M545.8 H	DPR Monitoring Range A
S-M545.7 H	DPR Monitoring Range B
S-M545.3 H	DPR Monitoring Range C
S-M544.3 H	DPR Monitoring Range D
S-M544.1 D	DPR Monitoring Range E
S-M545.9 H	DPR Monitoring Range H
S-M546.3 H	DPR Monitoring Range I
S-M544.6 H	DPR Monitoring Range N
S-M545.6 B	DPR Monitoring Range F (Smith's Creek Thalweg) - Discontinued
8/ USFWS/LTRM Vegetation Transect	
V-M545.0 B	
9/ COE Vegetation Transects	
V-M545.8 H	DPR Transect K
V-M545.5 H	DPR Transect L

10/ Mapping

September 2, 1989, Color Aerial Photography
July 12, 1993, Color Aerial Photography
November 20, 1995, Black and White Aerial Photography

APPENDIX C

COOPERATING AGENCY CORRESPONDENCE

CENCR-ED 8 March 1994

Brown's Lake
Habitat Rehabilitation and Enhancement Project
Great Flood of 93 Damage Assessment

1. **Sponsor.** The sponsor for this project is the U.S. Fish and Wildlife Service.

2. **Damage Description.** The following summarizes the extent of damage to project features of the Brown's Lake Project. All construction contracts are complete and have been closed out on the Brown's Lake Project. A separate re-vegetation contract with Iowa State University is still underway. However, this is the last year for this re-vegetation contract.

a. **Levees.** Levees were overtopped. The Green Island Levee, which forms the Northern boundary of the Brown's Lake Complex and serves as an access road to the water control structure and sediment deflection levee, was overtopped resulting in loss of the crushed stone road surface from the top of this levee. The sediment deflection levee was overtopped on the Northern end at the water control structure. This resulted in loss of crushed stone road surfacing in this overtopping reach. No other levee damage has been observed.

b. **Water control structures.** The water control structure was inundated and overtopped. No structural damage is apparent. Large sediment accumulations exist in the river access channel, on the inlet structure apron and in the water control structure pipes. The riprap adjacent to the water control structure is completely buried in sediment. The degree of sedimentation in the river access channel, on the inlet structure apron and in the water control structure pipes will be investigated as weather permits. Sediment removal will be the maintenance responsibility of the U.S. Fish and Wildlife Service. One water control structure gate has been successfully opened to allow oxygenated water to enter the Brown's Lake Complex.

c. **Dredged channels.** Soundings have been taken by LTRM at transect locations S-M545.5A, S-M545.4C and S-M 544.2C to determine the extent of sedimentation in the dredged channels within the Brown's Lake Complex. The location of these transects are shown on plate 1. At this point in time the Rock Island District has not received this information from LTRM. However, conversations with LTRM representatives indicate that no major accumulations of sediment occurred in the dredged channels, generally less than 6 inches.

d. **Tree plantings.** Mast production trees were planted in the two dredged material containment cells as part of the Habitat Restoration and Enhancement Project. These tree planting areas were inundated during the flood. The mast trees planted in the upstream dredged material containment cell have died as a result of prolonged inundation. These trees represent approximately 1/3 of the total mast trees planted at the Brown's Lake site. Because of the long-standing problem of getting mast production trees established in this upstream cell, no plans are being made to re-plant this cell. This decision is fully supported by the Sponsor.

3. **<u>Corrective Actions.</u>** The following is a description of actions to repair flood related damages at the Brown's Lake site.

a. **Levees.** The crushed stone surfacing on the Green Island Levee will be replaced by the Iowa DNR as part of their cost share for PL 84-99 levee repairs performed by the Corps of Engineers on the Green Island Levee. The crushed stone surfacing on the sediment deflection levee will be replaced by the U.S. Fish and Wildlife Service as part of normal maintenance.

b. **Water Control Structure** Sediment removal from the river access channel, water control structure apron and pipes will be accomplished by the U.S. Fish and Wildlife Service as part of normal operation and maintenance of the project.

4. **<u>Cost Estimate.</u>** No cost estimate has been made for the repairs listed above since they are considered part of normal operation and maintenance of the Brown's Lake Complex.

U.S. Department of the Interior
National Biological Survey
Iowa Cooperative Fish and Wildlife Research Unit
11 Science II, Iowa State University, Ames 50011
PH 515-294-3056 FAX 515-294-5468 INTERNET eklaas@iastate.edu CC:MAIL R8CUIA

MEMORANDUM

December 28, 1994

To: Michael Cockerill
Chief, Environmental Analysis Branch
Rock Island District
U.S. Army, Corps of Engineers
Clock Tower Building - P. O. Box 2004
Rock Island, IL 61204-2004

From: Erwin E. Klaas (Phone 515-294-3056)
Leader, Iowa Cooperative Fish & Wildlife Research Unit

Subject: Final report

I am pleased to send you this final report on revegetation of fine-grained dredge material at Brown's Lake, Iowa.

The report is organized in four chapters: Chapter 1 is a general introduction that states the project objectives and describes the site in some detail. Chapter 2 is a brief literature review of consolidation and revegetation of dredged material deposits. Chapter 3 is prepared as a manuscript for publication on the experimental aspects of the study. Chapter 4 is a statement of the general conclusions of the project and some recommendations for future work.

Extremely wet weather and the Great Flood of 1993 hampered the project and affected the experimental design of the studies intended to compare species suitability and cultural treatments. All seedlings on more than half (12 of 23) of the original plots were lost to flooding. Flooding occurred on all plots but, surprisingly, seedlings of many species survived on 11 plots that were slightly higher in elevation. Higher elevations occurred near the dredge pipe outlet on the eastern end of the larger cell. Most of the seedlings that appeared dead in the fall of 1993 resprouted new stems from the root crown in 1994. A total of 11,080 seedlings were planted on the site and 4,081 were alive in October, 1994.

Wet weather and flooding caused the site to become completely resaturated after having dried out well enough by the summer of 1991 to drive vehicles and tractors everywhere except a few low spots. The site was still too wet to support a vehicle in October 1994. Under more "normal" conditions I believe that a much larger percentage of trees would have survived. It is also possible that treatment effects would have been more evident in the experiments that were conducted.

Prairie voles (*Microtus pennsylvanicus*) were abundant on the site during the fall and winter of 1993-94 and caused a great deal of damage to seedlings. The voles girdled the stems by chewing off the bark. Many of the rodent damaged seedlings resprouted secondary stems during the 1994 growing season.

Based on our experience at Brown's Lake, I suggest that you reconsider your objectives for planting hardwood mast trees on fine-grained dredge material. As the dredged material began to dry out at the Brown's Lake site, conditions were ideal for the regeneration of tree species common in the surrounding floodplain forest. The moist soil provided an ideal substrate for floodplain adapted species such as silver maple, cottonwood, and willow for which there was an abundant supply of seed. I agree that it is highly desireable to increase species diversity in the floodplain forest and provide more mast producing trees that would benefit a greater variety of wildlife. However, reestablishment of hardwoods can probably be done more efficiently and less expensively on other areas of the floodplain, such as on abandoned cropland.

An alternative approach might be to plant hardwood trees after the site is revegetated with wet-soil adapted species. The trees would assist in the dehydration of the site through transpiration of water and the root systems would help to consolidate the material and provide structure to the soil. After 5 to 10 years the pioneering saplings could be cut and sold for pulp or energy producing biomass. Then the site might be more suitable for planting the desired hardwood species.

In summary, despite all of the unanticipated problems that we encountered on this project, we did succeed in establishing a reasonable number of hardwood trees on the site. Although some mortality will continue to occur, there should be enough trees to provide a seed source for the area in later years. We also learned that fine-grained dredge material presents special problems and that management of these sites, at least in the early years after construction, can be quite difficult.

Distribution:

Dave Hansen
Richard Hall
Richard Schultz
Gary Swenson
Bob Sheets
Randy Robinson
Larry Wargowsky
Kevin Porteck
John Duybejonck
Eric Nelson
Joe Jordan

OPERATION AND MAINTENANCE MANUAL

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM

POOL 13, RIVER MILE 545.8

JACKSON COUNTY, IOWA

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by William B. Davison Date 6-19-95

Type of Inspection (Annual) (Emergency) (other)

1. PROJECT INSPECTION (DEFICIENCIES REQUIRE CORRECTION)

Item	Comment
a. Deflection Levee.	
(✓) Settlement, sloughs, or loss of section. ok	
(✓) Seepage, saturated areas, sand boils. ok	
(✓) Wavewash, scouring. ok	
(✓) Overtopping erosion ok	
(✓) Vegetative cover. – ok mowed top and sides	Vegetation on load-top sprayed with Round-up®.
(✓) Displaced/missing riprap. – ok	
(✓) Burrowing animals. – ok	
(✓) Unauthorized grazing or traffic. – ok	
(✓) Encroachments. ok	
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms. ok	Gate mechanism was greased and inspected.
( ) Concrete. ok	
( ) Displaced/missing riprap ok	
( ) Blockage of inlet and outlet channels. ok	
( ) Erosion adjacent to structure. ok	
c. Inlet Channel Improvement.	
(✓) Debris. ok	
(✓) Waste materials/unauthorized structures. ok	
(✓) Bank Erosion ok	

– work pending through COE to dredge out inlet channel due to siltation from Flood 1993.

6-19-95

d. Side Channel Excavation.

(✓) Debris. ok
(✓) Waste materials/unauthorized structures. ok
(✓) Bank erosion. ok

e. Lake Dredging.

(✓) Debris/waste materials.

f. Dredged Material Placement Site.

(✓) Mowings, herbicide.

2. PROJECT MONITORING (OBSERVATIONS AID PROJECT EVALUATION). LTRM Bellevue Iowa Monitors water quality etc. Russ Gent (319) 872-5495

a. Deflection Levee.

(✓) Sedimentation in excavated channels.

b. Water Control Structure.

UNK {
( ) Water clarity.
( ) Dissolved oxygen.
( ) Fish effects from gate operation.

c. Dredging.

( ) Fish population/species changes.
( ) Sedimentation in lake excavated areas.
( ) Sedimentation/scouring changes in Lainsville Slough.

d. Dredged Material Placement Site.

( ) Mast tree survivability.

Ed Britton
Site Manager

OPERATION AND MAINTENANCE MANUAL

BROWN'S LAKE REHABILITATION AND ENHANCEMENT

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM

POOL 13, RIVER MILE 545.8

JACKSON COUNTY, IOWA

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by William B. Davison Date 4-9-96

Type of Inspection (Annual) (Emergency) (other)

1. PROJECT INSPECTION (DEFICIENCIES REQUIRE CORRECTION).

Item — Comment

a. Deflection Levee.

(✓) Settlement, sloughs, or loss of section.
(✓) Seepage, saturated areas, sand boils.
(✓) Wavewash, scouring.
(✓) Overtopping erosion.
(✓) Vegetative cover. – needs mowing
(✓) Displaced/missing riprap.
(✓) Burrowing animals. 1 small hole noticed on Dike top (will fill)
(✓) Unauthorized grazing or traffic.
(✓) Encroachments.

b. Water Control Structure.

(✓) Pipes, gates, and operating mechanisms. – will grease
(✓) Concrete.
(✓) Displaced/missing riprap.
(✓) Blockage of inlet and outlet channels.
(✓) Erosion adjacent to structure.

c. Inlet Channel Improvement.

(✓) Debris.
(✓) Waste materials/unauthorized structures.
(✓) Bank Erosion.

Work continues on dredging.

4-9-96

d. Side Channel Excavation.

(✓) Debris.
(✓) Waste materials/unauthorized structures. – 2 duck Blinds to remove
(✓) Bank erosion. – some erosion

e. Lake Dredging.

(✓) Debris/waste materials.

f. Dredged Material Placement Site.

(✓) Mowings, herbicide.

2. PROJECT MONITORING (OBSERVATIONS AID PROJECT EVALUATION). LTRM Bellevue, IA monitors Water Quality etc.
Russ Gent
(319) 872-5495

a. Deflection Levee.

( ) Sedimentation in excavated channels.

b. Water Control Structure.

( ) Water clarity.
( ) Dissolved oxygen.
( ) Fish effects from gate operation.

c. Dredging.

( ) Fish population/species changes.
( ) Sedimentation in lake excavated areas.
( ) Sedimentation/scouring changes in Lainsville Slough.

d. Dredged Material Placement Site.

( ) Mast tree survivability.

Ed Britton
Site Manager

CENCR-OD-MN 17 June 1996

MEMORANDUM FOR RECORD

SUBJECT: Brown's Lake EMP-HREP Tree Planting

1. Gary Swenson (OD-MN), Charlene Carmack (PD-E), and Linda Miller (USFWS-Savanna) visited the tree planting area of the Brown's Lake EMP-HREP on 20 May 1996.

2. There was standing water in much of the smaller dredged material containment cell. Willow is becoming established as the dominant woody cover in this cell.

3. The larger cell had much less standing water than the smaller cell. The predominant woody vegetation is willow, with some cottonwood. Silver maple seedlings are common throughout the cell, along with lesser amounts of green ash. Of the planting done by Iowa State University researcher Dave Hansen, it appears that the only surviving trees are in the southeast quarter of the cell and the ridge that extends towards the middle of the cross dike separating the cells. Bur oak, red oak, cottonwood (and Populus spp.), red-osier dogwood, sycamore, eastern redcedar, and black walnut trees are growing. Most of the walnut were in poorer condition than the other trees. Survival percentage was not measured, but based on ocular estimates probably has not dropped too much from the 37% reported by Hansen.

4. I read through the DPR for Brown's Lake Rehabilitation and Enhancement (November, 1987), Hansen's final report on revegetation of fine-grained dredge material (December, 1994), and the Brown's Lake Post Construction Performance Evaluation Report (May, 1993). Most of the discussion in the DPR and the EA with regard to revegetation is about mast tree establishment on the dredged material disposal site. I read it to mean that the entire disposal site will be planted to mast trees once the material has settled (consolidated). Current site conditions are not what I interpret to have been envisioned in the DPR.

5. Mast trees are growing on the suitable sites available within the dredge material disposal area that were planted. Additional sites would be suitable for mast trees if the containment cells had better drainage. Naturally occurring locations with a significant mast tree presence are best characterized as subtle ridges, i.e. a slight rise (two feet or more) above adjacent flat ground. The containment cells are, in fact, more than two feet

above the adjacent flat ground, however they are ringed by a berm that appears to be partly responsible for the poor drainage within the cells. The berm is the closest thing to a subtle ridge in the disposal area, however it was not planted with mast trees. The cells could almost be considered to be upside down, that instead of being convex, they are concave.

6. The intention of the experimental helicopter acorn seeding was to see if aerial seeding of a suitable planting site was feasible. It is. Survival of seedlings that were seeded by this method was never intended to replace the planting of the cells. The seedlings that sprouted from the acorn drop have since died from extended inundation. There are situations where aerial seeding may prove to be a reasonable method for planting. If this site had better drainage, had not been inundated by the 1993 flood, and had not been selected for a research planting project, this method might have been successful.

7. Point of contact for comments or questions is Gary Swenson at (309) 794-4489.

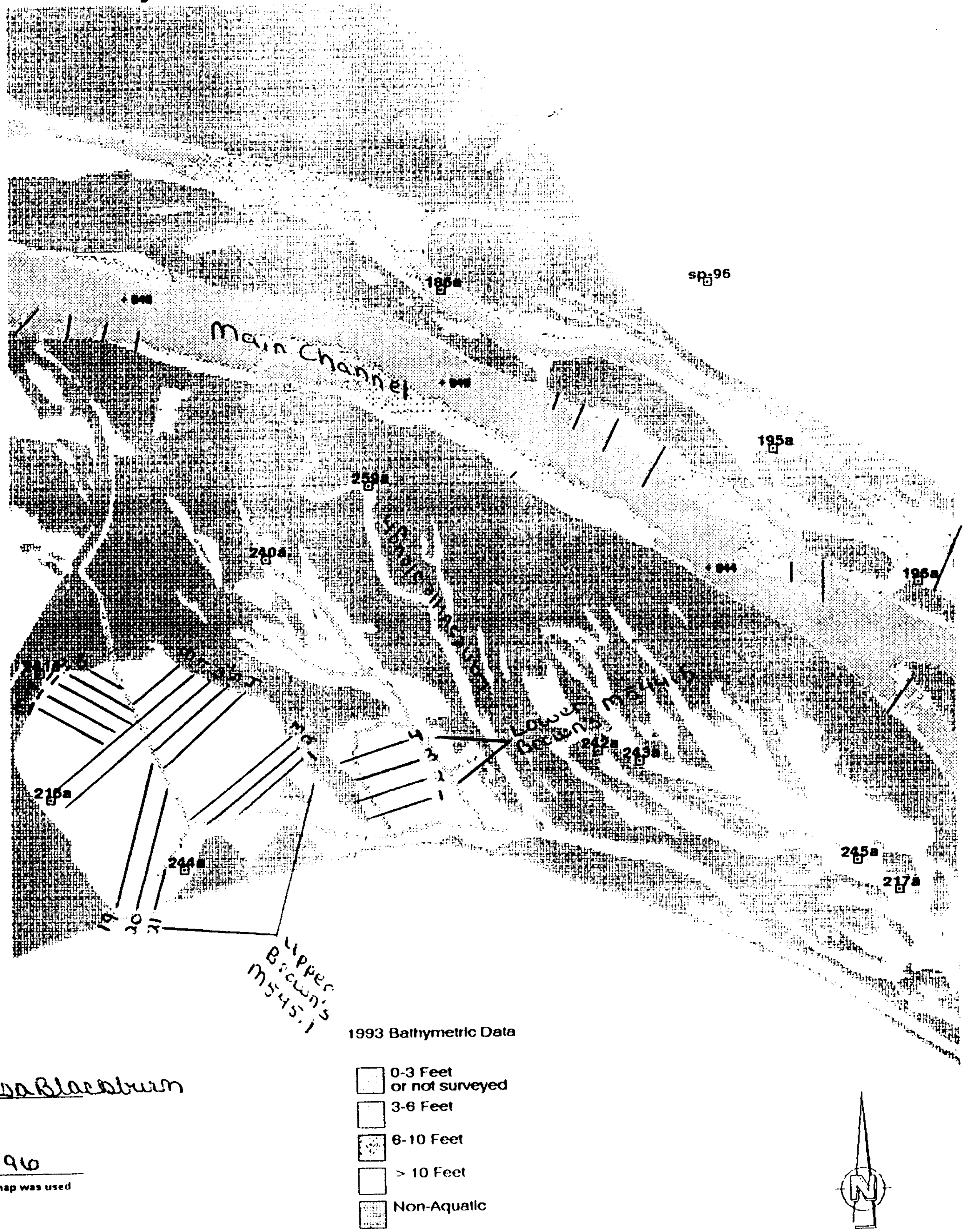
GARY V. SWENSON
Forester

CF:
OD-MN
OD-T
PD-E
PD-W
ED-DN
USFWS-RIFO
USFWS-UMR, Savanna
USFWS-UMR, Beseke
IADNR, Griffin
IADNR, Sheets

VEGETATION Transects

~~Water Quality - Alternate~~ Sampling Sites

P13-4



Theresa Blackburn

Crew Leader

6-4-96

Date(s) this map was used

APPENDIX D

WATER QUALITY DATA

Table D-1. Water quality monitoring results from samples collected at site W-M545.8F

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	9.30	*	**	1	100	7
3/1/94	12.50	0.034	**	0	100	5
3/29/94	10.70	0.106	0.1	3	75	5
5/3/94	13.40	0.115	0.3	12	10	9
5/17/94	12.65	0.000	0.0	12	0	1
5/31/94	9.85	0.180	0.1	24	60	3
6/21/94	9.35	0.238	0.0	32	5	2
7/12/94	10.90	*	0.0	30	15	1
8/2/94	9.60	0.000	0.0	27	10	2
8/23/94	9.15	0.186	0.2	24	30	7
9/6/94	8.85	0.106	0.1	19	10	2
9/19/94	9.50	0.045	0.0	20	0	1
10/11/94	9.60	0.050	0.0	9	0	2
11/15/94	9.20	0.060	0.1	3	20	3
12/13/94	9.20	*	**	-4	100	3
1/24/95	9.30	0.000	**	-9	5	0
2/21/95	9.40	0.000	**	-2	95	2
3/28/95	12.00	0.047	0.0	7	100	1
4/18/95	12.00	0.055	0.1	17	25	1
5/11/95	13.10	0.043	0.0	12	20	4
5/30/95	12.40	0.085	0.0	22	0	0
6/20/95	10.10	0.139	0.0	23	10	0
7/5/95	9.00	0.099	0.4	21	95	11
7/18/95	8.90	0.000	0.0	21	0	1
7/31/95	9.45	*	0.1	27	5	4
8/22/95	11.30	*	0.0	22	15	0
9/5/95	11.05	0.000	0.0	20	10	0
9/19/95	8.55	0.000	0.0	14	100	1
10/3/95	8.00	0.033	0.0	15	95	1
10/17/95	12.00	***	0.2	14	50	5
11/21/95	9.70	0.101	0.2	-3	70	7
MIN.	8.00	0.000	0.0	-9	0	0
MAX.	13.40	0.238	0.4	32	100	11
AVG.	10.32	0.069	0.1	14	40	3

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

Table D-1 (Cont.). Water quality monitoring results from samples collected at site W-M545.8F

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO3)
1/25/94	N	0.2	11.06	7.72	203
3/1/94	N	0.0	4.78	7.18	140
3/29/94	NW	7.8	18.72	9.01	152
5/3/94	SE	13.7	14.40	8.70	152
5/17/94	SE	18.2	10.67	8.53	155
5/31/94	NW	24.9	7.84	7.90	215
6/21/94	N	30.1	5.91	8.11	189
7/12/94	S	27.5	11.38	8.56	199
8/2/94	SE	27.1	5.63	8.08	189
8/23/94	S	24.8	*	8.32	182
9/6/94	N	18.9	8.79	8.10	190
9/19/94	SW	23.7	7.98	8.45	180
10/11/94	S	14.1	9.72	8.63	205
11/15/94	N	9.0	7.96	8.66	238
12/13/94	E	1.9	14.32	8.17	250
1/24/95	-	-0.1	13.38	*	187
2/21/95	NW	0.3	17.37	8.41	188
3/28/95	SE	8.9	12.98	9.38	133
4/18/95	S	10.9	8.85	8.49	130
5/11/95	W	15.5	*	*	145
5/30/95	-	18.8	5.98	7.85	160
6/20/95	-	28.1	4.75	7.99	163
7/5/95	S	23.3	4.79	7.96	183
7/18/95	NW	27.0	3.96	7.90	164
7/31/95	S	29.9	5.35	8.17	172
8/22/95	-	27.2	2.58	7.50	172
9/5/95	-	24.8	3.63	7.76	189
9/19/95	S	18.2	3.87	6.71	180
10/3/95	N	18.2	6.92	8.07	183
10/17/95	SE	11.3	10.06	8.20	220
11/21/95	NW	3.2	8.23	7.52	263

MIN.	-	-0.1	2.58	6.71	130
MAX.	-	30.1	18.72	9.38	263
AVG.	-	16.4	8.68	-	183

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

Table D-1 (Cont.). Water quality monitoring results from samples collected at site W-M545.8F

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (FT)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
1/25/94	416	**	3	2.5
3/1/94	283	**	22	18.5
3/29/94	303	1.15	13	44.0
5/3/94	355	1.50	9	24.0
5/17/94	362	1.70	8	14.0
5/31/94	449	1.10	10	21.0
6/21/94	397	1.35	13	20.0
7/12/94	412	1.40	10	21.0
8/2/94	403	1.15	14	19.0
8/23/94	377	1.10	16	20.0
9/6/94	434	1.10	13	21.0
9/19/94	439	1.20	17	41.0
10/11/94	431	1.40	12	22.0
11/15/94	446	1.00	17	35.0
12/13/94	426	**	10	20.0
1/24/95	375	**	7	<1
2/21/95	363	**	10	7.0
3/28/95	259	1.00	18	42.0
4/18/95	298	1.15	18	40.0
5/11/95	318	1.55	16	27.0
5/30/95	373	2.20	11	15.0
6/20/95	418	1.40	15	19.0
7/5/95	420	1.00	29	57.0
7/18/95	426	0.80	18	33.0
7/31/95	447	1.15	18	28.0
8/22/95	479	1.45	15	18.0
9/5/95	460	1.45	21	16.0
9/19/95	480	0.90	25	48.0
10/3/95	472	1.15	20	30.0
10/17/95	376	1.40	16	20.0
11/21/95	404	1.60	12	18.0

MIN.	259	0.80	3	<1
MAX.	480	2.20	29	57.0
AVG.	397	1.28	15	24.6

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

Table D-1 (Cont.). Water quality monitoring results from samples collected at site W-M545.8F

DATE	CHLOROPHYLL a (MG/M3)	CHLOROPHYLL b (MG/M3)	CHLOROPHYLL c (MG/M3)	PHEOPHYTIN a (MG/M3)
1/25/94	<2.3	<1.3	<1.6	<2.7
3/1/94	5.9	6.9	13.5	<2.7
3/29/94	180.0	<1	17.0	<1
5/3/94	44.0	<1	2.4	2.3
5/17/94	31.0	<1	4.5	13.0
5/31/94	<1	5.5	<1	38.0
6/21/94	42.0	5.5	<1	5.0
7/12/94	30.0	1.5	<1	5.0
8/2/94	14.0	<1	<1	17.0
8/23/94	26.0	<1	2.4	<1
9/6/94	19.0	<1	<1	18.0
9/19/94	32.0	<1	2.3	<1
10/11/94	4.6	<1	1.3	16.0
11/15/94	73.0	<1	6.8	21.0
12/13/94	54.0	<1	2.8	<1
1/24/95	2.5	<1	<1	1.3
2/21/95	13.0	<1	<1	7.6
3/28/95	110.0	<1	15.0	52.0
4/18/95	44.0	<1	5.4	<1
5/11/95	47.0	<1	<1	10.0
5/30/95	24.0	3.0	5.9	<1
6/20/95	43.0	<1	<1	2.5
7/5/95	63.0	<1	4.3	25.0
7/18/95	88.0	<1	<1	82.0
7/31/95	35.0	<1	<1	12.0
8/22/95	54.0	<1	<1	<1
9/5/95	24.0	<1	<1	4.2
9/19/95	45.0	<1	<1	28.0
10/3/95	36.0	1.8	3.5	31.0
10/17/95	23.0	<1	<1	5.2
11/21/95	35.0	<1	<1	12.0

MIN.	<1	<1	<1	<1
MAX.	180.0	6.9	17.0	82.0
AVG.	40.1	-	-	-

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

FIGURE D-1. POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M545.8F

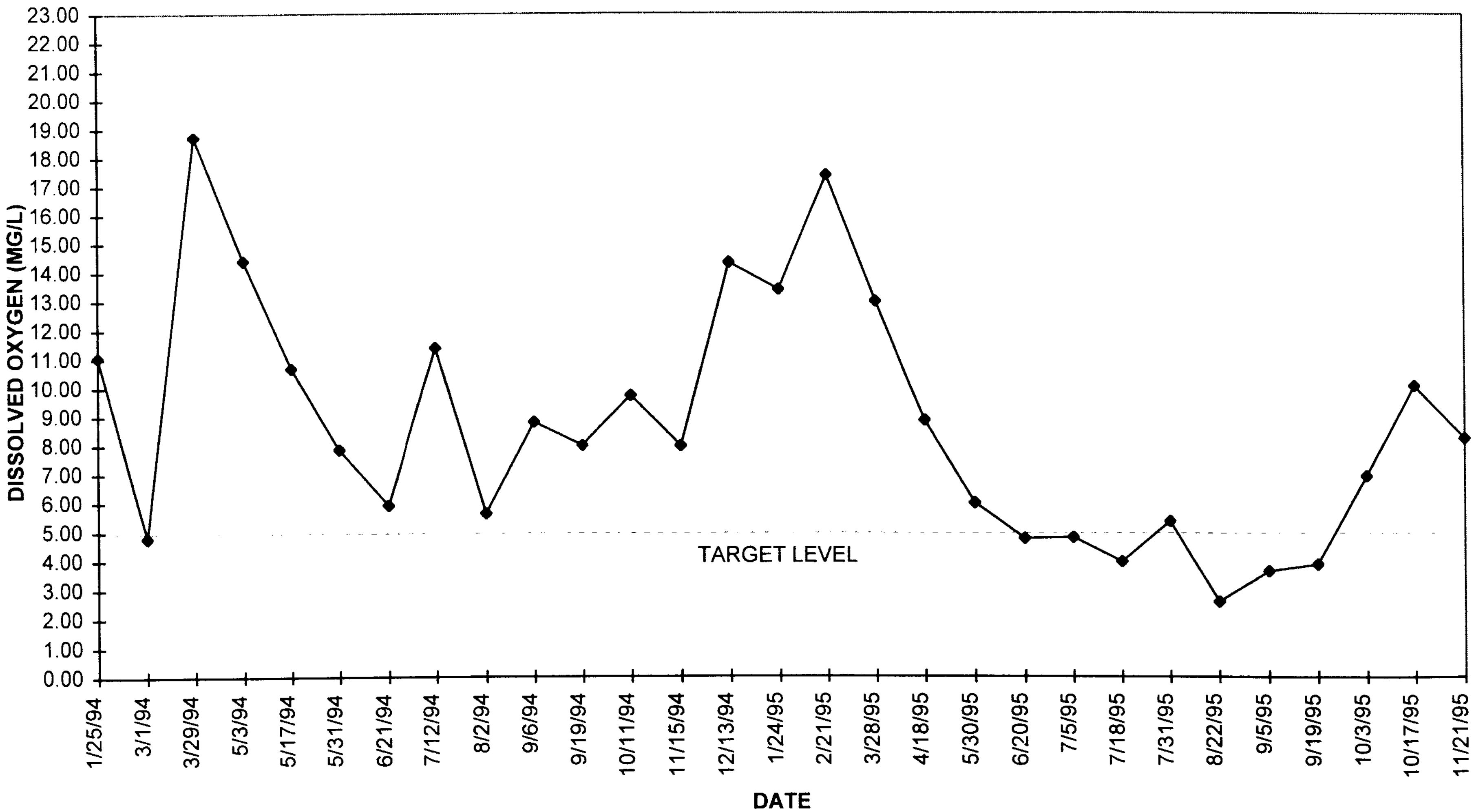


Table D-2. Water quality monitoring results from samples collected at site W-M545.5C

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	2.00	*	**	1	100	12
3/1/94	5.50	0.045	**	0	100	5
3/29/94	4.20	0.187	0.4	3	90	12
5/3/94	6.70	0.081	0.4	12	10	10
5/17/94	6.00	0.092	0.1	12	0	4
5/31/94	2.80	0.075	0.3	24	50	9
6/21/94	2.55	0.064	0.0	32	5	2
7/12/94	3.70	*	0.0	30	20	7
8/2/94	2.60	0.000	0.1	27	10	7
8/23/94	2.00	0.000	0.1	24	30	7
9/6/94	1.90	0.050	0.2	20	15	6
9/19/94	2.70	0.000	0.0	21	2	0
10/11/94	3.75	0.105	0.0	9	0	4
11/15/94	2.35	0.073	0.1	3	25	2
12/13/94	1.80	*	**	-3	100	1
1/24/95	2.20	0.000	**	-9	5	1
2/21/95	2.05	0.000	**	-1	95	1
3/28/95	5.60	0.085	0.0	7	100	0
4/18/95	5.25	0.118	0.3	17	20	5
5/11/95	6.45	0.085	0.2	12	20	4
5/30/95	5.70	0.056	0.0	22	0	0
6/20/95	3.35	0.063	0.0	23	10	3
7/5/95	2.40	0.127	0.0	21	95	8
7/18/95	2.25	0.000	0.0	21	0	5
7/31/95	2.50	0.000	0.0	27	5	4
8/22/95	5.00	0.000	0.0	22	20	0
9/5/95	4.60	0.000	0.0	20	10	3
9/19/95	1.80	0.000	0.0	14	100	3
10/3/95	1.70	0.035	0.0	16	95	0
10/17/95	5.20	***	0.3	14	50	5
11/21/95	3.00	***	0.6	-3	65	9

MIN.	1.70	0.000	0.0	-9	0	0
MAX.	6.70	0.187	0.6	32	100	12
AVG.	3.54	0.052	0.1	14	40	4

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

Table D-2 (Cont.). Water quality monitoring results from samples collected at site W-M545.5C

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO3)
1/25/94	NE	0.0	10.74	8.02	212
3/1/94	N	-0.1	5.75	7.47	140
3/29/94	NW	7.0	20.30	9.30	146
5/3/94	SE	13.5	15.30	8.90	160
5/17/94	E	18.9	12.68	8.59	145
5/31/94	NW	24.6	8.62	8.26	198
6/21/94	N	31.8	9.22	8.69	210
7/12/94	SW	27.2	11.79	9.00	201
8/2/94	SE	26.8	6.31	8.51	173
8/23/94	S	25.1	*	8.38	178
9/6/94	W	19.8	12.65	8.68	198
9/19/94	-	23.8	8.46	8.46	186
10/11/94	S	13.5	14.38	8.99	195
11/15/94	NW	7.8	13.09	8.98	210
12/13/94	E	2.7	22.30	8.92	244
1/24/95	E	0.0	12.42	*	217
2/21/95	NW	0.6	17.34	8.41	192
3/28/95	-	8.1	13.78	9.20	140
4/18/95	SW	11.5	10.85	9.00	138
5/11/95	W	15.8	*	*	150
5/30/95	-	19.7	11.59	8.64	164
6/20/95	W	28.8	7.78	8.58	171
7/5/95	S	22.9	6.14	8.42	188
7/18/95	NW	24.8	5.30	8.24	168
7/31/95	SW	29.3	2.89	7.95	164
8/22/95	-	27.7	5.40	7.98	170
9/5/95	E	24.6	3.06	7.65	172
9/19/95	E	16.8	4.12	6.63	188
10/3/95	-	17.8	6.81	8.25	179
10/17/95	SE	10.8	10.95	8.60	231
11/21/95	NW	2.0	12.02	9.13	199
MIN.	-	-0.1	2.89	6.63	138
MAX.	-	31.8	22.30	9.30	244
AVG.	-	16.2	10.42	-	182

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

Table D-2 (Cont.). Water quality monitoring results from samples collected at site W-M545.5C

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (FT)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
1/25/94	420	**	4	3.4
3/1/94	267	**	16	7.6
3/29/94	279	1.00	15	50.0
5/3/94	351	1.60	9	24.0
5/17/94	365	1.80	9	16.0
5/31/94	424	0.85	15	34.0
6/21/94	371	0.80	24	41.0
7/12/94	396	1.95	8	13.0
8/2/94	388	0.70	19	30.0
8/23/94	372	0.90	23	25.0
9/6/94	421	1.10	14	25.0
9/19/94	440	1.10	16	36.0
10/11/94	402	1.45	14	26.0
11/15/94	378	1.10	15	35.0
12/13/94	394	**	10	20.0
1/24/95	386	**	6	<1
2/21/95	362	**	10	10.0
3/28/95	268	1.00	16	42.0
4/18/95	293	1.35	18	40.0
5/11/95	311	1.60	13	25.0
5/30/95	356	1.85	12	18.0
6/20/95	404	1.25	18	29.0
7/5/95	398	0.70	30	57.0
7/18/95	435	1.10	18	32.0
7/31/95	444	1.70	12	15.0
8/22/95	472	1.10	12	16.0
9/5/95	441	1.35	14	23.0
9/19/95	450	0.55	34	58.0
10/3/95	454	0.95	19	35.0
10/17/95	357	1.50	14	18.0
11/21/95	331	0.50	47	100.0
MIN.	267	0.50	4	<1
MAX.	472	1.95	47	100.0
AVG.	382	1.19	16	29.2

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

Table D-2 (Cont.). Water quality monitoring results from samples collected at site W-M545.5C

DATE	CHLOROPHYLL a (MG/M3)	CHLOROPHYLL b (MG/M3)	CHLOROPHYLL c (MG/M3)	PHEOPHYTIN a (MG/M3)
1/25/94	<2.3	<1.3	<1.6	<2.7
3/1/94	5.9	5.5	6.9	<2.7
3/29/94	170.0	<1	15.0	14.0
5/3/94	54.0	1.7	6.0	<1
5/17/94	46.0	1.8	5.0	9.9
5/31/94	40.0	4.1	<1	17.0
6/21/94	50.0	4.3	2.3	7.2
7/12/94	12.0	1.0	<1	<1
8/2/94	17.0	<1	<1	20.0
8/23/94	23.0	2.7	<1	<1
9/6/94	35.0	1.7	4.2	10.0
9/19/94	23.0	<1	<1	9.9
10/11/94	36.0	<1	2.6	4.8
11/15/94	80.0	<1	9.8	13.0
12/13/94	31.0	<1	<1	16.0
1/24/95	4.5	2.9	2.0	<1
2/21/95	28.0	<1	4.2	10.0
3/28/95	160.0	<1	18.0	3.8
4/18/95	33.0	<1	1.5	21.0
5/11/95	70.0	<1	7.6	<1
5/30/95	68.0	12.0	21.0	<1
6/20/95	110.0	12.0	<1	16.0
7/5/95	110.0	<1	5.2	6.2
7/18/95	81.0	<1	4.2	7.1
7/31/95	13.0	<1	<1	<1
8/22/95	31.0	<1	<1	16.0
9/5/95	37.0	<1	<1	29.0
9/19/95	49.0	<1	<1	13.0
10/3/95	34.0	<1	2.5	15.0
10/17/95	25.0	<1	1.0	3.7
11/21/95	60.0	<1	2.1	15.0

MIN.	<2.3	<1	<1	<1
MAX.	170.0	12.0	21.0	29.0
AVG.	49.6	-	-	-

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

FIGURE D-2. POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M545.5C

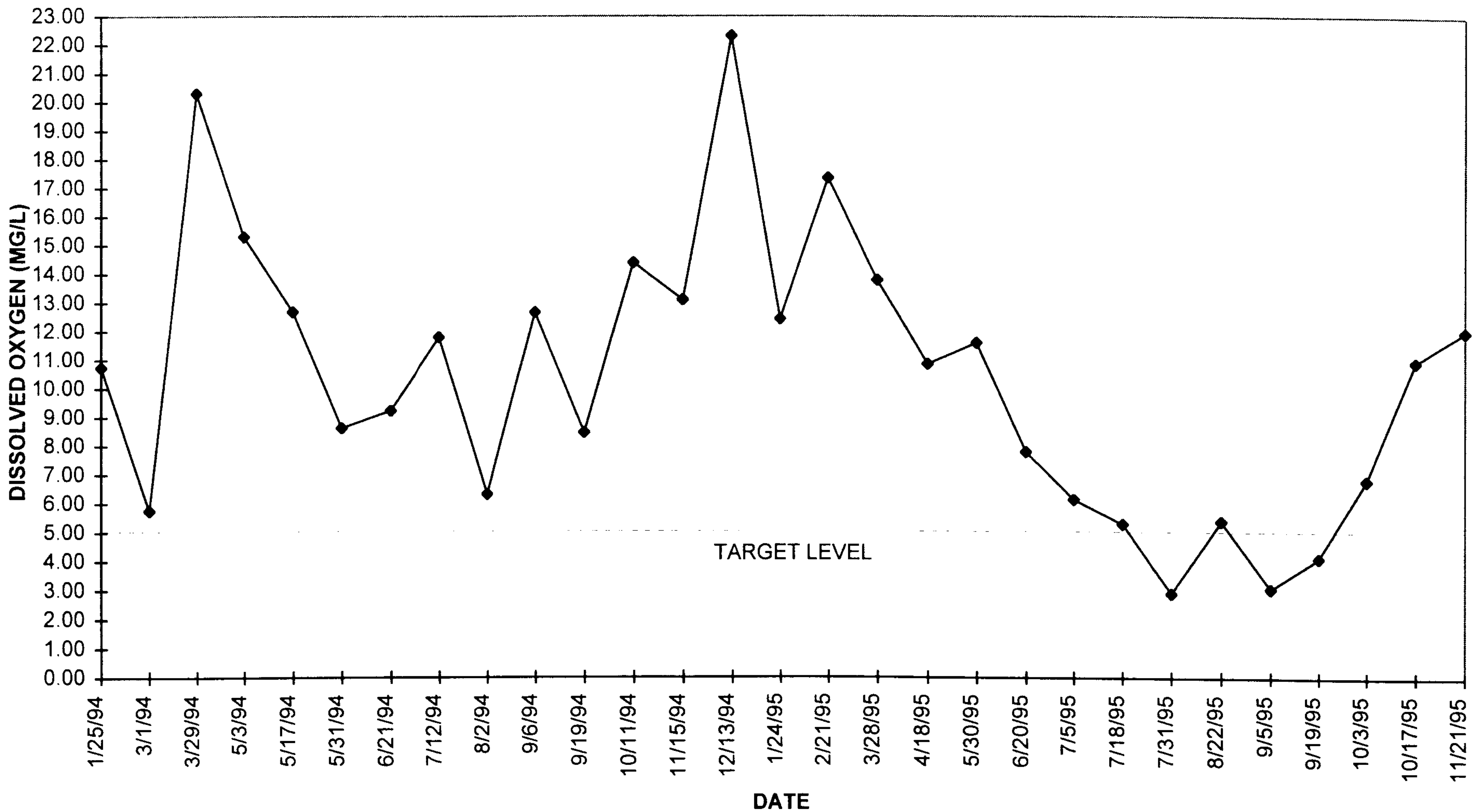


Table D-3. Water quality monitoring results from samples collected at site W-M544.2C

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	5.75	*	**	1	100	10
3/1/94	10.65	0.036	**	1	100	3
3/29/94	6.50	0.122	0.5	3	95	12
5/3/94	12.55	0.097	0.1	12	10	7
5/17/94	11.00	0.042	0.0	12	0	3
5/31/94	8.10	0.115	0.4	25	40	7
6/21/94	8.60	0.094	0.1	33	3	1
7/12/94	9.15	*	0.1	31	20	4
8/2/94	8.05	0.101	0.1	27	5	2
8/23/94	7.50	0.058	0.0	24	25	4
9/6/94	7.20	0.071	0.4	20	15	7
9/19/94	7.80	0.000	0.0	21	2	0
10/11/94	8.00	0.060	0.0	9	0	1
11/15/94	7.60	0.025	0.0	4	25	2
12/13/94	6.55	0.000	**	-4	100	0
1/24/95	7.80	0.068	**	-9	5	3
2/21/95	7.55	0.000	**	-1	95	2
3/28/95	9.50	0.090	0.0	7	100	0
4/18/95	10.30	0.125	0.1	17	15	5
5/11/95	11.30	0.164	0.2	13	20	6
5/30/95	10.55	0.153	0.0	22	0	2
6/20/95	7.90	0.119	0.1	23	10	3
7/5/95	8.00	0.089	0.1	21	70	2
7/18/95	7.15	0.110	0.3	21	0	8
7/31/95	7.90	*	0.2	27	10	1
8/22/95	9.90	0.470	0.1	22	0	5
9/5/95	9.59	0.000	0.1	21	10	2
9/19/95	6.70	0.000	0.0	14	100	1
10/3/95	6.10	0.049	0.0	16	100	0
10/17/95	9.50	***	0.1	15	50	3
11/21/95	9.20	***	1.1	-2	60	13

MiN.	5.75	0.000	0.0	-9	0	0
MAX.	12.55	0.470	1.1	33	100	13
AVG.	8.51	0.087	0.2	14	38	4

* Meter malfunction

** Not applicable, ice cover

*** Too windy to take measurement

**** Field/Laboratory accident

Table D-3 (Cont.). Water quality monitoring results from samples collected at site W-M544.2C

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO3)
1/25/94	NE	1.1	6.25	7.99	253
3/1/94	NE	0.0	8.42	7.28	175
3/29/94	NW	6.9	20.20	8.97	155
5/3/94	SE	11.8	9.53	8.25	156
5/17/94	E	17.8	7.58	8.30	156
5/17/94	NW	24.8	6.66	8.01	192
5/31/94	N	30.9	13.29	8.67	184
7/12/94	W	27.2	10.42	8.42	191
8/2/94	SE	26.4	5.55	8.29	186
8/23/94	E	23.8	*	8.13	181
9/6/94	W	20.1	11.76	8.53	200
9/19/94	-	25.2	21.30	9.17	164
10/11/94	E	13.3	10.06	8.36	167
11/15/94	NW	7.8	11.90	8.67	205
12/13/94	-	1.0	19.01	9.19	235
1/24/95	NW	2.7	7.22	*	230
2/21/95	NW	2.2	17.65	8.29	199
3/28/95	-	7.2	17.58	8.94	151
4/18/95	E	11.8	12.81	9.18	140
5/11/95	W	15.0	*	*	153
5/30/95	W	18.8	9.45	8.56	177
6/20/95	W	29.2	12.70	8.79	167
7/5/95	W	23.2	4.94	8.00	179
7/18/95	W	25.6	6.87	8.48	177
7/31/95	W	29.8	5.55	8.29	169
8/22/95	SE	27.4	6.33	8.13	179
9/5/95	E	24.8	5.36	7.82	178
9/19/95	E	17.7	5.82	7.05	175
10/3/95	-	17.7	7.45	8.18	180
10/17/95	E	11.8	8.72	7.90	227
11/21/95	NW	1.7	12.68	8.74	204

MIN.	-	0.0	4.94	7.05	140
MAX.	-	30.9	21.30	9.19	253
AVG.	-	16.3	10.45	-	183

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

Table D-3 (Cont.). Water quality monitoring results from samples collected at site W-M544.2C

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (FT)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
1/25/94	491	**	4	3.3
3/1/94	347	**	9	4.6
3/29/94	305	1.00	14	48.0
5/3/94	374	1.85	8	12.0
5/17/94	374	1.85	8	12.0
5/17/94	426	0.90	20	47.0
5/31/94	427	0.85	25	42.0
7/12/94	447	0.95	20	35.0
8/2/94	430	0.75	20	36.0
8/23/94	412	0.70	23	50.0
9/6/94	427	0.95	23	45.0
9/19/94	388	1.10	14	40.0
10/11/94	379	1.40	15	29.0
11/15/94	394	1.10	15	25.0
12/13/94	383	**	10	17.0
1/24/95	413	**	6	<1
2/21/95	393	**	11	4.0
3/28/95	323	1.50	14	27.0
4/18/95	290	1.35	13	27.0
5/11/95	361	1.35	18	22.0
5/30/95	404	1.65	17	18.0
6/20/95	435	1.30	18	33.0
7/5/95	479	0.70	37	69.0
7/18/95	458	0.65	36	83.0
7/31/95	473	1.15	16	35.0
8/22/95	438	1.50	17	22.0
9/5/95	368	1.10	18	22.0
9/19/95	403	0.90	18	36.0
10/3/95	396	1.00	24	39.0
10/17/95	320	1.30	16	22.0
11/21/95	353	0.90	30	49.0
MIN.	290	0.65	4	<1
MAX.	491	1.85	37	83.0
AVG.	397	1.14	17	30.8

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

Table D-3 (Cont.). Water quality monitoring results from samples collected at site W-M544.2C

DATE	CHLOROPHYLL a (MG/M3)	CHLOROPHYLL b (MG/M3)	CHLOROPHYLL c (MG/M3)	PHEOPHYTIN a (MG/M3)
1/25/94	<2.3	<1.3	<1.6	<2.7
3/1/94	<2.3	1.3	<1.6	<2.7
3/29/94	210.0	<1	26.0	<1
5/3/94	44.0	3.1	5.0	<1
5/17/94	44.0	3.1	5.0	<1
5/17/94	23.0	5.4	2.4	<1
5/31/94	57.0	7.5	4.4	8.3
7/12/94	35.0	3.8	3.6	<1
8/2/94	45.0	<1	3.8	11.0
8/23/94	17.0	<1	<1	5.0
9/6/94	44.0	1.9	1.9	26.0
9/19/94	82.0	<1	6.2	20.0
10/11/94	20.0	<1	<1	3.1
11/15/94	77.0	<1	11.0	16.0
12/13/94	56.0	<1	4.6	<1
1/24/95	9.7	1.9	<1	6.1
2/21/95	22.0	<1	2.7	8.9
3/28/95	120.0	<1	11.0	6.2
4/18/95	75.0	<1	8.4	1.1
5/11/95	57.0	<1	4.5	1.6
5/30/95	44.0	<1	<1	12.0
6/20/95	64.0	1.8	<1	10.0
7/5/95	40.0	<1	1.7	16.0
7/18/95	96.0	<1	<1	<1
7/31/95	44.0	<1	<1	<1
8/22/95	22.0	<1	1.2	1.7
9/5/95	****	****	****	****
9/19/95	26.0	<1	<1	11.0
10/3/95	27.0	<1	<1	9.4
10/17/95	17.0	<1	1.3	<1
11/21/95	19.0	<1	<1	2.1

MIN.	<2.3	<1	<1	<1
MAX.	210.0	7.5	26.0	26.0
AVG.	48.0	-	-	-

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

FIGURE D-3. POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M544.2C

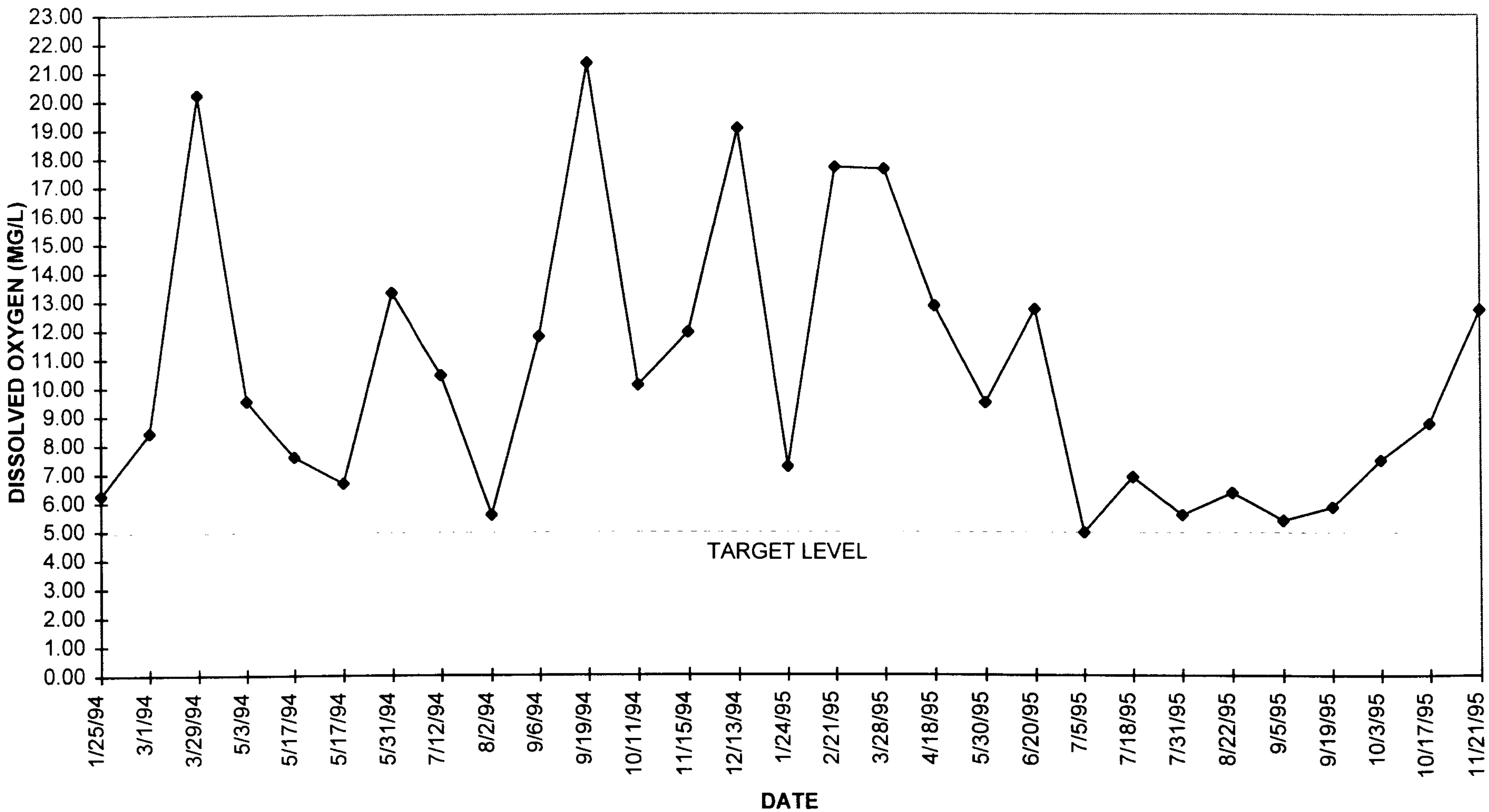


Table D-4. IADNR water quality monitoring results from samples collected at site W-M545.5B

DATE	WATER DEPTH (M)	VELOCITY (M/SEC)	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)
1/11/94	2.40	0.01	0.9	13.2
1/27/94	2.23	0.00	0.5	7.2
2/7/94	2.28	0.00	0.0	11.3
2/21/94	3.56	0.00	1.3	9.8
3/11/94	3.10	0.00	5.1	5.2
3/22/94	3.20	0.02	5.8	17.6
4/7/94	3.20	0.01	7.8	10.3
4/19/94	3.20	0.00	15.1	11.1
5/3/94	3.66	0.02	13.8	16.0
5/16/94	3.96	0.04	20.0	14.0
6/1/94	2.74	0.00	25.4	11.7
6/16/94	2.68	0.00	30.2	12.4
6/27/94	2.77	0.02	26.0	11.6
7/11/94	3.05	0.02	25.2	9.5
7/26/94	2.13	0.06	24.8	5.5
8/8/94	2.40	0.00	25.5	8.6
8/22/94	2.13	0.05	25.0	10.1
9/6/94	2.28	0.06	19.2	10.8
9/19/94	-	0.01	27.1	10.5
10/6/94	-	0.00	15.1	10.4
10/17/94	-	0.00	17.4	9.6
10/31/94	-	0.00	9.5	14.3
11/15/94	-	0.00	8.4	15.5
11/29/94	-	0.01	0.6	12.5
12/15/94	2.10	0.00	3.0	19.8
12/29/94	2.22	0.00	3.9	20.0

MIN.	2.10	0.00	0.0	5.2
MAX.	3.96	0.06	30.2	20.0
AVG.	2.76	0.01	13.7	11.9

Table D-4 (Cont.). IADNR water quality monitoring results from samples collected at site W-M545.5B

DATE	pH (SU)	CONDUCTIVITY (µS/CM)	SECCHI DISK DEPTH (CM)	TURBIDITY (NTU)
1/11/94	7.4	552	118	4
1/27/94	7.5	491	140	3
2/7/94	7.8	530	80	4
2/21/94	7.6	355	17	84
3/11/94	7.2	303	82	9
3/22/94	8.8	324	42	18
4/7/94	9.4	295	35	21
4/19/94	8.8	343	40	24
5/3/94	9.1	349	51	16
5/16/94	9.0	350	56	10
6/1/94	8.8	382	44	18
6/16/94	8.5	388	35	26
6/27/94	8.8	372	44	19
7/11/94	8.8	422	48	16
7/26/94	8.1	397	32	37
8/8/94	8.0	391	40	25
8/22/94	8.2	333	38	30
9/6/94	8.5	447	50	20
9/19/94	8.5	454	56	16
10/6/94	8.6	438	52	20
10/17/94	8.6	460	40	29
10/31/94	8.8	435	44	20
11/15/94	8.8	432	37	28
11/29/94	8.1	424	18	83
12/15/94	8.4	528	68	10
12/29/94	8.3	454	75	8

MIN.	7.2	295	17	3
MAX.	9.4	552	140	84
AVG.	-	410	53	23

FIGURE D-4. POST-PROJECT DISSOLVED OXYGEN CONCENTRATIONS AT SITE W-M545.5B

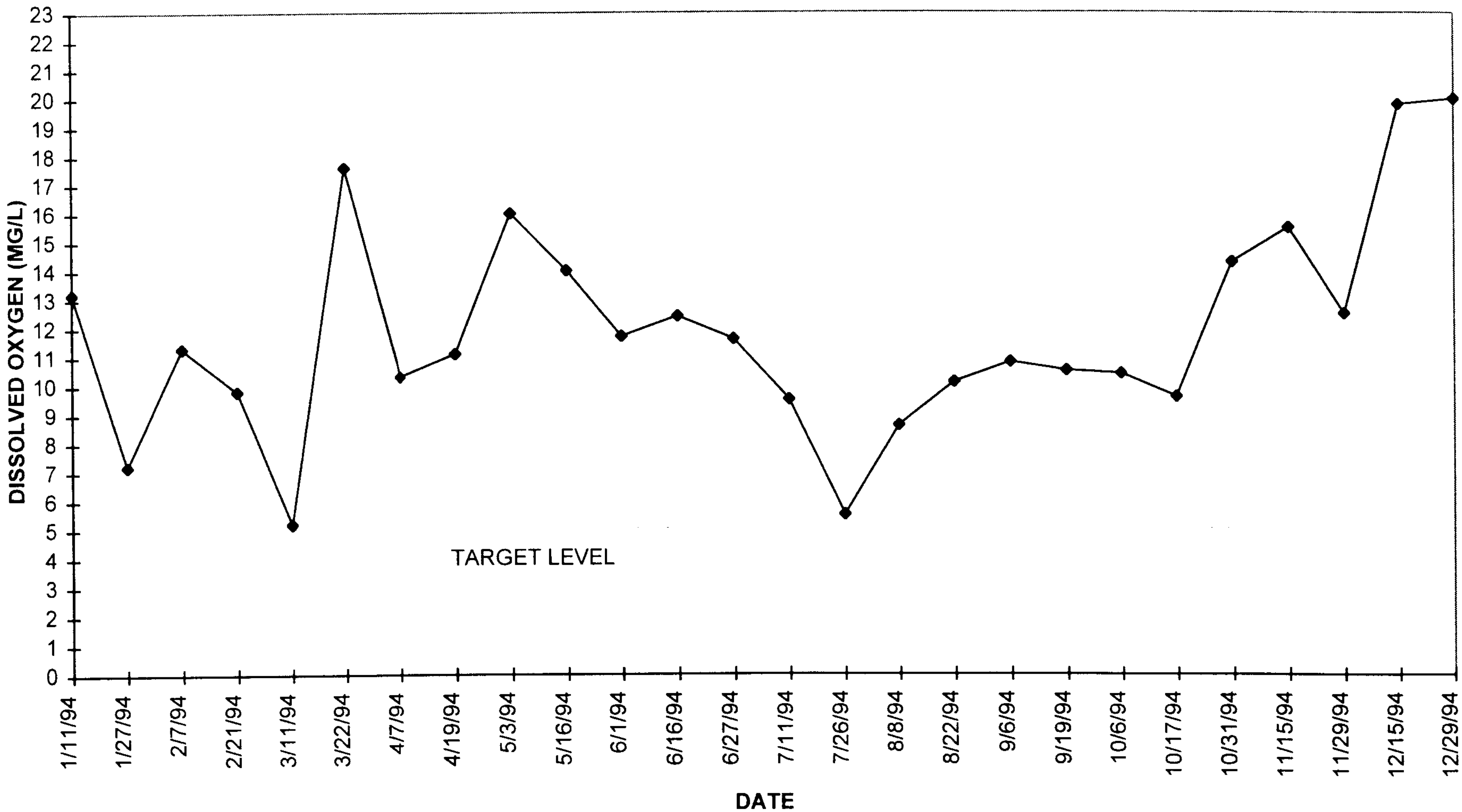


Table D-5. Water quality monitoring results from samples collected at site W-M544.1D

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	1.45	*	**	2	100	6
3/1/94	4.00	0.992	**	1	100	3
3/29/94	3.10	0.887	0.1	3	95	4
1/24/95	1.85	-	**	-	-	-
2/21/95	1.65	0.000	**	-	-	-
MIN.	1.45	0.000	0.1	1	95	3
MAX.	4.00	0.992	0.1	3	100	6
AVG.	2.41	0.626	0.1	2	98	4

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	SPECIFIC CONDUCTANCE (μMHOS/CM @ 25°C)
1/25/94	E	0.0	10.11	8.03	417
3/1/94	NE	-0.2	9.85	7.48	353
3/29/94	NW	6.3	13.93	8.24	369
1/24/95	-	0.5	13.18	-	-
2/21/95	-	0.7	17.72	-	-
MIN.	-	-0.2	9.85	7.48	353
MAX.	-	6.3	17.72	8.24	417
AVG.	-	1.5	12.96	-	380

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

Table D-6. Water quality monitoring results from samples collected at site W-M544.6F

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	7.00	*	**	1	100	10
3/1/94	10.65	0.042	**	0	100	5
3/29/94	9.55	0.061	0.3	3	95	12
1/24/95	7.55	-	**	-	-	-
2/21/95	6.90	0.0	**	-	-	-
MIN.	6.90	0.000	0.3	0	95	5
MAX.	10.65	0.061	0.3	3	100	12
AVG.	8.33	0.034	0.3	1	98	9

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)
1/25/94	E	0.3	6.26	7.96	494
3/1/94	NE	0.0	6.00	7.40	291
3/29/94	NW	7.3	20.90	9.33	311
1/24/95	-	2.6	4.03	-	-
2/21/95	-	2.4	14.04	-	-
MIN.	-	0.0	4.03	7.40	291
MAX.	-	7.3	20.90	9.33	494
AVG.	-	2.5	10.25	-	365

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

Table D-7. Water quality monitoring results from samples collected at site W-M544.7F

DATE	WATER DEPTH (FT)	VELOCITY (FT/SEC)	WAVE HEIGHT (FT)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (MPH)
1/25/94	1.40	*	**	2	100	8
3/1/94	4.35	0.059	**	1	100	5
3/29/94	3.30	0.076	0.1	3	95	6
1/24/95	1.55	-	**	-1	-	-
2/21/95	1.35	0.000	**	-1	-	-
MIN.	1.35	0.000	0.1	-1	95	5
MAX.	4.35	0.076	0.1	3	100	8
AVG.	2.39	0.045	0.1	1	98	6

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	SPECIFIC CONDUCTANCE (μMHOS/CM @ 25°C)
1/25/94	E	0.0	8.54	8.09	510
3/1/94	NE	-0.1	7.11	7.52	300
3/29/94	NW	7.8	22.20	8.99	317
1/24/95	-	1.9	9.79	-	-
2/21/95	-	1.9	13.64	-	-
MIN.	-	-0.1	7.11	7.52	300
MAX.	-	7.8	22.20	8.99	510
AVG.	-	2.3	12.26	-	376

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

APPENDIX E

TECHNICAL COMPUTATIONS

TABLE E-1
Brown's Lake Sediment Reduction

Sediment Transect	Period	Years	Section Length, Ft[1]	Scour, SF[1]	Deposition, SF	Total Scour(-)/ Deposition, SF	Total Scour(-)/ Deposition, Ft	Total Scour(-)/ Deposition, In/Year
Corps								
545.8H (Upper Brown's Lake)	29/30-95	65.5	4478.0		11894.0	11894.0	2.66	0.5
545.7H (Upper Brown's Lake)	29/30-95	65.5	3813.0	-707.0	7498.0	8205.0	2.15	0.4
545.3H (Upper Brown's Lake)	29/30-95	65.5	2955.0	-211.0	6221.0	6432.0	2.18	0.4
544.3H (Lower Brown's Lake)	38/39-95	56.5	1455.0	-1019.1	1236.0	2255.1	1.55	0.3
							Corps Average	0.4
USFWS								
545.5A (Upper Brown's Lake)	90-95	5.0	1025.0	21.6	312.3	290.7	0.28	0.7
545.4A (Upper Brown's Lake)	90-95	5.0	775.0		226.5	226.5	0.29	0.7
544.2A (Lower Brown's Lake)	89-95	6.0	400.0	110.5	449.8	339.3	0.85	1.7
							USFWS Average	1.0
IADNR								
545.8E (Upper Brown's Lake)	84-94	10.0	250.0		53.0	53.0	0.21	0.3
545.6B (Upper Brown's Lake)	89-94	10.0	100.0		5.5	5.5	0.06	0.1
544.9E (Lower Brown's Lake)	84-94	10.0	190.0		29.7	29.7	0.16	0.2
							IADNR Average	0.2
						Weighted Average[2]		0.3
						With-Project Annual Sediment Deposition, Acre-Feet		19.4
						Actual Acre-Feet of Annual Sediment Reduction [3]		11.4
						Design Acre-Feet of Annual Sediment Reduction [3,4]		21.6

[1] Corps section lengths and scour adjusted to exclude dredge cut areas.

[2] Based on % undisturbed project area (IADNR and Corps transects) and % project area dredged channels (USFWS transects)

Project Area = 740 acres

Dredged Channel Area = (19,520*60)/43560 = 27 acres

% Project Area Dredged Channels = 27/740 = 4%

[3] Without project annual sediment volume = 30.8 Acre-Feet (ref DPR A-2, 3).

[4] Based on with-project annual sediment deposition = 0.15" (.0125') (ref DPR, pg A-4,5)

TABLE E-2
Dredge Cut Sediment Deposition

Sediment Transect[1/]	1989 Area[2/] SF	1989 Depth Ft	1990 Area SF	1990 Depth Ft	1991 Area SF	1992 Area SF	1993 Area SF	1994 Area SF	1995 Area SF	1995 Depth Ft	1996 Area SF	1996 Depth Ft	Dredge Cut Deposition, SF	Dredge Cut Deposition, Ft (Depth - Depth)	Dredge Cut Deposition, Ft/Year (Depth - Depth)	Dredge Cut Deposition, In/Year (Depth - Depth)
Corps																
545.7H (Upper Brown's Lake)	702	9							1294.5	8.4				0.60	0.10	1.2
545.3H (Upper Brown's Lake)	702	9							424.9	6			277.10	3.00	0.50	6.0
545.6H (Lower Brown's Lake)	702	9							876.7	8.1				0.90	0.15	1.8
544.3HL (Lower Brown's Lake)	702	9							523.4	7.5			178.60	1.50	0.25	3.0
544.3HR (Lower Brown's Lake)	702	9							1976.1	8				1.00	0.17	2.0
544.1EL (Lower Brown's Lake)	702	9							642.2	7.1			59.80	1.90	0.32	3.8
544.1ER (Lower Brown's Lake)	702	9							446.9	6.7			255.10	2.30	0.38	4.6
														Corps Average	0.27	3.2
546.3H (Inlet Channel)	432	9							156.1	3.2	408.5	7.7	275.90	5.80	0.97	11.6
545.9H (Access Channel)	432	9							803.5	11.1						
USFWS																
545.5A (Upper Brown's Lake)			740.4	9	716.3		651.9	659.3	659.5	6.8			80.90	2.20	0.55	6.6
545.4A (Upper Brown's Lake)			728.8	8.8	652.9	600	544.8	539.5	497.0	6.4			231.80	2.40	0.60	7.2
544.2A (Lower Brown's Lake)	822.7	11	695.5				692.2	661	595.0	7.1			227.70	3.90	0.78	9.4
														USFWS Average	0.58	6.9
							Average Dredge Cut Depth			7.21				Average	0.38	4.6
														Additional Lake Volume at Year 6, Acre-Feet3/	169	

[1/] Dredge Cut (or portions thereof) Area Only, SF (Deep Hole Dredging excluded)

[2/] 1989 Areas for Corps sediment transects are design only--no as-built information is available.

[3/] Additional Lake Volume=230-((L*W*S)*Y/43560) L=19,520'; W=60', S=0.38', Y=6

TABLE E-3
Brown's Lake Sediment Deposition
Transects vs. Dredged Cuts

Sediment Transect	Total Deposition, In/Year	Dredge Cut Deposition, In/Year
Corps		
545.8H (Upper Brown's Lake)	0.5	
545.7H (Upper Brown's Lake)	0.4	1.2
545.3H (Upper Brown's Lake)	0.4	6.0
545.6H (Lower Brown's Lake)		1.8
544.3HL (Lower Brown's Lake)	0.3	3.0
544.3HR (Lower Brown's Lake)		2.0
544.1EL (Lower Brown's Lake)		3.8
544.1ER (Lower Brown's Lake)		4.6
545.9H (Access Channel)	N/A	N/A
546.3H (Inlet Channel)	N/A	N/A
Corps Average	0.4	3.2
USFWS		
545.5A (Upper Brown's Lake)	0.7	6.6
545.4A (Upper Brown's Lake)	0.7	7.2
544.2A (Lower Brown's Lake)	1.7	9.4
USFWS Average	1.0	7.7
IADNR		
545.8E (Upper Brown's Lake)	0.3	
545.6B (Upper Brown's Lake)	0.1	
544.9E (Lower Brown's Lake)	0.2	
IADNR Average	0.2	
Total Average	0.3	4.6

TABLE E-4
Brown's Lake Dredge Cut Average Annual Sediment Accretion

Year	Additional Lake Volume, Acre-Feet[1/,2/]	
	Design	Actual
0	230	230
1	230	220
2	229	210
3	229	199
4	229	189
5	229	179
6	228	169
7	228	158
8	228	148
9	228	138
10	227	128
11	227	118
12	227	107
13	227	97
14	226	87
15	226	77
16	226	67
17	225	56
18	225	46
19	225	36
20	225	26
21	224	15
22	224	5
50	217	

[1/] Assumes an annual sedimentation rate:
Design: S = 0.15 inches (0.01 foot)/year. Ref. DPR A-5.
Actual: S = 4.6 inches (0.38 foot)/year. See Table E-2.
[2/]Additional Lake Volume = 230-((L*W*S)*Y/43560)L = 19,520'; W =60'S =See [1/],Y = Year column

APPENDIX F

DISTRIBUTION LIST

DISTRIBUTION:

	Number of Copies	
	Draft	Final
Mr. William Hartwig Regional Director, Region 3 U.S. Fish and Wildlife Service Federal Building, Ft. Snelling Twin Cities, MN 55111		1
Mr. Keith Beseke EMP Coordinator U.S. Fish and Wildlife Service Upper Mississippi River Refuge Complex 51 East 4th Street, Room 101 Winona, MN 55987	1	1
Mr. Ed Britton U.S. Fish and Wildlife Service Savanna District Upper Mississippi River National Wildlife and Fish Refuge Post Office Building Savanna, IL 61074	1	3
Mr. Richard Nelson Field Supervisor U.S. Fish and Wildlife Service 4469 48th Avenue Court Rock Island, IL 61201	1	1
Dr. John Barko Environmental Management Technical Center 575 Lester Drive Onalaska, WI 54650	1	1
Ms. Holly Stoerker Upper Mississippi River Basin Association 415 Hamm Building 408 St. Peter Street St. Paul, MN 55111		1
Mr. Tom Boland Bellevue Research Station Iowa Department of Natural Resources Route 3, Box 1 Bellevue, IA 52031	2	2

	Number of Copies	
	Draft	Final
Mr. Harlan Hirt U.S. Environmental Protection Agency, Region V 77 West Jackson Blvd. Chicago, IL 60604		1
Mr. Donald Powell U.S. Army Engineer District, St. Paul Planning Division (CENCS-PE-P) 190 - 5th Street East St. Paul, MN 55101-1638		2
Mr. David Gates U.S. Army Engineer District, St. Louis Planning Division 1222 Spruce Street St. Louis, MO 63103-2833		2
Dr. Don Williams U.S. Army Engineer Division, North Central CENCD-PE-PD-PL 111 N. Canal - 12th Floor Chicago, IL 60606-7205	3	3
Steve Ashby U.S. Army Engineer Waterways Experiment Station CEWES-ES-P 3909 Halls Ferry Road Vicksburg, MS 39180-6199		1
Mr. Bob Sheets Iowa Department of Natural Resources Court House Maquoketa, IA 52060	1	1
Mr. Erwin E. Klaas Iowa Cooperative Fish and Wildlife Research Unit 11 Science II Iowa State University Ames, IA 50011	1	1
Mr. Russ Gent LTRM Mississippi River Monitoring Station 206 Rose Street Bellevue, IA 52031	2	2

INTERNAL DISTRIBUTION:

Dist File (PD)
PD-W (Niles)
PD-W (Skalak)
PD-E (Carmack)
ED-HQ (Bierl)
ED-DN
ED-DN (Kool)
OD-MN (Swenson)
PP-M (Kowalczyk)

ED-DN
Kimley.

Name	Division/Area of Evaluation	Phone
Charlene Carmack	PD (Biological performance)	5570
Darron Niles	PD (General coordination)	5400
Celia Kool	ED (Physical performance/ report preparation)	5623
Dave Bierl	ED (Water quality parameters)	5581

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

CF (all w/encl):
Dist File (PD)
PD (Herrmann)(wo/encl)
PD-W (wo/encl)
PD-W (Skalak)
PD-W (Niles)
PD-E (Carmack)
✓ED-DN
ED-DN (Kool)
ED-HQ (Bierl)
OD-MN (Swenson)
PP-M (Kowalczyk)

NILES/dmd/5400

Planning Division

SEE REPORT DISTRIBUTION LIST (APPENDIX F)

The Rock Island District of the U.S. Army Corps of Engineers has enclosed a draft of the Supplemental Performance Evaluation Report for the Brown's Lake, Iowa, Habitat Rehabilitation and Enhancement Project (HREP), as part of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP). The report is being provided for your review and comment. Final distribution of the subject report is scheduled for November 1996.

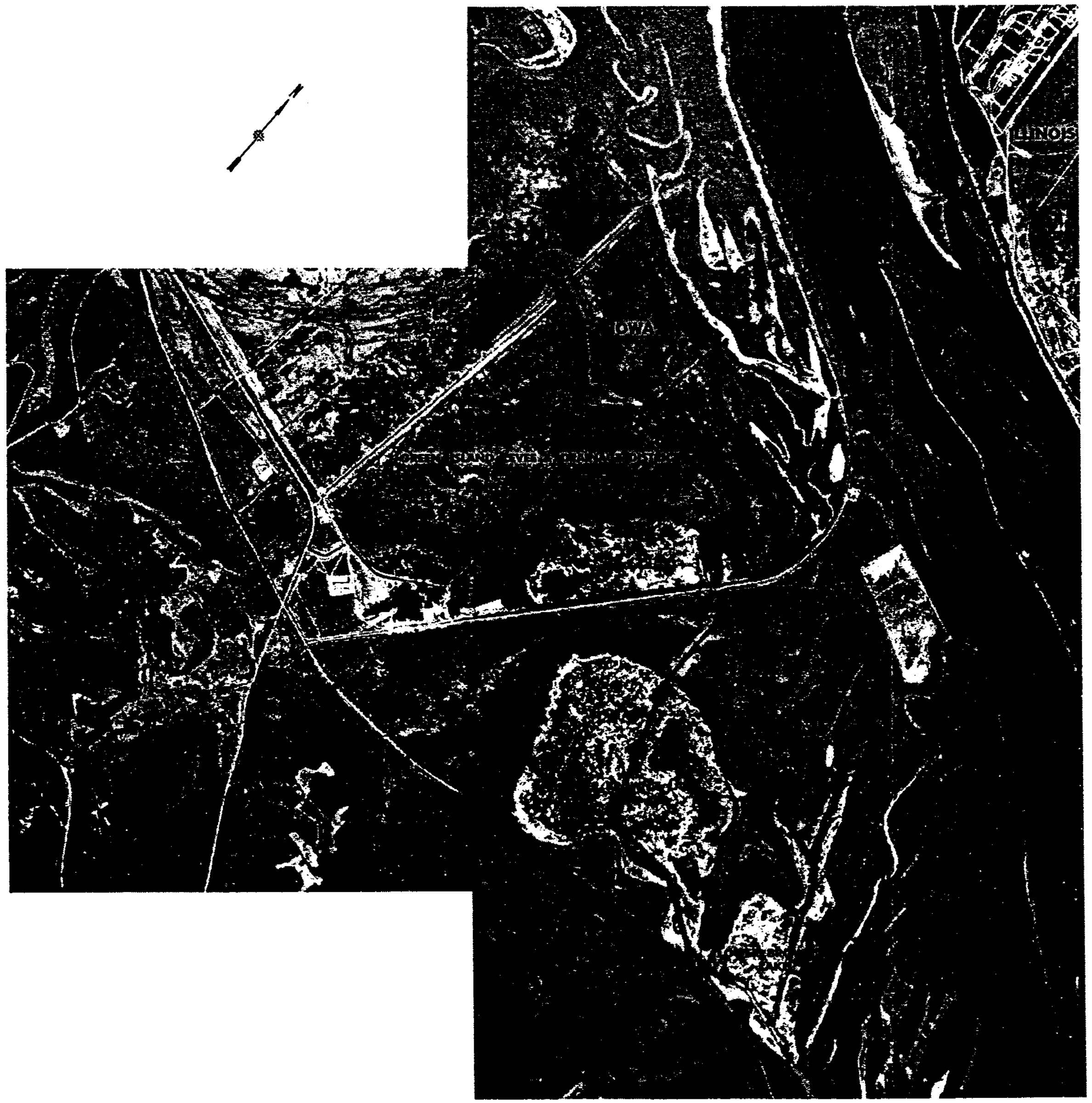
In addition to your evaluation of the subject report, we request that you make available to the appropriate Rock Island District elements (see report development team members listed below) copies and/or summaries of all data (raw or in final form) or other quantitative or qualitative information pertinent to the subject project but not reflected in this draft report. To both fully incorporate your input and realize the final distribution schedule acknowledged previously, we request that your response be received no later than close of business October 31, 1996.

The HREP Performance Evaluation Reports such as this one are the primary vehicle for communicating project effectiveness and will be the basis for assessing the overall success or failure of the UMRS-EMP's HREP element. For these reasons, we must assure that they are as comprehensive as possible. Your support and cooperation to that end is critical.

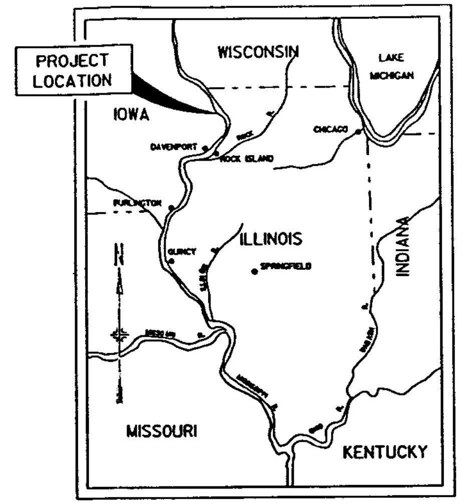
Should you have any questions regarding this correspondence, please call Mr. Darron Niles of our Waterway Systems Branch, telephone 309/794-5400.

The following is a list of the Performance Evaluation Report Development team members from Planning Division (PD) and Engineering Division (ED). The telephone number is 309/794-XXXX (number as shown in list):

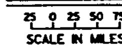
PLATES



DATE OF AERIAL PHOTO NOV.20,1995



VICINITY MAP



US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

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

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDH	Scale: AS SHOWN
Checked By: CCK	Drawing Code: XXXXX
Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

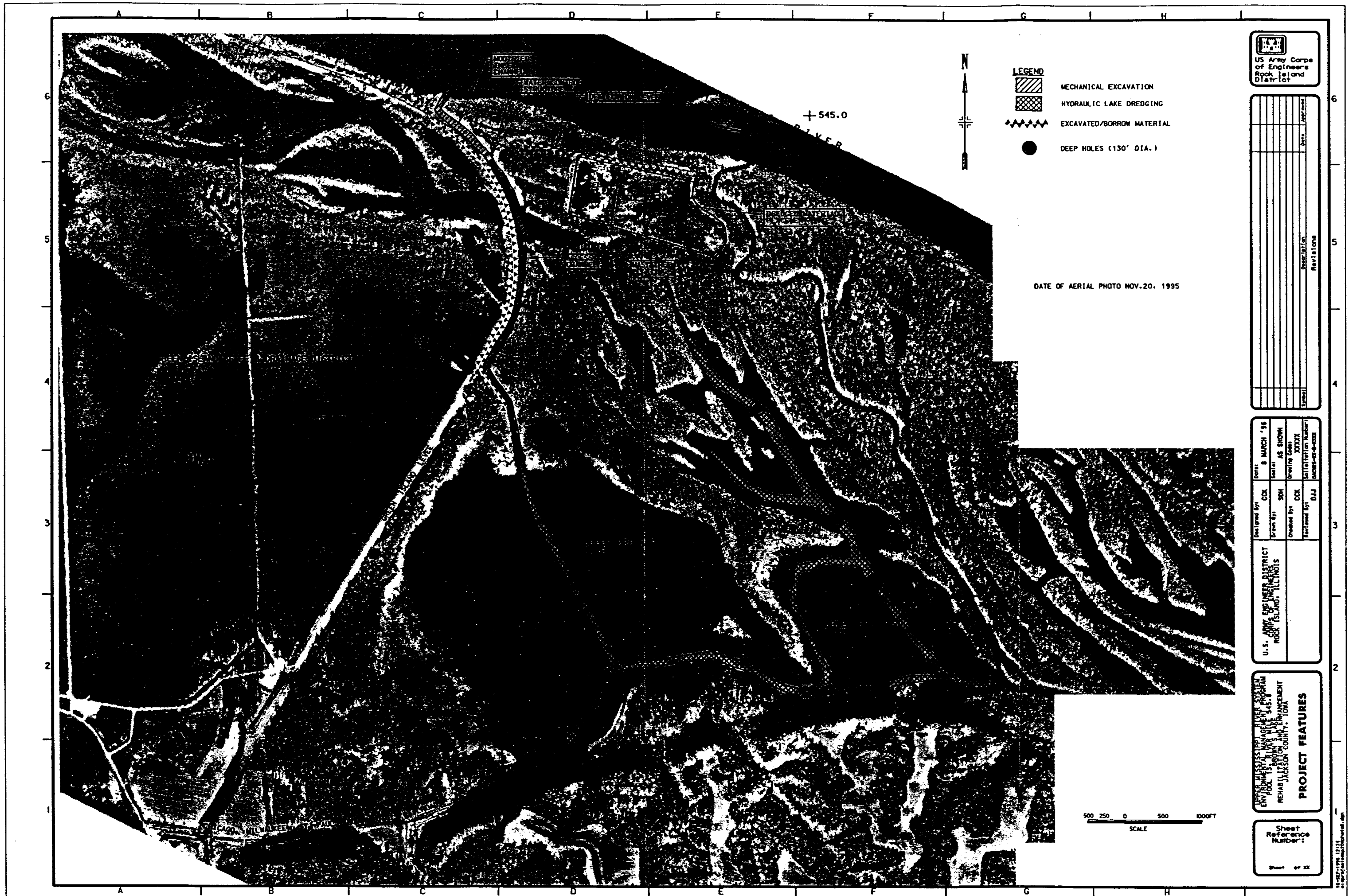
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

GENERAL PLAN AND VICINITY MAP

Sheet Reference Number:

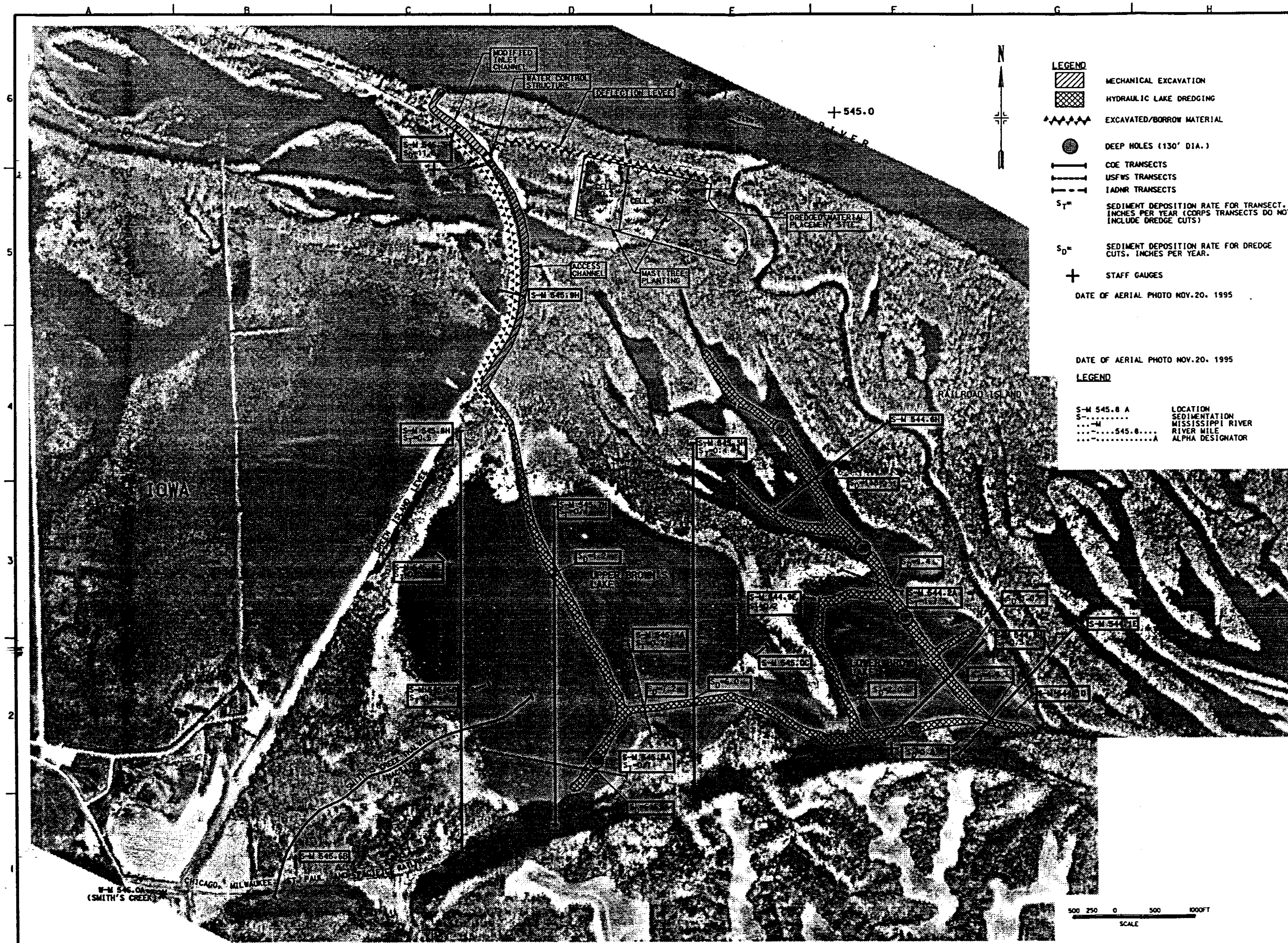
Sheet of XX

PLATE 1



LEGEND
MECHANICAL EXCAVATION
HYDRAULIC LAKE DREDGING
EXCAVATED/BORROW MATERIAL
DEEP HOLES (130' DIA.)
N
545.0
DATE OF AERIAL PHOTO NOV.20. 1995
500 250 0 500 1000FT
SCALE
US Army Corps of Engineers Rock Island District
Symbol
Description
Date
Approved
Revisions
Designed By: CCK
Drawn By: SOH
Checked By: CCK
Reviewed By: DJJ
Date: 8 MARCH '96
Scale: AS SHOWN
Drawing Code: XXXXX
Solicitation Number: DACW25-XX-B-XXXX
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.0
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA
PROJECT FEATURES
Sheet Reference Number:
Sheet of XX

PLATE 2



US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved
Revisions			

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

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDH	Scale: AS SHOWN
Checked By: CCK	Drawing Code: XXXXX
Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

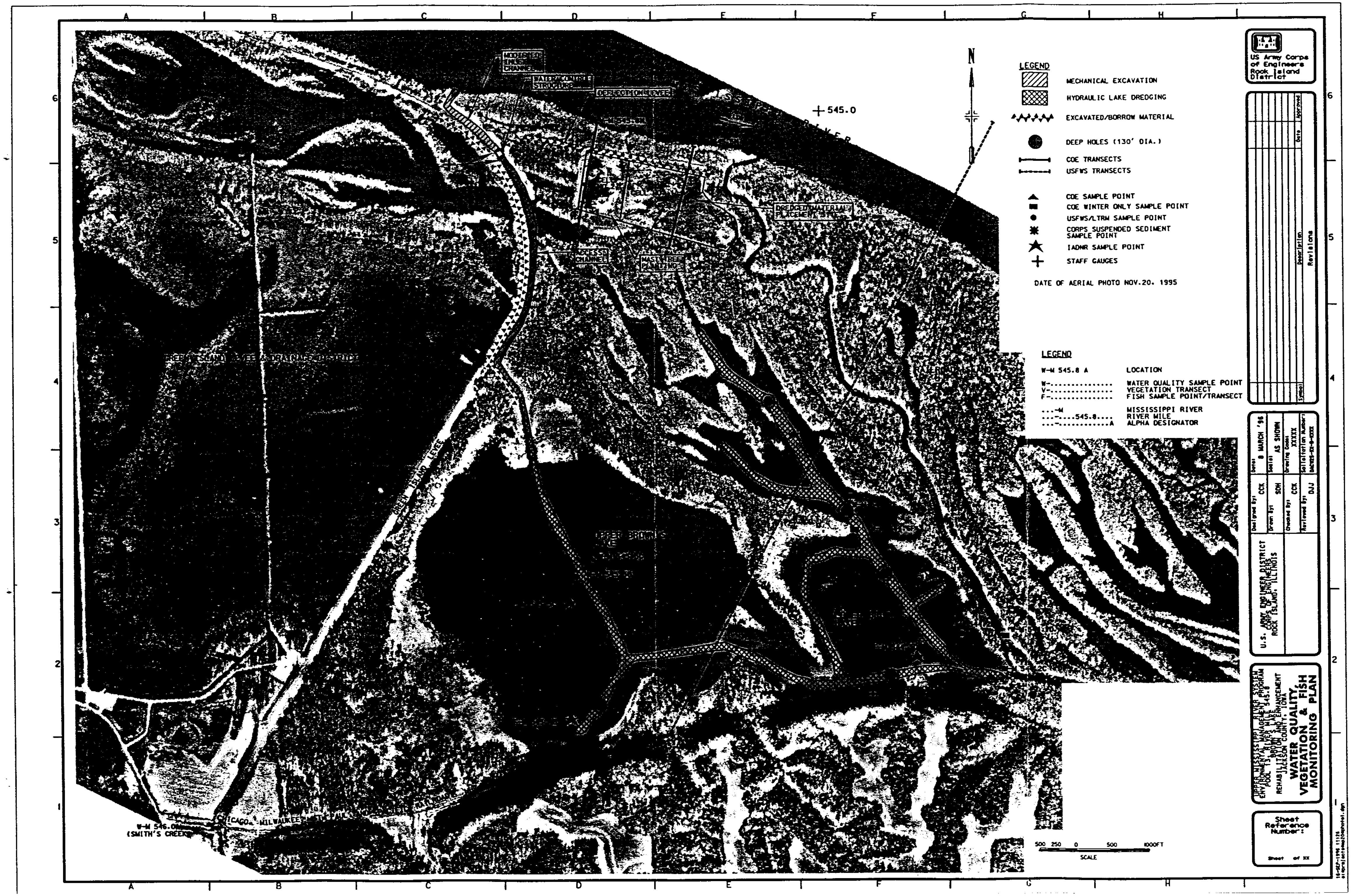
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

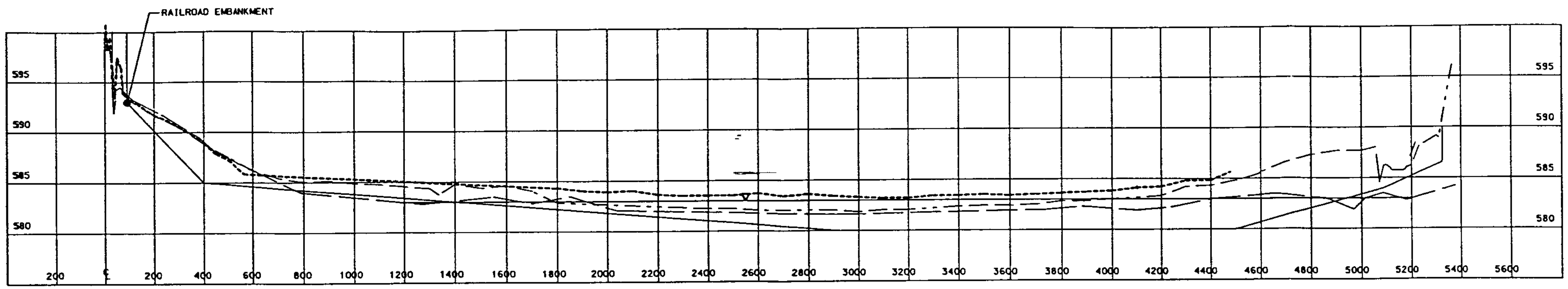
SEDIMENT TRANSECT MONITORING PLAN

Sheet Reference Number:

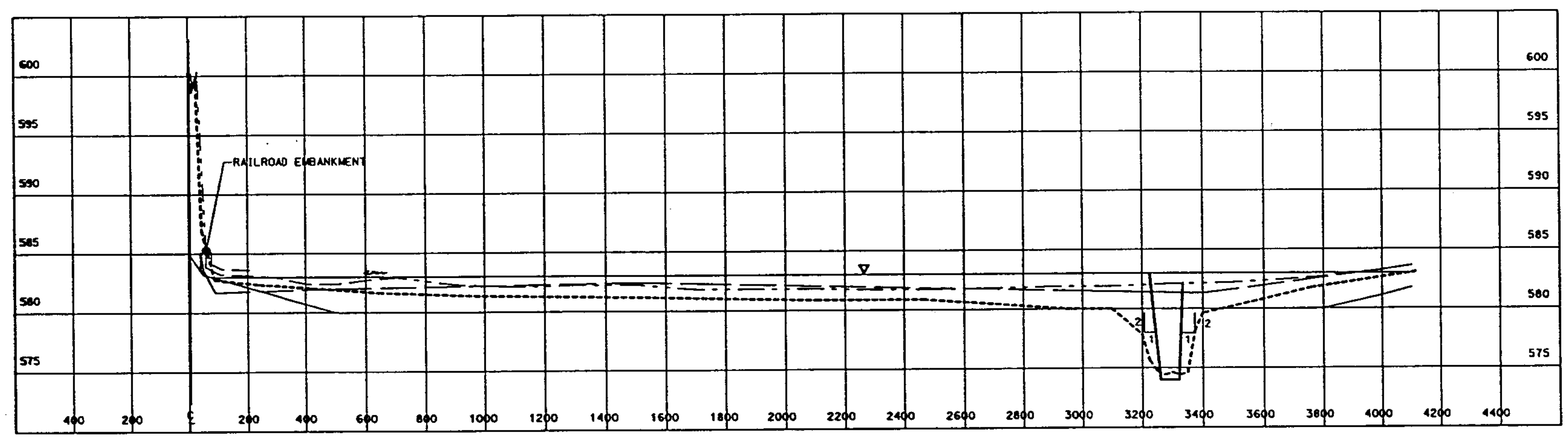
Sheet of XX

PLATE 3


LEGEND
MECHANICAL EXCAVATION
HYDRAULIC LAKE DREDGING
EXCAVATED/BORROW MATERIAL
DEEP HOLES (130' DIA.)
COE TRANSECTS
USFWS TRANSECTS
COE SAMPLE POINT
COE WINTER ONLY SAMPLE POINT
USFWS/LTRM SAMPLE POINT
CORPS SUSPENDED SEDIMENT SAMPLE POINT
IADNR SAMPLE POINT
STAFF GAUGES
DATE OF AERIAL PHOTO NOV.20, 1995
LEGEND
W-M 545.8 A LOCATION
W-............... WATER QUALITY SAMPLE POINT
V-............... VEGETATION TRANSECT
F-............... FISH SAMPLE POINT/TRANSECT
...-M MISSISSIPPI RIVER
...-...545.8.... RIVER MILE
...-.............A ALPHA DESIGNATOR
N
545.0
W-M 546.0
(SMITH'S CREEK)
500 250 0 500 1000FT
SCALE
US Army Corps of Engineers Rock Island District
Symbol Description Date Approved
Revisions
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed By: CCK
Drawn By: SDH
Checked By: CCK
Reviewed By: DJJ
Date: 8 MARCH '96
Scale: AS SHOWN
Drawing Code: XXXXX
Solicitation Number: DACW25-XX-B-XXXX
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA
WATER QUALITY, VEGETATION & FISH MONITORING PLAN
Sheet Reference Number:
Sheet of XX



S-M 545.8H



S-M 545.7H

LEGEND

MARCH & AUGUST 1995

APRIL 1987

DEC 1938 / FEB 1939

1929 / 1930

FLAT POOL = EL. 583.0

DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

Revisions

Symbol	Description	Date	Approved

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

Designed by: CCK	Date: 8 MARCH '96
Drawn by: SDH	Scale: AS SHOWN
Checked by: CCK	Drawing Code: XXXXX
Reviewed by: DJJ	Solicitation Number: DACW25-XX-B-XXXX

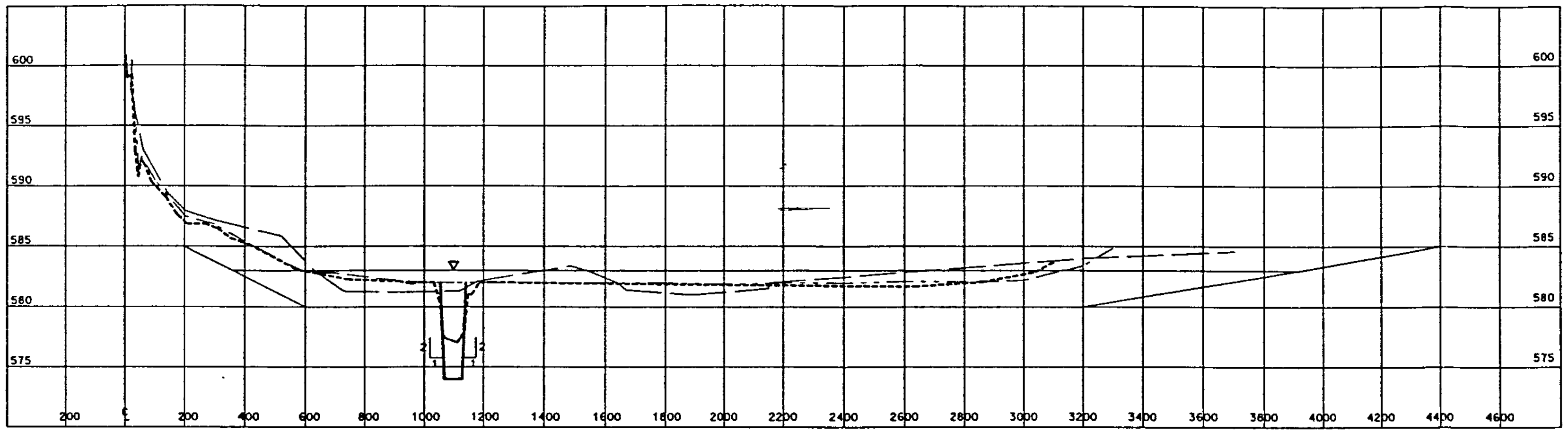
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

CORPS SEDIMENTATION TRANSECTS

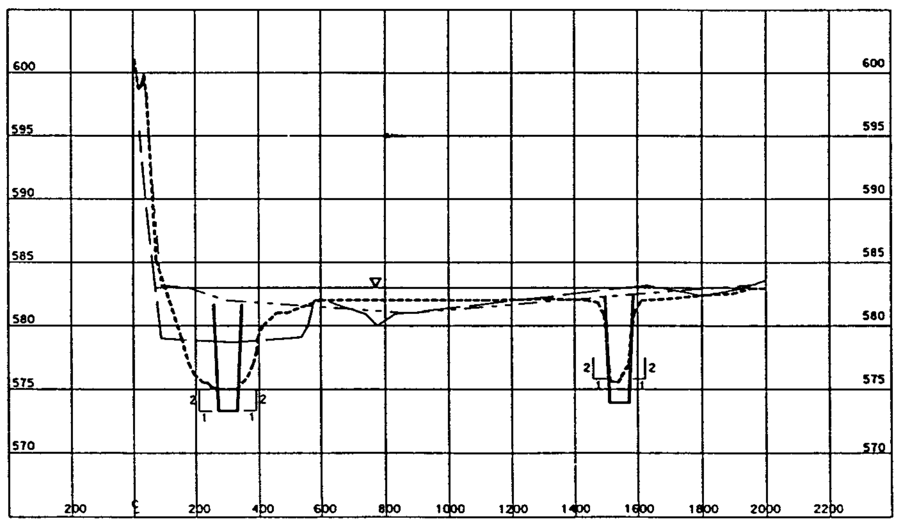
Sheet Reference Number:

Sheet of XX

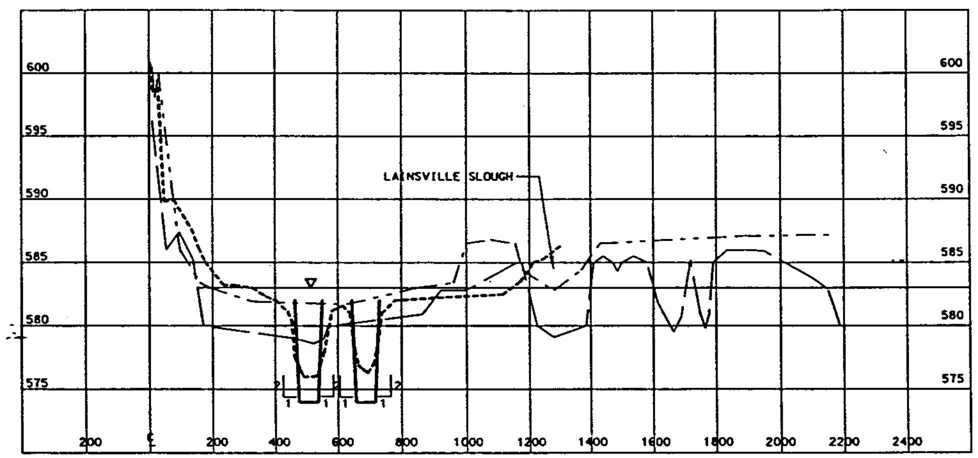
PLATE 5



S-M 545.3H



S-M 544.3H



S-M 544.1E

LEGEND

MARCH & AUGUST 1995

APRIL 1987

DEC 1938 / FEB 1939

1929 / 1930

FLAT POOL = EL. 583.0

DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

Designed by: CCK	Date: 8 MARCH '96
Drawn by: SDH	Scale: AS SHOWN
Checked by: CCK	Drawing Code: XXXXX
Reviewed by: DJJ	Solicitation Number: DACW25-XX-B-XXXX

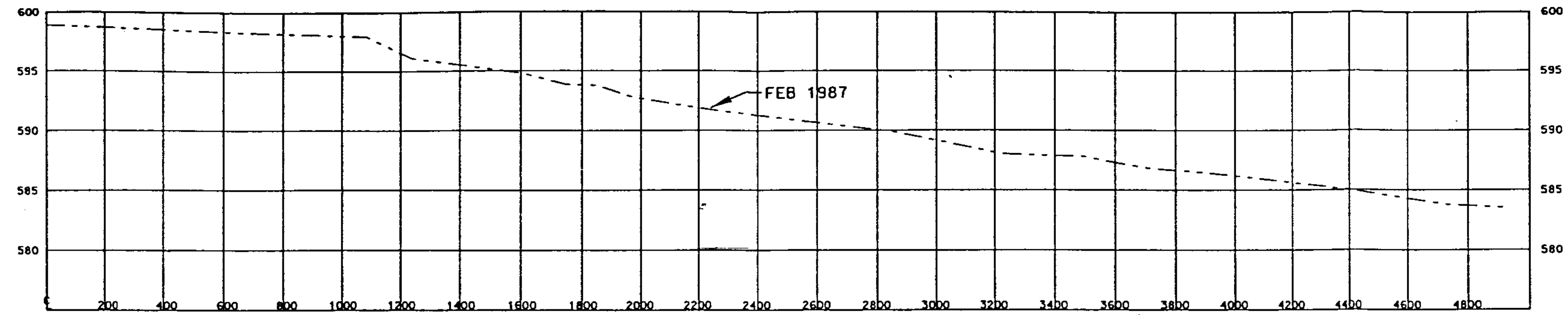
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

CORPS SEDIMENTATION TRANSECTS

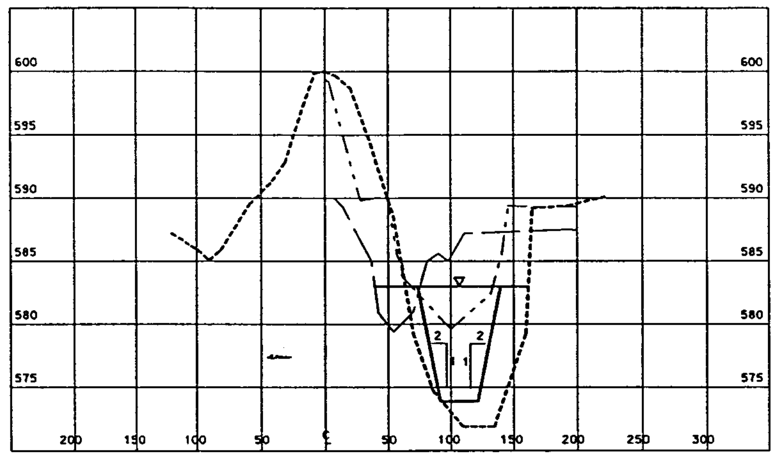
Sheet Reference Number:

Sheet of XX

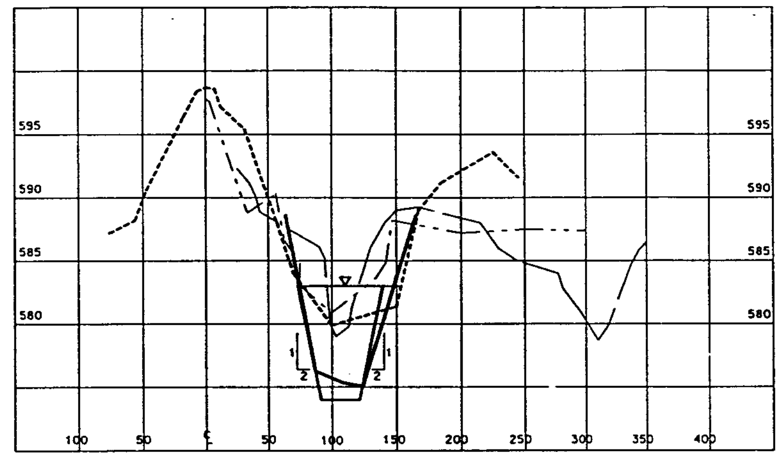


S-M 545.6B

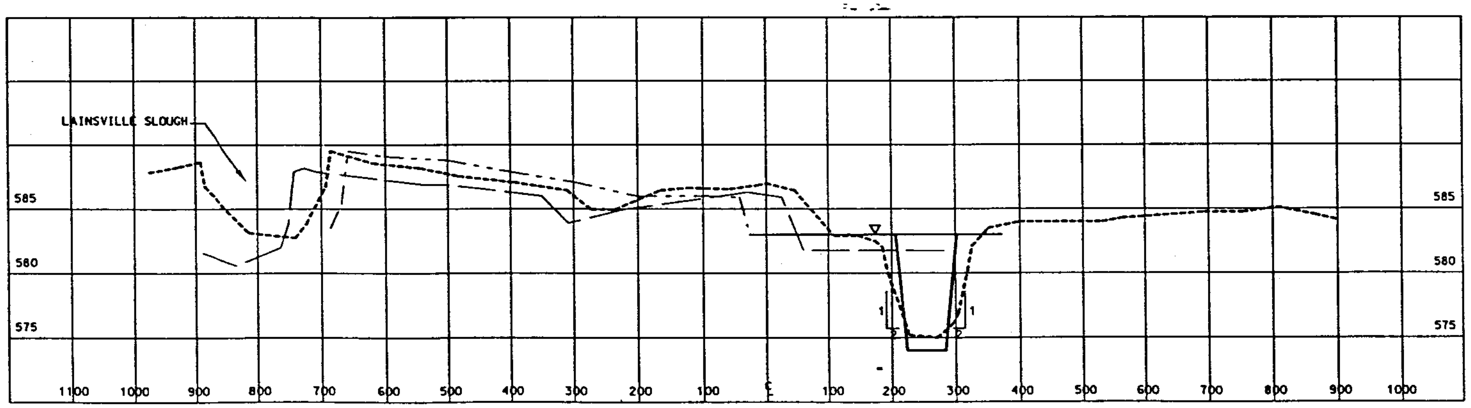
SMITH'S CREEK THALWEG (INACTIVE)



S-M 545.9H
ACCESS CHANNEL ADJACENT TO GREEN ISLAND LEVEE



S-M 546.3H
INLET CHANNEL



S-M 544.6H

LEGEND

MAY 23 1996

MARCH / AUGUST 1995

FEBUARY / APRIL 1987

DEC 1938 / FEB 1939

1929 / 1930

FLAT POOL = EL. 583.0

DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

Revisions

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDH	Scale: AS SHOWN
Checked By: CCK	Drawing Code: XXXXX
Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

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

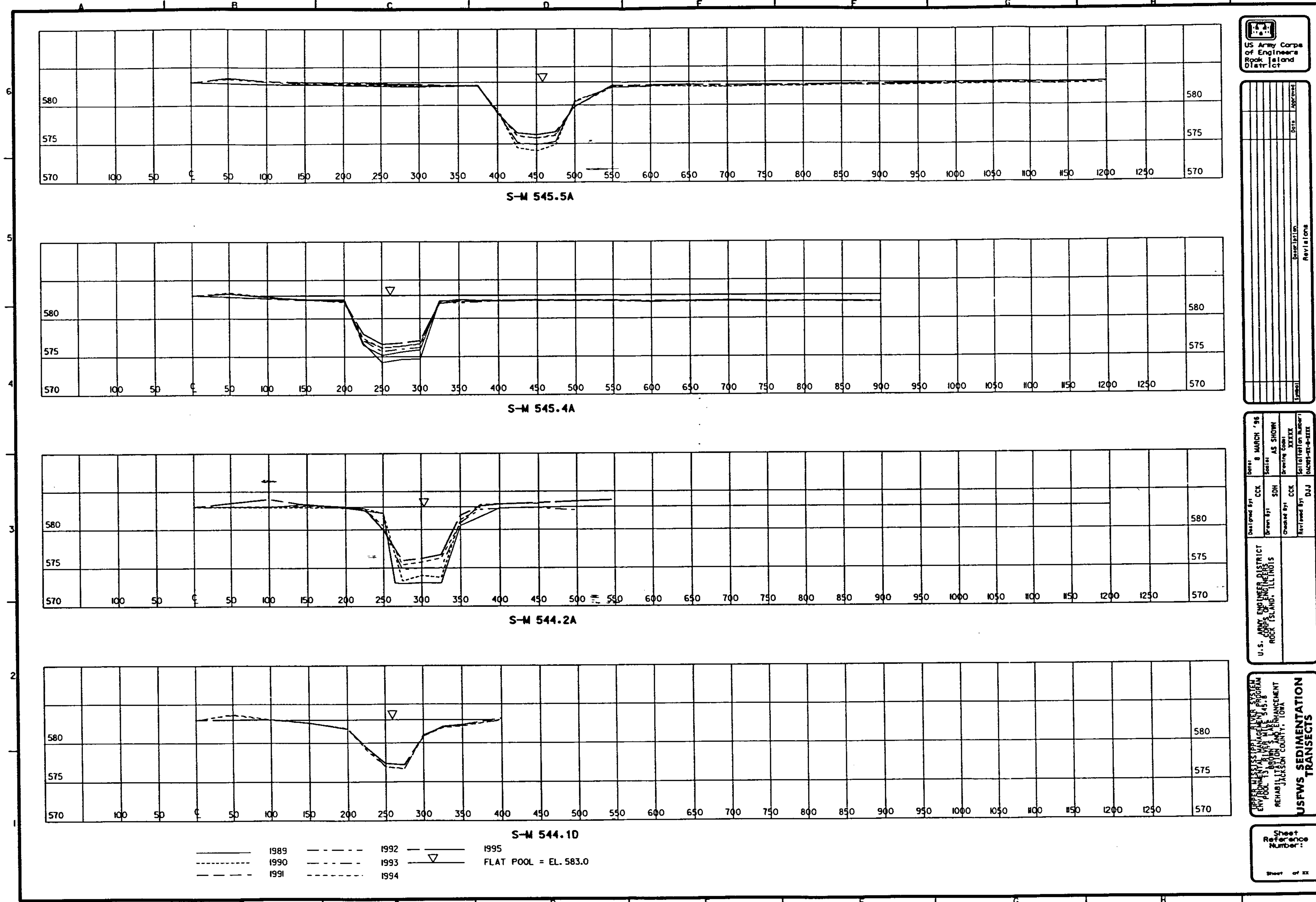
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

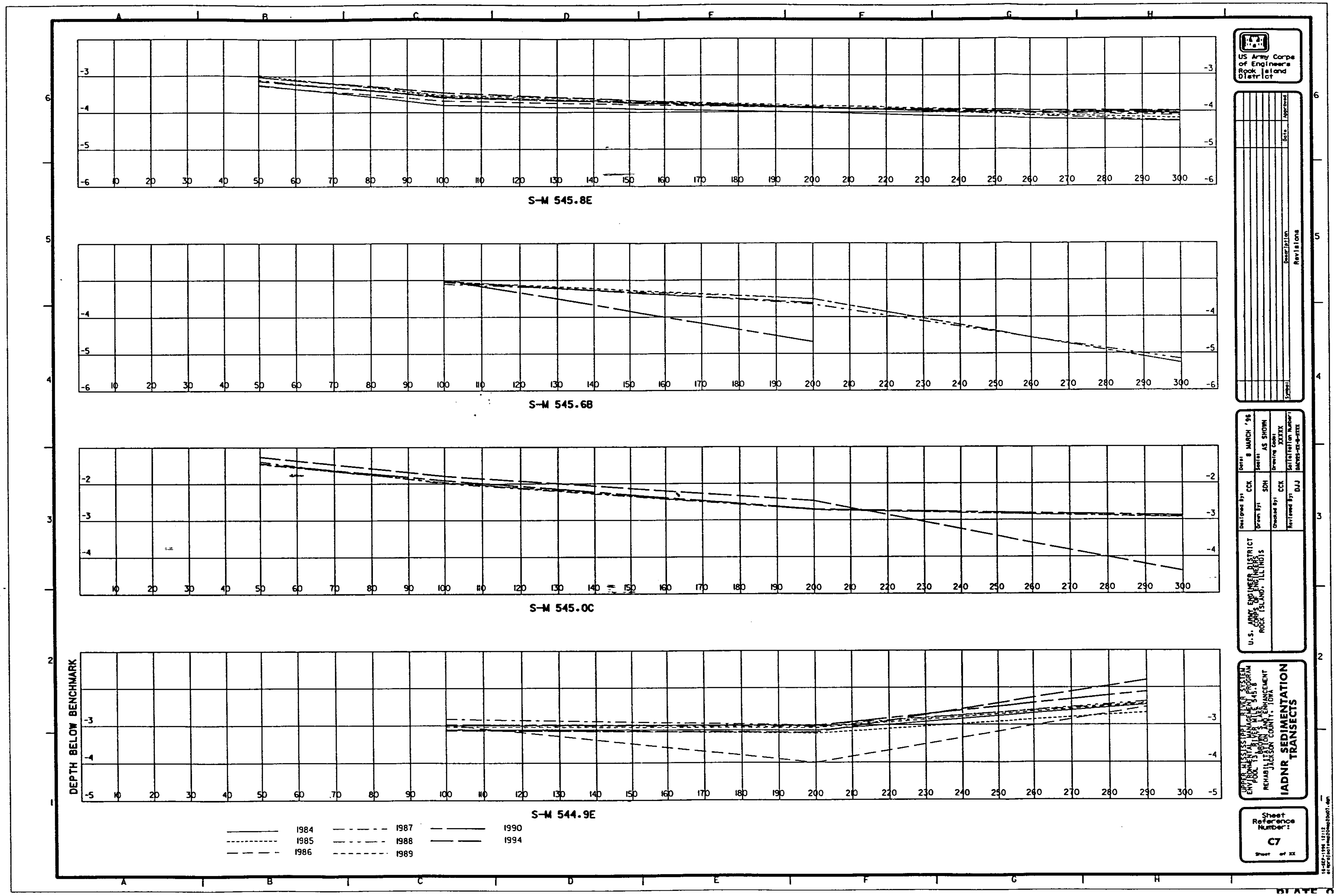
CORPS SEDIMENTATION TRANSECTS

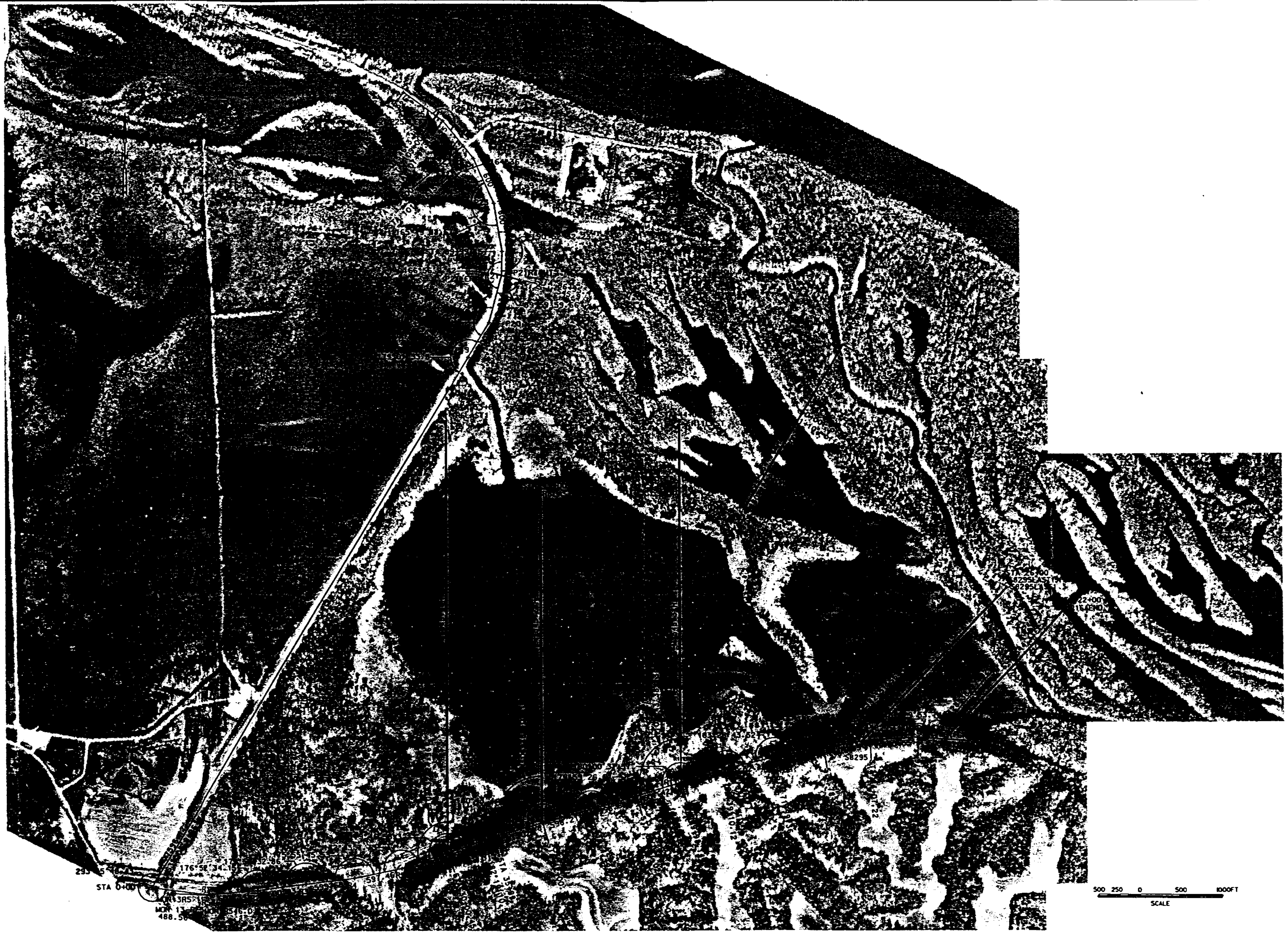
Sheet Reference Number:

Sheet of XX

PLATE 7


S-M 545.5A
S-M 545.4A
S-M 544.2A
S-M 544.1D
1989
1990
1991
1992
1993
1994
1995
FLAT POOL = EL. 583.0
US Army Corps of Engineers Rock Island District
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by: CCK
Drawn by: SDH
Checked by: CCK
Reviewed by: DJJ
Date: 8 MARCH '96
Scale: AS SHOWN
USFWS SEDIMENTATION TRANSECTS
Sheet Reference Number:


S-M 545.8E
S-M 545.6B
S-M 545.0C
S-M 544.9E
DEPTH BELOW BENCHMARK
1984
1985
1986
1987
1988
1989
1990
1994
US Army Corps of Engineers Rock Island District
Description
Revisions
Symbol
Date
Approved
Date: 8 MARCH '96
Scale: AS SHOWN
Drawing Code: XXXXX
Solicitation Number: DACW25-XX-B-XXXX
Designed By: CCK
Drawn By: SDH
Checked By: CCK
Reviewed By: DJJ
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA
IADNR SEDIMENTATION TRANSECTS
Sheet Reference Number:
C7
Sheet of XX



US Army Corps of Engineers
Rock Island District

Symbol	Description	Date	Approved

Revisions

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

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDH	Scale: AS SHOWN
Checked By: CCK	Drawing Code: XXXXX
Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

SURVEY LAYOUT FOR
COE SEDIMENT TRANSECTS

Sheet Reference Number:

Sheet of XX

16-SEP-1996 12:16

BROWNS LAKE EMP — Traverse.wr1 — 3/19/96 RHO

COORDINATES : from COMPUTATIONS sheets
"Traverse going up Green Island Levee" FC-87-3, pp.20-22 and
"Traverse comps along RR tracks" FC-86-26,pp.2-13 (points R1 to R17)

PT	NORTHING	EASTING	ELEV	DESCRIPTION [IOWA NORTH/NAD 27: ELEV 1912]
CONTROL:				
MON13R5	251568.44	2873317.74	600.49	mon 13-R-5
R546	251543.11	2873805.64	602.18	R546.0
TRAVERSE POINTS FOR GREEN ISLAND LEVEE (RUNNING NORTH)				
P1	251543.11	2873805.64	0.00	STA 0+00. nail @ CL RR & CL LEVEE. Start of Green Isl. stationing
P19	258141.10	2876990.61	0.00	STA 75+96.17. nail
P20	258569.07	2877249.15	0.00	STA 80+96.17. nail (shd.levee)
P21	259149.34	2877398.71	605.30	STA 86+95.4 . nail (shd.levee) S-M 545.9
P22	259443.00	2877405.83	~~0.00~~	STA 89+99.15
P23	260034.79	2877306.94	0.00	STA 95+99.15
P24	260582.25	2877061.40	0.00	STA 101+99.15
P24P104	260737.13	2876933.52	0.00	STA 104+00. COGO
P25	261044.40	2876679.85	0.00	STA 107+98.45. nail
P25A	261103.48	2876597.25	601.80	STA 109+00. COGO
P26	261392.73	2876192.91	0.00	STA 113+97.15
P26A	261044.98	2877341.42	0.00	line from p26 nail sta 12+00
P26B	261016.00	2877437.10	0.00	line from p26a nail sta 13+00
TRAVERSE ALONG CL OF RAILROAD (RUNNING EAST)				
R1	251557.85	2873768.43	604.48	STA 0+00. start of stationing along RR CL PK NAIL
R2	251600.25	2874368.87	601.45	from comps. PK NAIL
R3	251675.17	2874965.01	600.07	from comps. PK NAIL
R4	251750.20	2875559.98	600.31	from comps. PK NAIL
R5	251866.84	2876145.94	600.48	from comps. PK NAIL
R6	252057.79	2876715.34	600.11	STA 30+00.45. PK NAIL
R7	252250.30	2877282.26	600.46	STA 35+99.16. PK NAIL
R8	252420.36	2877858.72	600.12	STA 42+00.19. PK NAIL
R9	252582.42	2878434.56	600.11	STA 47+98.4. PK NAIL
R10	252744.59	2879010.80	600.06	STA 53+97.02. PK NAIL
R11	252907.61	2879589.70	600.17	STA 59+98.14. PK NAIL
R12	253069.82	2880166.12	600.15	from comps. PK NAIL
R13	253216.14	2880750.18	600.32	STA 71+99.36. PK NAIL
R14	253327.47	2881345.88	600.17	STA 78+05.37. PK NAIL
S8295	253405.23	2881829.41	0.00	STA 82+95. PK NAIL
R15	253425.41	2881939.71	600.35	STA 84+07.22. PK NAIL
R16	253456.06	2882539.48	600.32	STA 90+07.76. PK NAIL
R16A	253440.27	2882861.26	0.00	STA 93+30 W/NAIL
R17	253407.76	2883143.37	0.00	STA 96+13.58. PK NAIL

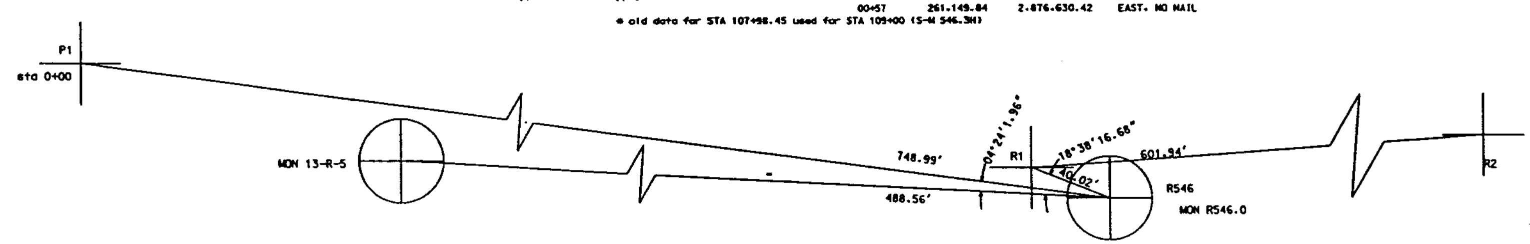
Brown's Lake Sed. Plot Data — Report.wr1 — 3/19/96 RHO

Source of data for sections/ranges: "drwg." : data from "Brown's Lake, Monitoring Ranges",Plates 18,19,20,21
Fieldbooks: FC-92-16/pp.70-71,75 FC-95-5/pp.11-13
"Traverse comps going up Green Island Levee" (from FC-87-3, pp.20-22)
"Traverse comps along RR tracks" (from FC-86-26, pp.2-13:pts.R1 to R17) Coordinates : IOWA NORTH / NAD 27, from COMP sheets

S-M	Control	1995	1987	1936/39	1929/30	Section	North	East	descriptor
RR TRACK RANGES (going East)									
545.8H	30+00.45	——	FC-87-3 pp.2-5	drwg.	drwg.	00+00	252,057.79	2,876,715.34	PK NAIL
						01+28.9	252,186.73	2,876,715.34	END
						53+81	257,438.79	2,876,715.45	COGO
545.7H	42+00.19	FC-95-5 pp.11	FC-87-3 pp.8-9	drwg.	drwg.	00+00	252,420.36	2,877,858.72	PK NAIL
						00+21.4	252,441.73	2,877,858.72	12" NAIL
						51+00	256,520.36	2,877,858.71	COGO, NO NAIL
545.3H	59+98.14	FC-92-16 pp.79	FC-87-3 pp.14-15	drwg.	drwg.	00+00	252,907.61	2,879,589.70	PK NAIL
						03+73	253,280.62	2,879,589.69	12" NAIL
						44+00	257,307.61	2,879,589.68	COGO, NO NAIL
544.3H	82+95.00	FC-92-16 pp.78	drwg.	drwg.	drwg.	00+00	253,405.23	2,881,829.41	PK NAIL
						00+33	253,429.49	2,881,852.44	12" NAIL
						26+00	254,855.98	2,883,206.13	COGO, NO NAIL
544.1E	93+30.00	FC-92-16 pp.77	drwg.	drwg.	drwg.	00+00	253,440.27	2,882,861.26	NAIL
						01+62.96	253,559.03	2,882,972.65	NAIL
						22+00	255,043.56	2,884,367.73	COGO, NO NAIL
INNER BROWN'S LAKE RANGE (Southwest of Railroad Island)									
544.6H	30+00.00	FC-95-5 pp.12-13	drwg.	drwg.	drwg.	9+00	256,689.88	2,880,654.12	WEST
						0+00	257,461.57	2,881,117.25	S-M 544.6 H
						5+00	257,890.26	2,881,374.55	pt.8
						-9+75	258,297.54	2,881,619.01	EAST
GREEN ISLAND LEVEE (going Northeast)									
545.68	SMITH'S CREEK/ THALWEG	——	drwg.	drwg.	drwg.				
545.9H	86+95.40	FC-92-16 pp.76	FC-87-3/24 FC-87-5/13	drwg.	——	-1+21	259,179.54	2,877,281.54	WEST, NO NAIL
						00+00	259,149.34	2,877,398.71	12" NAIL
						02+21	259,094.18	2,877,612.72	EAST, NO NAIL
546.3H	109+00.00	FC-92-16 pp.58,60	*FC-87-3 pp.26	drwg.	——	-0+76	261,041.67	2,876,553.04	WEST, NO NAIL
						00+00	261,103.48	2,876,597.25	COGO
						00+57	261,149.84	2,876,630.42	EAST, NO NAIL

S-M 544.6H RANGE COORDINATES BASED ON GPS SOUNDING DATA OF 2/96 — 5/20/96 RHO

* old data for STA 107+98.45 used for STA 109+00 (S-M 546.3H)



SCALE: NONE

US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved
	Revisions		

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

Designed By: CCK — Date: 8 MARCH '96
Drawn By: SDH — Scale: AS SHOWN
Checked By: CCK — Drawing Code: XXXXX
Reviewed By: DJJ — Solicitation Number: DACW25-XX-B-XXXX

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 13, RIVER MILE 545.8 BROWN'S LAKE REHABILITATION AND ENHANCEMENT JACKSON COUNTY, IOWA

SURVEY CONTROL FOR COE SEDIMENT TRANSECTS

Sheet Reference Number: X1

Sheet 1 of XX