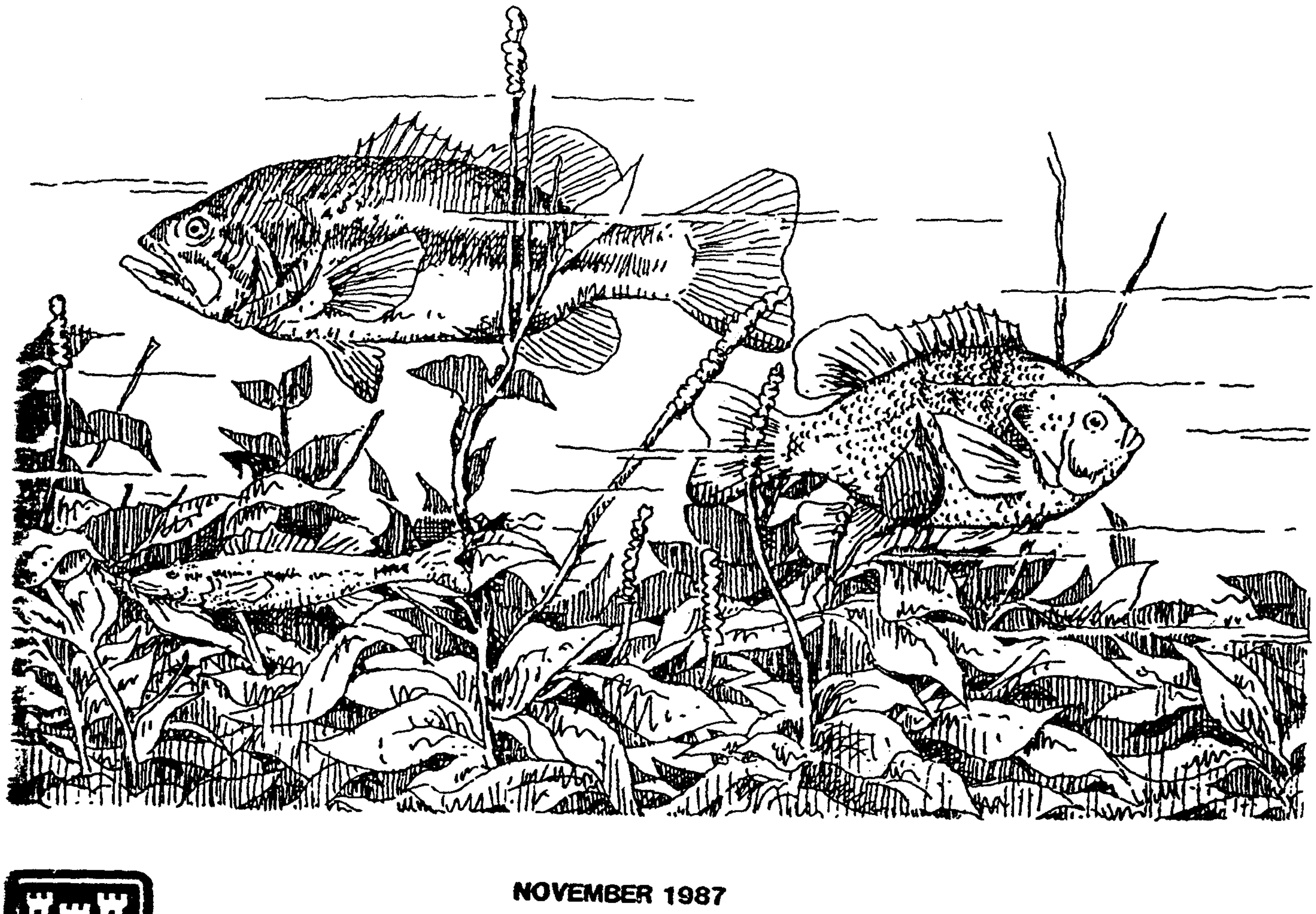
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

With
Environmental Assessment



NOVEMBER 1987

US Army Corps
of Engineers
Rock Island District

POOL 13, RIVER MILE 545.8
UPPER MISSISSIPPI RIVER
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-R

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REHABILITATION AND ENHANCEMENT

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WITH ENVIRONMENTAL ASSESSMENT

NOVEMBER 1987

ACKNOWLEDGMENT

Many members of the Rock Island District assisted in the preparation of this report. Primary study team personnel who contributed to the study are listed below.

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US Army Corps of Engineers

Rock Island District

WE'RE PROUD TO SIGN OUR WORK

SYLLABUS

Brown's Lake is a 453-acre backwater complex approximately 10 miles south of Bellevue, Iowa, on the Iowa side of the upper Mississippi River and is located in Pool 13. The lake is managed by the U.S. Department of Interior, Fish and Wildlife Service, as part of the Upper Mississippi River National Wildlife and Fish Refuge. Because of sedimentation, this area has gone from a lake which was up to 6 feet deep in the 1930's to a 6- to 18-inch-deep marsh complex. Continued sedimentation with associated water quality degradation will increase the frequency of winter fish kill and will negatively impact an historically important migratory waterfowl, fishery, and furbearer area.

The purpose of this Definite Project Report is to present a detailed proposal for the rehabilitation and enhancement of Brown's Lake. The report marks the conclusion of the planning process and will serve as a basis for approval of the preparation of final plans and specifications and subsequent project construction.

The recommended plan, termed Basic Development Plan, consists of the construction of a deflection levee, water control structure, side channel access excavation, and lake dredging to be accomplished at 100 percent Federal funding under the authorization of the Upper Mississippi River System - Environmental Management Program authority. The purposes of these features are to increase deepwater habitat, to enhance oxygen-rich water to enter Brown's Lake from the main channel, and to reduce deposition of sediment from floodwaters in Brown's Lake. The estimated cost of the project is $2,873,000.

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SECTION 1 - INTRODUCTION

STUDY AUTHORITY

The authority for this report is provided by the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The proposed project would be funded and constructed under this authorization. Section 1103 is summarized as follows:

Section 1103. UPPER MISSISSIPPI RIVER PLAN

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

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

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

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

(B) implementation of a long-term resource monitoring program;

(C) implementation of a computerized inventory and analysis system;

(D) implementation of a program of recreational projects;

(E) assessment of the economic benefits generated by recreational activities in the system; and

(F) monitoring of traffic movements on the system.

PURPOSE AND SCOPE

PURPOSE

The purpose of this report is to present a detailed proposal for the rehabilitation and enhancement of Brown's Lake. This report provides planning, engineering, and sufficient construction details of the selected plan to allow final design and construction to proceed subsequent to approval of this document.

SCOPE

Brown's Lake is a 453-acre backwater complex approximately 10 miles south of Bellevue, Iowa, on the Iowa side of the Upper Mississippi River and is located in Pool 13. The project area is approximately at Upper Mississippi River mile 545.8 in Jackson County, Iowa (see plate 1).

The Brown's Lake project consists of habitat rehabilitation and enhancement. All of the area is included in the Upper Mississippi River National Wildlife and Fish Refuge. This area has gone from a lake which was up to 6 feet deep in the 1930's to a 6- to 18-inch-deep marsh complex. Continued sedimentation increases the probability of winter fish kill and negatively impacts an historically important migratory waterfowl, fishery, and furbearer area.

The scope of this study has focused on proposing project features that will reduce sedimentation, improve existing water quality, restore lost water habitat, improve terrestrial habitat, and be consistent with management and economic considerations.

RELATED STUDIES, REPORTS, AND EXISTING WATER PROJECTS

STUDIES AND REPORTS

Upper Mississippi River System - Environmental Management Program, General Plan, U.S. Army Corps of Engineers, North Central Division, January 1986, with addendums. These documents provide a general plan for the implementation of the Environmental Management Program. The Brown's Lake Definite Project Report is considered to be an appendix to the General Plan. Habitat Rehabilitation and Enhancement projects are intended to enhance or rehabilitate aquatic and terrestrial habitat lost or threatened as a result of man-induced activities or natural factors.

Erosion Control Component. An erosion control component for Smith's Creek drainage basin of Brown's Lake also has been proposed. This component is described under "Development of Alternative Plans."

Long-Term Resource Monitoring and Computerized Inventory and Analysis. Section 1103 of the Upper Mississippi River Management Act of 1986 (Public Law 99-662) authorizes long-term data collection and resource monitoring. Post-construction monitoring of Brown's Lake will be performed under this program.

Upland Erosion Studies. The Iowa Soil Conservation Service is investigating basin erosion and resultant runoff sediment.

Sedimentation Ranges. Sediment ranges are defined and reproducible traverses which can be periodically surveyed to determine changes in elevations due to sediment movement. The Iowa Department of Natural Resources has established three sedimentation ranges in Brown's Lake effective in 1983. These ranges and resultant sedimentation have been incorporated in this report.

Fish Surveys. The Iowa Department of Natural Resources has conducted fish surveys since 1979.

EXISTING WATER PROJECTS

Mississippi River 9-foot Channel. The proposed Brown's Lake project is adjacent and contiguous to the Mississippi River 9-foot channel as authorized by the Rivers and Harbors Act of July 3, 1930. Proposed project features of this report will not affect navigation.

Green Island Levee and Drainage District No. 1.

The proposed Brown's Lake project is adjacent to the Green Island Levee and Drainage District No. 1 which is managed as the Green Island Wildlife Management Area. (See plate 4 for location.) Approximately 9.6 miles of levees protect some 4,486 acres along the Mississippi River and the Maquoketa River (Area No. 2). During construction of the Mississippi River Nine-Foot Channel Project, the Federal Government acquired 2,718 acres of land in Area No. 2 because it was more economical than payment of the estimated capitalized cost of rectification damages.

In 1943, the U.S. Army Corps of Engineers-owned land was made available to the Department of Interior, who later made the land available to the Iowa State Conservation Commission (now Department of Natural Resources). About one-fourth of the managed area is farmed on a lease basis with one-third of the grain crop being left in the fields for the benefit of wildlife. The remaining three-fourths of the managed area consists of natural ponds, lowlands, and ditches.

On September 6, 1955, the Jackson County Board of Supervisors and the Iowa Conservation Commission executed an agreement for levee maintenance. The agreement provides that the Conservation Commission is responsible for maintaining 4.8 miles of levee on or contiguous to the Government-owned land. The county supervisors agreed to maintain 4.8 miles of levee which protects the district from moderate overbank flows from the Maquoketa River. The original construction cost and date of levee construction are unknown.

The principal objectives of this management unit are the production and harvest of waterfowl; production of furbearers; support of public fishing; and maintenance and improvement of raptor, heron and egret feeding and roosting habitat. The area is managed, operated, and maintained by the Iowa Department of Natural Resources with an interior controlled water level of 585.6 feet MSL (mean sea level).

SECTION 2 - PLAN FORMULATION

ASSESSMENT OF WATER AND LAND RESOURCES

RESOURCE HISTORY

Brown's Lake is part of the Upper Mississippi River National Wildlife and Fish Refuge as established on June 7, 1924. Original acreage for the project was acquired through purchase, donation, and by withdrawal from public domain by the Department of Interior. The area was later enlarged by additional land acquisitions of the U.S. Army Corps of Engineers for navigational improvements. These additional tracts are managed as part of the refuge under terms of a Cooperative Agreement dated February 14, 1963, between the Department of the Army and Department of Interior.

PRESENT OPERATION AND FEATURES

Brown's Lake is presently operated by the U.S. Fish and Wildlife Service as an aquatic backwater habitat. From a flatpool elevation of 583.0 feet MSL, the average depth of water is 6 to 18 inches. Table 1 provides a summary of selected existing features.

TABLE 1

Brown's Lake Existing Features

Feature	Area, Acres
Aquatic Conditions	
Main Channel	-
Main Channel Border	-
Side Channel	
Adjacent to Green Island Levee	15
Lainsville Slough Side Channel	22
Sloughs	-
River Lake	
Upper Brown's	300
Lower Brown's	153
Tailwaters	-
Marsh	
Lake Perimeter	61
Smith's Creek (wetland emergent)	189
Total Aquatic	740
Terrestrial Conditions	
Forest	
Main lands	417
Islands (4)	4
Brush	-
Meadow	-
Sand	-
Mud Flat	-
Agriculture	-
Developed	-
Total Terrestrial	421
Total Aquatic and Terrestrial	1,161

HYDROLOGY

During low Mississippi River flows, water presently flows into Upper Brown's Lake through a side channel access as shown on plate 2. The entrance invert of this channel into Upper Brown's Lake is approximately 583.5 feet MSL. When Mississippi River levels drop below 583.5, the majority of surface river water entering Upper Brown's Lake stops. During these times, water surface elevations of Upper and Lower Brown's Lake will approximate the water elevation at the junction of Lainsville Slough and Lower Brown's Lake. Under low-flow conditions, the hydraulic gradient for this reach of the river is approximately 0.25 foot per mile.

River water overtops the banks during an approximate 2-year event. During these events, water enters Brown's Lake by the existing side channels and overland. The hydraulic gradient for flood events is approximately 0.4 foot per mile.

SEDIMENTATION

It is estimated that approximately 0.45 inch of sediment per year has been deposited in the Brown's Lake area. Sedimentation rates vary from 0.17 inch per year in Lower Brown's Lake to 1.18 inches per year at the mouth of Upper Brown's Lake. These estimates were based on a comparison of similar sedimentation ranges from 1930 contour maps (Brown's) and field surveyed elevations taken in February 1987. See plate 17 for sedimentation ranges and appendix A for sedimentation analyses. A summary of existing sedimentation is presented in table 2.

Smith's Creek is the predominant watershed adjacent to Brown's lake which directly contributes significant sediment. Besides the Mississippi River watershed at this location, other adjacent and relatively minor watersheds are shown on plate 4. The 3,650-acre Smith Creek watershed is approximately 50 percent cropland and 50 percent grazed forest and pastureland. Most of the cropland is on 5-14 percent slopes, with forest and pastureland on 15-25 percent slopes. Sediment is produced from excessive sheet and rill erosion on cropland and numerous gullies on the remaining land. The relatively small watershed has a high sediment yield based on observations. The total soil loss consisting of sheet and gully erosion amounts to approximately 28,000 tons per year. According to Iowa Soil Conservation Service estimates, approximately 40 percent of the total or 11,200 tons of sediment are being delivered to the mouth of Smith's Creek each year. Table 2 provides a summary of estimated sedimentation annual volumes.

TABLE 2

Summary of Sedimentation

Feature	Annual Sedimentation: Existing Conditions AC-FT	Existing Conditions %	Sediment Reduction Potential: Basic Development Plan AC-FT	Basic Development Plan %	Basic Development Plan and Updated Upland Erosion Control AC-FT	Basic Development Plan and Updated Upland Erosion Control %
Smith's Creek Watershed						
Existing	5.6	18.2	NA	NA	NA	NA
Upland Erosion Control	NA	NA	0	0	5.0	16.7
Mississippi River						
Existing	25.2	81.8	NA	NA	NA	NA
Basic Development Plan	NA	NA	20.1	65.3	20.1	65.3
Total	30.8	100.0	20.1	65.3	26.1	82.0

Soil borings were taken by Rock Island District personnel in February and June 1987. The logs with soil classifications are shown on plates 8 and 9. Boring B-87-1 is located at the delta of the Smith's Creek watershed entrance into Upper Brown's Lake. In situ water content and soil classification tests indicate that sediments in this area are approximating original river alluvium which is located at approximately 5 to 7 feet from the surface. These top sediments have consolidated more effectively and have not been affected by surface wave mixing.

Boring B-87-2 is located near the outlet of the existing side channel access into Upper Brown's Lake. Analysis of sediment in this area shows sediments to be predominantly organic fat clays with very high in situ water contents which approach the liquid limits of the soils. It appears that sediments in this zone have been recently deposited or that they have not effectively stabilized to denser soils.

Borings B-87-4 and B-87-5 are located in Lower Brown's Lake and indicate a more stable soil with in situ water contents approaching that of original river alluvium. Observed field water quality, fish habitat, and water depth all suggest that Lower Brown's Lake should be more conducive to aquatic enhancement.

WATER QUALITY

Water quality sampling was performed with results presented in appendix B. Elutriate analyses showed no parameter significantly exceeding surface water quality standards. Dissolved oxygen sampling was conducted during the winter of 1986/1987 and will continue in efforts to determine critical oxygen demands. This mild and snow-free winter did not specifically show problems with dissolved oxygen or observed winter kill. During this period, the majority of Brown's Lake was covered with full depth ice. Iowa Department of Natural Resources personnel have reported winter kill problems during past winters with heavy snow cover. Sampling by Rock Island District will continue through construction and as part of the Long-Term Resource Monitoring Program.

ENVIRONMENTAL RESOURCES

A 1979 fisheries survey conducted by the Iowa Conservation Commission (now DNR) documented a diverse fish community of 39 different species. White crappie, black crappie, and blue gill are the major sport fish species in Upper and Lower Brown's Lake. Carp and buffalo are the major commercial fish species. Brown's Lake complex also serves as an important resting area for fish, such as sauger, during periods of high current velocity in the main channel and main channel border habitats.

The project receives a high migratory bird use which is enhanced by the proximity of the area to the Green Island Wildlife Management Area. Some of the deeper aquatic habitat areas support submergent vegetation that is food for migrating, diving ducks. The shallow areas are used extensively by dabbling ducks and shore birds. Wood duck broods also have been noted in the area.

FUTURE CONDITIONS WITHOUT THE PROJECT

Without the proposed project, it is anticipated that sedimentation of the Brown's Lake area will continue at an approximate rate of 0.5 inch per year. At this rate, it is estimated that the aquatic habitat will be converted to terrestrial habitat within 25 to 50 years. During this time, existing emergent wetland habitat would succeed to terrestrial habitat; first as willows, then to silver maples and cottonwoods. Additional wetlands and mudflats would be created annually which would also succeed to terrestrial habitat. Ultimately, the area would be left with a few acres of wetland habitat associated with Smith's Creek drainage.

The current diversity of fish and wildlife would steadily decline until fish, waterfowl, and shorebird use would be almost nonexistent. Some fish species might use the area to spawn during high water periods. Wood ducks would probably find some suitable nest cavities. Furbearer use would be minimal.

Wildlife species such as white-tailed deer, woodpeckers, and squirrels would probably increase during this habitat change.

SPECIFIC PROBLEMS AND OPPORTUNITIES

The Brown's Lake project was selected as an environmental management program candidate through consultation with the U.S. Fish and Wildlife Service and Iowa Department of Natural Resources. The project was chosen because of the potential to improve and restore water habitat lost due to sedimentation.

The project meets the criteria for potential, feasible projects as presented in the General Plan. The project meets the following specific criteria:

Readiness. The project is properly defined with no significant institutional obstacles requiring resolution. This project is not subject to cost-sharing; advance engineering and design is sufficiently completed for construction with this report; permits/NEPA requirements have been completed; and coordination has been effected with other agencies.

Compatibility. The proposed project is consistent with the Fish and Wildlife Service Master Plan for Refuge Lands and Corps Land Use Allocation Plans.

Public and Agencies Support. This project is supported by the U.S. Fish and Wildlife Service, the Iowa DNR, and the Iowa Soil Conservation Commission. No known public agency has objected to this project.

Low Operation and Maintenance Cost. The proposed project features have been designed for low operation and maintenance costs.

Geographic Distribution. The project is located adequately relative to other Environmental Management Program proposed projects.

Visibility. The project is visible to the public as an existing refuge.

Corps Workload Distribution. The project is compatible with Corps workloads.

Minimal Land Acquisition by the Federal Government. The project requires no additional fee title lands. Minor construction easements will be required.

PLANNING OBJECTIVES/CONSTRAINTS

OBJECTIVES

The objectives for this project are:

(1) Retard the loss of fish and wildlife aquatic habitat by reducing sedimentation in Upper and Lower Brown's Lake.

(2) Improve water quality for Upper Brown's Lake and Lower Brown's Lake by decreasing suspended sediment concentrations and increasing winter dissolved oxygen concentrations.

(3) Increase fish habitat in Upper and Lower Brown's Lakes by dredging.

(4) Increase fish diversity by providing varied water depths.

(5) Increase habitat available for wintering fish by providing deeper water areas.

(6) Increase bottomland hardwood diversity by increasing selected terrestrial elevations and reducing frequency of flooding for such hardwoods.

CONSTRAINTS

In addition to coordination and support with the U.S. Fish and Wildlife Service, the Iowa DNR, and other agencies, all Corps of Engineers water resources planning projects are bound by all Federal and State laws and Executive Orders.

DEVELOPMENT OF ALTERNATIVE PLANS

MEASURES AVAILABLE TO ADDRESS PROBLEMS

There are two principal measures to meet the improved water quality/reduced sedimentation objectives described previously: provide upland erosion control to prevent/reduce upland sediments from reaching Brown's Lake and prevent/reduce river sediments from reaching Brown's Lake. Both measures complement each other and together meet the total project objectives. Mechanical excavation and hydraulic dredging with terrestrial confined disposal appear to be the only measures available to increase aquatic habitat and provide bottomland hardwood diversity.

FORMULATION CRITERIA

Completeness

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments, or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or agency actions if they are crucial to the objectives.

Effectiveness

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the recognized opportunities.

Efficiency

Efficiency is the extent to which an alternative plan is considered to be a cost-effective means of solving the specified problems and realizing the recognized opportunities.

Acceptability

Acceptability is the viability of an alternative plan with respect to the desires of the U.S. Fish and Wildlife Service, state, local governments, and the public. In order to be acceptable, the plan must be in accordance with existing laws, regulations, and public policies.

ALTERNATIVE A - NO FEDERAL ACTION

No Federal action would consist of no Federal funds being provided to meet the project purposes. State and local funds would be required to restore and enhance aquatic habitat.

ALTERNATIVE B - BASIC DEVELOPMENT PLAN

The basic development plan consists of the construction of a deflection levee, a water control structure, an improved inlet side channel, side channel excavation, lake dredging, terrestrial dredged material disposal and planting of mast-producing trees. These features are shown on plate 2.

The deflection levee would consist of an earthen embankment levee constructed to a 50-year flood frequency event. A water control structure would be located at the junction of the new deflection levee and the existing Green Island Levee. A riprapped overflow section, or equivalent overflow consideration, would be provided to minimize overtopping damage. The purpose of the deflection levee and water control structure is to prevent Mississippi River flood flows and associated continuous sediment loads from directly entering Brown's Lake. Sedimentation effects are presented in table 2.

The existing inlet channel to Upper Brown's Lake would be improved to restrict/reduce river debris and sediment from reaching Upper Brown's Lake. The inlet channel would be realigned with the mouth oriented downstream rather than the existing upstream orientation. A similar realigned mouth of Lainsville Slough, as completed in the early 1980's, improved entrance conditions and has performed satisfactorily. The excavated material would be placed upstream and downstream of the modified inlet to provide greater debris blockage/deflection during overland flood flows.

Side channel excavation would be performed adjacent to the existing Green Island Levee to provide year round fish access from the river to Upper Brown's Lake. Material from this excavation would be placed on the river side of the Green Island Levee.

Lake dredging would be performed as shown on plate 2. Approximately 370,000 cubic yards of fine-grained sediments would be hydraulically dredged and placed into a terrestrial disposal site. The terrestrial disposal site would be ringed by a containment levee built from adjacent borrow.

The terrestrial disposal site would be filled to a depth of approximately 6 to 8 feet. The entire disposal site would be cleared and replanted at the higher elevation. Replanting would principally consist of mast-producing trees that provide fruits/nuts to area wildlife such as wood ducks, wild turkeys, squirrels, and white-tailed deer. The disposal site also would serve as a continuation of the deflection levee.

ALTERNATIVE C - FULL EXPANSION PLAN

This alternative consists of all features of the Basic Development Plan as described above, with increased construction features as follows: provide an additional 500,000 cubic yards of lake dredging in both Upper and Lower Brown's Lake; provide a new disposal site adjacent to Upper Brown's Lake dredging areas; extend the deflection levee southerly forming a complete ring levee around the entire Upper and Lower Brown's Lake; and perform existing side channel access cleanout and debris removal from Lainsville Slough. These features are shown on plate 3.

The increased lake dredging would provide additional aquatic habitat. This dredging would require an additional terrestrial disposal site as shown. Similar treatment of the disposal site as in the basic plan is proposed.

The extension of the deflection levee forming a ring levee would totally isolate Upper and Lower Brown's Lake from Mississippi River events up to a 50-year frequency. An additional outlet closure structure would be required at the junction of the levee tie-off adjacent to Lower Brown's Lake and high ground.

Approximately 2,000 lineal feet of Lainsville Slough is blocked by debris and sand sedimentation. Removal of this debris and sedimentation would increase fish habitat and river access to Brown's Lake. Conversely, removal of this natural blockage may allow sediment bedloads to enter Lower Brown's Lake and could decrease fish habitat in the slough.

ALTERNATIVE D - UPLAND EROSION CONTROL

Construction of upland erosion control facilities and management to achieve sound soil conservation practices would prevent upland sedimentation from entering Upper Brown's Lake from the Smith's Creek watershed. Proposed upland erosion control would involve the installation of approximately 16 grade stabilization structures and upland land treatment consisting of: 580 acres of contour strip cropping; 94 water and sediment control basins; 34,500 feet of terraces; 411 acres of conservation tillage; and 19 small grade stabilization structures. Through implementation of the upland erosion control component, it is estimated that sediment delivery to Brown's Lake from Smith's Creek should be reduced as shown in table 2.

Upland erosion control is being pursued as a future, separable element of the Brown's Lake project as discussed under "Related Studies, Reports, and Existing Water Projects." A decision on whether to proceed with this component is not expected until the mid-1990's. This timeframe will allow the proposed Brown's Lake features to be constructed and evaluated for overall sediment reduction. This project would be subject to cost sharing.

EVALUATION OF ALTERNATIVE PLANS

Alternative A does not meet the rehabilitation and enhancement objectives for Brown's Lake. No action consequences are described in "Development of Alternative Plans."

Features of Alternative C were eliminated as immediate program alternatives principally due to economic constraints. The increased lake dredging would provide an additional 240 acre-feet of aquatic habitat. Conversely, this increased dredging would require an additional terrestrial disposal site of approximately 50 acres.

Completion of the levee forming a ring closure around Brown's Lake would provide management control of all waters entering and leaving Brown's Lake. However, fish studies have shown that such closures have tendencies to reduce fish species and aquatic diversity.

The estimated first cost of Alternative C is $6,589,000. Annual operations and maintenance costs of approximately $17,700 would be required to operate and maintain the entire levee as a water retaining structure including the water control structures.

Alternative B has an estimated first cost of approximately $2,873,000 A detailed cost estimate is presented in table 7. Annual operation and maintenance costs are estimated at $11,260, which are necessary for maintenance of the closure structure, initial years of mast planting care, and deflection levee maintenance (table 6). This plan provides a commensurate increase of habitat rehabilitation and enhancement consistent with estimated costs.

Both Alternatives B and C provide beneficial use of the excavated/dredged soil. Mechanical excavation along the Green Island Levee would be placed on the river side of the levee to increase section. The hydraulically dredged lake material would be beneficially used for the planting of bottomland seedings and provide a future borrow site.

With respect to excavation along the Green Island Levee, both Alternatives B and C were analyzed to determine seepage effects. Seepage analyses showed no measureable effect from seepage into or out of the Green Island Levee zone.

An evaluation of alternatives using formulation criteria from section 2 is shown in table 3.

TABLE 3

Evaluation of Alternatives

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
A-No Federal Action	No	No	No	No
B-Basic Development Plan	Yes	Yes	Yes	Yes
C-Full Expansion	Yes	Yes	No	No
D-Upland Erosion Control	No	Yes	Yes	Yes

SELECTION OF FINAL PLAN

Alternative B, Basic Development Plan, was selected as the final plan. This plan meets all program objectives and is cost effective. This plan further provides an acceptable trade-off balance between the additional aquatic habitat versus the loss of existing terrestrial vegetation. Should additional funds become available, additional lake dredging should be performed from the Full Expansion Plan with disposal into the primary disposal site of the Basic Development Plan.

SECTION 3 - DESCRIPTION OF THE SELECTED PLAN

PLAN COMPONENTS

DEFLECTION LEVEE

The deflection levee will be built to elevation 598.4 feet MSL, a 50-year flood event. This elevation is approximately equivalent to the elevation of the existing Green Island Levee system. The levee would function as a water deflection feature to prevent continuous flow through and subsequent sedimentation during Mississippi River flood events. The maximum differential head would be less than 1 foot. It is estimated that a single water column of floodwater sedimentation with each event will occur with the deflection levee as compared to a continuous water column during uncontrolled river events. The deflection levee will reduce sedimentation as shown in table 2.

The levee will be built parallel to the Mississippi River approximately 200 feet from the shoreline. The levee will start adjacent to the existing Green Island Levee and extend to the Lainsville Slough for an approximate length of 3,500 feet. The average height of the levee will be approximately 8 to 10 feet. The levee would be built when river levels are low with conventional construction equipment using adjacent borrow sites as shown on plates 10 and 13. Side slopes of the deflection levee will be 3 horizontal to 1 vertical. Alternative borrow is discussed under "Design and Construction Considerations."

A turnaround structure will be constructed at the end of the levee near Lainsville Slough. Riprap will be placed at this location for protection from floodwater erosion. A riprapped depressed section of the deflection levee with crown elevation of 597.4 feet MSL also will be constructed to allow floodwaters to overtop the levee. This feature is not considered significant due to minor differential heads (less than 1 foot) and will be reevaluated during final design.

WATER CONTROL STRUCTURE

Connecting the proposed deflection levee with Green Island Levee will be a water control structure which will limit the amount of water entering Upper Brown's Lake. When water levels of the Mississippi River rise with heavy sediment bedloads, the gatewell structure will be closed to prevent such flows from entering Upper Brown's Lake. The gates will remain closed with flows deflected from direct entrance into Brown's Lake until the levee is overtopped.

The water control structure will consist of 4 slide gates, each 5 feet by 5 feet, with individual operating stems. Stems should be stainless steel to ensure long-term maintenance free use. Gates should be operated to optimally control quality and quantity of water entering Upper Brown's Lake. The slide gates will operate against a 1 foot head differential. The concrete of the structure will provide additional dimension to allow future installation of sluice gates against a differential head of approximately 15 feet, should future expansion complete a ring levee around the entire Upper and Lower Brown's Lake.

INLET CHANNEL IMPROVEMENT

The inlet channel will be improved as shown on plate 11. Typical cut and fill sections are shown on plate 15. The purpose of this modification is to restrict debris and bedload sedimentation from reaching the new water control structure and Brown's Lake by reorienting the mouth downstream rather than the present upstream. Excavation could be performed by either land-based or floating plant dragline or clamshell. Material will be side-cast upstream and downstream of the modified entrance to provide additional debris deflection and service access to the entrance. Finished side slopes of 4 horizontal to 1 vertical for the excavated material, along will immediate seeding, should stabilize this area against overland flood erosion.

SIDE CHANNEL EXCAVATION

Side channel excavation will be performed adjacent to the existing Green Island Levee as shown on plates 2 and 15. The centerline of the proposed excavation will be approximately 115 feet from the centerline of the Green Island Levee. Excavation could be performed by land-based or floating-plant dragline or clamshell. Material will be side-cast onto the river side of the Green Island Levee to provide additional levee section, stability, and future borrow. Material from the last reach of access channel leading into Upper Brown's will be side-cast to the west to provide a connecting service from the levee.

LAKE DREDGING

Lake dredging is proposed as shown on plate 2. Dredging will be performed to ensure a minimum maintained water depth of 7 feet below flat pool as shown in table 5. Occasional deep holes approximately 20 feet in depth will be provided for diversity.

TERRESTRIAL DREDGED MATERIAL DISPOSAL

The terrestrial dredged material disposal area with typical sections is shown on plates 13 and 14. The containment levee will be placed using adjacent borrow. Clearing for the containment levee, borrow and disposal site will be required. The approximate height of the containment levee will vary from 8 feet to 10 feet which will allow a dredged material depth of 6 to 8 feet. Table 4 provides a comparison between the 6- and 8-foot dredged material depths.

TABLE 4

Contrast of Hydraulically Dredged Material Containment Depths

Area, Acres	Disposal Depth	
	6 feet	8 feet
	Volume, YD3	Volume, YD3
15	145,200	193,600
20	193,600	258,200
25	242,000	322,700
30	290,400	387,200
35	338,800	451,700
40	387,200	516,300
45	435,600	580,800
50	484,000	645,300
55	532,400	-
60	580,800	-
65	629,200	-

Column settling analyses were performed to determine the required dredged water detention time and total volume for dredged material containment as presented in appendix D. The dredged material will require approximately 14 hours of settling time to meet effluent water quality and will occupy an initial volume approximately 1.5 times larger than the in situ sediments.

The disposal site will be replanted with species such as swamp white oak, pin oak, northern pecan, and shell bark hickory after sufficient drying/consolidation. Seedlings 2 to 3 feet in height are proposed. Trees should be spaced approximately 1 tree per 100 square feet and placed in rows to facilitate maintenance mowing during initial years of tree establishment. Lack of maintenance mowing during these years will result in these trees being overtaken by volunteer vegetation/trees. Herbicides should be used during the maintenance period to assist seedlings in competing against volunteer herbaceous species. After construction, the disposal site must consolidate/dry before tree planting. Fall planting should be effected to avoid spring flooding damage and allow planting during the normal dormant stage.

DESIGN AND CONSTRUCTION CONSIDERATIONS

EXISTING SITE ELEVATIONS

As shown on plates 10 and 13, the entire construction zone is located within the floodplain of the Mississippi River. Existing ground elevation of the deflection levee ranges from approximately elevation 588 to 590 feet MSL which corresponds to an approximate 2-year flood event.

The cost estimate for the proposed features is based on use of conventional earthmoving and compaction equipment. It is estimated that such construction can normally occur during the months of July through February. Unusually wet fall years could affect construction contract expenditures.

BORROW SITES

Initial borrow sites have been located at high ground locations as shown on plate 13. It is estimated that with normal pool conditions from July through February of each year, construction equipment can excavate from borrow sites down to elevation 586 feet MSL without unreasonable excavation or drying techniques. A borrow site alternative consists of using hydraulically dredged sand from Lower Brown's Lake. Side slopes on the deflection levee would be increased to 4 horizontal to 1 vertical.

Where practical, the final design will require wetland development by excavating borrow sites to elevation 583.0 feet MSL.

DREDGING DEPTHS AND EQUIPMENT

With the exception of selected deep hole dredging, dredging depth was based on water clearances as shown in table 5.

TABLE 5

Basis of Dredging Depth

Elevation (MSL)	Description
583.0	Pool 13 flat pool
- 1.0	Present low-flow winter regulation
- 7.0	Maintained water depth *
- 1.0	100 years of sediment (.1 inch per year)
574.0	Minimum dredge depth

* A depth of 6 to 8 feet is typical of existing side channels.

A cutter head dredge approximately 10 to 14 inches in size, will be required to remove the soft overburden and original firm alluvium. Intermittent tree stumps would be removed by a dragline/clamshell. Explosives would be allowed for stump removal. A stump survey will be conducted during preparation of final plans and specifications.

EROSION CONTROL

Riprap is proposed at the river face of the water control structure as shown on plate 16 to provide protection against entrance flow erosion and wind-generated wave erosion and at the depressed section during controlled overtopping. Additional riprap is proposed at the terminus of the deflection levee adjacent to Lainsville Slough.

An estimated width of 200 feet of existing forest will remain between the deflection levee and the Mississippi River. This zone should adequately buffer the new deflection levee from Mississippi River events. A similar buffer zone in the adjacent Green Island Levee area has performed satisfactorily. An existing forest zone of approximately 50 feet will remain between the riverside of the dredged material containment levee and Lainsville Slough. Construction and borrow in these buffer zones should not occur.

Placement

DREDGED ~~DISPOSAL~~ SITE

The final design will provide contractor options for disposal methods while meeting effluent standards. It is anticipated that the final design will require a two-cell disposal area. One cell would be in use while the other cell would be settling and consolidating. For ponding depths of 1 to 2 feet, minimum settling time ranges from 14 hours to 33 hours to meet an overall removal objective efficiency of 96 percent (see appendix D). The final area required for disposal may vary due to sediment types and settling characteristics.

PERMITS

A Section 404 process of the Clean Water Act will be completed prior to submission of this report for final approval. A Section 401 water quality certificate and Section 404(b)(1) evaluation are contained in the Environmental Assessment in appendices B and C, respectively.

A consolidation/drying period of the disposal site will be required prior to final mast tree planting. This work will be performed by a subsequent construction contract. Coordination with the U.S. Fish and Wildlife Service and the Iowa DNR will be effected during the final design of this phase regarding the species types, clearing practices, planting layouts and elevation control.

REAL ESTATE REQUIREMENTS

LOCAL COOPERATION AGREEMENT/COST-SHARING

The project is proposed for 100 percent Federal funding for first costs. The Brown's Lake project area is part of the Upper Mississippi River National Wildlife and Fish Refuge. The Water Resources Development Act of 1986 (Public Law 99-662) is the basis for first cost Federal funding and provides:

Section 906. FISH AND WILDLIFE MITIGATION.

(e) ... the first costs of such enhancement shall be a federal cost when -

(3) such activities are located on lands managed as a national wildlife refuge.

CONSTRUCTION EASEMENTS

All project features are located on lands owned by the Federal Government. The U.S. Fish and Wildlife Service has provided a letter of consent authorizing work on Department of Interior lands. A construction easement/agreement with the Green Island Levee District will be required for construction access purposes and placement of excavated soil.

OPERATION AND MAINTENANCE CONSIDERATIONS

OPERATION

The U.S. Fish and Wildlife Service would be the responsible agency for operation and maintenance. The estimated annual operation costs are presented in table 6.

TABLE 6

Estimated Annual Operation and Maintenance Costs
(June 1987 Price Level)

Item	Quantity	Unit	Unit Costs	Total Costs
Operation				
Gate Control	80	hr	17	1,360
Maintenance				
Inspection	40	hr	17	680
Mow deflection levee/ seedling care (3 mowings)	126	ac	30	3,780
Herbicide treatment of seedling area	43	ac	80	3,440
Debris removal	40	hr	50	2,000
Total Annual Operation and Maintenance				11,260

The gates of the water control structure should be operated in an open position except for most Mississippi River flood events. When Mississippi River flood events occur or when flood flows from the Maquoketa River produce significantly turbid entrance flows, all gates in the closure structure should be closed. An Operations and Maintenance Manual will be prepared by Rock Island District for U.S. Fish and Wildlife Service use prior to construction completion.

MAINTENANCE

The proposed features have been designed to ensure low annual maintenance requirements with the estimated annual maintenance costs presented in table 6. After construction, the main deflection levee should be mowed periodically to prevent growth of trees and brush. This procedure will ensure future flexibility if a Brown's Lake total levee closure were constructed.

The water control structure should be annually inspected to ensure gates, seals, and equipment are performing satisfactorily. Riprap in the vicinity of the control structure and at the deflection levee terminus should be inspected annually to ensure riprap blanket integrity and effectiveness. Debris immediately upstream of the water control structure should be removed as needed to prevent gate jamming with associated fresh water flow loss into Upper Brown's Lake.

LONG-TERM MONITORING

Proposed monitoring ranges are shown on plate 17. Monitoring under the Long-Term Resource Monitoring element of the Environmental Management Program minimally should be accomplished as follows:

(1) Establish base sedimentation ranges in the Brown's Lake complex, including Lainsville Slough, and perform annual sedimentation measurements at the same ranges to assess effects of the proposed project.

(2) Perform ground surface measurements to provide erosion estimates of the deflection levee and the containment levee.

(3) Perform in-stream flow measurements relative to river stage through the water control structure and Lainsville Slough to verify inflow effectiveness and improve gate operation.

(4) Perform dissolved oxygen concentrations during critical seasons at fixed stations to verify project effectiveness.

(5) Perform soundings of dredged lake and access channels to provide estimates of channel sloughing.

(6) Perform bottomland hardwood survival inventories of planted species to assess survival rates and productivity in Brown's Lake and Lainsville Slough.

(7) Perform fishery inventories to assess effects from project features.

(8) Perform submergent vegetation inventories in Brown's Lake and Lainsville Slough to assess effects from project features.

(9) Perform associated monitoring as need dictates.

COST ESTIMATE

A detailed estimate of cost is presented in table 7. Quantities may vary during final design.

TABLE 7

Detailed Estimate of Cost
(June 1987 Price Level)

Item	Quantity	Unit	Unit Cost($)	Total Cost ($)
Deflection Levee				
Clearing	7	ac	2,000.00	14,000
Stripping	5,300	yd3	2.00	10,600
Embankment Fill	50,200	yd3	4.00	200,800
Riprap	5,600	ton	26.00	145,600
Seeding	7	ac	1,500.00	10,500
				381,500

TABLE 7 (Cont'd)

Water Control Structure				
Embankment Fill	5,200	yd3	6.00	31,200
Excavation	3,100	yd3	6.00	18,600
Concrete	485	yd3	350.00	169,750
Dewatering	60	Days	300.00	18,000
Slide Gates	4	ea	8,000.00	32,000
				269,550
Channel to Water Control Structure				
Clearing	1	ac	2,000.00	2,000
Excavation	8,600	yd3	3.50	30,100
Seeding	2	ac	1,500.00	3,000
				35,100
Channel from Water Control Structure to Upper Brown's				
Excavation	6,300	yd3	3.50	22,050
Clearing	1	ac	2,000.00	2,000
Seeding	5	ac	1,500.00	7,500
				31,550
Confined Disposal Site				
Clearing	43	ac	1,500.00	64,500
Confinement Levee Fill	34,900	yd3	2.00	69,800
Mast Planting/Revegetation	43	ac	1,000.00	43,000
				177,300
Hydraulic Dredging	370,000	yd3	3.50	1,295,000
Subtotal				2,190,000
Contingencies (15%)				329,000
Estimated Construction Cost				2,519,000
Engineering and Design (8%)				202,000
Supervision and Administration (6%)				152,000
TOTAL				2,873,000

SUMMARY OF PLAN ACCOMPLISHMENTS AND EFFECTS

PROJECT DATA SUMMARY

Table 8 presents a summary of project data.

TABLE 8

Project Data Summary

Deflection Levee		
Embankment Fill	55,400	cubic yards
Length	3,500	feet
Crown elevation	598.4	feet MSL
Side slopes	3:1	H:V
Riprap	5,600	tons
Overflow section		
Length	250	feet
Overflow elevation	597.4	feet MSL
Estimated Sediment Effects		
Existing annual river sedimentation		
Volume	25.2	acre-feet
Average depth	0.4	inch
Annual river sedimentation with project implemented		
Volume	5.1	acre-feet
Average depth	0.1	inch
Water Control Structure		
Type	-	slide gate in embankment fill
Gates	4-5'x5'	slide gates
Invert elevation	577.0	feet MSL
Trashracks	-	upper and lower ends
Modified Inlet Channel		
Length	1,200	feet
Invert elevation	574.0	feet MSL
Section dimension	-	Bottom (invert) width of 30 feet
Side slopes	2:1	H:V
Access Channel Adjacent to Green Island Levee		
Length	4,000	feet
Invert elevation	574.0	feet MSL
Section dimension	-	Bottom (invert) width of 30 feet
Side slopes	2:1	H:V
Terrestrial Dredged Material Site		
Containment levee	5,000	feet
Material depth	8	feet
Area	43	acres
Capacity	550,000	cubic yards

TABLE 8 (Cont'd)

Mast Planting at Disposal Site		
Pin Oak	6,000	each
Northern Pecan	4,000	each
Shellbark Hickory	4,000	each
Black Walnut	1,000	each
Total planting area	35	acres
Lake Dredging		
Volume	370,000	cubic yards
Invert elevation	574.0	(9' from flat pool)
Deep hole invert elevation	563.0	(20' from flat pool)

EFFECTS

The proposed project will reduce sedimentation in both Upper and Lower Brown's Lake due to the construction of the deflection levee and inlet water control structure. By selecting desirable river inlet water, improved lake water quality will benefit both aquatic and waterfowl habitat. Bottomland hardwood revegetation will benefit terrestrial habitat. Side access channel and lake dredging will increase aquatic habitat.

SECTION 4 - PLAN IMPLEMENTATION

SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 9 presents the schedule of project completion steps.

TABLE 9

Project Implementation Schedule

Requirement	Scheduled Date
Submission of Draft DPR to Corps of Engineers, North Central Division for Review	Jun 87
Distribution of DPR for Public and Agency Review	Oct 87
Submit Final and Public Reviewed DPR to the Chief of Engineers for Review, Approval and Funding for Plans and Specifications	Nov 87
Receive Plan and Specification Funds	Dec 87
Construction approval by Assistant Secretary of the Army (Civil Works)	Jan 88
Initiate Real Estate Permits/Agreement	Feb 88
Submit Final Plans and Specifications to North Central Division for Review and Approval	Mar 88
Obtain Real Estate Permits/Agreement	Apr 88
Advertise Contract	May 88
Award Contract	Jun 88
Complete Construction	Sep 90
Complete Revegetation	Sep 92

IMPLEMENTATION RESPONSIBILITIES AND VIEWS

CORPS OF ENGINEERS

The Corps of Engineers, Rock Island District, is responsible for project management and coordination with the U.S. Fish and Wildlife Service, the State of Iowa, and other affected agencies. The Rock Island District will submit the subject detailed project report; program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration.

U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service will ensure that adequate operation and maintenance functions are performed. Authorization has been provided to the Corps of Engineers for construction on Fish and Wildlife owned lands.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

COORDINATION MEETINGS

Close coordination between the Corps of Engineers, the U.S. Fish and Wildlife Service, and the Iowa Department of Natural Resources personnel was effected during the study period. A listing of meetings follows:

(1) March 14, 1986, discussed project scope and objectives.

(2) September 22, 1986, discussed project scope and objectives.

(3) March 13, 1987, rescoped project objectives.

(4) April 24, 1987, performed site visit.

(5) June 8, 1987, performed site visit to verify alternatives.

(6) August 23, 1987, reviewed draft DPR.

ENVIRONMENTAL REVIEW PROCESS

This project meets the requirements of the National Environmental Policy Act as evidenced by the attached Environmental Assessment and Finding of No Significant Impact.

SECTION 5 - RECOMMENDATION

I recommend that the Basic Development Plan, consisting of a deflection levee, water control structure, side channel access excavation, and lake dredging, be approved for implementation as a 100 percent Federal project under the authorization of the Upper Mississippi River System-Environmental Management Program authority.

Neil A. Smart
Colonel, U.S. Army
District Engineer

HYDROLOGY AND HYDRAULICS

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UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

POOL 13, RIVER MILE 545.8
UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

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APPENDIX A
HYDROLOGY AND HYDRAULICS

GENERAL

Brown's Lake, shown on plate A-1, is located at approximate river mile (RM) 545.8 in Pool 13 of the Mississippi River. Locks and Dams 13 and 12 are located at RM 522.5 and RM 556.7, respectively. This indicates that Brown's Lake is in the upstream third of the pool. Typically, upper reaches of a pool, being further away from the dam, continue to transport sediment similar to open river conditions. However, these upper reaches did not gain the increased depth as did those closer to the dams when the pools were created. About 20 million tons of sediment are transported through Pool 13 each year. Typical concentrations are approximately 100 parts per million (ppm). The concentrations are higher during flood flows, and much of the annual sediment is transported during only a few periods of high flows.

The purpose of this appendix is to present the development and evaluation of proposed improvements which will provide greater water depths, reduce the impacts or rate of sediment deposition, and improve the water quality in the backwater area.

CLIMATE

The climate in east-central Iowa is characterized by extreme temperatures and moderate precipitation. The National Weather Service operates a weather station in Clinton, located about 20 miles south of Brown's Lake, which has over 100 years of record. Temperatures range from a maximum of 109 degrees Fahrenheit in the summer to a minimum of -27 degrees Fahrenheit in the winter.

Most of the precipitation occurs in summer and fall months, with a record 24-hour rainfall of 8.7 inches and the maximum monthly total of 11.94 inches in September 1927. The minimum total monthly precipitation was only a trace recorded in October 1952. The average annual precipitation is 35.5 inches, and the normal temperature is 50.4 degrees Fahrenheit. The average annual snowfall is 29.55 inches. Table A-1, shown below, lists the approximate monthly rainfall amounts at the Clinton gage for the 100 years of record during the periods 1865 to 1871 and 1878 to 1970.

TABLE A-1

Average Monthly Precipitation

Month	Inches	Month	Inches
January	1.69	July	3.78
February	1.58	August	3.88
March	2.62	September	3.79
April	3.20	October	2.55
May	4.08	November	2.10
June	4.47	December	1.76

HYDROLOGY

Mississippi River discharge frequency relationships and corresponding water surface profiles were promulgated by the Upper Mississippi River Basin Commission (UMRBC) in a November 1979 study entitled Upper Mississippi River Water Surface Profiles, River Mile 0.0 to River Mile 847.5. Plate A-2 presents this basic hydrologic data. Actual water surface elevations are recorded daily at Sabula, Iowa, (RM 535) and at Lock and Dam 12's tailwater (RM 556.7). These elevations were averaged to obtain daily stages at RM 545.8 near Brown's Lake. Plates 5, 6, and 7 of the main report show the daily stage hydrographs for the period of record 1965 through 1986.

Typical floods appear to last for at least 25 days and raise the water surface about 4 feet. These data were used to compute monthly and year-round elevation duration relationships for Brown's Lake as presented on plates A-3 through A-6. The 50 percent duration elevation can be interpreted as the average elevation. The months of January, August, and September have the lowest normal elevations, referenced to feet above mean sea level (MSL), of 584.9, 584.4, and 584.5, respectively. The year-round normal elevation is about 585.5 feet MSL.

SEDIMENT CONDITIONS

Sediment conditions and impacts on the habitat of the area are the major concerns of this project. Historical records of past sedimentation rates are essentially nonexistent. Plates A-7 and A-8 are copies of information provided by the Iowa Department of Natural Resources. This information indicates a loss in depth of about 0.06 and 0.13 foot per year in Upper and Lower Brown's Lake.

A paper by J. Roger McHenry, dated March 1981, entitled "Recent Sedimentation Rates in Two Backwater Channel Lakes, Pool 14, Mississippi River" indicates widely varying deposition rates, with an average of about 0.1 foot per year. "Sedimentation in Quincy Bay and Potential Remedial Measures," Illinois State Water Survey Report 108 (1987), estimated the average annual deposition in Quincy Bay (a backwater of the Mississippi River near RM 328) to be 0.08 foot per year. This report also estimated that 22.4 percent of the sediment entering the bay is deposited in it.

Plate A-9 shows the elevation area capacity relationship for Brown's Lake based on mapping done in 1930 before the locks and dams were constructed. Survey data were obtained in 1987 in conjunction with this project. Plate 17 shows the locations of selected ranges. Comparison of the survey data with the 1930 survey data used to develop the elevation area capacity curve indicates that a total of 2.16 feet of sediment has been deposited in the 57 years, or an average of about 0.5 inch per year. Thus, an annual volume of about 30.8 acre-feet of sediment has occurred over the 740-acre area.

The Quincy Bay report also noted that most of the sediment was contributed by Mississippi River flows rather than by the several small tributary streams draining directly into the bay. There is one tributary which drains directly into Brown's Lake. This stream, Smith's Creek, has a drainage area of about 4.8 square miles. The Soil Conservation Service estimated the sediment yield to be 5.6 acre-feet per year. If all of this sediment is deposited over the 740 acres in Brown's Lake, it would result in an aggradation of about 0.1 inch per year. This is greater than estimates based on Appendix G of the Upper Mississippi River Comprehensive Basin Study prepared under supervision of the Coordinating Committee in 1970. However, measures to reduce the yield from Smith's Creek would be rather costly and are considered separately from this report.

In summary, the survey data indicate a total annual deposition rate of 0.5 inch. Since Smith's Creek contributes 0.1 inch, the deposition due to Mississippi River flow conditions is approximately 0.4 inch per year over the 740 acres, or an annual amount of approximately 25 acre-feet.

HYDRAULICS OF EXISTING CONDITIONS

In general, sediment deposition is directly related to the amount of sediment brought into the area and the percent of the sediment trapped in the area. Although deposition in Brown's Lake is dependent on several complex, interrelated hydraulic variables which change with time, average values for inflow and entrapment can be estimated.

Plates A-10 and A-11 indicate the velocity distribution in the study area for existing conditions during the 2- and 50-year events, respectively. This is obtained from the RMA-2 computer model, and indicates a significant flow through Brown's Lake. The average downstream component of velocity through the area of interest is 1.5 feet per second (ft/s) for the 50-year flow.

The amount of sediment transported by a stream is related to the velocity of the moving water. Higher velocity flows can transport larger concentrations of sediment. The present conditions at Brown's Lake allow floodwater for large discharge events from the Mississippi River to flow continuously through the backwater area. During these times, the sediment concentrations are relatively high. As the flow spreads out through the larger area of Brown's Lake, the velocity is reduced. As a result, a significant portion of the sediment can no longer be transported and is deposited in the backwater area. This process is continuous throughout each flood event.

The flood flow through a 5,000-foot-wide section of the backwater area, 4 feet deep, at a velocity of 1.5 ft/s for 25 days, with an average concentration of 100 ppm and an assumed entrapment ratio of 20 percent would result in about 40,400 tons of sediment being deposited. At a density of 75 pounds per cubic foot (pcf), this is equivalent to approximately 24 acre-feet which is equal to the average annual deposition attributed to the Mississippi flow conditions in the area as previously discussed.

Plate A-12 shows the water surface profile computed for the study reach for the 50-year event. This profile was obtained using the HEC-2 computer program for standard step backwater computations. The starting water surface elevation was based on the UMRBC profiles, but an exact calibration was not attempted. The purpose of this profile is only to indicate the magnitude of the impact of the proposed project on flood profiles.

HYDRAULICS OF PROPOSED PROJECT CONDITIONS

The proposed project includes a levee constructed to the height of the 50-year flood event. The levee does not keep floodwater out of Brown's Lake since it does not enclose the backwater area. However, for floods up to the 50-year event, it does prevent water from flowing continuously through the area. Plates A-13 and A-14 indicate the velocity distribution in the study area for the project conditions during the 2- and 50-year events, respectively. The proposed levee results in significantly reduced flows and velocities through Brown's Lake for the 50-year event. The average downstream component of velocity through the area of interest is 0.15 ft/s with the proposed levee in place.

An estimate of the minimum deposition per flood event expected with the proposed project is all the sediment from a volume of water required to fill the area. This volume of water is on the order of 3,000 acre-feet for a 4 foot increase in depth. At a concentration of 100 ppm and a density of 75 pcf, this would deposit 0.25 acre-foot of material for an event. Comparing the present deposition rate of 25 acre-feet with the 0.25 acre-foot indicates the maximum possible impact of the project to be a 99 percent reduction in the sediment deposition.

A more direct estimate of the reduction could be based on the ratio of the velocities obtained from the RMA-2 model. Comparison of the 0.15 ft/s to the 1.5 ft/s velocities indicates a reduction in the deposition of sediment to 10 percent of the 0.4 inch per year currently being experienced. This results in a deposition of 0.04 inch due to the Mississippi River and 0.1 inch due to Smith's Creek, or a total of 0.14 inch per year. In order to conservatively evaluate this project and realizing the unpredictability of sediment deposition, it is assumed that this project will reduce the total deposition in Brown's Lake to 30 percent of the current value, or 0.15 inch per year.

Plate A-12 shows the computed water surface profile for the 50-year event with the proposed project compared to that computed for existing conditions. This is considered to be the most critical condition. The maximum difference is much less than 0.1 foot. Profiles for smaller flows will be affected even less. Impacts for larger flows are estimated to be insignificant since the project will be overtopped.

INLET AND WATER CONTROL STRUCTURE

Another significant aspect of the project is the flow control structure through the proposed levee. This gated structure, along with the proposed dredging as shown on plate 2 of the main report, is designed to allow for controlled flow into and through Brown's Lake in order to maintain acceptable levels of dissolved oxygen through low-flow periods. As described in the water quality discussion, a flow of approximately 350 cubic feet per second is considered desirable. Survey data indicate that during low-flow conditions a head of approximately 0.2 foot will be available. This was assumed to generate a velocity of about 3.5 ft/s through the culvert. Therefore, an area of about 100 square feet is required. This will be provided by the four proposed 5-foot by 5-foot box culverts as shown on plate 16 of the main report.

Plate 11 of the main report shows the alignment and size of the dredged inlet channel to the flow control structure. This channel is oriented downstream to reduce the tendency for debris entrapment. During high Mississippi River flows, the gates will be closed and flow in the channel will be negligible. When the gates are open during low Mississippi River conditions, the velocity in the inlet channel will be less than 4 ft/s.

RIPRAP AND EROSION CONTROL

Although a nonscouring velocity is anticipated in the approach channel, riprap protection is recommended to protect against improper operation of the gates. Riprap is also provided at the downstream end of the proposed levee to eliminate the scour that would normally be expected to occur. The riprap, as shown on plate 16 of the main report, is designed based on experience with wing dams and levees along the Mississippi River.

To reduce the maintenance costs that would be incurred if the proposed levee were to be overtopped, a spillway section is included as shown on plates 10 and 15 of the main report. This spillway was sized to pass approximately 200 cubic feet per second with a head of 0.5 foot and an assumed weir coefficient of 3. This is estimated to be enough water to fill the Brown's Lake area to the flood elevation in 1 day and prevent the rising Mississippi River flow from overtopping the levee for the 50-year design event. This is not a major concern since the protected area will fill with water from the downstream end. The spillway feature will be reevaluated during the final design stage. Higher flows will overtop the entire structure, but it is expected that the water surface elevation difference will be negligible so that significant erosion will not develop. Riprap is provided in the spillway section.

SEEPAGE CONCERNS

Although the dredged areas will provide increased depth and tend to distribute the flow through the area, concern was expressed related to the reduced seepage path from the ponded water in the Green Island Refuge Area. This is addressed in appendix C.

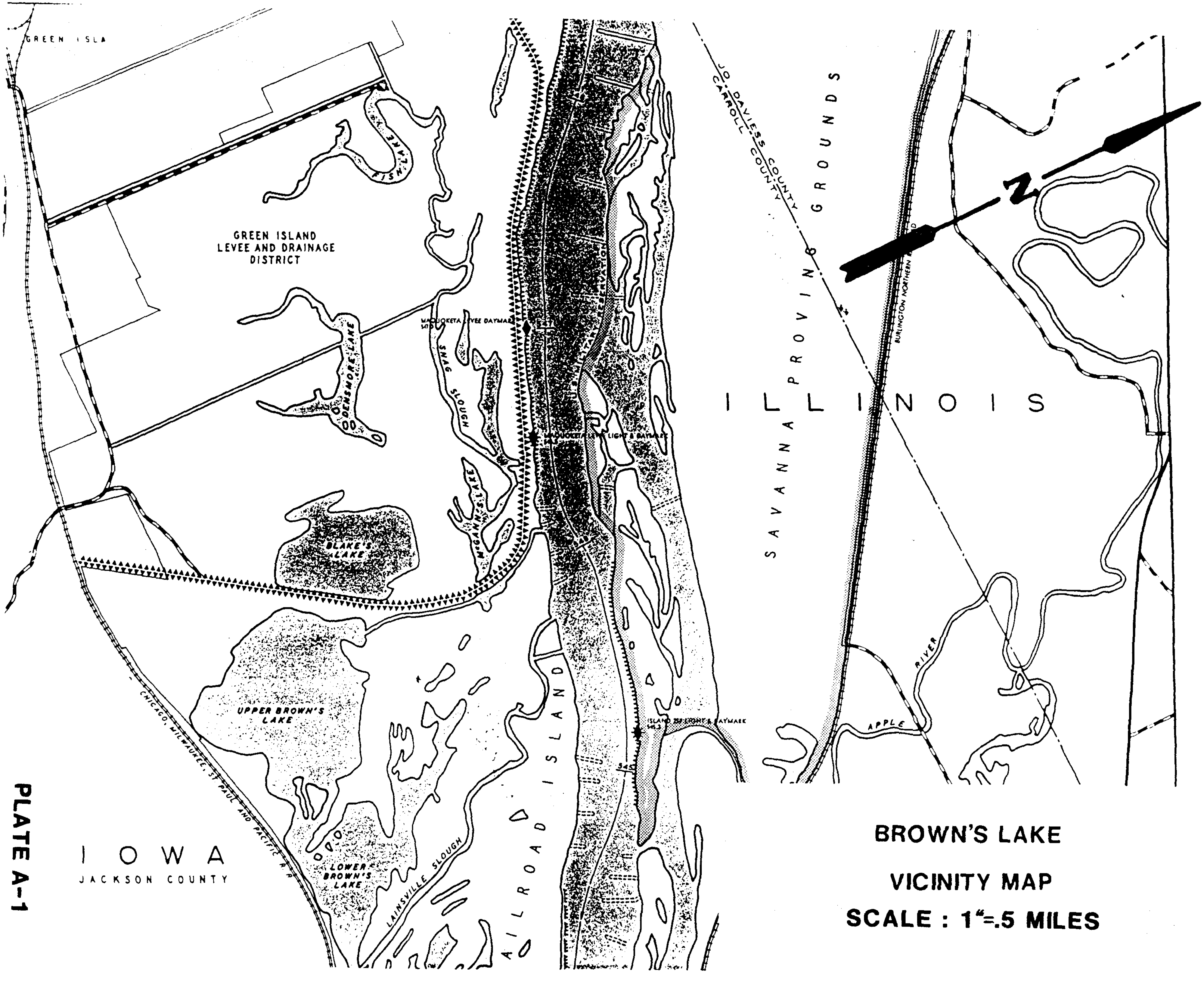


PLATE A-1

BROWN'S LAKE

VICINITY MAP

SCALE : 1"=.5 MILES

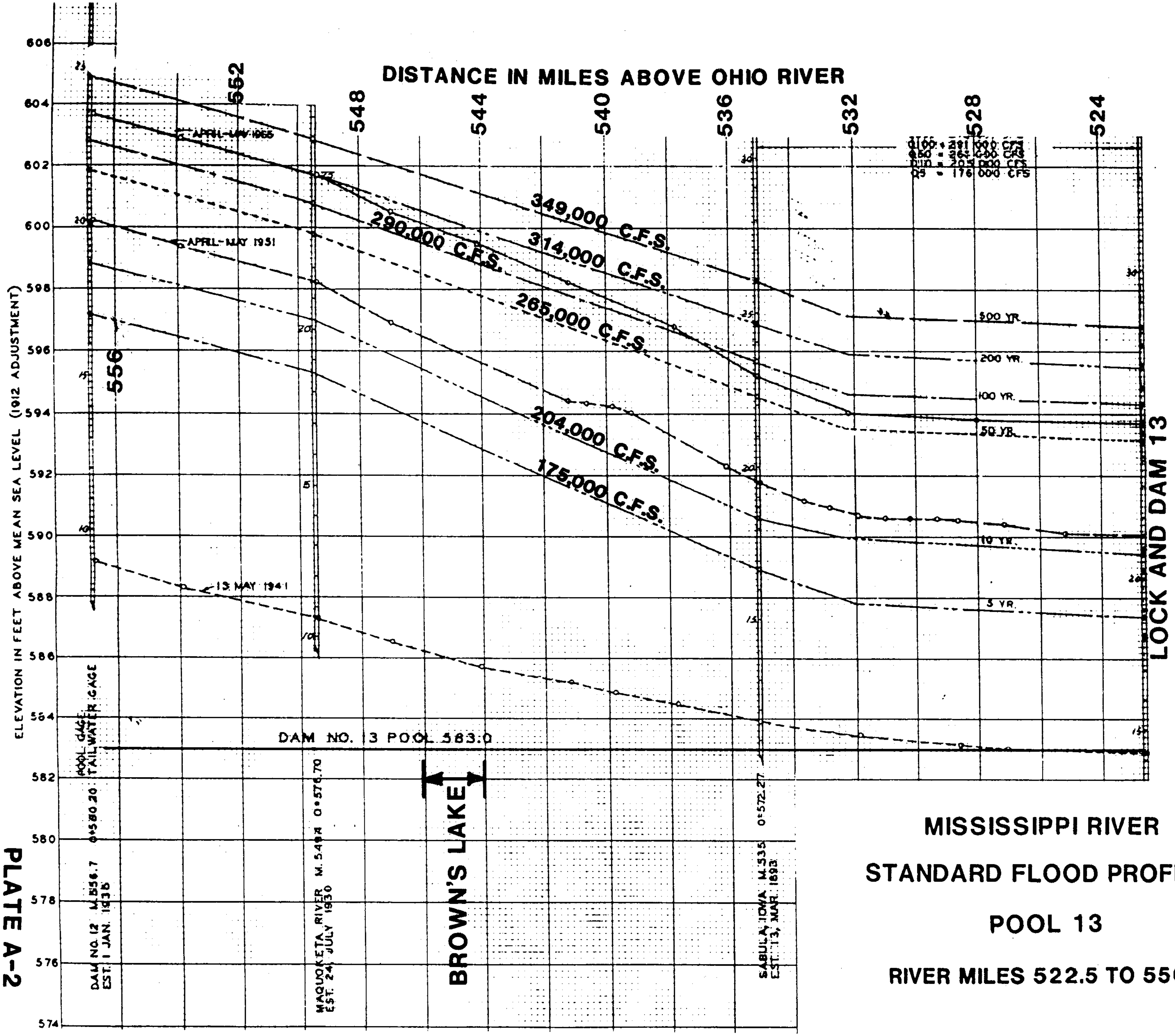


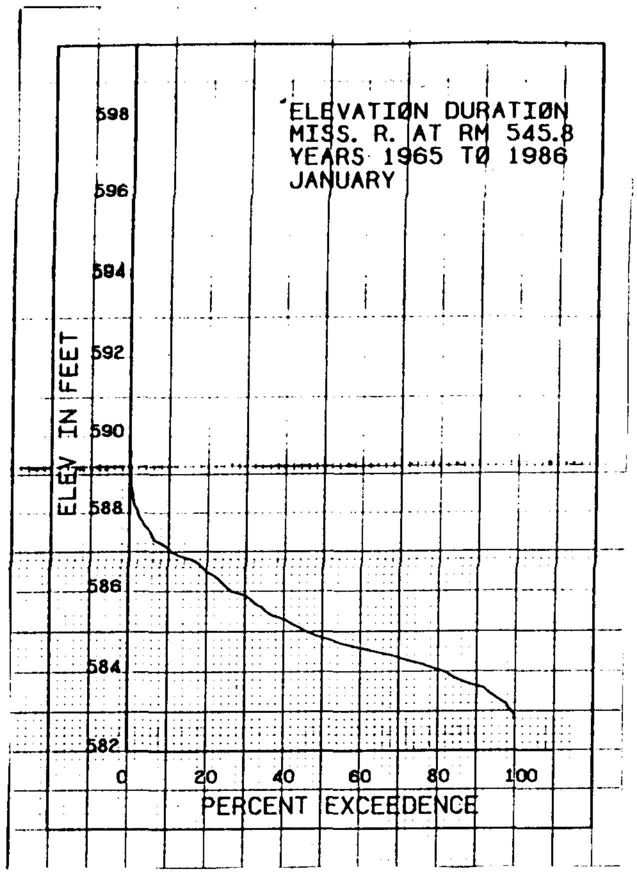
PLATE A-2

MISSISSIPPI RIVER

STANDARD FLOOD PROFILES

POOL 13

RIVER MILES 522.5 TO 556.7


ELEVATIØN DURATIØN
MISS. R. AT RM 545.8
YEARS 1965 TØ 1986
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ELEV IN FEET
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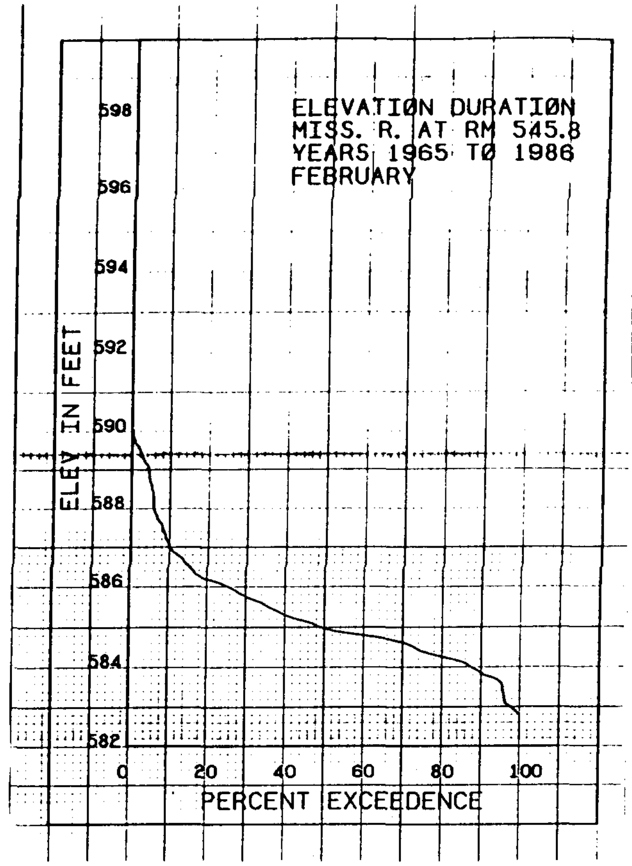
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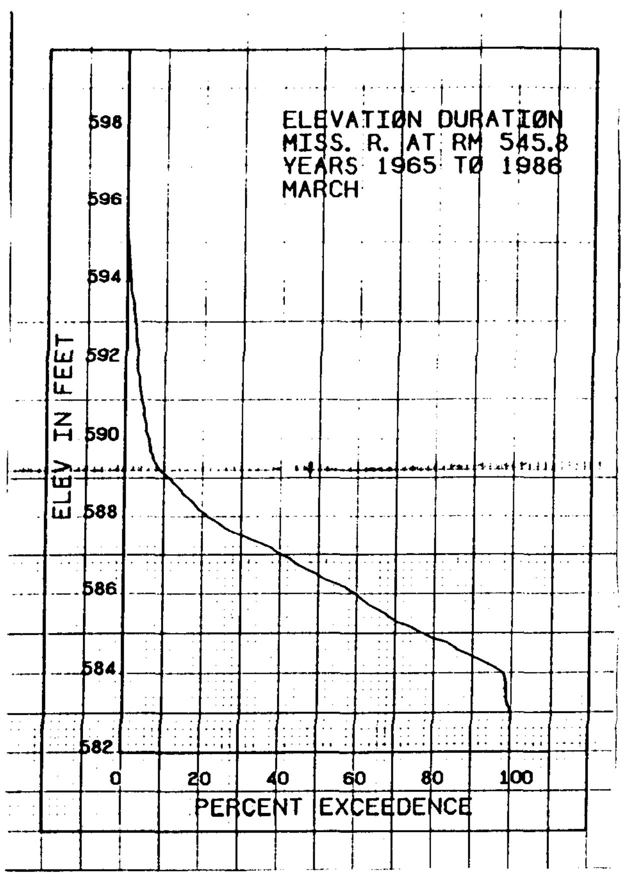
100
PERCENT EXCEEDENCE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MISS. R. AT RM 545.8
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ELEV IN FEET
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596
594
592
590
588
586
584
582
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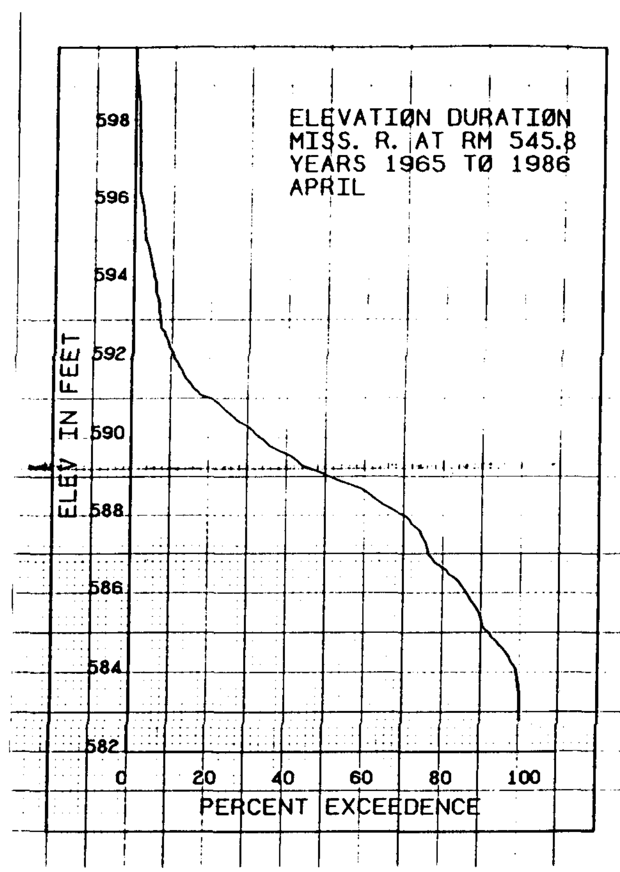
20
40
60
80
100
PERCENT EXCEEDENCE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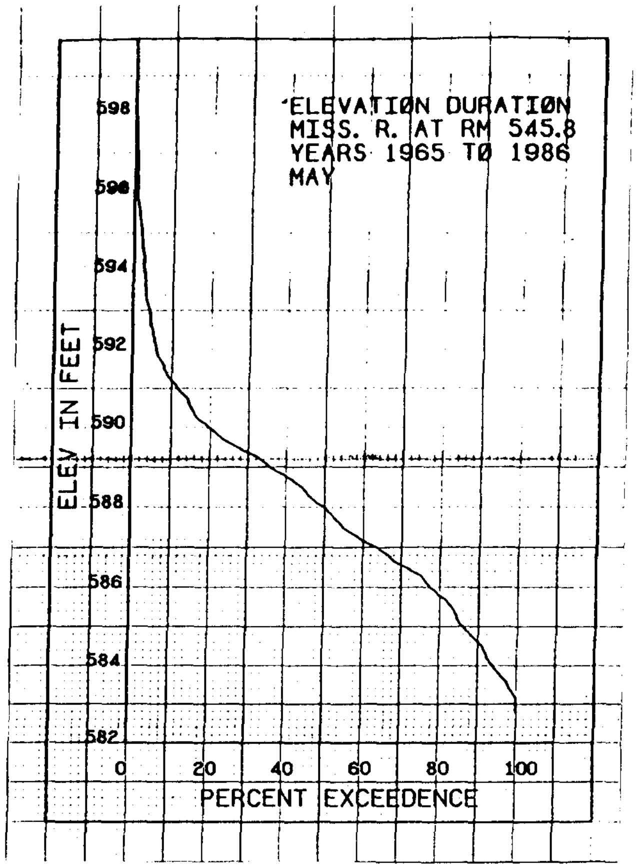
80
100
PERCENT EXCEEDENCE

PLATE A-3



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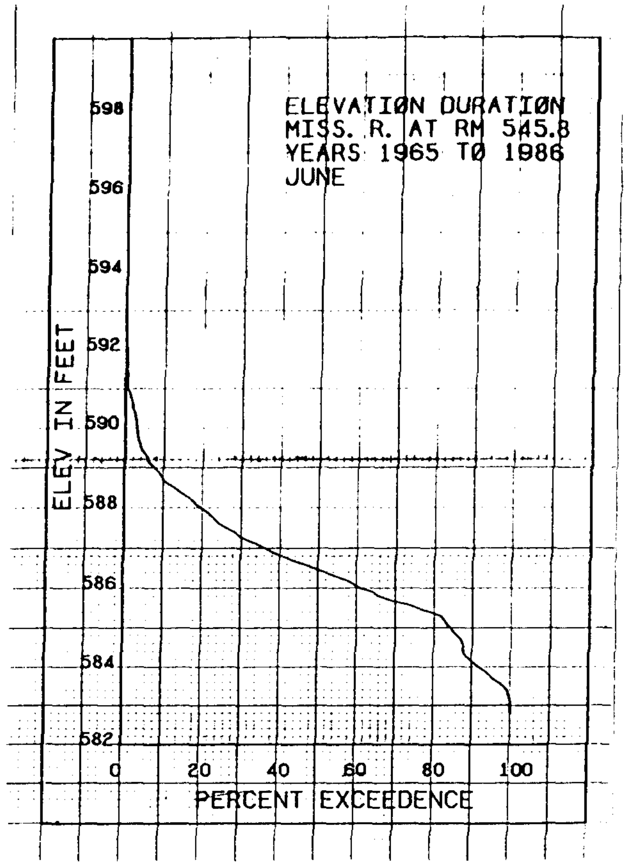
PERCENT EXCEEDENCE



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100
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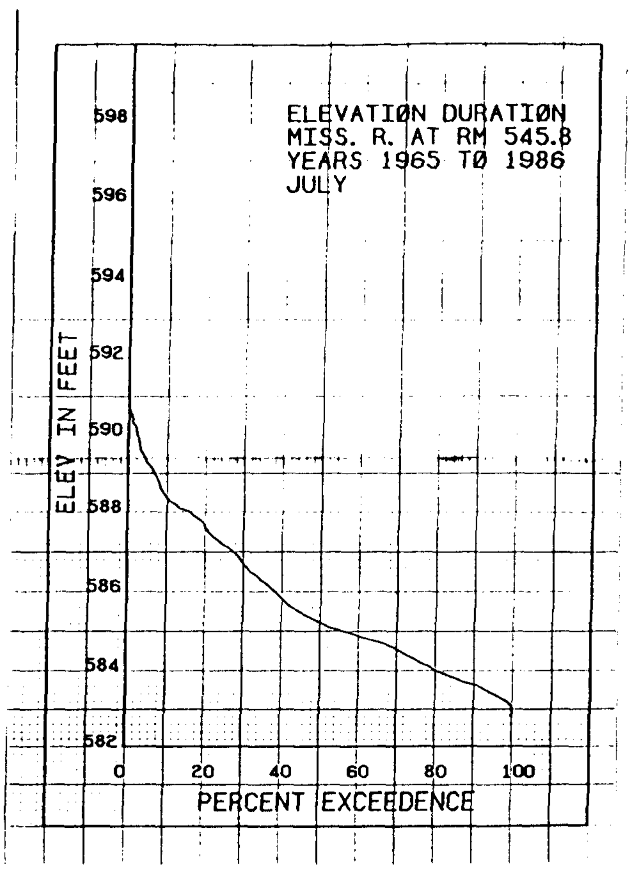

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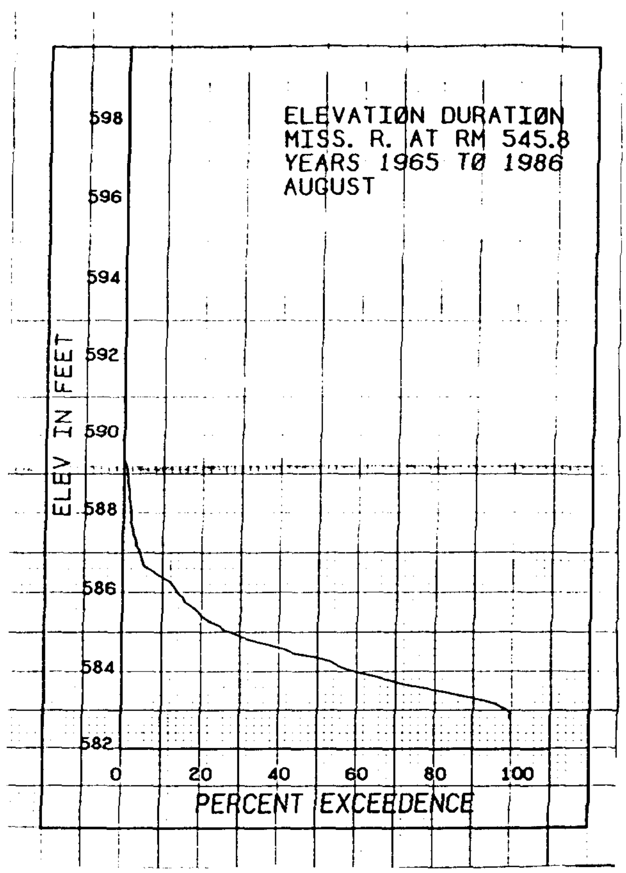

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ELEV IN FEET
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588
586
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582
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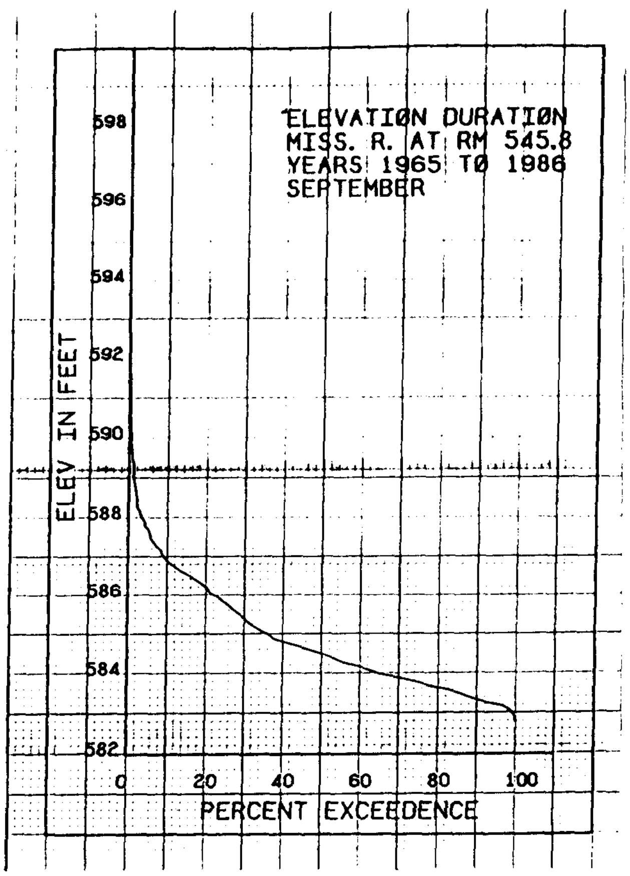
40
60
80
100
PERCENT EXCEEDENCE

PLATE A-4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MISS. R. AT RM 545.8
YEARS 1965 TØ 1986
SEPTEMBER
ELEV IN FEET
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590
588
586
584
582
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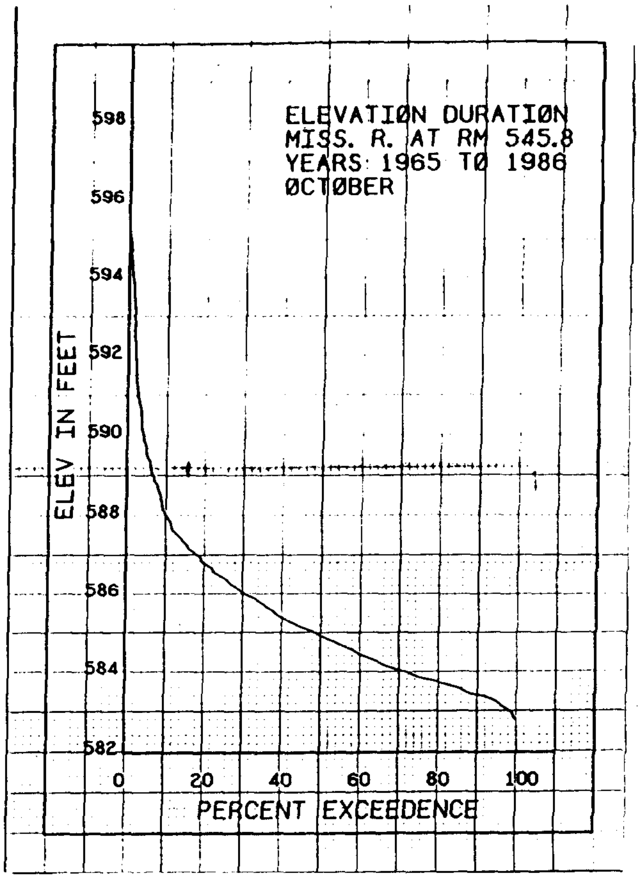
20
40
60
80
100
PERCENT EXCEEDENCE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ØCTØBER
ELEV IN FEET
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588
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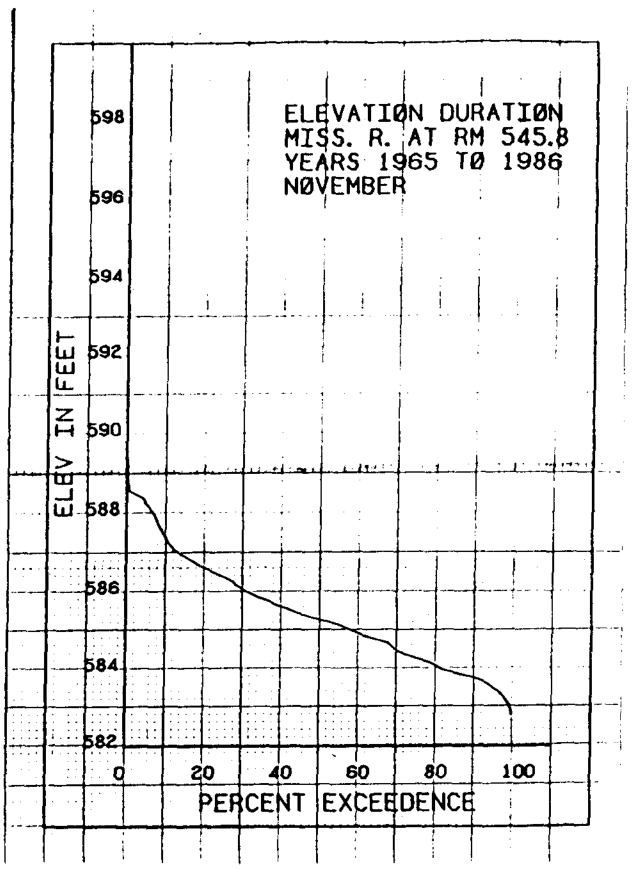
40
60
80
100
PERCENT EXCEEDENCE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YEARS 1965 TØ 1986
NØVEMBER
ELEV IN FEET
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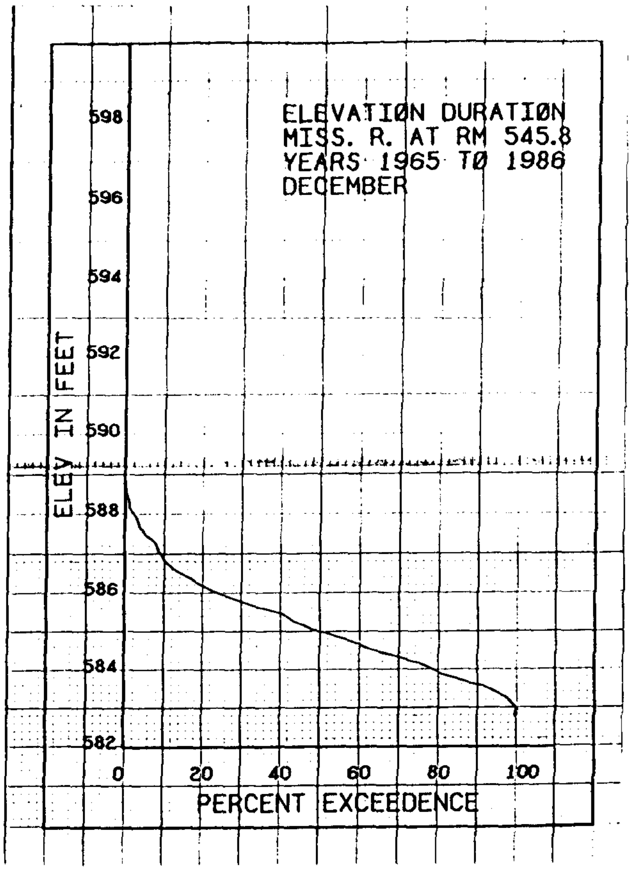
40
60
80
100
PERCENT EXCEEDENCE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MISS. R. AT RM 545.8
YEARS 1965 TØ 1986
DECEMBER
ELEV IN FEET
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20
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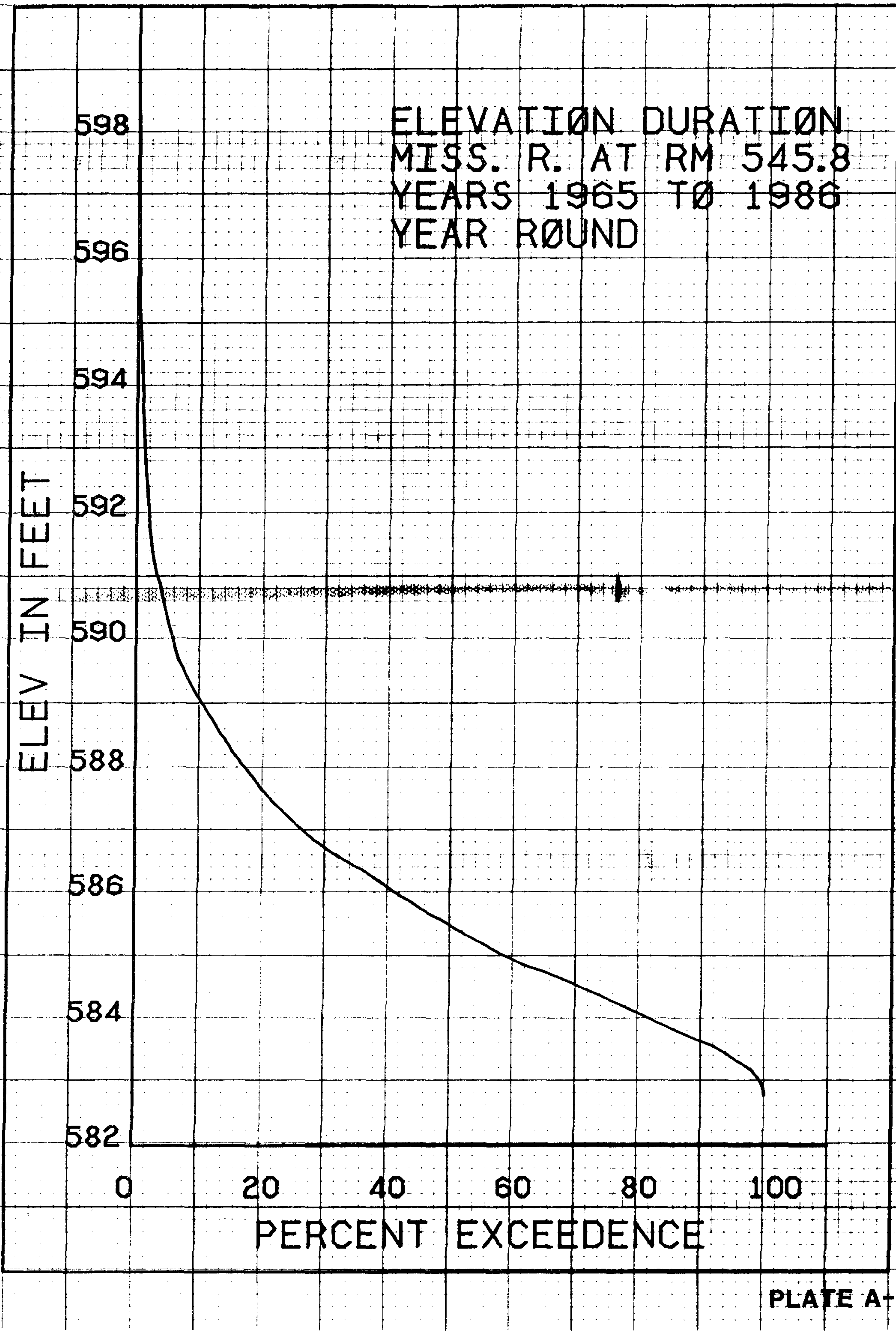
60
80
100
PERCENT EXCEEDENCE

PLATE A-5



ELEVATIØN DURATIØN
MISS. R. AT RM 545.8
YEARS 1965 TØ 1986
YEAR RØUND
ELEV IN FEET
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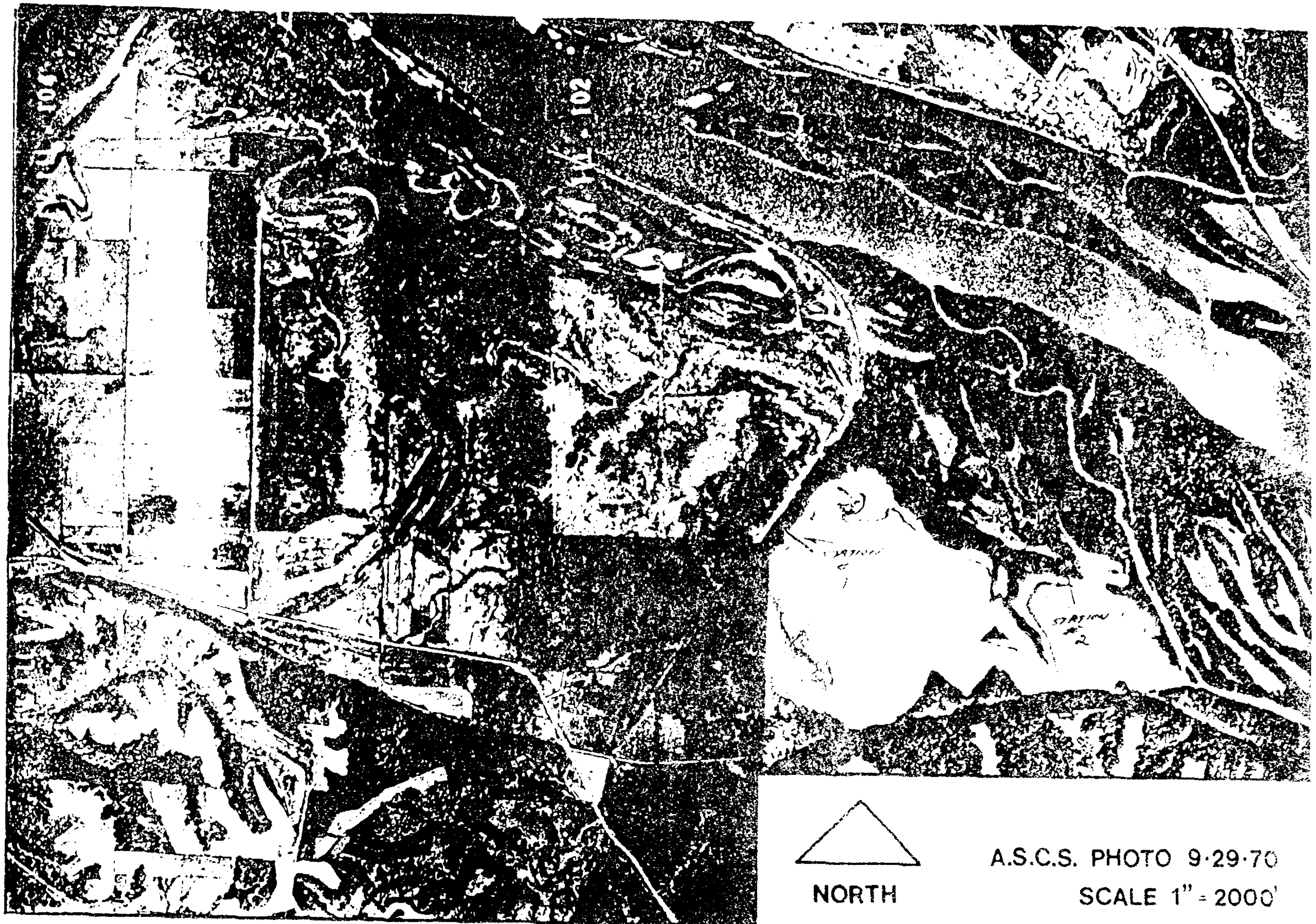
596
594
592
590
588
586
584
582
0
20
40
60
80
100
PERCENT EXCEEDENCE

PLATE A-6

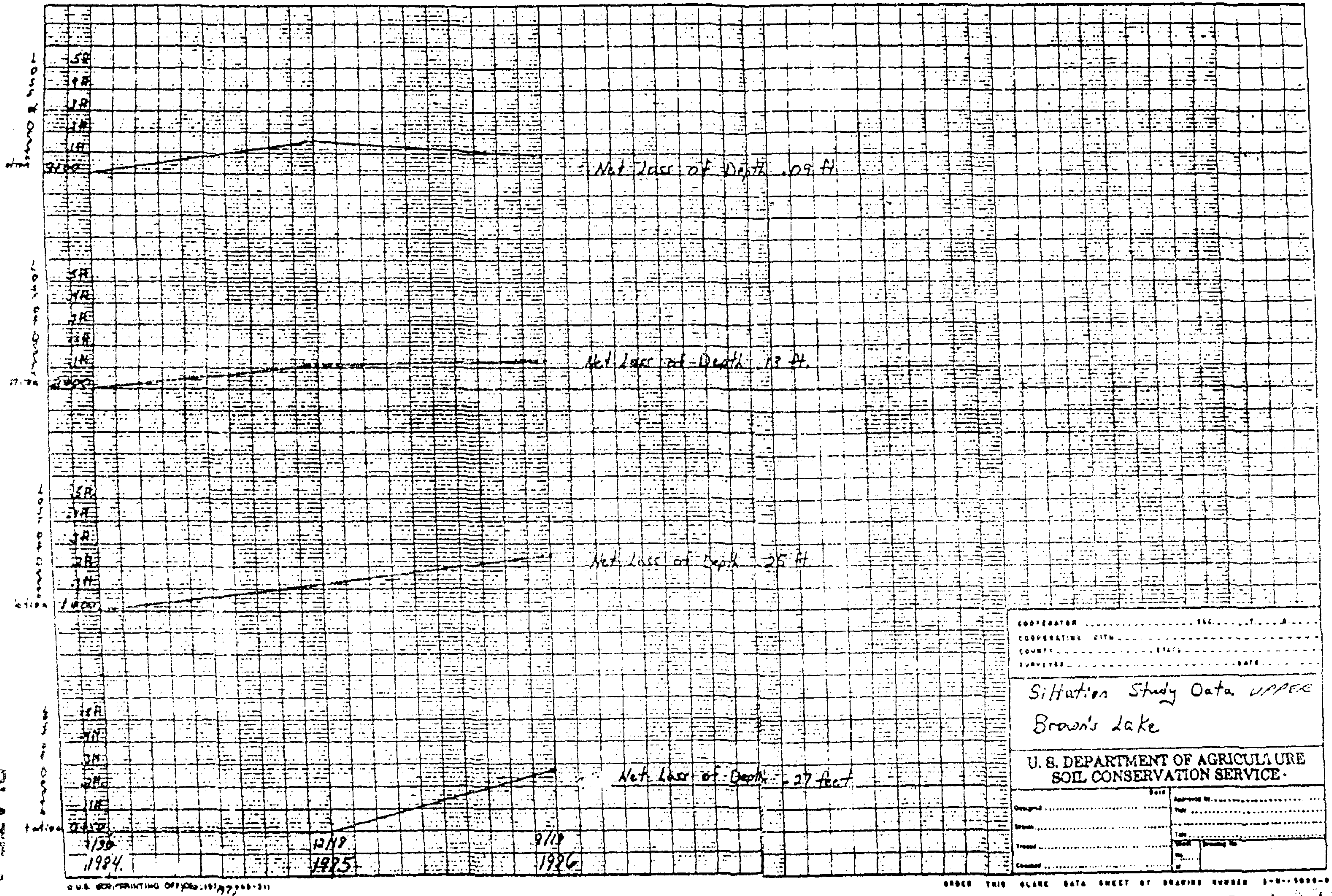
PLATE A-7



GREEN ISLAND WILDLIFE AREA

JACKSON COUNTY, IOWA

IOWA CONSERVATION COMMISSION
FISH AND WILDLIFE DIVISION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Net Loss of Depth .13 ft.
Net Loss of Depth .25 ft.
Net Loss of Depth .27 feet
1/30 1984
12/18 1985
9/19 1986
Siltation Study Data UPPER
Brown's Lake
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE A-8

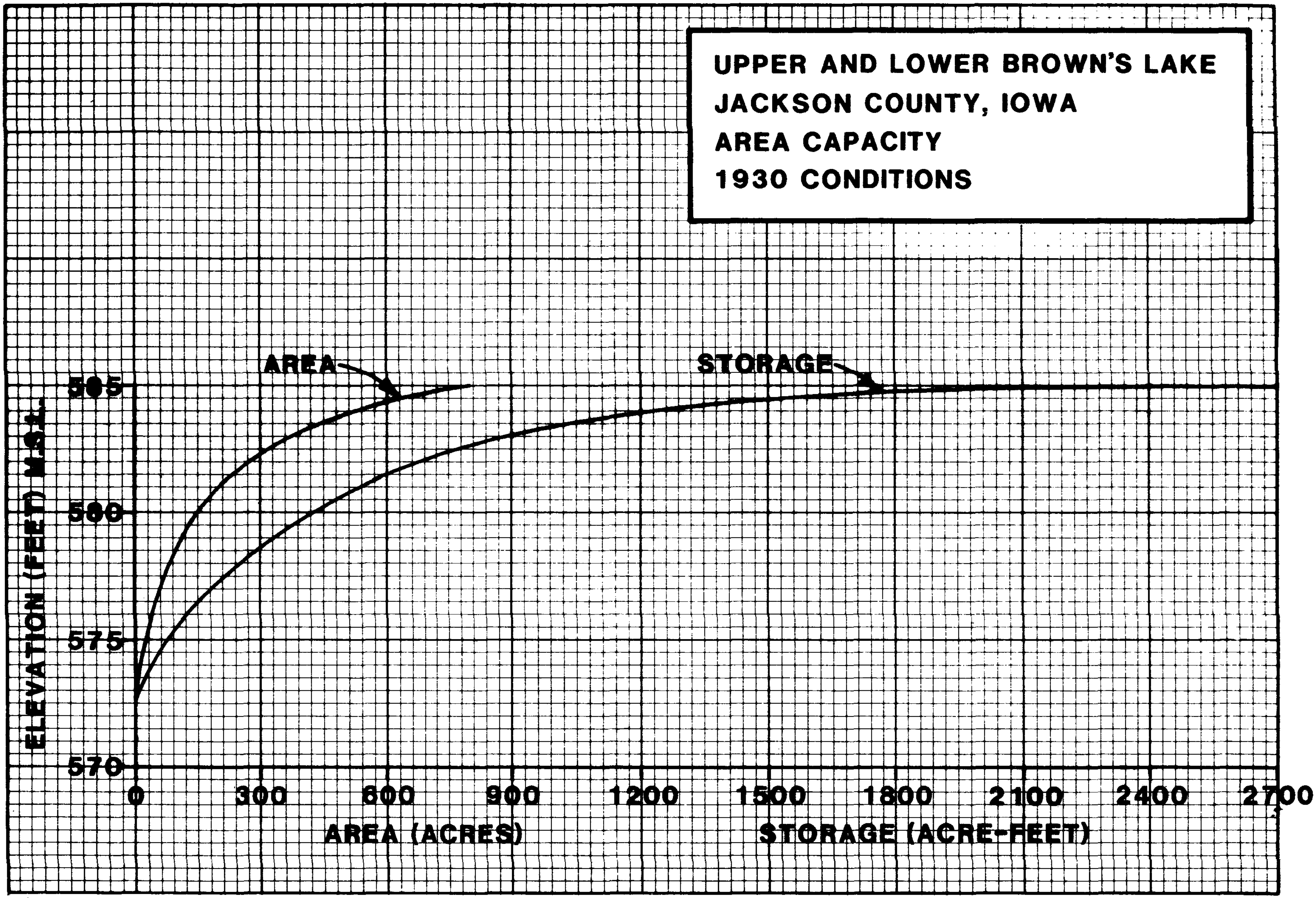

UPPER AND LOWER BROWN'S LAKE
JACKSON COUNTY, IOWA
AREA CAPACITY
1930 CONDITIONS
AREA
STORAGE
ELEVATION (FEET) M.S.L.
585
580
575
570
0
300
600
900
1200
1500
1800
2100
2400
2700
AREA (ACRES)
STORAGE (ACRE-FEET)

PLATE A-9

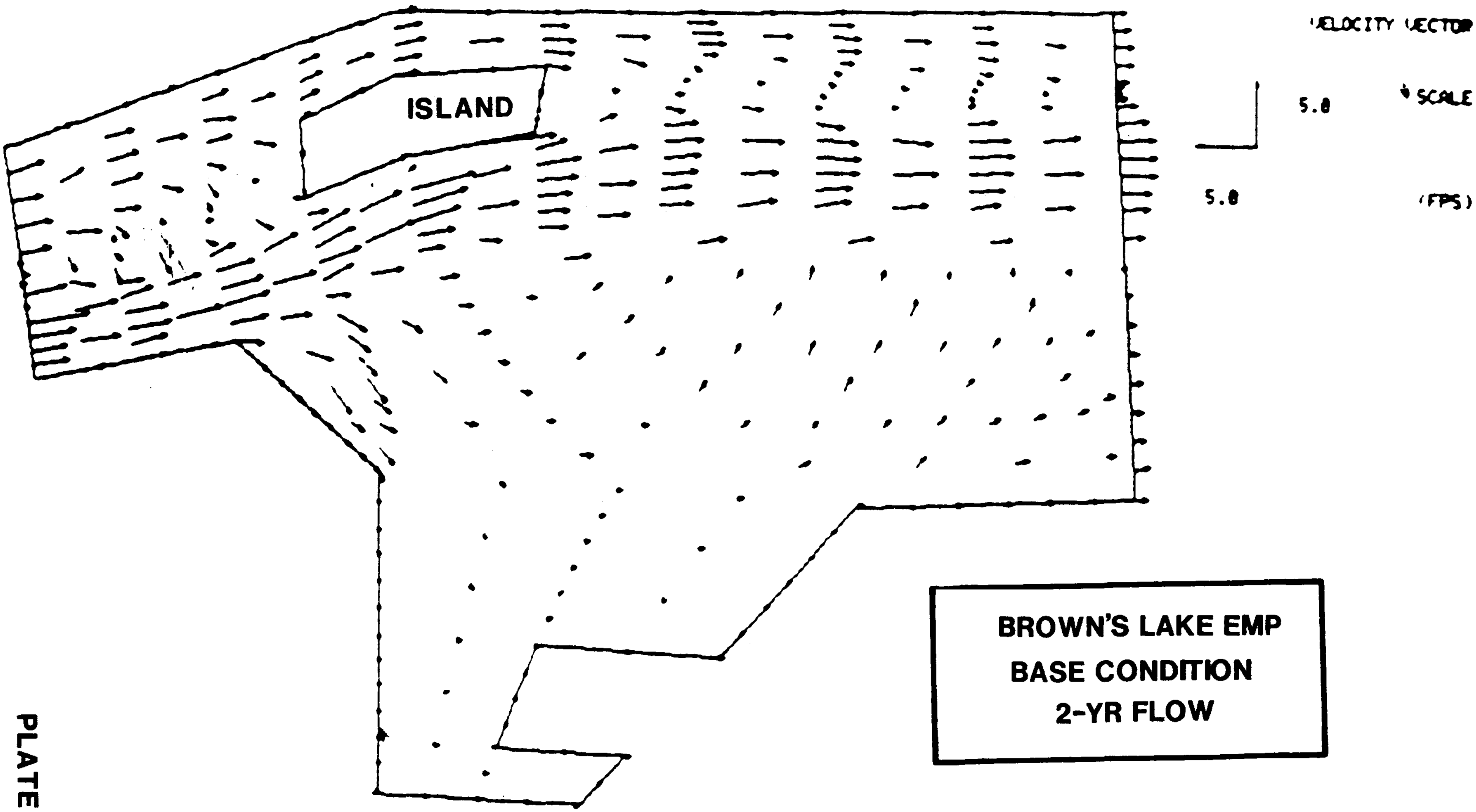
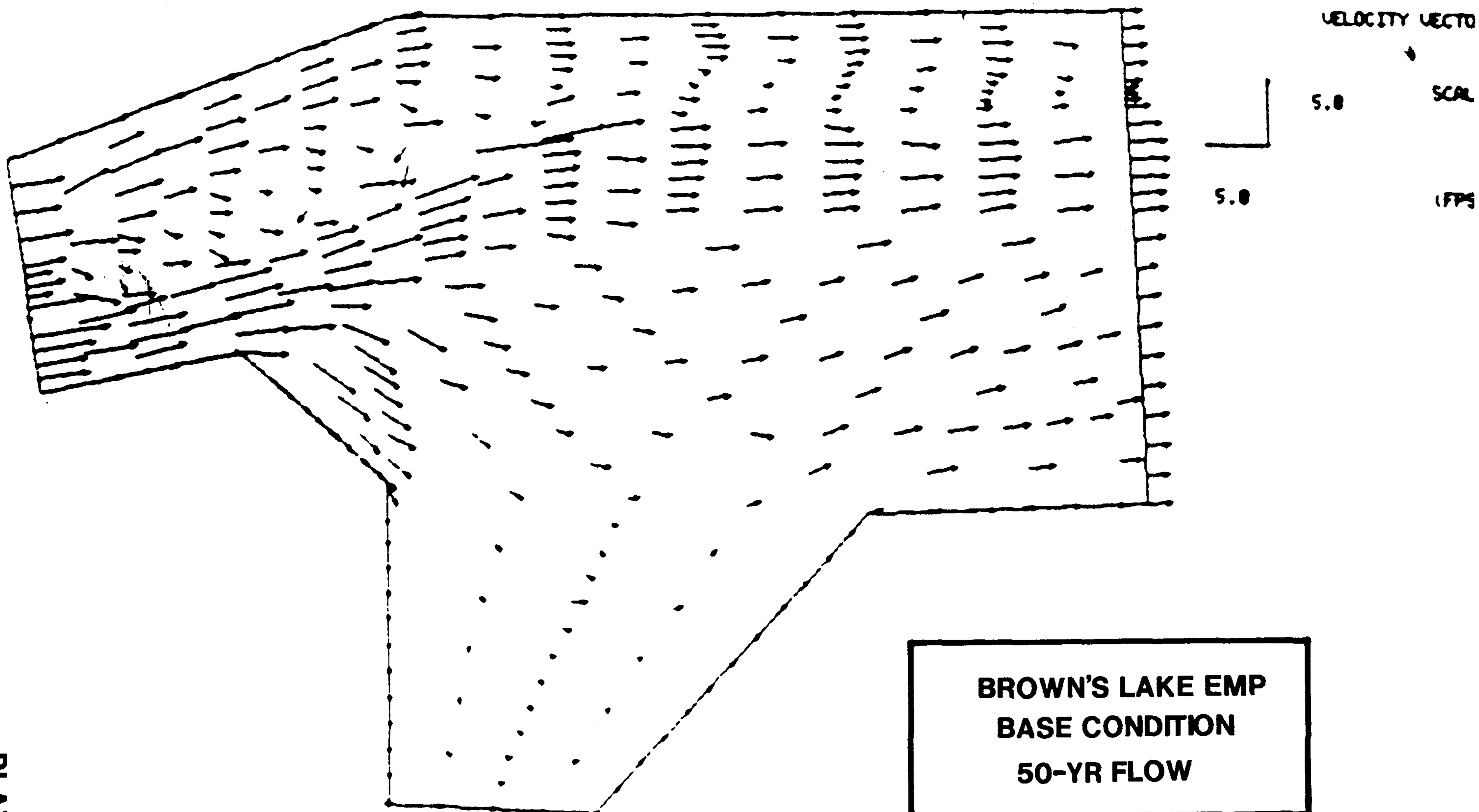
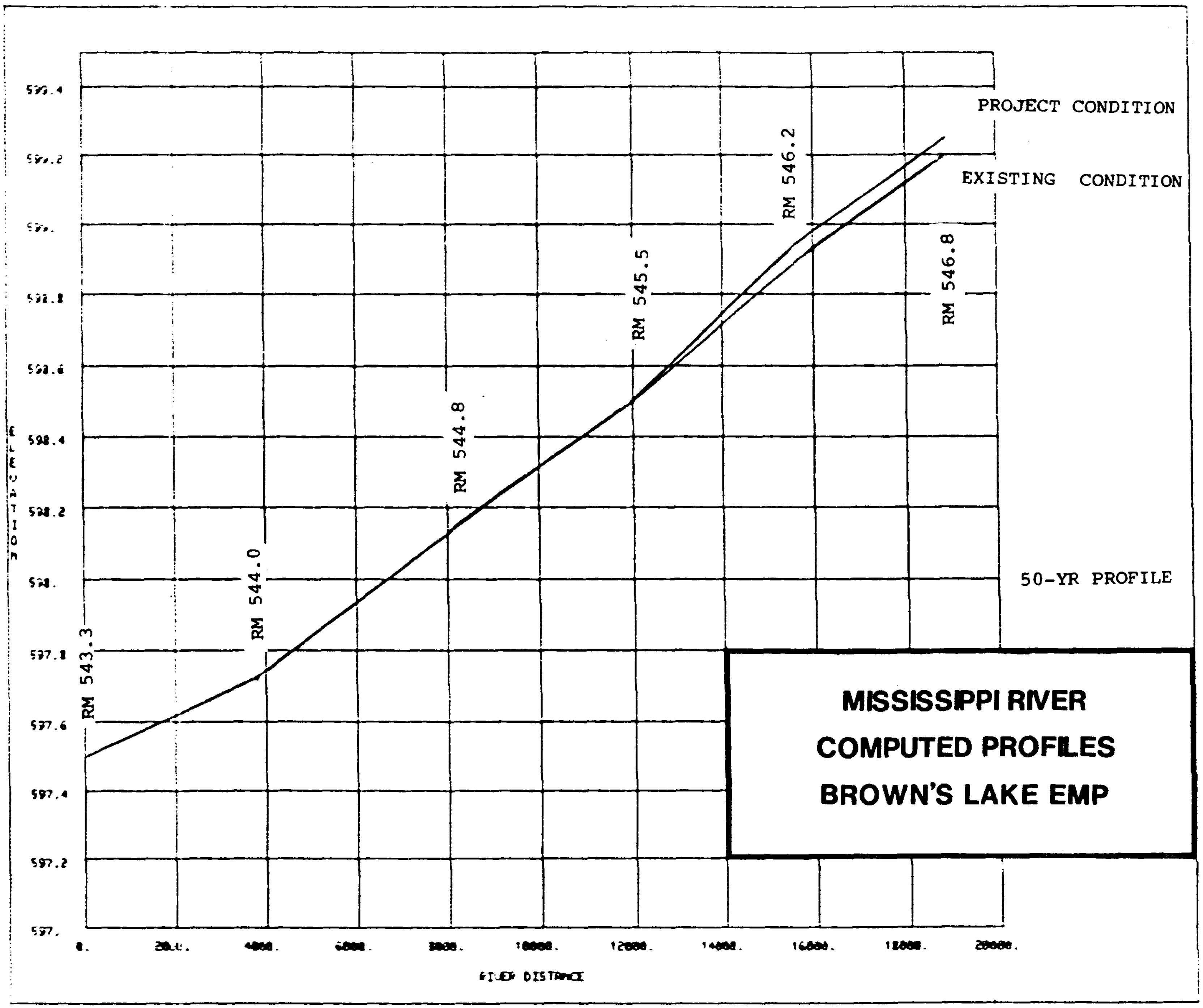

ISLAND
VELOCITY VECTOR
5.0
SCALE
5.0
(FPS)
BROWN'S LAKE EMP
BASE CONDITION
2-YR FLOW

PLATE A-10

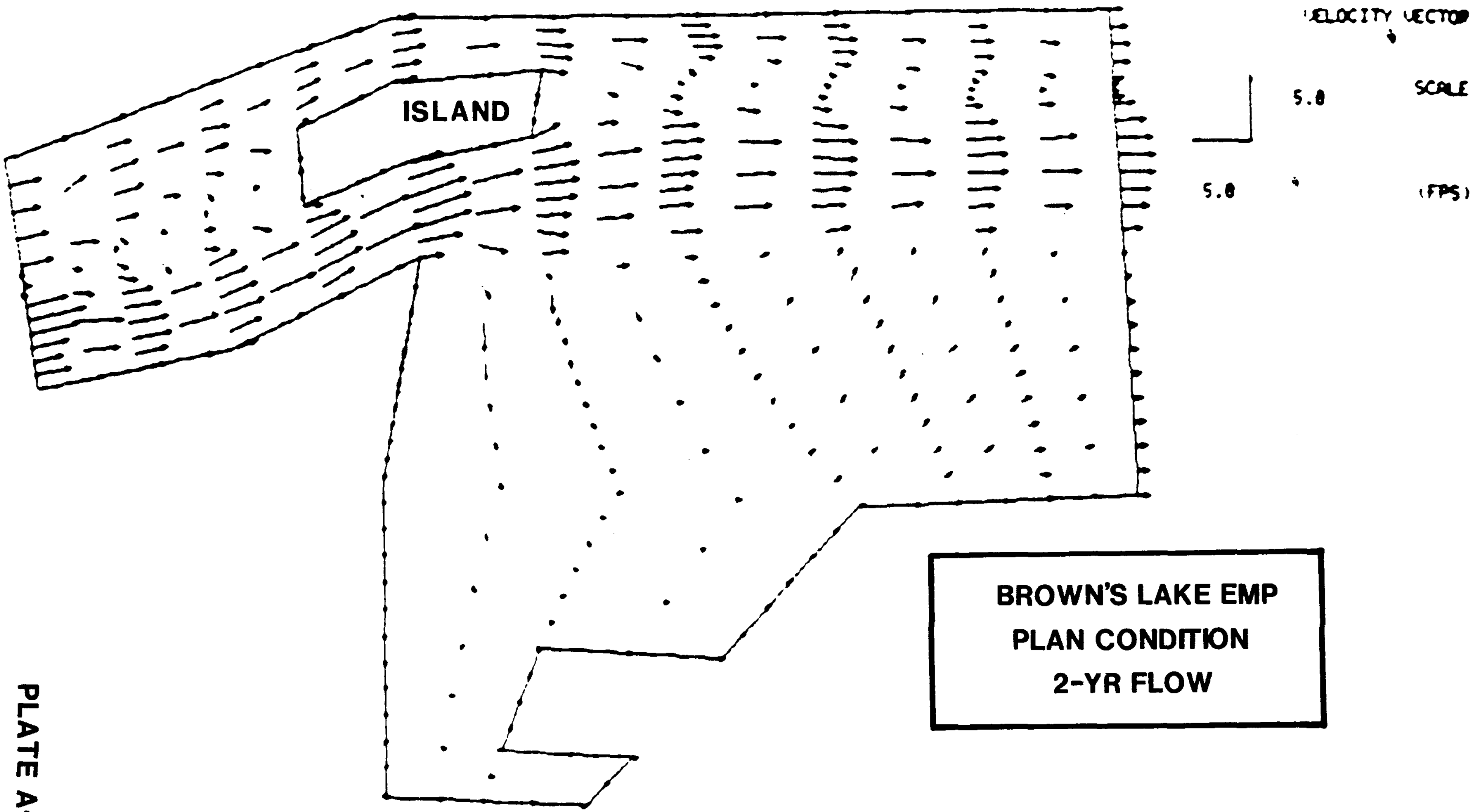


BROWN'S LAKE EMP
BASE CONDITION
50-YR FLOW

PLATE A-11

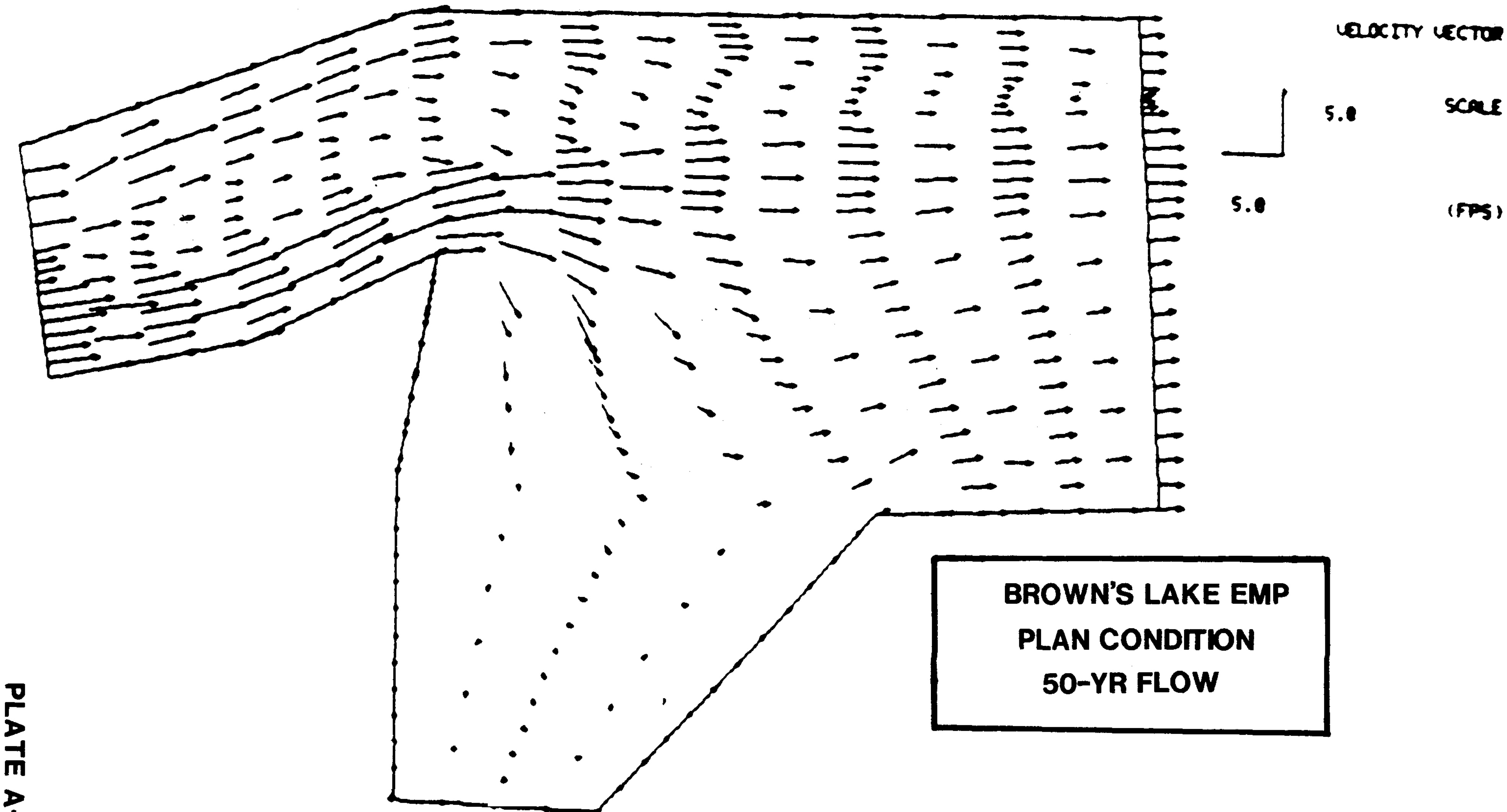


PROJECT CONDITION
EXISTING CONDITION
50-YR PROFILE
RM 543.3
RM 544.0
RM 544.8
RM 545.5
RM 546.2
RM 546.8
598.4
598.2
598.
597.8
597.6
597.4
597.2
597.
0.
4000.
6000.
8000.
10000.
12000.
14000.
16000.
18000.
20000.
MISSISSIPPI RIVER
COMPUTED PROFILES
BROWN'S LAKE EMP



BROWN'S LAKE EMP
PLAN CONDITION
2-YR FLOW

PLATE A-13



BROWN'S LAKE EMP
PLAN CONDITION
50-YR FLOW

WATER QUALITY

APPENDIX B

UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

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JACKSON COUNTY, IOWA

APPENDIX B
WATER QUALITY

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APPENDIX B
WATER QUALITY

OVERVIEW

Discussions with representatives of the Iowa Department of Natural Resources (DNR) indicated that water quality within Brown's Lake is currently adequate to support the native fisheries during the summer months. However, under ice cover there would be periods where dissolved oxygen (D.O.) becomes depleted to the point where fish kills occur. There is no scientific evidence to substantiate that this currently is a problem, but for the purpose of this analysis it was assumed that winter kills were the most significant water quality problem in Brown's Lake. This is a reasonable assumption given the fact that wind mixing of the shallow water will prevent severe problems from developing during the summer. One way to avoid winter kills is to provide a supply of oxygenated river water to the lakes on a continuous basis. It is desirable to minimize this flow, however, to avoid excessive transport of suspended sediment to the lake.

Due to the lack of field data for this preliminary analysis, a number of assumptions were made regarding the biological and chemical processes occurring within the lake. This was necessary in order to estimate the D.O. requirement of a warm water fishery during a severe Iowa winter. It was concluded that the best approach to determine the minimum flow into the lake necessary to sustain the existing fishery was to perform a D.O. mass balance. Data were available from other studies conducted on water bodies having characteristics similar to those of Brown's Lake. These data, in combination with the results of limited field testing, provided the basis for the mass balance analysis.

METHODS

Samples were collected on three dates. On January 21, 1987, water samples were collected for the purpose of determining D.O. concentrations. On February 5, 1987, water and sediment samples were collected for the performance of elutriate and ambient water quality analyses. On April 28, 1987, sediment samples were collected for the purpose of determining sediment oxygen demand (S.O.D.). Samples for water column and elutriate testing were obtained by drilling a hole in the ice and using a Kemmerer bottle and a sediment coring device equipped with a plastic liner. Samples for S.O.D. analyses were taken by boat again using a sediment core. Field analyses included D.O., pH, temperature and specific conductance. Grain size analyses were performed in accordance with U.S. Army Corps of Engineers, Engineer Manual 1110-2-1906, Appendix 5, November 1970. Chemical analyses were performed according to Standard Methods for the Examination of Water and Wastewater, 16th Edition, American Public Health Association, Washington, D.C., 1985. Elutriate samples were prepared by mixing 1 part sediment with 4 parts ambient water, shaking for 30 minutes and allowing 4 hours to settle. Sediment oxygen demand was determined according to Procedures for Handling and Chemical Analyses of Sediment and Water Samples, Technical Report EPA/CE-81-1, May 1981.

RESULTS

Results of all field sampling are presented in tables B-1 through B-4. Figures B-1 and B-2 show the sample locations. Because of the mild winter and below average snowfall, D.O. concentrations were quite high on both sampling dates. Results of the elutriate analyses were within the normal ranges except for copper in one sample which exceeded the State of Iowa standard. Results of the grain size analyses reveal that the sediment is very fine throughout the lake. A complete grain size hydrometer analysis is presented in appendix C. The S.O.D. test results are expressed as mg O_2/g sed/day. Assuming the upper 2 inches of the sediment will exert this demand and that the average weight of the sediment is 68 pounds per cubic foot, the S.O.D. can be estimated to be 8.0 g/m^2/day. This value compares quite favorably with literature values.

TABLE B-1

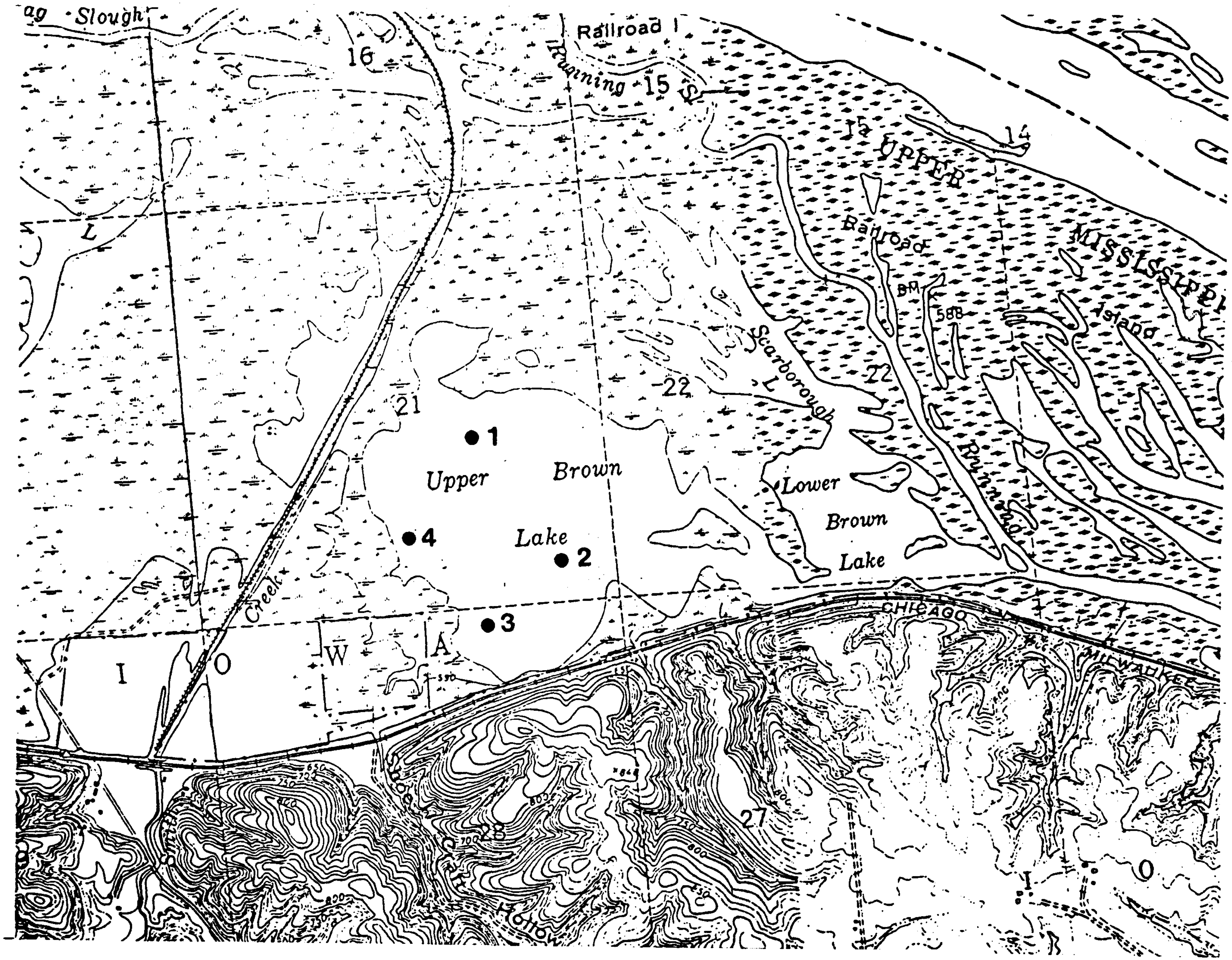
Water Quality Analyses, January 21, 1987

Parameter	Location 1	2	3	4
Dissolved Oxygen (mg/l)	19.4	21.3	19.7	22.9

TABLE B-2

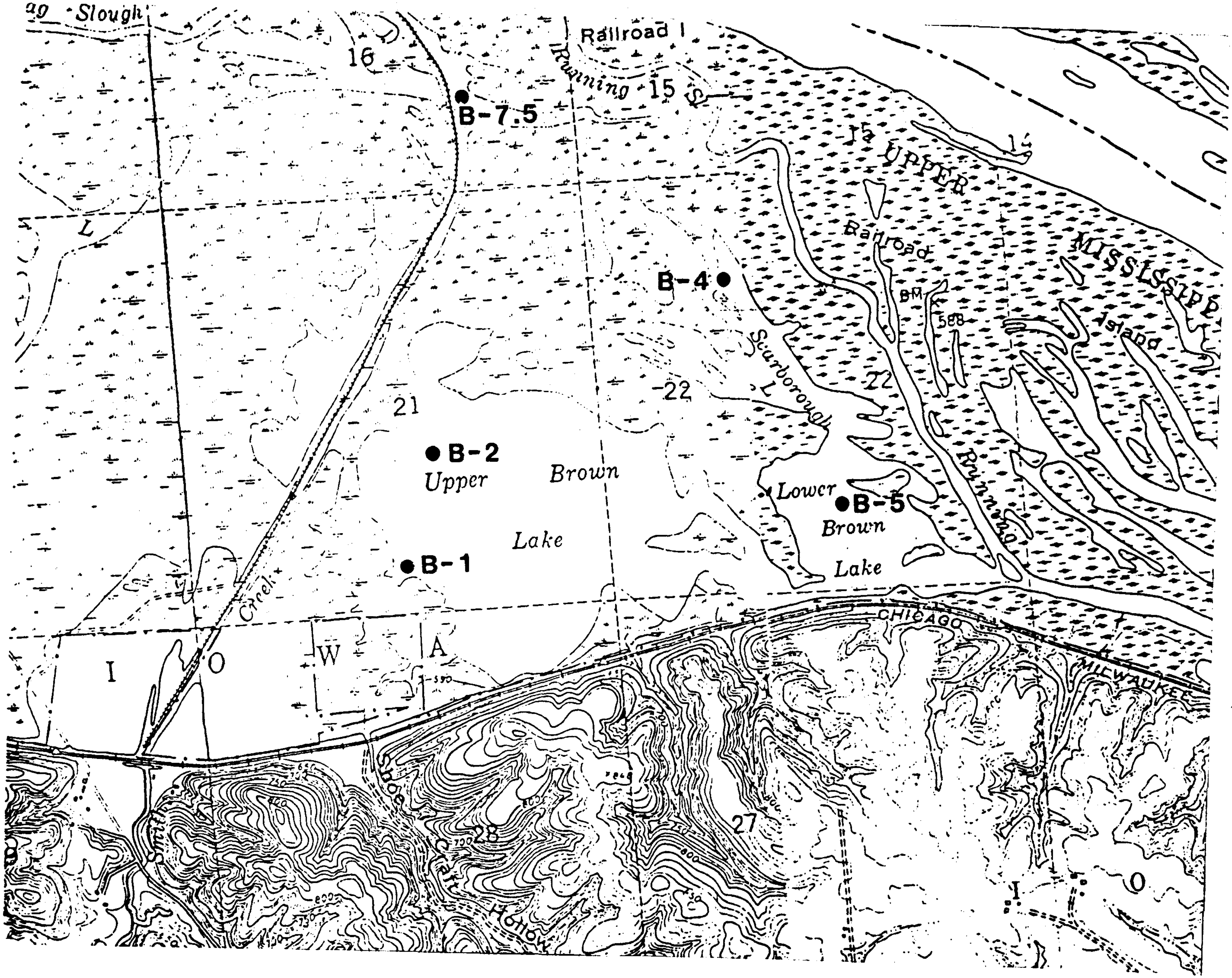
Results of Field and Chemical Analyses from Samples
Collected at Brown's Lake on February 5, 1987
(All units are mg/l unless stated otherwise)

Parameter	B-1	B-4	B-5	B-7.5	B-5
	Field Analyses				
Dissolved Oxygen (5)*	11.75	15.7	19.0	16.75	
pH, units	8.1	-	8.1	-	
Temperature, Deg. C	2.0	-	1.0	-	
Conductivity, umhos @ 25 Deg. C	402	-	335	-	



Location of Dissolved Oxygen Sampling Points

Figure B-1



Location of Dissolved Water Quality and Sediment Sampling Points
Figure B-2

TABLE B-2 (Cont'd)

	Elutriate				Ambient Water
Arsenic (0.1)	<.01	<.01	<.01	<.01	<.01
Barium (1.0)	.27	.23	.28	.22	<.1
Cadmium (0.01)	.001	.001	.001	.001	.001
Chromium (0.05)	<.01	<.01	<.01	<.01	<.05
Copper (0.02)	.02	.01	.01	.09 **	<.01
Cyanide (0.005)	<.01	.01 **	<.01	.02 **	<.01
Lead (.01)	.02	.01	.02	.03	<.01
Mercury (0.00005)	<.0005	<.0005	<.0005	<.0005	<.0005
Nickel	<.01	<.01	<.01	.04	.01
Zinc (1.0)	.03	.02	.03	.03	.02
Ammonia Nitrogen (5)	1.7	4.3	1.0	4.9	.26
Kjeldahl Nitrogen	1.9	4.3	1.3	4.9	.70
Nitrate Nitrogen	2.0	2.2	2.0	2.3	2.3
Oil and Grease	1	1	1	2	1
PCBs	<.0002	<.0002	<.0002	<.0002	<.0002
BOD	5	3	6	5	4
COD	11	15	23	24	14
TOC	5.6	5.5	6.3	7.8	3.89
Total Solids	332	275	328	312	339
Total Suspended Solids	79	56	58	46	8
Aldrin	.00002	.00002	.00006	.00001	<.00001
Chlordane	<.0001	<.0001	<.0001	<.0001	<.00001
DDD	<.0001	<.0001	<.0001	<.0001	<.0001
DDE	<.0001	<.0001	<.0001	<.0001	<.0001
DDT	<.0001	<.0001	<.0001	<.0001	<.0001
Dieldrin	<.00001	<.00001	<.00001	<.00001	<.00001
Endrin	<.00001	<.00001	<.00001	<.00001	<.00001
Heptachlor	<.00001	<.00001	<.00001	<.00001	<.00001
Heptachlor Epoxide	<.00001	<.00001	<.00001	<.00001	<.00001
Lindane	<.00001	<.00001	<.00001	<.00001	<.00001
Methoxychlor	<.01	<.01	<.01	<.01	<.01
Toxaphene	<.0002	<.0002	<.0002	<.0002	<.0002

* Iowa Class "B" water quality standards in parentheses
** Exceeds Iowa Class "B" water quality standard

TABLE B-3

Grain Size Analyses, February 5, 1987

Location	Percentage of Sediment Passing a Number 230 Sieve
B-1	99.6
B-4	100.0
B-5	100.0
B-7.5	94.5

TABLE B-4

Sediment Oxygen Demand, April 28, 1987

Location	S.O.D. (mg O_2/g sed/day)
B-2	0.14
B-4	0.22
B-5	0.13

DISSOLVED OXYGEN MASS BALANCE

Using limited field data and other data available from the literature, a D.O. mass balance was performed in order to determine the minimum flow requirements into the lake.

The first step in the analysis was to identify the most important sources and sinks for D.O. during the winter. The sources include the oxygen present in the ambient water prior to the onset of ice cover, and any oxygen present in the river water flowing into the lake. Sinks include water column biochemical oxygen demand (B.O.D.), fish respiration, and S.O.D. For this purpose of this analysis, it is further assumed that:

a. The river is at flat pool throughout the winter;

b. The period of ice cover is Dec 15 - Mar 31 (100 days, uninterrupted);

c. The ice and overlying snow is sufficient to prevent any net photosynthetic activity in the lake once ice forms; and

d. Inflowing river water will only partially mix with the ambient lake water (50 percent mixing efficiency).

These assumptions are felt to be conservative, yet realistic, based upon worst case observations of Midwestern lakes.

Table B-5 lists the components of the mass balance as well as the source of the values used. Computation sheet B-1 shows the calculations based on these values.

Computation Sheet B-1

Disolved Oxygen Sinks

1. Sediment oxygen demand

$$\frac{8.0 \text{ g } O_2 \text{ @ 20 C}}{m^2 \text{ .day}} = \frac{2.83 \text{ g } O_2 \text{ @ 4 C}^*}{m^2 \text{ .day}} \quad \frac{2.83 \text{ g } O_2}{m^2 \text{ .day}} \times 375 \text{ acres} \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times \frac{(0.3048 \text{ m})^2}{\text{ft}^2} \times 100 \text{ days} = 4.29 \times 10^8 \text{ g } O_2$$

* Temperature correction $= K_T = K_{20}\ (1.067^{T-20})$

2. Biochemical Oxygen Demand

$$\frac{5.0 \text{ mg}}{1} \times \frac{28.32 \text{ l}}{\text{ft}^3} \times 900 \text{ acre .ft} \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{50 \text{ lake volumes}^*}{100 \text{ days}} \times .5 \text{ (mixing efficiency)} = 1.39 \times 10^6 \text{ g } O_2$$

* based on estimated rates of inflow to the lake

3. Fish Respiration

$$\frac{500 \text{ lbs}}{\text{acre}} \times 375 \text{ acres} \times \frac{0.0119 \text{ ml } O_2}{\text{g.hr}} \times 1.7^* \times \frac{24 \text{ hr}}{\text{day}} \times \frac{1.6 \times 10^{-7} \text{moles } O_2}{\text{ml } O_2} \times \frac{32 \text{ g } O_2}{\text{mole } O_2} \times 100 \text{ days} \times \frac{454 \text{ g}}{\text{lb}} = 2.12 \times 10^4 \text{g } O_2$$

* fish active/standard metabolism ratio

Dissolved Oxygen Sources

1. Disolved oxygen in lake

$$900 \text{ acre ft} \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times \frac{28.32 \text{ l}}{\text{ft}^3} \times \frac{10 \text{ mg}}{1} \times \frac{1\text{g } O_2}{1000 \text{ mg } O_2} = 1.11 \times 10^7 \text{ g } O_2$$

$$\frac{350 \text{ ft}^3}{\text{sec}} \times \frac{10 \text{ mg } O_2}{1} \times \frac{28.32 \text{ l}}{\text{ft}^3} \times \frac{86{,}400 \text{ sec}}{\text{day}} \times 100 \text{ days} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times .5 \text{ (mixing efficiency)} = 4.28 \times 10^8 \text{ g } O_2$$

TABLE B-5

Mass Balance Components and Sources of Data

D.O. Sources	Values Used	Source of Data
Mississippi River inflow	80% of saturation	Observation
Initial D.O. content of lake	80% of saturation	Observation
D.O. Sinks		
S.O.D.	8.0 g/m^2/day @20°C	Measured
B.O.D.	5 mg/l	Measured
Fish respiration rate	0.0119 ml O_2/hr	Leidy, 1977
Standing crop of fish	56 g/m^2	Leidy, 1977

CONCLUSIONS

Based on the field observations, literature values, and conservation assumptions of this analysis, it is estimated that approximately 350 cubic feet per second of river water will be required to ensure adequate D.O. throughout the winter in order to prevent winter kills. It should be realized that this value is approximate and will vary from year to year. It is also possible that more or less flow will be required during the summer months.

BIBLIOGRAPHY

Leidy, G. R. and R. M. Jenkins, 1977. The development of fishery compartments and population rate coefficients for use in reservoir ecosystem modeling. Contract Rept. CR-Y-77-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

GEOTECHNICAL CONSIDERATIONS

APPENDIX C

UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

POOL 13, RIVER MILE 545.8
UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

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JACKSON COUNTY, IOWA

APPENDIX C
GEOTECHNICAL CONSIDERATIONS

PURPOSE AND SCOPE

This appendix is intended to depict the general geologic setting and geotechnical aspects for the subject project. The scope includes the review of Iowa and Illinois Geological Survey reports, bulletins, and circulars. Information and analysis presented herewith also includes results of interpretations of surface and subsurface information gathered during the reconnaissance and field explorations.

PHYSIOGRAPHY

The Brown's Lake area lies in the Dissected Till Plains Section of the Central Lowlands Province. The specific site is situated in the Mississippi alluvial valley at river mile (RM) 545, some 8 miles upstream of Savanna, Illinois. The mouth of the Apple River lies directly across channel from the proposed project, and the Maquoketa River empties into the Mississippi just 3.5 miles upstream on the Iowa shore. Topographic relief within the project site is of little consequence since the entire area consists of a series of sloughs and shallow backwater lakes. Elevation varies from about 585 to 590 feet MSL (mean sea level) over a 2-mile reach.

About 2.5 miles east of Green Island, a gravel terrace borders the valley where Smith Creek empties into the floodplain. This feature rises to as much as 20 feet above the floodplain and can be traced for some distance up the channel of the creek. Materials forming the terrace consist of small, well-rounded pebbles and gravel.

PLEISTOCENE AND RECENT DEPOSITS - THE SOILS

Although most of Jackson County was covered with Kansan ice which left drift and subsequent deposits of loess on the uplands, the subject area, being in the floodplain, contains fluvial materials that were, in part, laid down during recent time. The largest of these areas is found along the eastern limits in the southern portion of the county. In the vicinity of the project this alluvial plain has a width of 1.5 to 2 miles and reaches up to 3 miles just upstream at Green Island. Of the four types of soils found in Jackson County (i.e., the loess, sands, alluvial, and residual materials) the alluvial varieties will be addressed.

A large portion of the alluvial land along the floodplain of the Mississippi River is covered with wide marshes and threaded with backwater lakes such as Upper and Lower Brown's Lake. Most of this area is too low to be successfully cultivated except where levee and drainage systems have been constructed such as at Green Island. Because much of this area is subject to overflow, siltation has been occurring at progressive rates and lake depths have been reduced to a more marsh-like environment.

Since the recommended plan for the environment enhancement of this area involves the construction of a deflection levee, a water control structure, channel excavation, and lake dredging, the nature of the alluvial material and requirements for the construction of these aforementioned structures are of concern and are addressed in this appendix.

Generally, these alluvial soils contain porous sands, silts (which can retain moisture), and humus or decaying organic matter and soluble minerals. Both gray and brown mottled clays also are present and range from lean to fat. Greater detail of the engineering properties will be discussed under "Foundations of Respective Structures."

SUBSURFACE EXPLORATIONS

Since access to this site is, in part, limited by surface water, 6 of 8 initial borings were taken through the ice during February 1987, and 2 were from land. These 8 initial borings, B-87-1 through B-87-8, were obtained by hand with a 4-inch Iwan auger. In two of these holes, B-87-4 and B-87-7, a 2-inch tube sampler was used to sample the lower gray fine sand.

During the last week of May 1987 and first week of June 1987, 21 additional exploratory borings were completed. These are numbered B-87-9 through B-87-29. Three of these holes, B-87-23, 26, and 27, were obtained with a CME-45 drill rig using a 4-inch hollow stem auger and 2-inch split spoon sampler employing standard penetration tests. The other holes were obtained using a 4-inch Iwan hand auger and a 3-inch tube sampler. Some of the holes were taken from a boat. The three borings taken with the drill rig extended a depth of 40 feet, approximate elevation 558 feet MSL.

BEDROCK STRATIGRAPHY AND STRUCTURE

Although Ordovician rock of the Maquoketa Formation may underlie the project area, none of the hand auger or rotary drill borings encountered bedrock to depths of 40 feet. Typical depths to bedrock in this valley floodplain often reach 70 to 100 feet. Where bedrock is present, such as in the bluffs just south of Brown's Lake, the Maquoketa Formation is capped by younger Silurian rocks of the Niagaran Series. As one progresses down river from Green Island, a southward dip in the strata is more rapid than the fall in the river. The height to which the Maquoketa shale appears in the bluffs gradually decreases while the cap of the Niagaran constantly increases in thickness. In the bluffs adjacent to the project, the top of the Maquoketa appears about 15 feet above the floodplain while near Lainsville, 4 miles further eastward, the Niagaran limestone may be seen down to the very base of the bluffs.

DEFLECTION LEVEE EMBANKMENT

The proposed deflection levee is approximately 9 feet high and 3,500 feet long and will be built with semicompacted impervious material. For ease of construction and normal maintenance and operation, the crown of the levee will be 10 feet wide. The side slopes of the levee will be 1 vertical on 3 horizontal. Side slopes will be grass seeded since a heavy timber growth is evident on both sides of the proposed levee. Therefore, it is anticipated that grass protection will be adequate against wave wash and rain water. The proposed levee alignment parallel to Mississippi River and typical cross sections is shown on plates 2, 10, and 15 of the main report.

To achieve a maximum desirable degree of compaction of the embankment, all impervious material will be placed or spread in layers not more than 12 inches in thickness prior to compaction. Each layer will be compacted by not less than four complete passes of a tamper-type roller or by not less than two complete passes of a rubber-tired roller. No moisture control will be required.

CONTAINMENT DIKE EMBANKMENT

The average 9-foot-high containment dike will be constructed of semicompacted impervious fill. The proposed dike will have both side slopes of 1.0 vertical on 1.5 horizontal with a 2-foot crown width. Dredged spoil will be expected to pond near the crest of the dike. The proposed dike alignment and typical cross section are shown on plates 13 and 14 of the main report.

To achieve acceptable compaction effort of the embankment, all impervious material will be placed or spread in layers not more than 12 inches in thickness prior to compaction. Each layer will be compacted by not less than four complete passes of a tamper-type roller or by not less than two complete passes of a rubber-tired roller. No moisture control will be required.

FOUNDATIONS FOR EMBANKMENTS

The entire area within the limits of the deflection levee and containment dike foundation will be stripped of vegetation and other deleterious materials to a depth of 6 inches. All tap roots, lateral roots, or other projections over 1.5 inches in diameter within the embankments' foundation areas will be removed to a depth of 3 feet below natural ground surface.

The proposed deflection levee and containment dike foundations were investigated by several hand auger borings, most of them terminating in sand. Samples in all borings were taken generally at 2-foot intervals of depth or at visual changes of material. The borings' locations and logs are shown on plates 2, 3 and 8, 9, respectively, of the main report. Reviewing these borings, the top stratum varies in thickness from 5 to 12 feet and consists of CL and CL-CH material. The moisture content ranges from 18 to 42 percent (average of 32 percent) for CL soils, and 36 to 46 percent (average of 39 percent) for CL-CH soils.

The liquid limits and plastic limits ranged from 39/22 to 42/23 percent in the CL materials. The hand auger borings which terminated in sand show that the clay material is underlain by brown medium to fine sand (SP). Boring B-87-8 shows that top 2 feet consists of brown clayey sand (SC) underlain by 2 feet of brown fine sand (SP). The sand is underlain by gravelly brown medium clay (CL-CH) with a moisture content of 38. Underlying this clay is brown medium to fine sand (SP). None of these borings were extended to bedrock. According to bedrock stratigraphy, the bedrock in this floodplain valley varies from 70 to 100 feet deep. The ground water levels encountered in the vicinity of the proposed embankment areas were found to be fairly consistent from hole to hole. The depths at which water was located ranged from 3 to 5 feet; from elevations 583.4 to 590.2 feet MSL.

FOUNDATION FOR OTHER STRUCTURES

A water control structure will be constructed to connect the proposed deflection levee with the existing Green Island Levee. The structure will consist of four sluice gates, each 5 feet by 5 feet, with individual operating stems. Because of standing water and extremely soft ground conditions, mechanical equipment could not be utilized to investigate subsurface conditions. Therefore, two hand auger borings B-87-22 and B-87-22A, 12 feet and 7 feet deep, respectively, were taken in the vicinity of the proposed structure.

Boring B-87-22 revealed the presence of about 4 feet of gray, fat clay (CH), and 2 feet of medium clay (CL-CH). The moisture content varied from 57 to 58 percent, Atterberg limits of 58/24 for CH soils. The moisture content for CL-CH was found to be 40. This is underlain by brown medium to fine sand (SP). Boring B-87-22A indicated the top 3 feet consisted of medium to fine sand which was underlain by gray, fat clay with moisture content of 50 percent. Sand was not encountered below this.

Applying the concrete structures load to this unsuitable soil profile would result in excessive differential settlements. It also could create major construction problems. Therefore, it will be necessary to remove the soft clay or any other unsuitable material which might not have been located by the two hand auger borings. The unsuitable material should be replaced with compacted sand fill. A dewatering system will be required to maintain the excavation area in dry condition. Foundation design details of the structure will be completed during final design.

FOUNDATION OF GREEN ISLAND LEVEE

The existing 10-foot-high levee was built between 1925 and 1930 with impervious material. The side slopes of the levee are 1 vertical on 2.7 horizontal. The existing levee foundation was investigated to determine the effects the proposed Brown's Lake Rehabilitation and Enhancement project would have on it. The investigation program, consisting of four borings, was designed to provide detailed subsurface information. Three borings, B-87-23, B-87-26, and B-87-27 were extended to depths of 40 feet. One hand auger boring, B-87-24, was drilled to 12 feet deep. The borings' locations and logs are shown on plates 2, 3 and 8, 9 of the main report. Samples in all borings were taken at 2-foot intervals or at visual changes of material. Tests of soils samples included moisture content, Atterberg limits, gradation and standard penetration (B-87-23, B-87-26, and B-87-27). Detailed descriptions of tests with soil classifications are given on plate 9 of the main report.

According to borings B-87-23, B-87-26 and B-87-27, the top stratum beneath the levee varies in thickness from 5 to 16 feet, consisting of impervious materials classified as lean clay (CL) and medium clay (CL-CH). The SPT "N" values recorded during drilling operations for the clay soils ranged from 5 to 16 (average of SPT "N" values of 8). Semipervious materials (SC, SP-SC, and SP-SM) were found underlying the clay soils in borings B-87-26 and B-87-27. These borings were terminated in sand. Hand auger boring B-87-24, which was taken on the land side of the levee, revealed a top stratum that consisted of 6 feet of lean clay (CL) and 6 feet of medium clay (CL-CH).

The moisture content ranged from 23 to 38 percent (average of 32 percent) for the CL soils and from 25 to 39 percent (average of 31 percent) for the CL-CH soils. The Atterberg limits of the medium clay (CL-CH) ranged from 53/19 to 54/20 percent.

Impervious and semipervious materials were found to be underlain by sand of unknown depth, since borings were not extended to bedrock. The sand was found to be 21 feet deep at elevation 577 feet MSL in boring B-87-23, 22 feet deep at elevation 573 in boring B-87-26, and 31 feet deep at elevation 566 in boring B-87-27.

The groundwater level along the existing levee alignment was found to be consistent from hole to hole. The depths at which water was located below the top of the levee ranged from 12.5 feet to 14 feet; from elevation 585.6 to 584.5 feet MSL.

EXISTING GREEN ISLAND LEVEE UNDERSEEPAGE

The calculated underseepage quantity for the existing Green Island 10-foot-high levee, consisting of impervious materials, is based on an analysis of the thickness and permeability characteristics of the impervious top stratum both riverward and landward of the levee. Case 7 (EM 1110-2-1913, page B-17) - semipervious top strata both riverside and landside was considered appropriate for use in determining the quantity of underseepage, since 10- to 17-feet-thick top stratum appears to exist on the riverside of the existing levee and at least 5 feet of semipervious top stratum is estimated to exist on the land side (Blake's Lake) of the Green Island levee.

The quantity of underseepage was obtained for three different conditions: (a) during high Mississippi River events (elevation 598), from the riverside of the levee under the existing condition; (b) during high Mississippi River events (elevation 598) with an existing channel on riverside of the Green Island levee dredged to a depth of 14 feet as proposed in the main report; and (c) during low Mississippi River events (elevation 583.0, flatpool), from the Blake's Lake side (ponding elevation of 585.6) of the levee.

Criteria used in the underseepage analysis conform to Engineer Manual 1110-2-1913, "Design and Construction of Levees," March 31, 1978. Vertical blanket permeability ratios were selected in accordance with the minutes of the Geotechnical Conference held at Rock Island District on April 29 and 30, 1976.

Design values and methodology used in calculating the underseepage quantity are given on plates C-1 through C-5. The computed quantities of underseepage for the previously mentioned three conditions are 4.0, 5.0, and 1.0 gallons per minute per lineal foot as shown on plates C-3, C-4, and C-5, respectively. A discussion of significant parameters for each specific reach is not deemed necessary since the data shown on plates C-1 through C-5 and the Terminology of Methodology (plates C-6 through C-8) are generally self-explanatory.

SETTLEMENT

The deflection levee configuration used for the settlement analysis is shown on plate C-9. The embankment near the location of boring B-87-11 is found to be most critical with respect to settlement study. At this location, the maximum 10-foot-high levee will impose a maximum load of 0.6 ton per square foot on the 14-foot-thick alluvial clay top stratum foundation.

A settlement analysis conforming to Joseph E. Bowles' "Foundation Analysis and Design," 3rd edition (1982) indicates total settlement to be on the order of 13 inches, as shown on plate C-9. In order to anticipate the unexpected settlement, a shrinkage allowance of 10 percent of the levee height will be provided in the specifications to allow for any consolidation of the embankment and settlement in the foundation. Although no excavation of existing top stratum soils is considered necessary, any material clays encountered during construction that are softer than those encountered during the exploration program will be removed to prevent excessive settlement.

SLOPE STABILITY

The slope stability analysis for end of construction conditions of a typical cross section deflection levee and containment dike was based on available soil data. The maximum height of both embankments will be 10 feet. The stability of slopes was analyzed by the Modified Swedish Method for a circular arc slope stability analysis in accordance with EM 1110-2-1902, "Engineering and Design Stability of Earth and Rockfill Dams," dated April 1, 1970.

To estimate the stability of 10-foot-high deflection levee with 1V on 3H side slopes, the Q shear strength of semicompacted impervious fill is anticipated to be at least 800 pounds per square foot (psf) and no frictional angle. For the 10-foot-high containment dike, the Q shear strength and no frictional angle of impervious fill is assumed to be 500 psf, since minimum compaction efforts will be required. The design shear strength (Q) of 300 to 600 psf and no frictional angle was estimated for impervious top stratum based on established correlations between moisture contents and shear strengths by Rock Island District for the similar type soils from other projects. However, a conservative shear strength (Q) of 250 psf and no frictional angle was selected for impervious foundation, since undisturbed samples were not obtained to verify the soil strength.

The summary of the slope stability analysis and the solution of the most critical arcs appear on plates C-10 and C-11. The computed minimum safety factors for the proposed deflection levee is 3.4, and 2.7 for the retaining dike. Both computed safety factors exceed the 1.3 required by EM 1110-2-1902, "Engineering and Design Stability of Earth and Rockfill Dams." Therefore, no stability problems are expected. The District's experience with the performance of levee embankments during high water provided a basis for judgment on the adequacy of the proposed sections for slope stability during falling or constant river stages. Slope stability analyses were considered inappropriate for any loading condition other than the end of construction condition.

BORROW MATERIAL

The borrow material will be removed from an area shown on plate 13 of the main report. The material has been classified as a brown lean clay (CL) and a brown medium clay (CL-CH) with an average moisture content of 23.4 percent and 33 percent, respectively. The optimum moisture content was 22.5 percent with a maximum dry density of 97 pounds per cubic foot for the brown lean clay. For the medium clay, the optimum moisture content was 24 percent with a maximum dry density of 95.5 pounds per cubic foot. The liquid limit and plastic limit are 40/26 for the lean clay (CL) and 47/28 for the brown medium clay (CL-CH). Plates C-12 and C-13 show compaction curves for the proposed borrow material.

Borrow materials may require drying prior to placement, until the moisture content is reduced to desirable moisture content for proper compaction. No compaction or shear strength difficulties with this are anticipated.

Subject		Date
BROWN LAKE, SEEPAGE COMPUTATION ON L.S. OF THE EXISTING LEVEE		JUN 87
Computed by SZ	Checked by	Sheet 1 of 5

SEEPAGE QUANTITIES IN ACCORDANCE WITH EM 1110-2-1913 DESIGN AND CONSTRUCTION OF LEVEES 31 MAR 78.

GENERAL EXISTING LEVEE ALIGNMENT CONDITION

CASE 7 SEMIPERVIOUS TOP STRATA BOTH RIVER SIDE AND LAND SIDE.

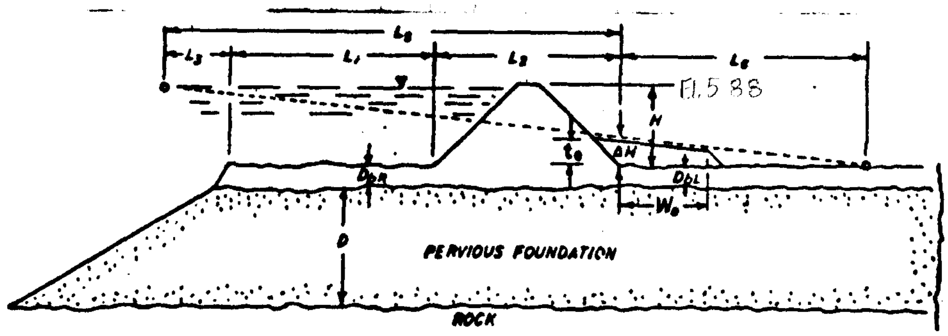


ILLUSTRATION OF RID NOMENCLATURE

$Q = \$ K_f H$ EQ. B-11 PAGE B-12

$H = 10$ FT

$K_f = 0.40$ ft/min, ESTIMATED HORIZONTAL PERMEABILITY

$$\$ = \frac{d}{X_1 + L_2 + X_3}$$ EQ. B-25 PAGE B-17

OR

$$\$ = \frac{D}{L_1 + L_3 + L_2 + L_4}$$

NCR Form 381b
1 Aug 80

$L_1 = C_R * \tanh L_R/C_R$ — RID UNDERSEEPAGE ANALYSIS DATA & BERM ANALYSIS

L_R = NAT. BLANKET LENGTH R.S. — "

$C_R = \sqrt{B \cdot D_{bR} \cdot D}$ — "

$B = K_f / K_{bR}$ (RIVER SIDE) — "

D_{bR} = TRANS. SEMIPERVIOUS THICKNESS R.S. — "

D = THICKNESS OF PERVIOUS STRATUM = 90 FT (ASSUMED)

L_2 = BASE WIDTH OF LEVEE = 64. FT

L_3 = 0.44D = 40 FT — RID UNDERSEEPAGE ANALYSIS DATA & BERM ANALYSIS

$L_e = C_L * \tanh L_L/C_L$ — "

L_L = NAT. BLANKET L.S. — "

$C_L = \sqrt{A * D_{BL} * D}$ — "

$A = K_f / K_{bL}$ LANDSIDE — "

D_{BL} = TRANS. SEMIPERVIOUS THICKNESS L.S. — "

Subject		Date
Browns Lake Seepage Computation on L.S. of the Existing Levee		June 1987
Computed by R.P.	Checked by SZ	Sheet 3 of 5

Seepage Quantities Under Existing Conditions During High Mississippi River Events (Elevation 598)

STATION (LIN. FT.)	L_L (FT)	L_R (FT)	B	D_{bR}	C_R (FT)	L_1 (FT)	A	D_{bL} (FT)	C_L (FT)	L_e	$	Q* 7.48 GPM/LIN FT
67+00 TO 76+00	∞	5500	800	8	759	759	200	5	300	300	.08	2.32
76+00 TO 94+00	∞	83	800	10	849	83	200	5	300	300	.18	5.53
94+00 TO 103+50	∞	1100	800	6	657	612	200	5	300	300	.09	2.70

TOTAL Q (3650 LIN FT) = 14,607 GPM FOR H = 10'

AVE Q = 4.0 GPM FOR H = 10'

NCR Form 381b
1 Aug 80

Subject BROWN LAKE, SEEPAGE COMPUTATION ON L.S. OF THE EX. LEVEE		Date JUNE 1987
Computed by SE	Checked by SE	Sheet 4 of 5

SEEPAGE QUANTITIES DURING HIGH MISSISSIPPI RIVER EVENTS (ELEVATION [illegible]), AND PROPOSED 14 FEET DEEP DREDGED CHANNEL AS A SOURCE OF SEEPAGE ENTRANCE.

STATION (LIN. FT)	L_L (FT)	L_R (FT)	B	D_{bR} (FT)	C_R (FT)	L_1 (FT)	A	D_{bL} (FT)	C_L (FT)	L_e (FT)	$	Q×7.48 GPM/LIN FT
67+00 TO 76+00	∞	450	800	17	1106	427	200	5	300	300	.11	3.24
76+00 [illegible] 83+00	∞	83	800	15	1039	83	200	5	300	300	.18	5.53
83+00 TO 103+50	∞	83	800	10	849	83	200	5	300	300	.18	5.53

TOTAL Q (3,650 LIN FT) = 18,124 GPM FOR H = 10′

AVE Q = 5.0 GPM FOR H = 10′

NCR Form 381b
1 Aug 80

PLATE C-4

Subject: BROWN LAKE, SEEPAGE COMPUTATION FROM BLAKE LAKE	Date: JUN 82
Computed by: SZ / Checked by: SZ	Sheet 5 of 5

SEEPAGE QUANTITIES PASSING BENEATH THE LEVEE FROM THE BLAKE LAKE SIDE, WHEN LAKE WATER EL = 585.6 AND WATER LEVEL IN EXCAVATED CHANNEL = 583.0 (ΔH= 2.6)

STATION (LIN FT)	L_L (FT)	L_K (FT)	B	D_{bR} (FT)	C_R (FT)	L_1 (FT)	A	D_{bL} (FT)	C_L (FT)	L_e (FT)	⌀	Q*7.48 (GPM/LIN FT)
67+00 TO 76+00	450	∞	800	5	600	600	200	14	502	359	.08	.66
76+00 TO 83+00	83	∞	800	5	600	600	200	12	465	82	.11	.89
83+00 TO 103+50	83	∞	800	5	600	600	200	7	355	82	.11	.89

TOTAL Q (3,650 LIN. FT.) = 3,042 GPM FOR ΔH= 2.6'

AVE Q = 0.84 ≅ 1.0 GPM/LIN FT FOR ΔH = 2.6'

A Method to Estimate the Thickness and Width of Sand Berms for Sand Levees

Notes:

(a) Measured from cross section at elev. of landside toe.

(b) Computed berm width. If base width equals or exceeds 10H no berm required.

(c) Procedure and computation on separate sheets.

(d) If L_L is less than 100 ft. provide berm and/or fill depressions to elev. of landside toe for a distance of 100 ft. beyond toe of levee or berm.

(e) If D_{bL} is zero provide berm as for (d). Transformed thickness if blanket includes semipervious soils. Use 0.5 of natural thickness for ML, 0.1 for SM, 0.0 for sand and 1.0 for impervious.

(f) Transformed thickness as for (e) except, when impervious blanket is overlain with pervious or semipervious soils, then the natural total thickness is used for the overlying soils.

(g) For D_{bL} equal to or less than 4, A = 100: for D_{bL} equal to or greater than 5, A = 200, = K_f/K_{bL}.

(h) For parallel diversion levees with blocked entrance, use 1/2 distance between riverside toes of levees.

(i) Transformed thickness as for (e).

(j) For D_{bR} equal to or less than 4, B = 400: for D_{bR} equal to or greater than 5, B = 800, = K_f/K_{bR}.

(k) For parallel diversion levees with clay in thalweg, use L_3 = 0.

(l) Use $L_{1(o)}$ for an open (o) entrance.

(m) Use $L_{1(x)}$ for blocked (x) entrance.

(n) Use $L_{e(o)}$ for finite open (o) exit or infinite blanket.

(o) Use $L_{e(x)}$ for blocked (x) exit.

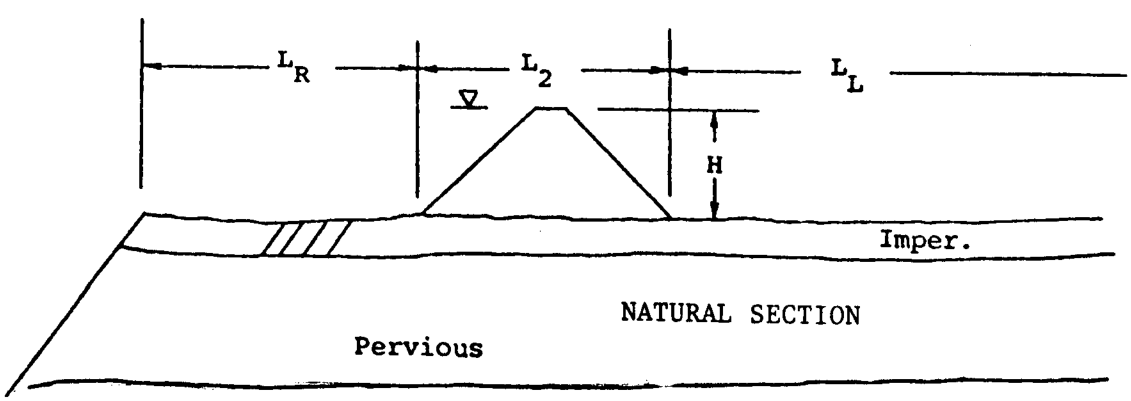
(p) γ_{bL} is submerged unit weight of landside blanket cover and berm (use 53 p.c.f.). γ_W is 62.4 p.c.f.

(q) Computed berm thickness for a factor of safety of 1.5 at landside toe of levee.

(r) For factor of safety computed at the landside toe of the levee, a berm is not required if F.S. greater than 1.5. Berm required if F.S. is equal to or less than 1.0. If F.S. greater than 1.0 and less than 1.5, and if computed berm thickness (q) is greater than 2.0, berm required. If F.S. greater than 1.0 and less than 1.5, and if computed berm thickness (q) is less than 2.0, judgment will determine whether a berm is required.

(s) Minimum 3.0 ft.

(t) Minimum 30 ft.



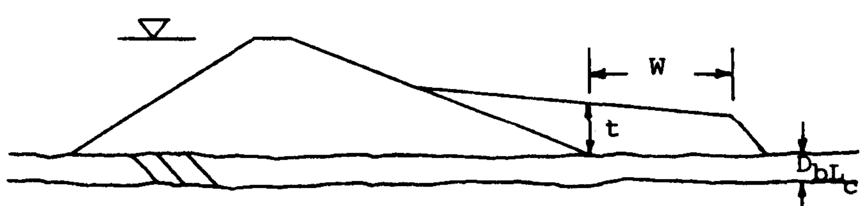
30 April 1976

A Method to Estimate the Thickness and Width of Sand Berms for Sand Levees

			Notes*	Stations
	Elev. top of levee			
	Elev. landside toe (tailwater)			
H	Gross head			
L_2	Base width of levee		(a)	
W_o		$10H - L_2$	(b)	
D	Trans. thickness perv. found.		(c)	
L_L	Landside blanket - width		(d)	
D_{bL}	- thickness		(e)	
D_{bL_c}	- cover		(f)	
A	- perm. ratio		(g)	
C_L		$\sqrt{A \cdot D_{bL} \cdot D}$		
L_R	Riverside blanket - width		(h)	
D_{bR}	- thickness		(i)	
B	- perm. ratio		(j)	
C_R		$\sqrt{B \cdot D_{bR} \cdot D}$		
L_3	Entrance:	$0.44D$	(k)	
$L_{1(o)}$	Riverside:	$C_R \cdot (\tanh L_R/C_R)$ (or)	(l)	
$L_{1(x)}$		$C_R/(\tanh L_R/C_R)$	(m)	
$L_{e(o)}$	Landside:	$C_L \cdot (\tanh L_L/C_L)$ (or)	(n)	
$L_{e(x)}$		$C_L/(\tanh L_L/C_L)$	(o)	
$L_s + L_e$	Total:	$L_2 + L_3 + L_1 + L_e$		
ΔH		$H \cdot L_e/(L_s + L_e)$		
F.S.		$(\gamma_{bL} \cdot D_{bL_c})/(\Delta H \cdot \gamma_W)$	(p)	
t_o		$(1.5\gamma_W \cdot \Delta H - D_{bL_c} \cdot \gamma_{bL})/(1.5\gamma_W + \gamma_{bL})$	(q)	
Probable Control			(r)	
t	Selected berm thickness		(s)	
W	Selected berm width		(t)	

All dimensions in feet.

*Notes on separate sheet.



Sketch of levee and foundation configurations on separate sheet.

PLATE C-7

30 April 1976

Procedure for Transformation of Pervious Foundation

$$D = \sqrt{\Sigma(d_{(n)}K_{h(n)})\ \Sigma\ (d_{(n)}/K_{v(n)})}$$

$$K_f = \sqrt{\Sigma(d_{(n)}K_{h(n)})/\Sigma\ (d_{(n)}/K_{v(n)})}$$

where

d (1,2,3....n) = increment (1,2,3....n) of depth of pervious strata

K_h (1,2,3....n) = horizontal permeability for corresponding increment (1,2,3....n) of pervious strata*

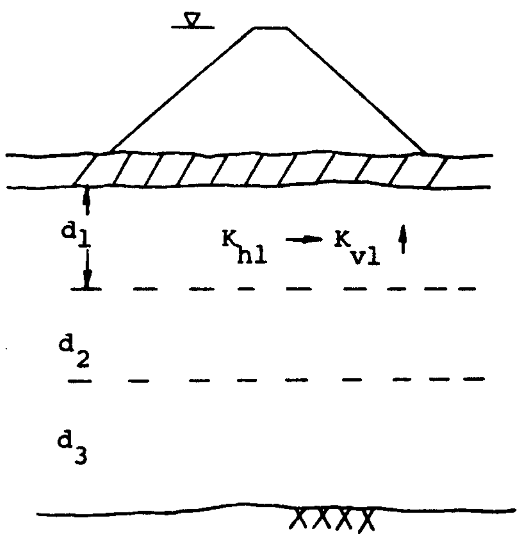
K_v (1,2,3....n) = vertical permeability for corresponding increment (1,2,3....n) of pervious strata

K_h (1,2,3....n)/K_v (1,2,3....n) = 1 if $D_{10} > 0.30$

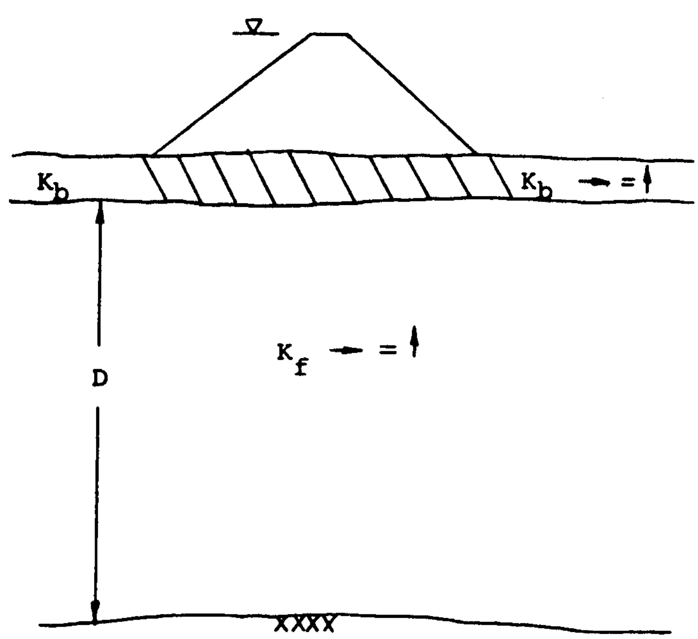
= 2 if $0.20 < D_{10} \leq 0.30$

= 3 if $D_{10} < 0.20$

*The value of K_h is estimated from the D_{10} size and the graph shown in Transactions of A.S.C.E., Vol. 126, 1961, Part 1, p. 1449, Figure 12.

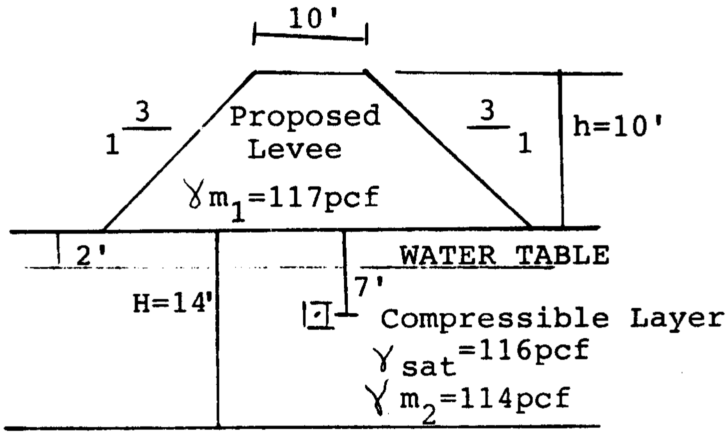


NATURAL



TRANSFORMED

BROWN LAKE
DEFLECTION LEVEE
SETTLEMENT ANALYSIS



Assumptions:
- Ave. Moisture content of Comp. Layer = 36%
- Ave. LL(WL)=41, Ave PL(WP)=23 Specific Gravity = 2.70
- Comp. Layer is normally consolidated

$$e_o = \frac{WG_s}{S} = \frac{(.36)(2.70)}{1} = .972$$

Compression Index, C_c:

C_c = .009(LL-10) = .342 — Ref. fnd. Analysis & Design 3rd Edition by Joseph E. Bowles

$C_c = .37(e_o+.003WL +.0004W_n-.34)$= .292 — "

$C_c = .30(e_o-.27)$ = .211 — Ref. Physical & Geotechnical Properties of Soils by Joseph E. Bowles

Ave. Value of C_c = .282

Use .292 as recommended by Joseph E. Bowles, which has a reported 86 percent reliability.

P_o:

@ mid depth = 2(114)+5(116-62.4)=496 psf

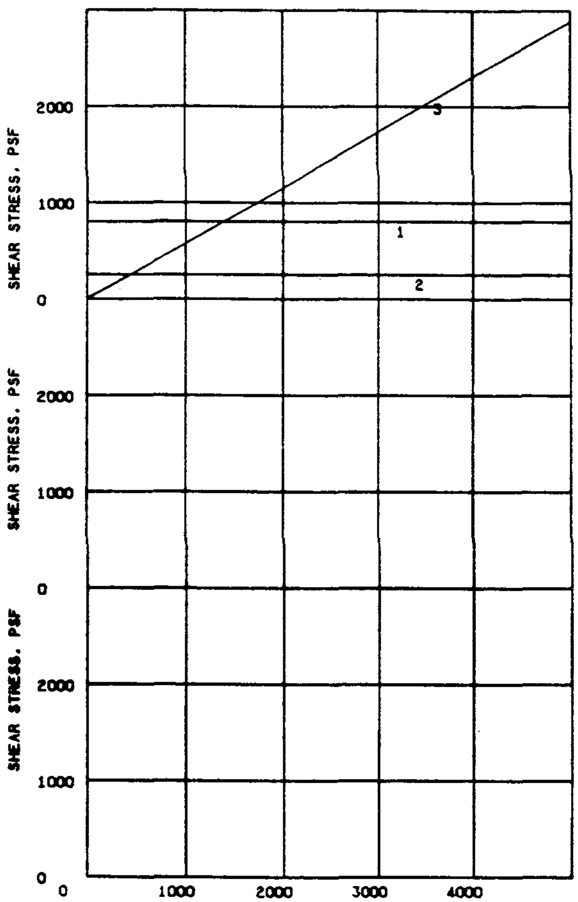
ΔP:

ΔP = Boussinesq Coeff. *h* γm_1= (0.950)(10)(117) = 1,112 psf

Solving for Settlement, S:

$$S = 12 \text{ X } \frac{Cc}{1+e_o} H \text{ Log}_{10} \frac{Po+\Delta P}{Po} = 12 \text{ X } \frac{0.292}{1+.972} \text{ X } 14 \text{ X Log}_{10} \frac{496+1112}{496} = 12.7 \quad 13"$$

Total Settlement = 13 inches

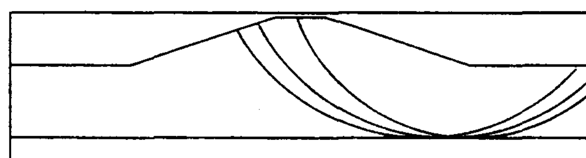


DESIGN ENVELOPES

MATERIAL		SOIL WT. LBS./CUFT		SHEAR STRENGTH							
				Q		R		S		(R+S)/2	
		MOIST	SAT.	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF
IMPERVIOUS FILL EL.589 TO EL.599	1	117.00	120.00	0.00	800.00	12.00	800.00	29.00	0.00	21.00	400.00
CLAY FOUNDATION EL.574 TO EL.589	2	110.00	115.00	0.00	250.00	12.00	250.00	29.00	0.00	21.00	150.00
SAND FOUNDATION EL. TO EL.574	3	120.00	120.00	30.00	0.00	30.00	0.00	30.00	0.00	30.00	0.00

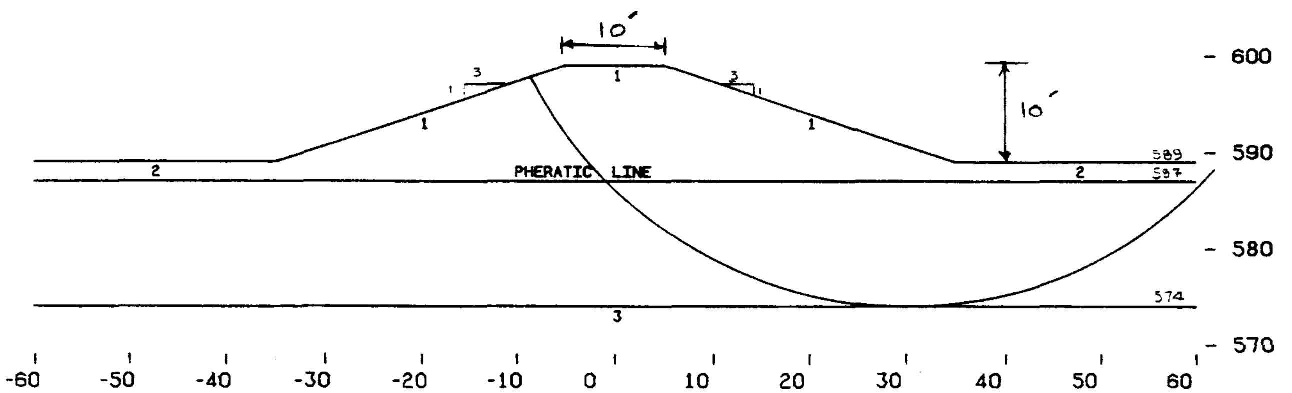
CIRCLE FAILURE SURFACE
RESULTS BY HARRIS-500
COMPUTER PROGRAM 741-H5-F424A
TANGENT TO ELEV 574.10
TRIAL ARCS

RADIUS OF CIRCLE	CENTER OF CIRCLE DISTANCE FROM ℄	CENTER OF CIRCLE ELEV	F.S. Q ψ= 0.00	
43.00	30.00	617.00	3.35	
43.00	25.00	617.00	3.53	
38.00	35.00	612.00	3.71	
28.00	25.00	602.00	4.10	
48.00	20.00	622.00	3.38	
43.00	35.00	617.00	3.51	



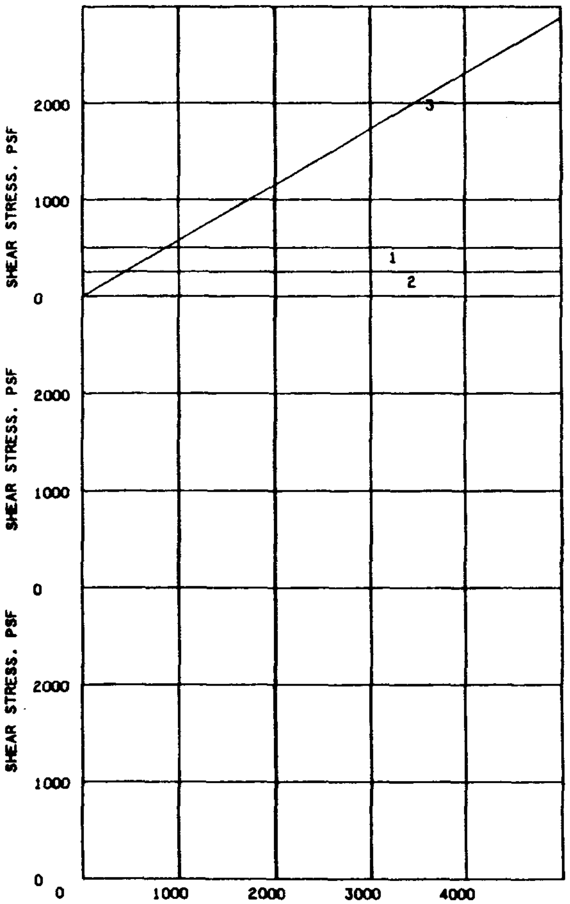
RANGE OF TRIAL FAILURE SURFACES

NOTES
1- ANALYSES WERE RUN ACCORDING TO EM 1110-2-1902 DATED APRIL 1970
2- THE SIDE EARTH FORCE DIRECTION WAS TAKEN AS THE AVERAGE OF THE EMBANKMENT SLOPES IMMEDIATELY ADJACENT TO THE SLICE INTERFACE
3- PSI-SIESMIC COEFFICIENT USED IN ANALYSES



BROWN LAKE REHAB. ENHANC. PROJECT
DEFLECTION LEVEE
END OF CONSTRUCTION.DEFLECTION LEVEE
CIRCLE SLOPE STABILITY ANALYSIS.(RS)
JUNE 1987 (SZ)

PLATE C-10

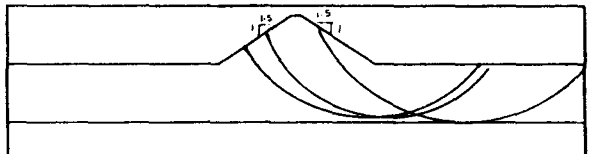


DESIGN ENVELOPES

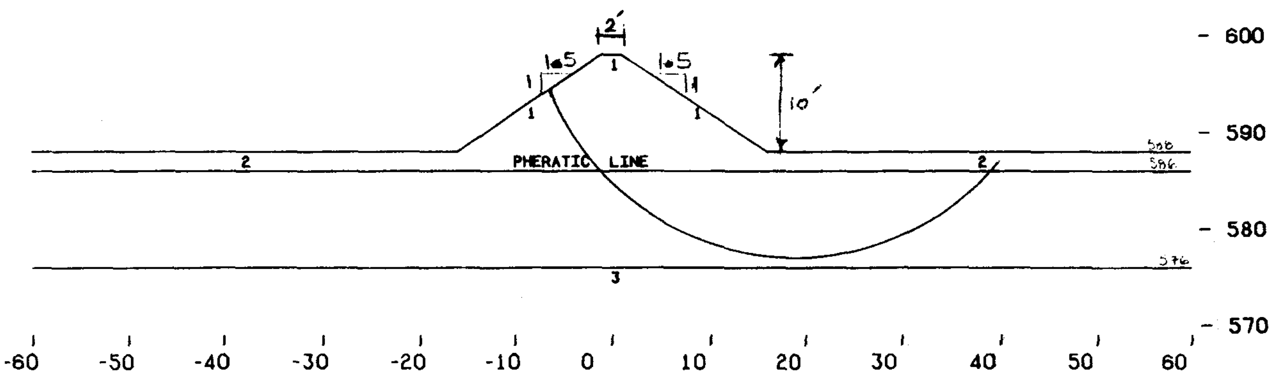
MATERIAL		SOIL WT. LBS./CUFT		SHEAR STRENGTH							
				Q		R		S		(R+S)/2	
		MOIST	SAT.	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF
IMPERVIOUS FILL EL.588 TO EL.598	1	117.00	120.00	0.00	500.00	12.00	500.00	29.00	0.00	21.00	200.00
CLAY FOUNDATION EL.576 TO EL.588	2	110.00	115.00	0.00	250.00	12.00	250.00	29.00	0.00	21.00	150.00
SAND FOUNDATION EL. TO EL.576	3	120.00	120.00	30.00	0.00	30.00	0.00	30.00	0.00	30.00	0.00

CIRCLE FAILURE SURFACE
RESULTS BY HARRIS-500
COMPUTER PROGRAM 741-HS-F424A
TANGENT TO ELEV 576.10
TRIAL ARCS

RADIUS OF CIRCLE	CENTER OF CIRCLE DISTANCE FROM ℄	CENTER OF CIRCLE ELEV	F.S. Q ψ= 0.00	
27.00	18.00	604.00	2.70	
30.00	15.00	607.00	3.31	
34.00	35.00	610.00	8.02	
25.00	19.00	601.00	2.80	
40.00	21.00	616.00	3.08	
30.00	17.00	608.00	2.89	


RANGE OF TRIAL FAILURE SURFACES

NOTES
1- ANALYSES WERE RUN ACCORDING TO EM 1110-2-1902 DATED APRIL 1970
2- THE SIDE EARTH FORCE DIRECTION WAS TAKEN AS THE AVERAGE OF THE EMBANKMENT SLOPES IMMEDIATELY ADJACENT TO THE SLICE INTERFACE
3- PSI-SIESMIC COEFFICIENT USED IN ANALYSES



BROWN LAKE REHAB. ENHANC. PROJECT
CONTAINMENT DIKE
END OF CONSTRUCTION
CIRCLE SLOPE STABILITY ANALYSIS.(RS)
JUNE 1987 (SZ)

PLATE C-11

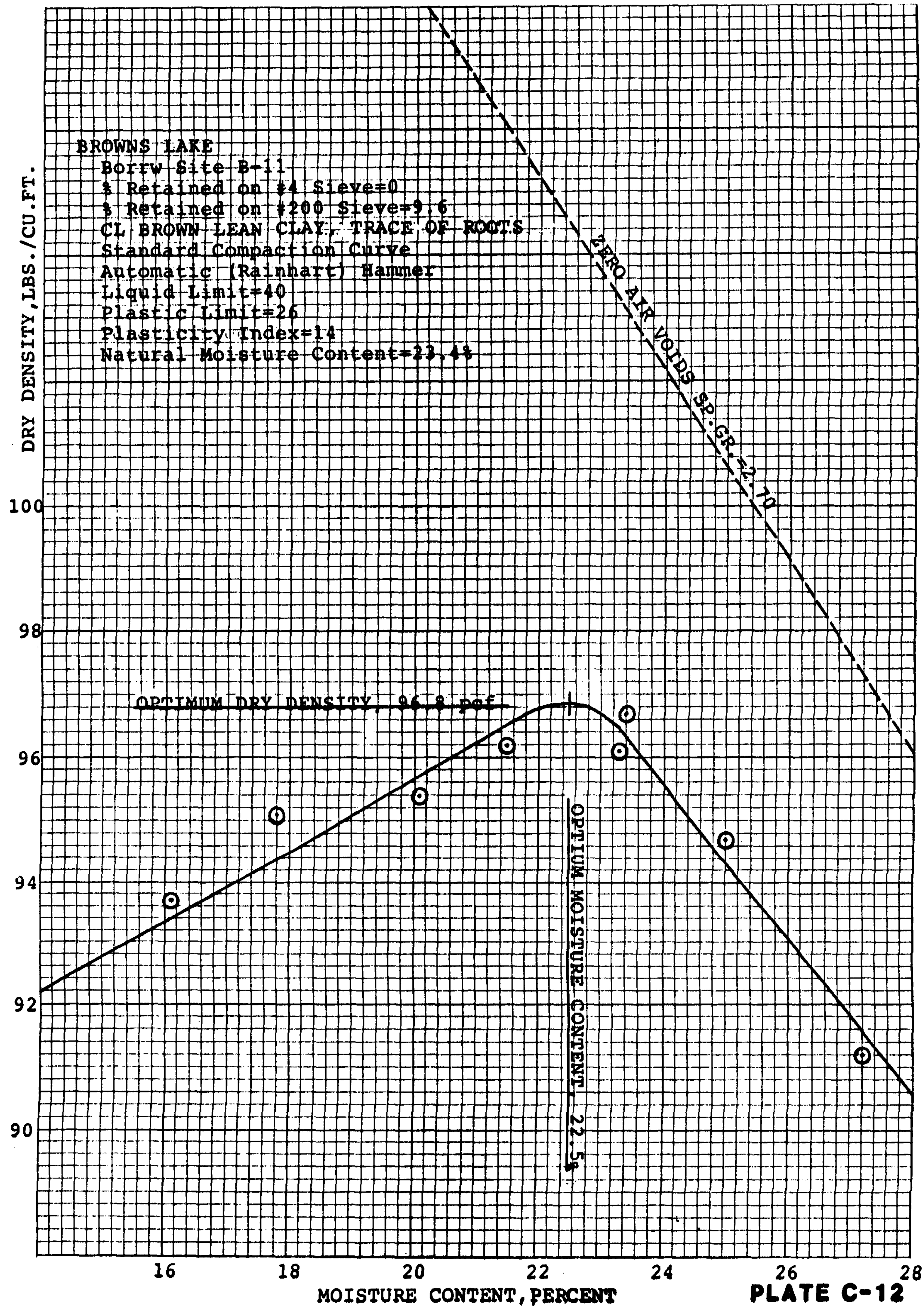

BROWNS LAKE
Borrw Site B-11
% Retained on #4 Sieve=0
% Retained on #200 Sieve=9.6
CL BROWN LEAN CLAY, TRACE OF ROOTS
Standard Compaction Curve
Automatic (Rainhart) Hammer
Liquid Limit=40
Plastic Limit=26
Plasticity Index=14
Natural Moisture Content=23.4%
ZERO AIR VOIDS SP.GR.=2.70
OPTIMUM DRY DENSITY, 96.8 pcf
OPTIUM MOISTURE CONTENT 22.5%
DRY DENSITY, LBS./CU.FT.
100
98
96
94
92
90
16
18
20
22
24
26
28
MOISTURE CONTENT, PERCENT

PLATE C-12

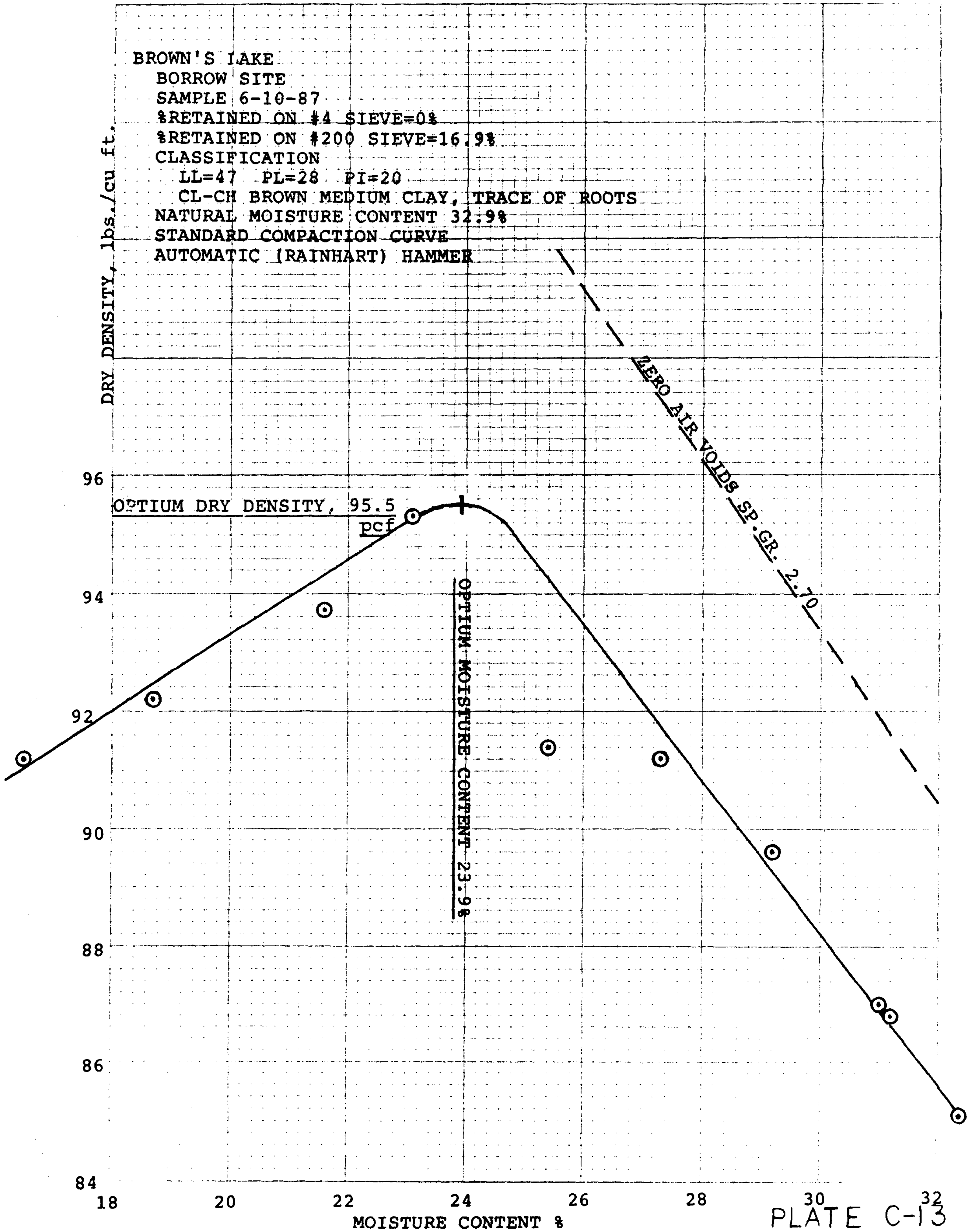

BROWN'S LAKE
BORROW SITE
SAMPLE 6-10-87
%RETAINED ON #4 SIEVE=0%
%RETAINED ON #200 SIEVE=16.9%
CLASSIFICATION
LL=47 PL=28 PI=20
CL-CH BROWN MEDIUM CLAY, TRACE OF ROOTS
NATURAL MOISTURE CONTENT 32.9%
STANDARD COMPACTION CURVE
AUTOMATIC (RAINHART) HAMMER
DRY DENSITY, lbs./cu ft.
OPTIUM DRY DENSITY, 95.5 pcf
OPTIUM MOISTURE CONTENT 23.9%
ZERO AIR VOIDS SP.GR. 2.70
96
94
92
90
88
86
84
18
20
22
24
26
28
30
32
MOISTURE CONTENT %

PLATE C-13

TERRESTRIAL DREDGED MATERIAL DISPOSAL

A
P
P
E
N
D
I
X

D

UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

POOL 13, RIVER MILE 545.8
UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

APPENDIX D
TERRESTRIAL DREDGED MATERIAL DISPOSAL

TABLE OF CONTENTS

CENCR-ED-DG

7/14/87
DJH

Subject: Required Volume of Confined Disposal Facility (CDF)

Reference: EM 1110-2-5006

$V_{CDF} = V_i + \Delta V_i + V_{sd}$

$V_T =$

V_{sd} = sand volume ≃ 15% (from borings)
= $.15\ V_D$

V_D = Volume dredged ?

V_i = volume of in-situ fine sediments
= $(1.0 - 0.15)\ V_D = 0.85\ V_D$

ΔV_i = change in volume after disposal in containment area

$$\Delta V_i = 0.85\ V_D \left(\frac{e_o - e_i}{1 + e_i} \right)$$

$e = \frac{V_v}{V_s}$ = void ratio

$$e_i = \frac{w_i\ G_s}{S_D}$$

G_s = 2.67 (from B-87-7 lab tests)

S_D = 100% for dredged sediments

w_i = water content in-situ before dredging

= 60%

Boring	w, range	w_{avg}	γ_s, lb/ft³
B-4	86-43	64	62
B-5	43-38	40	81

($\Rightarrow \gamma_s = 64$ lb/ft³)

$$e_i = \frac{(.60)(2.67)}{1.00} = 1.60$$

$$e_o = \frac{G_s \gamma_w}{\gamma_s} - 1$$

$\gamma_s = 62.4\ lbs/ft^3$ Figure D-3 (at 42 days)

$$e_o = \frac{(2.67)(62.4)}{62.4} - 1 = 2.65$$

$$\therefore \quad \Delta V_i = .85\, V_D \left(\frac{2.65 - 1.60}{1 + 1.60}\right) = .85\, V_D\, (.40)$$

$$= .34\ V_D$$

$$\therefore\ V_{CDF} = V_D\,(.85 + .34 + .15) = V_D\,(1.34) \Rightarrow V_D\,(1.5)$$

$$\boxed{V_{CDF} = 1.5\ V_D}$$

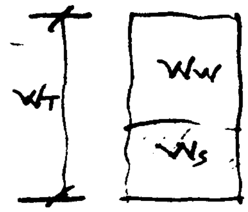
$V_D = 400{,}000\ yd^3$

$V_{CDF} = (1.5)(400{,}000) = \underline{\underline{600{,}000\ yd^3}}$

Subject: Determination of Laboratory Sample Size For Column Settling Analyses

W_s = desired sample size = $145 \frac{g}{\ell}$ (dry weight)

= 13 % (dry weight) = average dredging conditions



$$W_T = W_w + W_s$$

$$w = \frac{W_w}{W_s} = \text{water content}$$

$$W_w = w\,W_s$$

$$W_T = w\,W_s + W_s = \text{Sample size}$$

Table D-1

Sample	w 1/	W_T
B-87-15	.52	220
B-87-5	.43	207.4

1/ Composite in-situ water content

Subject: Column Settling Data and Analyses

Table D-2

Boring B-87-15

Observed Flocculent Settling Concentrations with Depth, g/l 1/

Time, days	Depth from top of settling column				
	2	3	4	5	6
0 2/	145	145	145	145	145
.042	47.1	56.3	53.6	57.5	57.7
.25	20.1	32.5	32.6	37.4	37.4
.42		26.8	30.2	32.9	35.1
1		17.2	19.2	26.6	31.2
2		10.7	15.0	19.8	29.2
3		5.5	6.7	11.7	14.6
4		4.3	6.7	9.2	12.0
5		3.8	2.5	5.3	7.3
10			1.7	2.0	3.0
15			0.6	1.2	1.6

1/ Analyzed by University of Iowa with results dated 24Jul87

2/ Actual values adjusted for time=0.

Table D-3

Boring B-87-15

<u>Percent of Initial Concentration with Time</u>

Time, d	Depth from top of settling column, ft			
	2	3	4	5
0	100	100	100	100
.042 = 1 hour	32	39	37	40
.25 = 6 hours	14	22	22	26
.42 = 10 hours		19	20	23
1		12	13	18
2		7.4	10	14
3		3.8	4.6	8.1
4		3.0	4.6	6.3
5		2.6	1.7	3.7
10			1.2	1.4
15			0.4	6.8

Table D-4

B-87-15

Concentration of Settled Sediment as a Function of Time

Time, h	Concentration, g/l
.5	281.2
1.0	373.6
1.5	472.0
2.0	493.7
2.5	518.4

Table D-5

B-87-15

Removal Percentages as a Function of Settling (from Figure D-1)

Time, days	Depth from top of Settling Column, ft		
	1	2	3
.042 (1 h)	89.4	82.5	77.5
.25 (6 h)	96.2	94.1	89.9
1.0	96.7	95.6	93.1
2.0	97.1	96.8	95.8
4.0	98.4	98.2	97.4
10.0	99.5	99.0	98.7

$$\gamma_s = \frac{G_s \gamma_w}{1 + \frac{w G_s}{S}}$$, S= 1.0 for saturated soil

$$\boxed{\gamma_s = \frac{G_s \gamma_w}{1 + w G_s}}$$

<u>Use</u>

Given: w (from sampling)

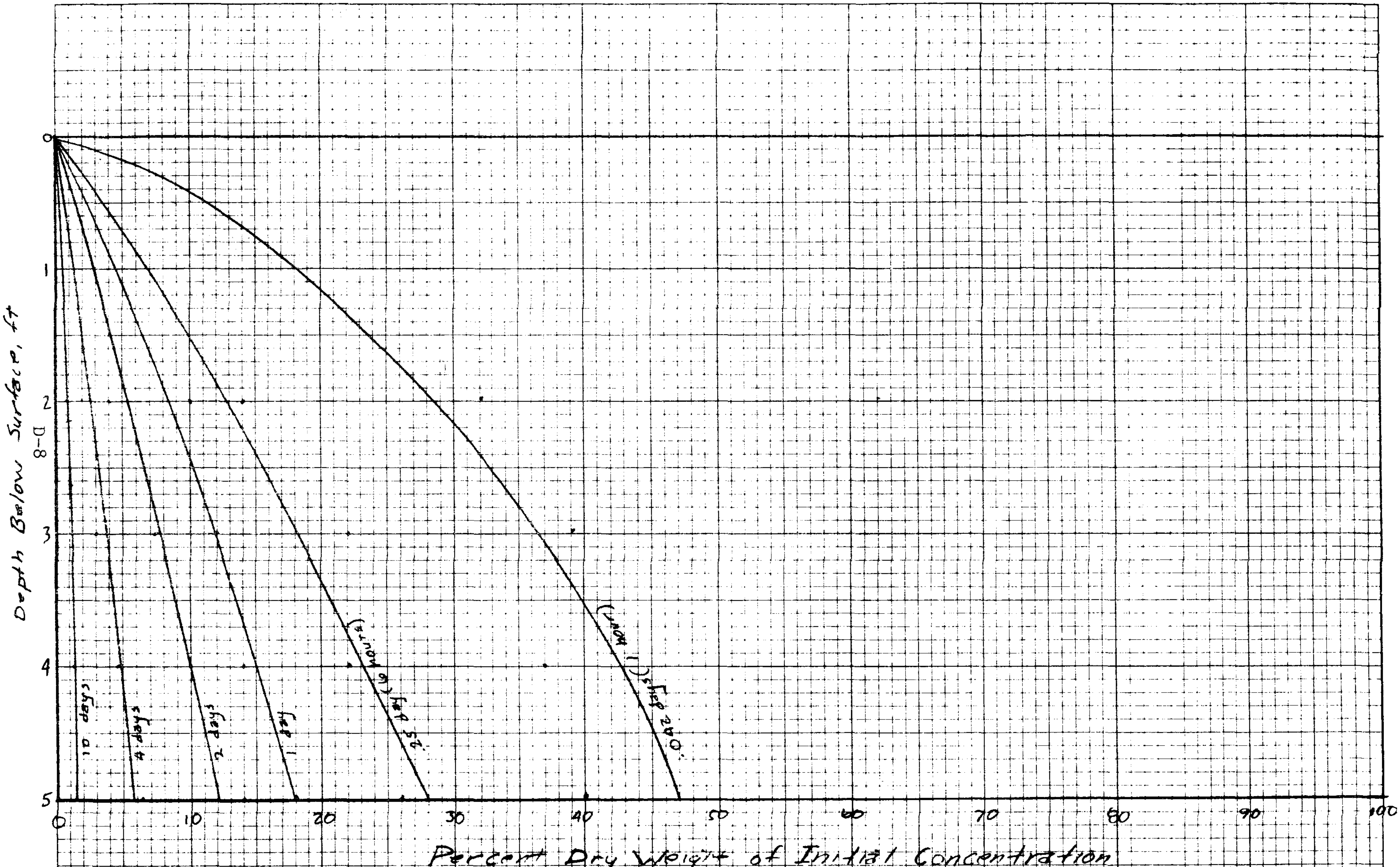
Find: γ_s

$$\Rightarrow \boxed{w = \frac{\gamma_w}{\gamma_s} - \frac{1}{G_s}}$$

<u>Use</u>

Given: γ_s (from column settling)

Find: w



B-87-15

Figure D-1

NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

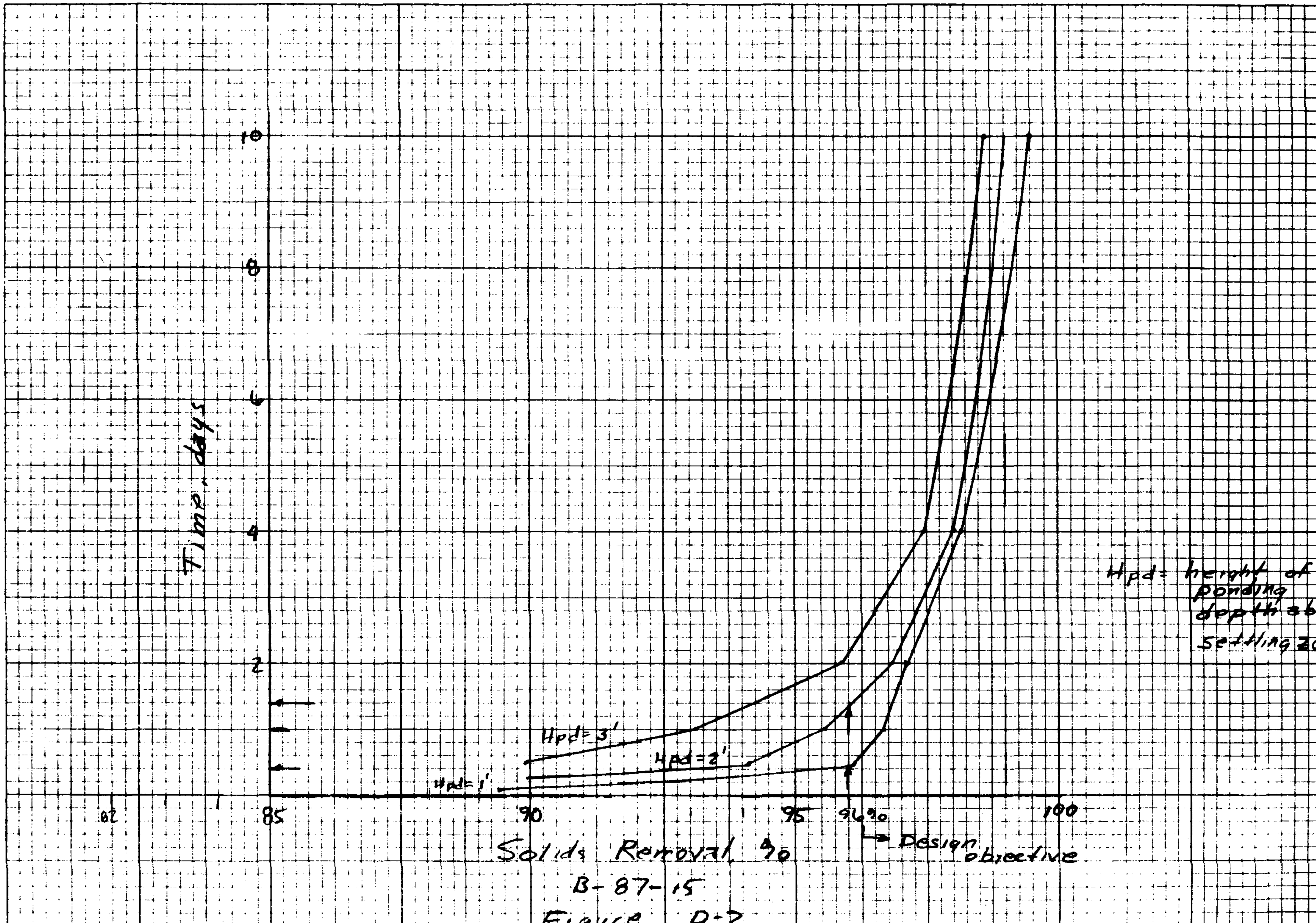
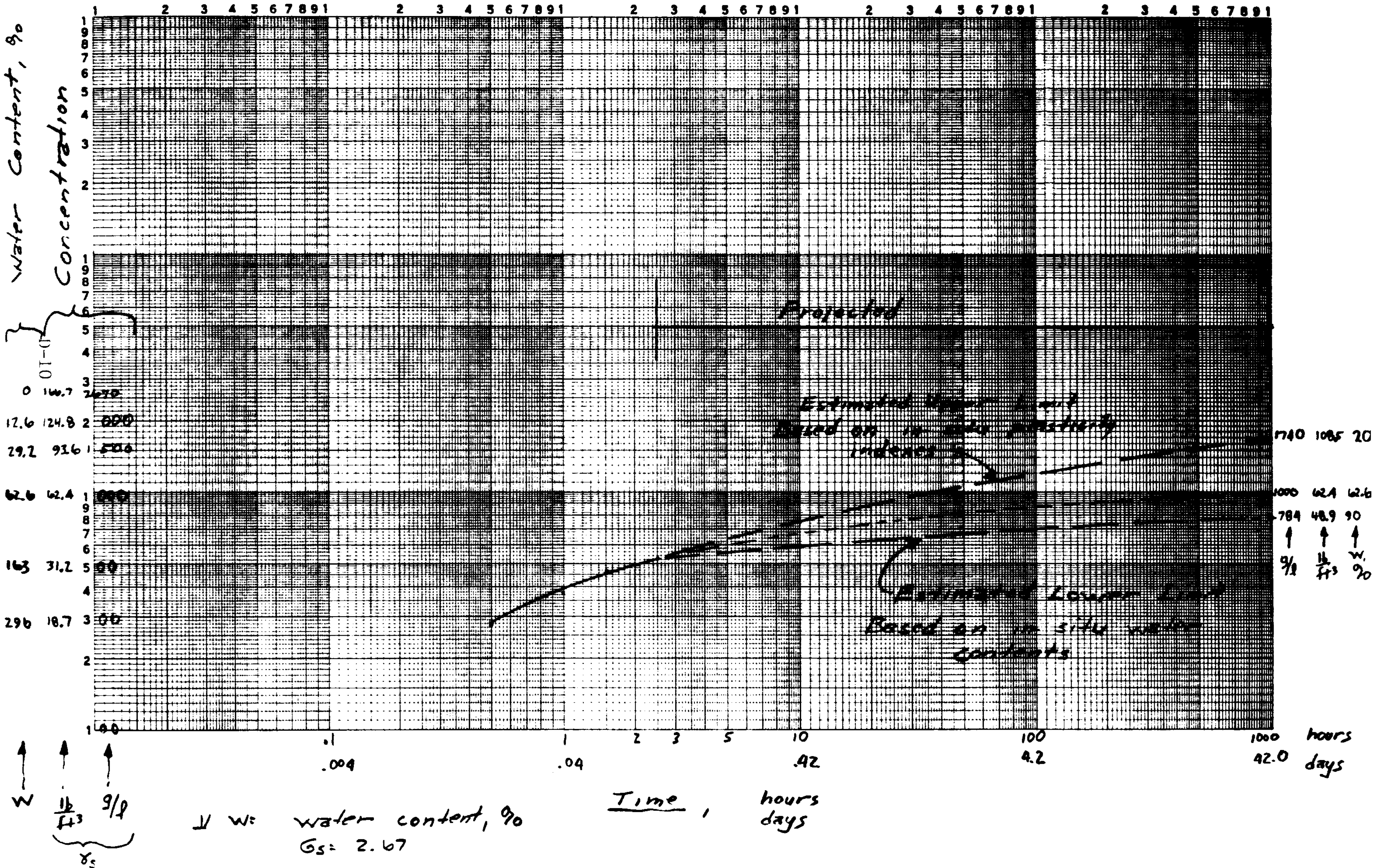


Figure D-2

Figure D-3

Time vs. Concentration of Settled Sediment



Subject: Required Detention Time

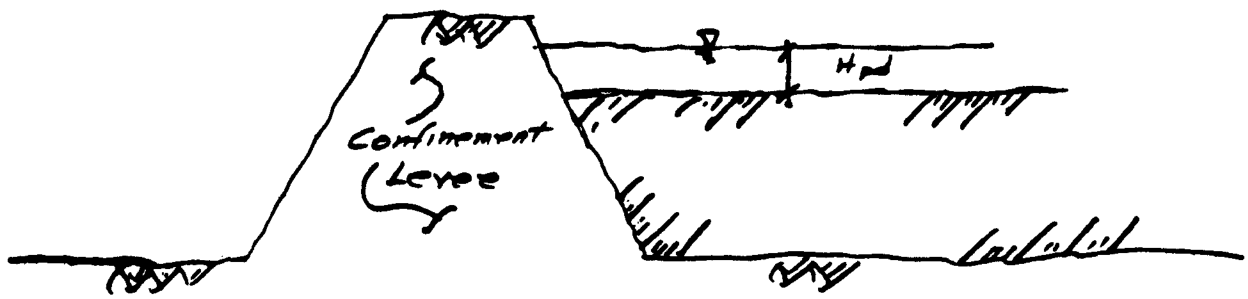


Table D-6

Estimated Detention Time, hours 1/

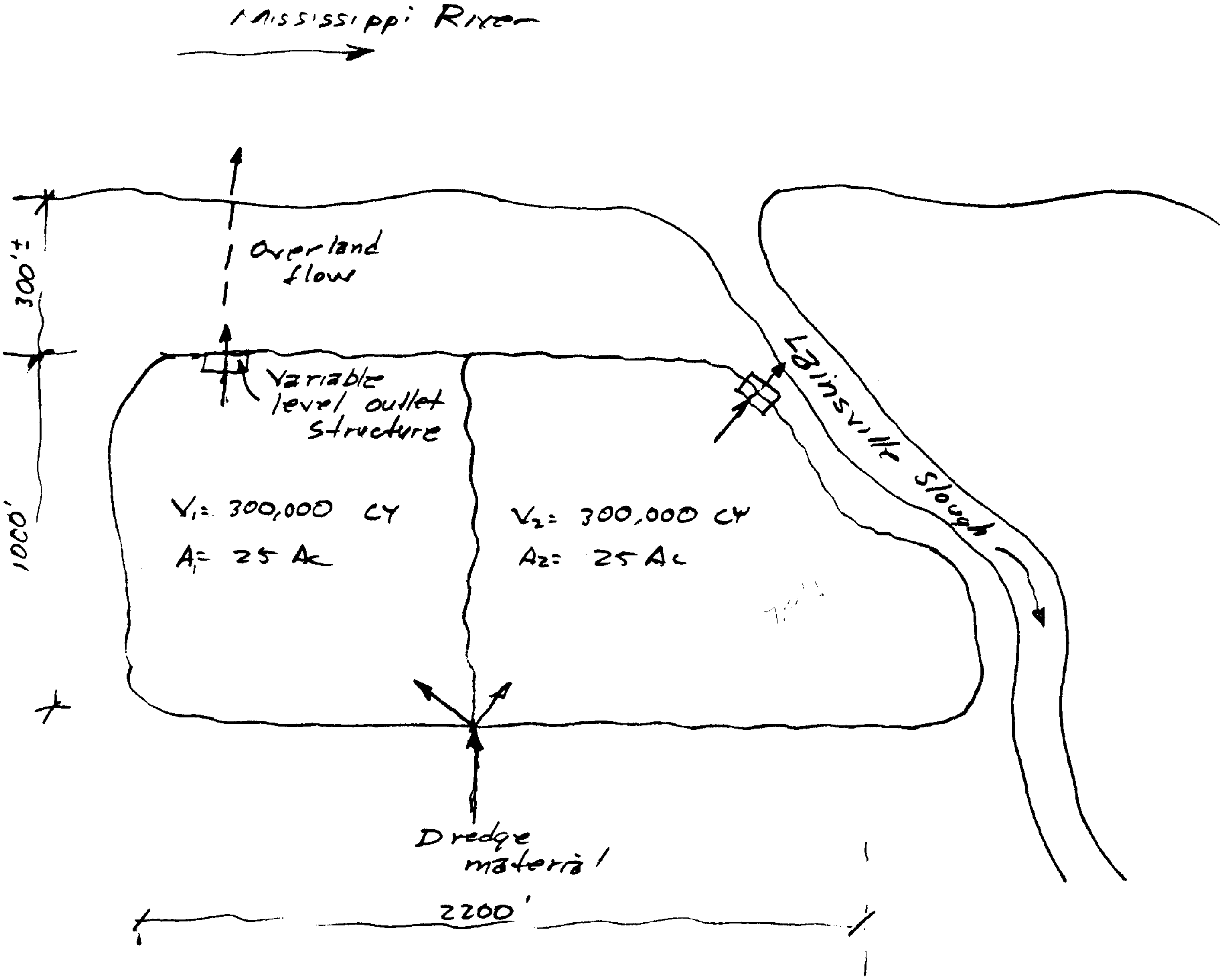
Hpd = height of ponding

Removal Efficiency	Hpd 1'	Hpd 2'	
99	173	240	
98	89	96	
97	43	55	
96 ✓	10	33	← Design objective 2/
95	9	19	
94	7	12	

1/ Data from Figure D-2

2/ Based on equipment analysis, detention time, water quality standards. (min. det. time = 14 hours per 401 cert.)

Subject: Dredging Site Plan and Flow Diagram



Estimate of total dredging time

Given

Volatile solids	= 6%	(from lab.)
$G_{vol.\ solids}$	= 1.1	(assumed)
$G_{fixed\ solids}$	= 2.67	(lab.)
% Solids during dredging	= 13%	(assume average)
γ_s of in-situ soil	= 64 lb/ft3	(from boring an...

Results

G fixed + vol. solids = ~~2.46~~

G dredge slurry = ~~1.08~~

Vol. (dredged slurry) = 7.3 ft³ slurry / ft³ in-situ soil

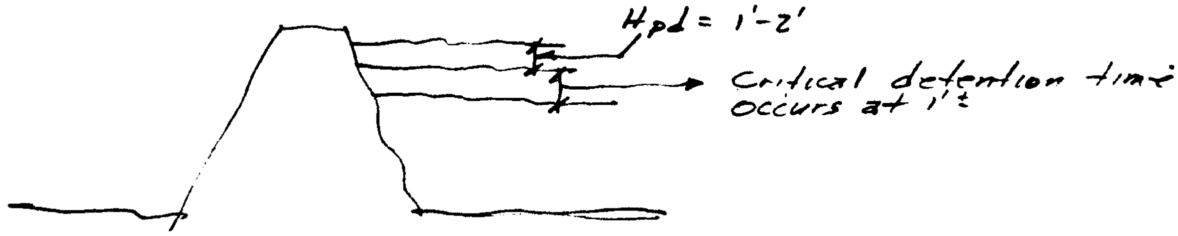
Vol (total dredging) = 7.3 (400,000 CY)(27)(7.5)
= 591.3 $\times 10^6$ gal

Table D-7
Estimated Dredging Time

Dredge Size	Output, gpm	Total Dredging Time hours	days [1]
10"	3,600	2,700	228
12"	5300	1900	154
14"	7200	1400	114
16"	9200	1000	89

[1] Based on a 12 hour work day

Critical pumping / detention time will occur within the last 1'-2' of the confinement facility



Each vertical foot within each cell of the CDF contains:

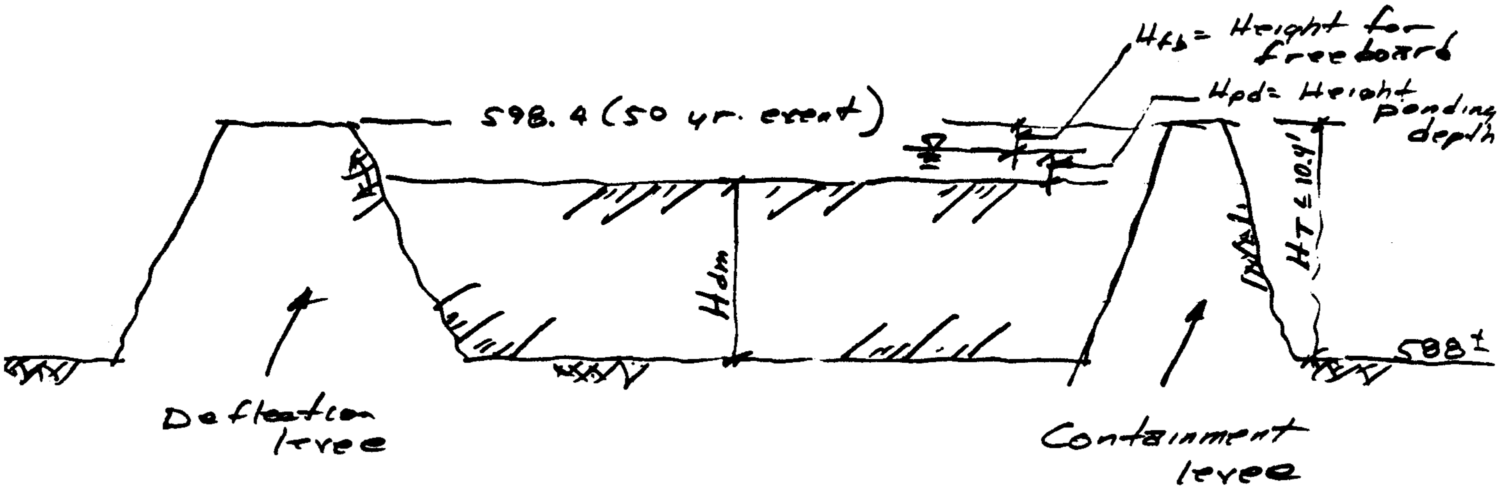
$$V_{(1\ foot,\ 1\ cell)} = (25\ Ac)(43{,}560)(1') = 1{,}089{,}000\ ft^3$$
$$= 8{,}167{,}000\ gal$$

Table D-8
Dredging Time for Each Vertical Foot in Each Cell of the CDF

Dredge Size	Output, gpm	Dredging Time, hours
10	3600	38 91
12	5300	26 57
14	7200	19 42
16	9200	15 33.0

An alternating, 2 cell arrangement, with detention time of 14 hours (minimum), meets probable dredging equipment efficient use.

Subject: Confinement Levee Height and Area



$$H_T = H_{dm} + H_{pd} + H_{fb}$$

H_T = total levee height

H_{dm} = height dredged material

H_{fb} = height free board = 1' (min)

H_{pd} = height ponding depth = 1' (min.)

$$H_{dm} = \frac{V_T}{A_{CDF}} = \frac{(600{,}000\ CY)(27)}{(46Ac)(43{,}560)}$$

= 8.0 or elevation 596

$$H_T = 8.0 + 1.0 + 1.0 = 10.0 < 10.4' \quad \text{O.K.}$$

$\therefore A_{CDF} = 46\ Ac \pm$

Subject: Consolidation Considerations

Consolidation will occur from both the dredged material and the foundation soil.

Estimated consolidation for both is approximately 20% of H_{dm},

or

$$\Delta H = (.2)(8') = 1.6$$

Estimated final elevation in the CDF = 596 - 1.6 = 594.4 ⇒ $8^{\pm}$ year river event

A
P
P
E
N
D
I
X

E

STRUCTURAL DESIGN

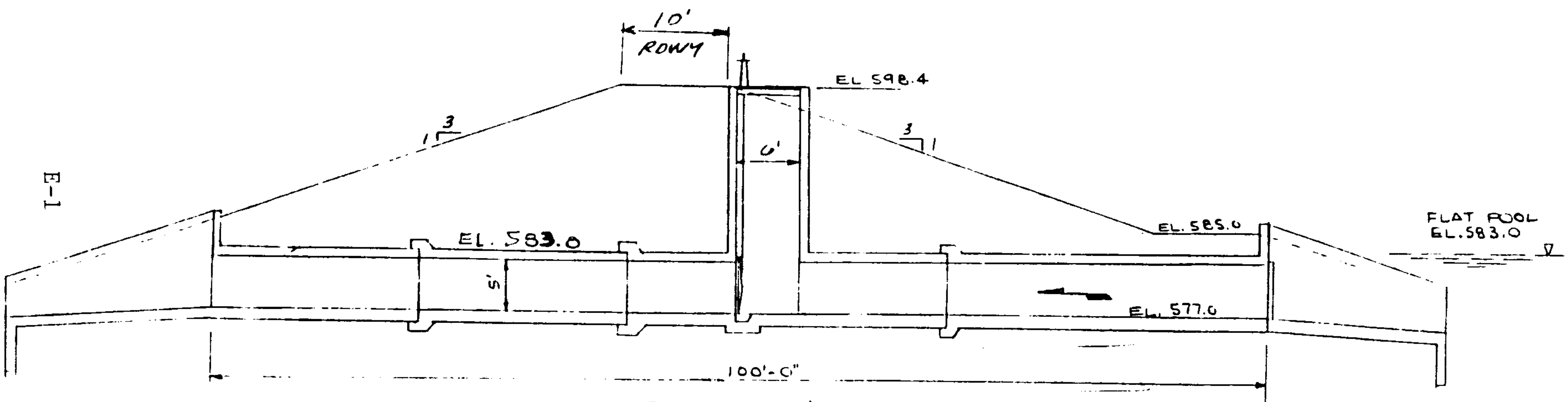
Subject: BROWN'S LAKE H_2O CONTROL STRUCT.

Date: 30 APR. 87

Computed by: KEW

Checked by:

Sheet of

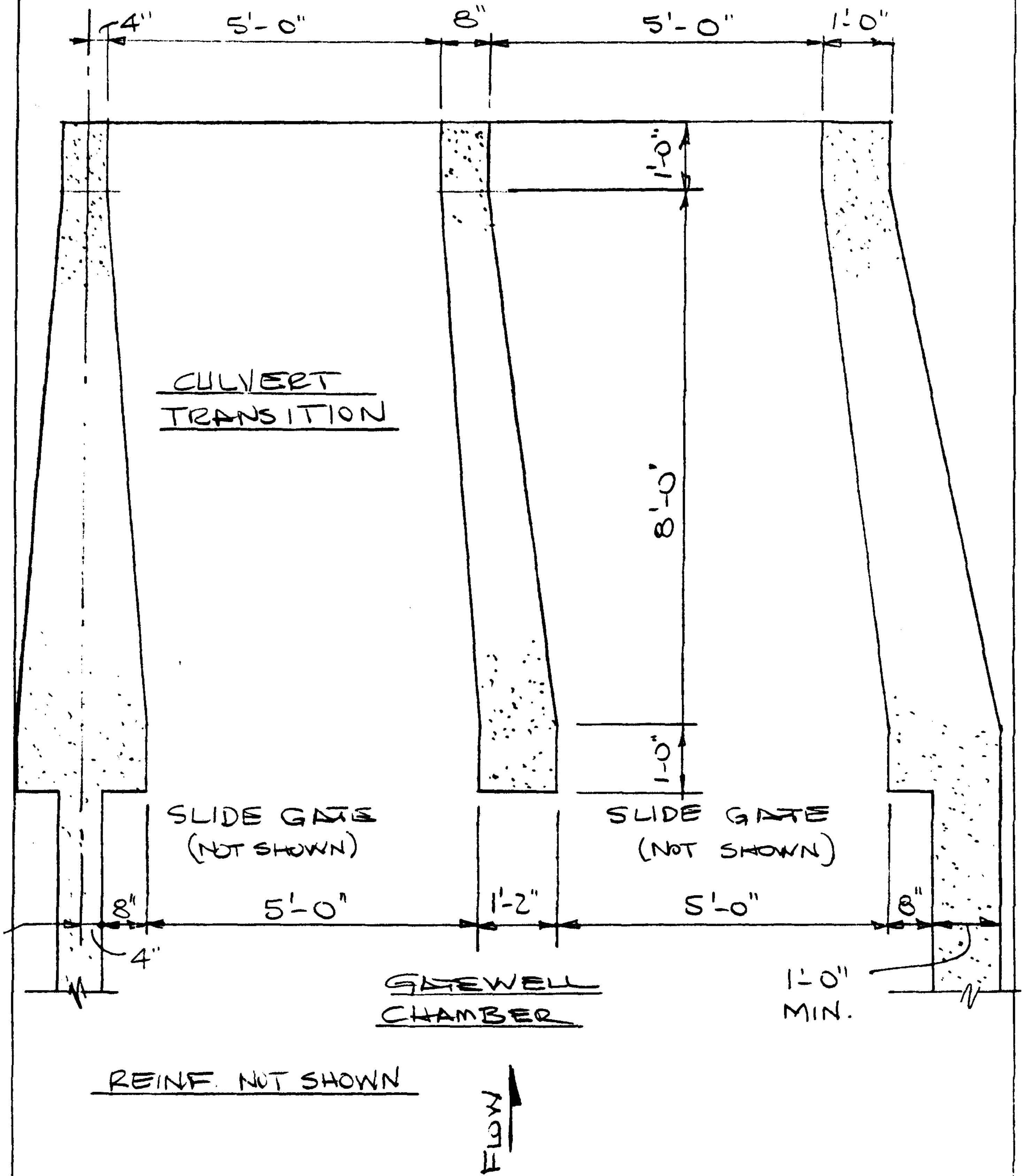


SECTION A-A

1" = 10'-0"

E-1

Subject BROWN'S LAKE H_2O CONTROL STRUCT.		Date JUNE 87
Computed by KEW	Checked by	Sheet of



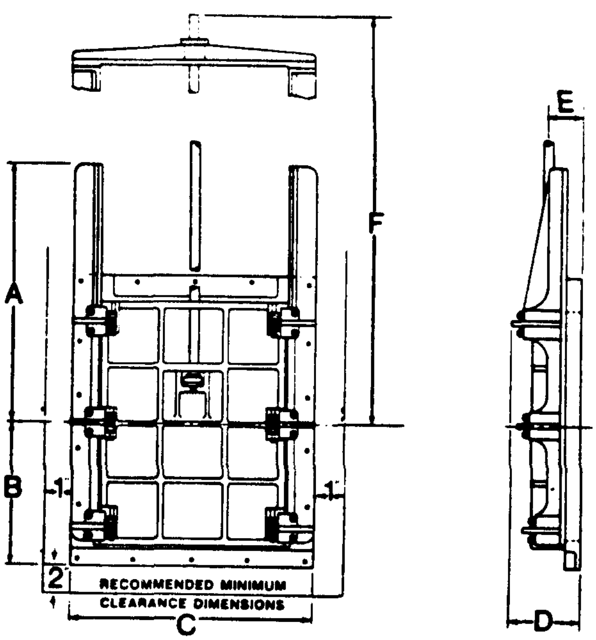
Subject: BROWN'S LAKE H_2O CONTROL STRUCT		Date: JUNE 87
Computed by: KEW	Checked by	Sheet of

FUTURE SLUICE GATE DIMENSIONS

NOTE: THE PRESENT CONTROL STRUCTURE WILL HAVE SLIDE GATES THAT WILL BE APPROX. 6" WIDER THAN THE 5'-0" WIDTH OF THE CULVERTS.

FOR SEATING HEADS UP TO 40 FEET

L
FLAT



Dimensions shown in this table are for Rodney Hunt sluice gates described by the following Series Numbers:

240-L	245-L	HY-Q 240-L	HY-Q 245-L
280-L	285-L	HY-Q 280-L	HY-Q 285-L

Many gates, including self-contained gates are available in sizes not shown in this table. Information describing their characteristics is readily available. Because all dimensions are subject to change, certified prints will be sent to you on request.

TABLE OF SLUICE GATE DIMENSIONS (inches)

GATE SIZE	A	B	C	D	E	F	GATE SIZE	A	B	C	D	E
6 x 6*	8	5 3/4	12	5 1/2	2 7/8	24 1/4	54 x 54*	59 1/4	34 1/2	68	16 5/8	8 5/8
8 x 8*	10	6 3/4	14	5 1/2	2 7/8	27 1/4	60 x 36	39 3/4	25	70 3/4	10 3/8	6 7/8
10 x 10*	12	7 3/4	16	5 1/2	2 7/8	30 1/4	60 x 48	54 3/8	31 1/2	74	13 3/4	7 1/4
12 x 12*	14	9	19 3/4	6 1/8	4 5/8	35 1/8	60 x 60*	64 3/4	37	72	14 7/8	7 1/8
12 x 18	20	12	19 3/4	6 1/8	4 5/8	44 1/8	60 x 72	78 5/8	43	74 1/2	17 1/8	9 1/8
12 x 24	25	17	22	8 5/8	5 3/8	54	60 x 84	91	48 3/4	71 1/2	16	8 3/8
14 x 14*	16	10	21 3/4	6 1/8	4 5/8	38 1/8	60 x 96	102 5/8	55	74 3/4	19	9 1/4
15 x 15*	17	10 1/2	22 3/4	6 1/8	4 5/8	39 5/8	60 x 108	115 3/8	63 1/4	75	19	9 1/8
16 x 16*	18	11	23 3/4	6 1/8	4 5/8	41 1/8	60 x 120	126	67	75	19	9 1/8
18 x 18*	20	12	25 3/4	6 1/8	4 5/8	44 1/8	66 x 66*	72 1/4	39 1/2	80	16 3/8	8 3/8
18 x 24	25	17	28	9 3/8	6 1/8	56	72 x 48	53 5/8	31	86	15 1/4	8 1/2

Subject: BROWN'S LAKE H_2O CONTROL STRUCT.		Date: 30 A[illegible] 87
Computed by: KEVI	Checked by	Sheet: 1C

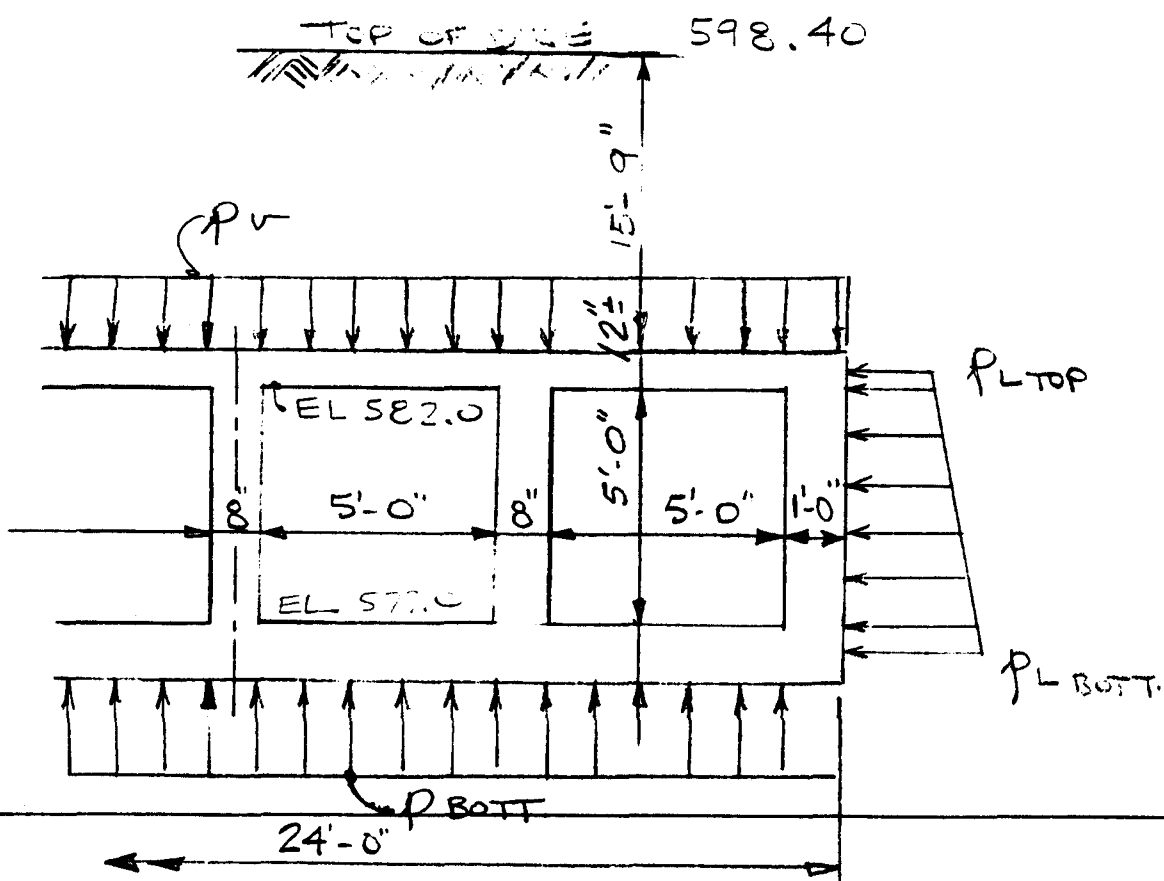
GATEWELL AND CULVERT

CULVERT DESIGN (DOWNSTREAM OF GATEWELL)

TOP OF DIKE EL. 598.40
TOP OF CULVERT EL. 582.67
DEPTH OF FILL 15.73 FT SAY 15'-9"

WEIGHT OF FILL = 120 pcf

REFERENCES
① EM 1110-2-2902 "CONDUITS, CULVERTS AND PIPES"
② ETL 1110-2-265 "STRENGTH DESIGN CRITERIA FOR REINF. CONC. HYDRAULIC STRUCT."



NCR Form 381b
1 Aug 80

Subject: BROWN'S LAKE H_2O CONTROL STRUCT.		Date: 1 MAY 87
Computed by: KEW	Checked by:	Sheet: 2c

CULVERT DESIGN (D.S)

LOAD CASE 1 – NO WATER

MAX VERT. PRESSURE COEFF. = 1.5
MIN. LATERAL PRESSURE COEFF = 0.5
NO WATER

$$p_v = 1.5\underset{\text{SOIL}}{(120)(15.75)} + \underset{\text{CONC}}{150(1.00)}$$
$$= 2,835 + 150 = 2,985 \text{ psf}$$

$$p_{v_u} = 2,835\,(1.9) + 150\,(1.5) = 5,612 \text{ psf}$$

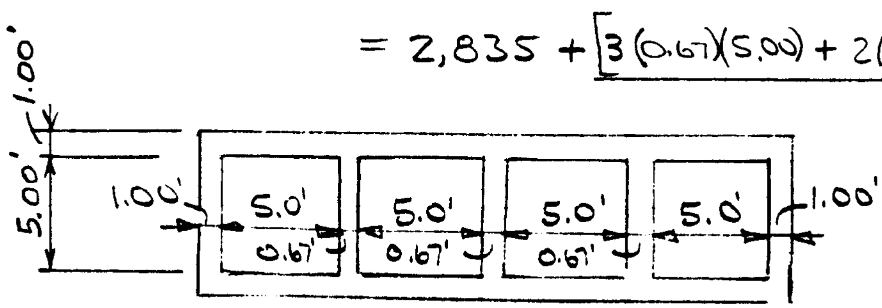
$$p_{L\,TOP} = 0.50\,(120)(16.083) = 965 \text{ psf}$$

$$p_{L_u\,TOP} = 965\,(1.9) = 1,833 \text{ psf}$$

$$p_{L\,BOTT.} = 0.50\,(120)(21.916) = 1,315 \text{ psf}$$

$$p_{L_u\,BOTT} = 1,315\,(1.9) = 2,499 \text{ psf}$$

$$p_{BOTT} = p_{SOIL} + p_{CONC.WT} \quad \text{(SEE BELOW)}$$
$$= 2,835 + \frac{[3(0.67)(5.00) + 2(1.00)(5.00) + 1(1.0)(24.0)]\,150}{24.00}$$



$$= 2,835 + 275$$
$$= 3,110 \text{ psf}$$

NCR Form 381b 1 Aug 80

$$p_{BOTT_u} = 2835(1.9) + 275(1.5) = 5,799 \text{ psf}$$

Subject: BROWN'S LAKE H_2O CONTROL STRUCT.
Computed by: KEV
Checked by:
Date: 12 JUNE 87
Sheet: 3c of

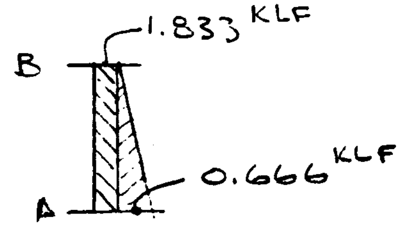
CULVERT DESIGN (D.S.)

MOMENT DISTRIBUTION (LOAD CASE 1)

	15.403	15.403	16.399	17.568	15.168
	-0.498	-0.498	0.498	1.200	-1.200
	15.901	15.901	15.901	16.368	16.368
	14.19	-14.19	17.01	-17.01	10.01
	0	0	0.32	0.31	-0.68
	-0.60	0.60	0	-0.63	0.58
	0	0	1.21	1.17	-1.27
	-0.23	0.23	0	-2.38	0.22
	0	0	0.46	0.44	-4.76
	15.02	-15.02	15.02	-15.92	15.92
	0.500	0.500	0.507	0.493	0.514
D.F.	0.500	0.500	0.507	0.493	0.514
FEM	-15.52	15.52	-15.52	16.45	-16.45
DIST.	0	0	-0.47	-0.46	4.82
C.O.	0.23	-0.23	0	2.41	-0.23
DIST.	0	0	-1.22	-1.19	1.27
C.O.	0.61	-0.61	0	0.63	-0.59
DIST.	0	0	-0.32	-0.31	0.61
$-M_u$	-14.68	14.68	-17.73	17.73	-10.57
	16.431	16.431	16.431	16.914	16.914
	-0.538	-0.538	0.538	1.227	-1.227
V_u	15.893	15.893	16.969	18.141	15.687

℄ SYMM.

ULTIMATE MOMENTS & SHEARS



$$FEM_{AB} = 1.833\frac{(6.1667)^2}{12} + 0.666\frac{(6.1667)^2}{20}$$

0.486	0.486
7.08	-6.65
4.55	-4.51
-2.25	2.27
1.21	-1.21
-0.60	0.60
0.58	-0.50
10.57	-10.00
5.652	5.652
1.369	0.685
0.092	-0.092
7.113	6.245

$$FEM_{BA} = 1.833\frac{(6.1667)^2}{12} + 0.666\frac{(6.1667)^2}{30}$$

NCR Form 381b 1 Aug 80

E-6

Subject BROWN'S LAKE H_2O CONTROL STRUCT.		Date 12 JUNE 87
Computed by KEW	Checked by	Sheet 4c of

CULVERT DESIGN (D.S.)

TOP SLAB

$$X = \frac{15.403}{5.612} = 2.745^{FT}$$

$$+M_u = 15.403(2.745) - 5.612\left(\frac{2.745}{2}\right)^2 - 14.19 = 6.95^{K-FT}$$

CHK

$$+M_u = 16.399(2.922) - 5.612\left(\frac{2.922}{2}\right)^2 - 17.01 = 6.95^{K-FT} \text{ OKAY}$$

$$X = \frac{17.568}{5.612} = 3.130^{FT}$$

$$+M_u = 17.568(3.130) - 5.612\left(\frac{3.130}{2}\right)^2 - 17.01 = 10.56^{K-FT}$$

BOTT. SLAB

$$X = \frac{15.893}{5.799} = 2.741$$

$$+M_u = 15.893\left(\frac{2.741}{2}\right) - 14.68 = 7.10^{K-FT}$$

$$X = \frac{18.141}{5.799} = 3.128$$

$$+M_u = 18.893\left(\frac{3.128}{2}\right) - 17.73 = 11.82^{K-FT}$$

SIDE

$$0 = 6.245 - 1.833(X) - 0.108\left(\frac{X}{2}\right)^2$$

$$X^2 + 33.944X - 115.648 = 0 \quad ; \quad X = 3.12^{FT}$$

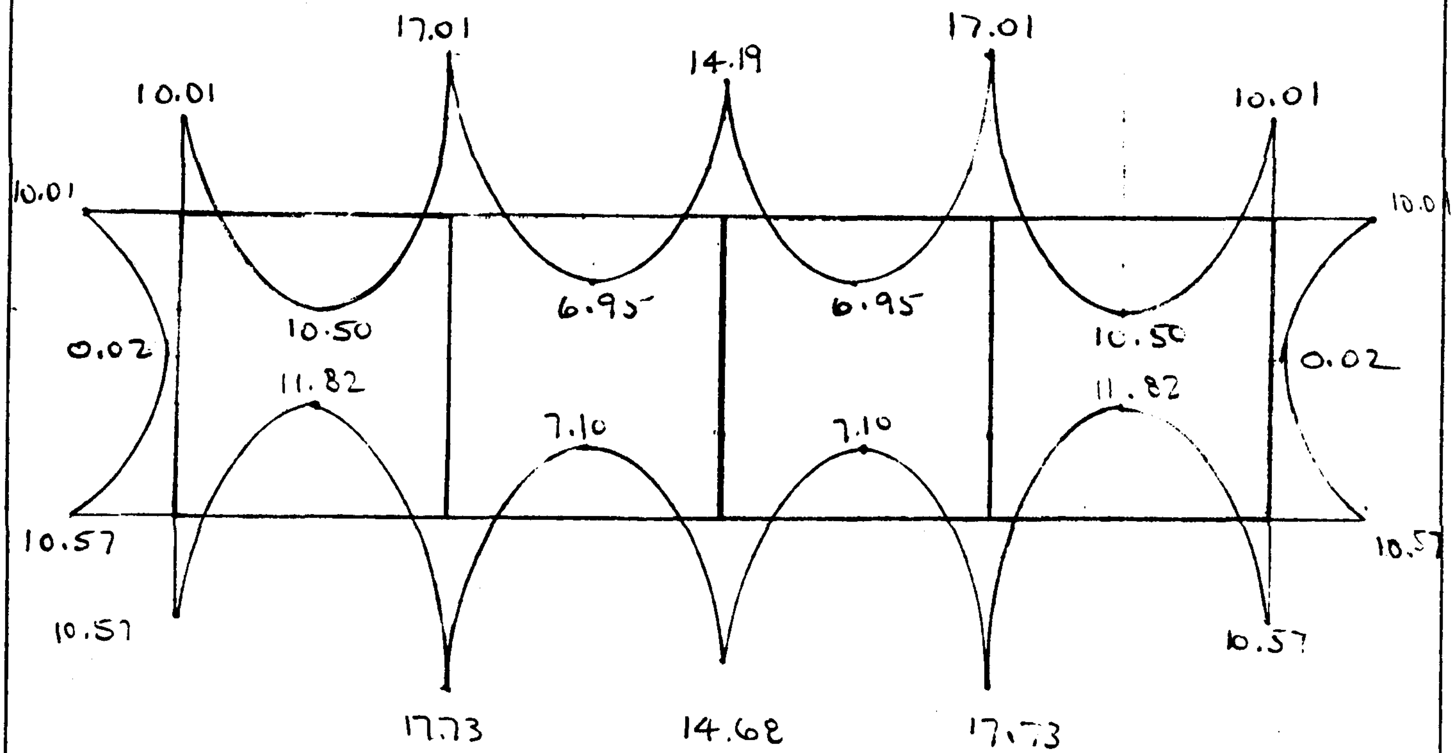
$$+M_u = 6.245(3.12) - 1.833\left(\frac{3.12}{2}\right)^2 - 0.108\left(\frac{3.12}{6}\right)^3 - 10.00$$

$$= 0.02^{K-FT}$$

NCR Form 381b
1 Aug 80

Subject BROWN'S LAKE H_2O CONTROL STRUCT.		Date 12 JUNE 87
Computed by KEW	Checked by	Sheet 5C of

CULVERT DESIGN (D.S.)



ULTIMATE MOMENT DIAGRAM

TOP SLAB

$M_u = 17.01^{K-FT}$; $P_u = 6.245 + 0.5(1.833)(1.9) = 7.99^K$

$V_{u_d} \simeq 17.568 - 5.612\left(0.333 + \frac{9.5}{12}\right) = 11.256^K$

Subject: BROWN'S LAKE H_2O CONTROL STRUCT.		Date:
Computed by: KEW	Checked by:	Sheet: 1 GW of

GATEWELL AND CULVERT

GATEWELL DESIGN

LOAD CONDITION

MAX. LATERAL PRESSURE COEF. = 0.70

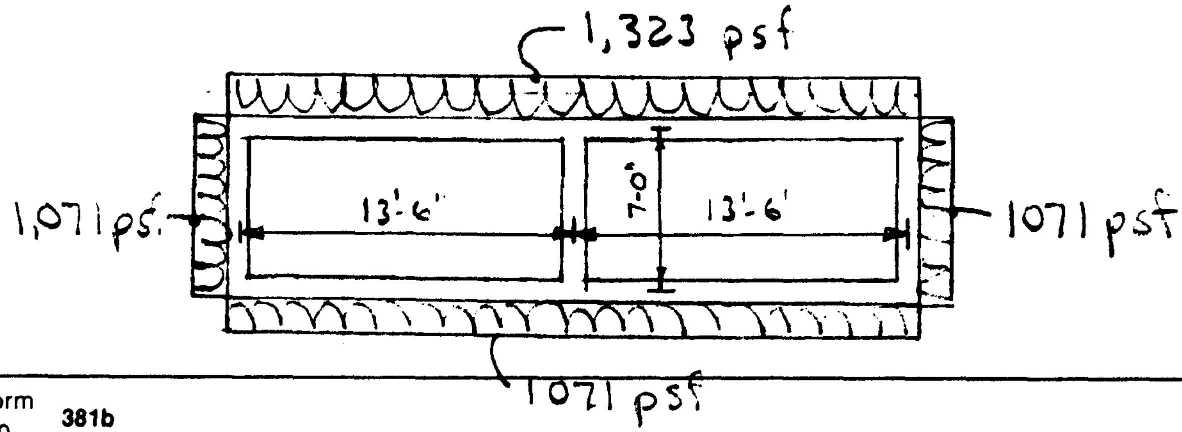
MAX. SOIL DEPTH - 15.75 FT

LIVE LOAD SURCHARGE = 240 psf = 2 FT SOIL (AASHTO)

CHECK HORIZ. STRIP OF GATEWELL 2 FT ABOVE TOP OF CULVERT. BASE OF GATEWELL IS BRACED BY CULVERT SLAB.

$p_{L\ \text{ROADWAY SIDE}} = 0.70(120)(15.75) = 1{,}323\ \text{psf}$

$p_{L\ \text{OTHER SIDES}} = 0.70(120)(12.75) = 1{,}071\ \text{psf}$



Subject: BROWN'S LAKE H_2O CONTROL STRUCT.		Date: 12 JUNE 87
Computed by: KEW	Checked by	Sheet: 26W of

GATEWELL DESIGN

MOMENT DISTRIBUTION

V.	9.717	9.717	8.143
	0.787	0.787	−0.787
	8.930	8.930	8.930
−M	23.44	−23.44	12.81
	0	0	−0.58
	0.67	−0.67	0
	0	0	−1.34
	2.68	−2.68	0
	0	0	−5.36
	20.09	−20.09	20.09
	0.500	0.500	0.341
	℄ SYMM.		0.659 / 0.659
D.F.	0.500	0.500	0.341
FEM	−16.27	16.27	−16.27
DIST	0	0	4.06
C.O.	−2.03	2.03	0
DIST	0	0	1.77
C.O.	−0.89	0.89	0
DIST	0	0	0.44
−M	−19.19	19.19	−10.06
	7.229	7.229	7.229
	0.681	0.681	−0.681
V	7.910	7.910	6.548

Wall distribution (top / bottom):

Top	−4.37	−10.36	3.92	−2.58	1.71	−1.13	−12.81	3.749	0.401	4.150
Bottom	4.37	7.84	−5.18	3.41	−1.29	0.85	10.00	3.749	−0.401	3.348

Σ >

$$X = \frac{9.717}{1.323} = 7.345^{FT}$$

$$+M = 9.717(7.345) - 1.323\frac{(7.345)^2}{2} - 23.44 = 12.24^{K\text{-}FT}$$

$$X = \frac{3.348}{1.323} = 3.126^{FT}$$

$$+M = 3.348(3.126) - 1.071\frac{(3.126)^2}{2} - 10.00 = -4.77^{K\text{-}FT}$$

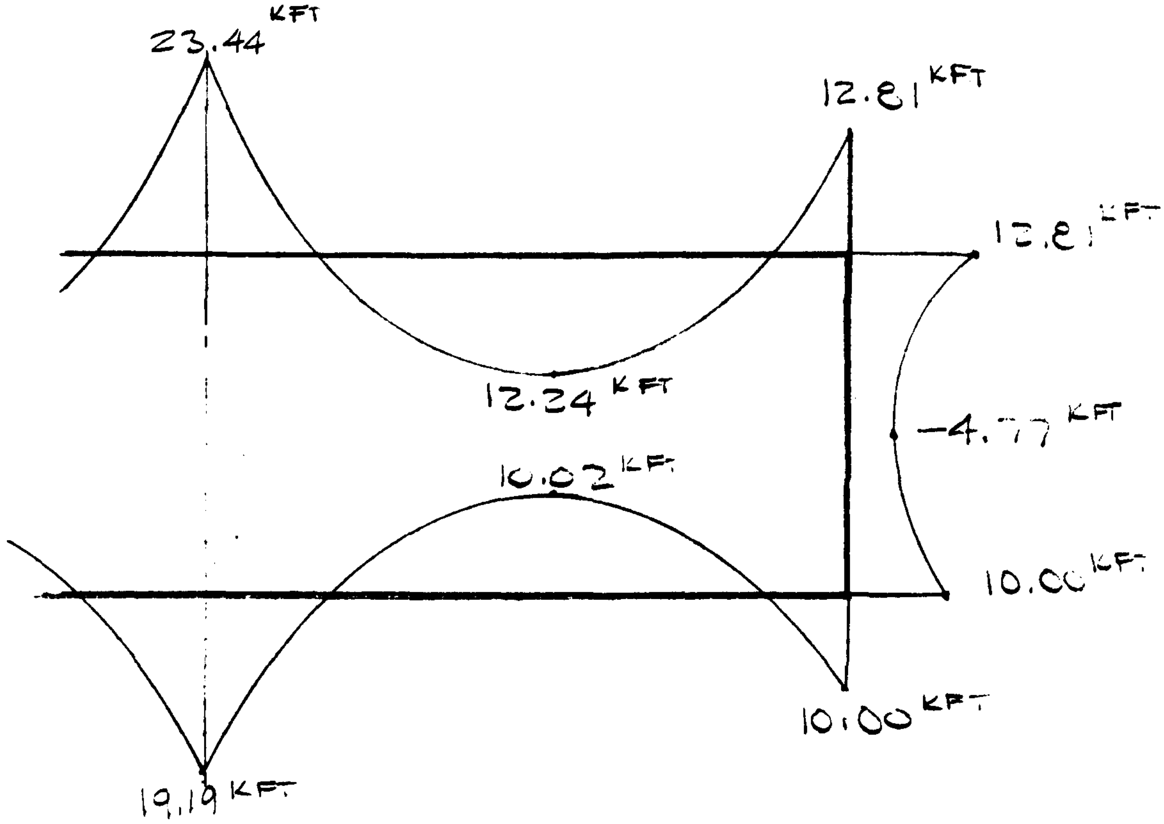
$$X = \frac{7.910}{1.071} = 7.386^{FT}$$

$$+M = 7.910(7.386) - 1.071\frac{(7.386)^2}{2} - 19.19 = 10.02^{K\text{-}FT}$$

NCR Form 381b
1 Aug 80

Subject BROWN'S LAKE H_2O CONTROL STRUCT.		Date 12 JUNE 87
Computed by KEW	Checked by	Sheet 3GW of

GATEWELL DESIGN



MOMENT DIAGRAM

$$M_{u_{MAX}} = 1.90(23.44) = 44.54^{K\text{-}FT}$$

$$P_u = 1.90\left[4.150 + 0.5(1.071)\right] = 8.902^K$$

$$V_{u_d} \simeq \left[9.717 - 1.323\left(0.333 + \frac{9.5}{12}\right)\right]1.9 = 15.64^K$$

CORRESPONDENCE

APPENDIX F

UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-2)

BROWN'S LAKE
REHABILITATION AND ENHANCEMENT

POOL 13, RIVER MILE 545.8
UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

APPENDIX F
CORRESPONDENCE

TABLE OF CONTENTS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
AW/PSW

JUL 8 1986

Brigadier General Joseph Pratt
Division Engineer
U. S. Army Corps of Engineers
536 South Clark Street
Chicago, Illinois 60605

Dear General Pratt:

We have reviewed the First Annual Addendum to the General Plan for the Upper Mississippi River System Environmental Management Program (UMRS-EMP). Since many of the proposed habitat projects are located on National Wildlife Refuge System lands, we will comment on their status relating to coordination and development with the states involved.

Procedures currently in use permit both the Fish and Wildlife Service and the States to propose habitat and recreation projects. It is important for the States to develop project proposals with the Service as projects located on refuge lands must be approved by the Service and also be compatible with the purpose for which the refuge was established. So far, meetings with the States of Minnesota, Iowa, and Missouri have helped define and develop several proposed projects. We have encouraged the other states involved to set aside the time to discuss projects to be located on refuge lands with our refuge field offices.

Following are brief comments on the habitat projects listed in the First Annual Addendum:

<u>St. Louis District:</u>

Clarksville Refuge, MO:	This project has been reviewed with the State and we concur with the project as presently planned.
Dresser Island, MO:	This project has not been reviewed with the State, but from preliminary information available, the concept of the project appears acceptable.
Stump Lake, IL:	This project has not been reviewed with the State, but from preliminary information available, the concept of the project appears acceptable.

Rock Island District:

Monkey Chute, MO: This project has been reviewed with the State and we concur with the project as presently planned.

Brown's Lake, IA: This project has been coordinated and jointly developed with the State. We concur with this project as now planned.

Andalusia Refuge, IL: This project has not been reviewed with the State, but from preliminary information available, the concept of the project appears acceptable.

Bestrom Lake, WI: This project has not been reviewed with the State, but from preliminary information available, the concept of the project appears acceptable.

St. Paul District:

Island 42, MN: This project has been coordinated and developed jointly with the State and Corps and is now being designed. The Service has agreed to operation and maintenance responsibilities. We request the opportunity to review plans and specifications prior to construction.

Guttenberg Fish Ponds, IA: This project is approved and is being developed jointly by the Service, Corps, and State of Iowa.

Pool 4, Wildlife Mgmt. Area, IA: This project has been reviewed with the State and the Service concurs with the project as now planned.

Lake Onalaska Dredge Cut, WI: The Service has not reviewed this project with the State. The Service concurred with the project earlier, but only as a small, pilot project. A $3,000,000 project scheduled for FY 1988 may not be acceptable to the Fish and Wildlife Service.

Pool 8 Barrier Islands, WI: Project has been reviewed and discussed with the State and the Service concurs with the project as now planned.

Island 40, MN:	Project has been coordinated and developed with the State and Corps and is now being designed. The Service has not reviewed plans and specifications, but requests that they be made available prior to construction.
Pool 9 Island Protection, WI:	Project has not been discussed with the State. If located in Lake Winneshiek, the Service concurs with the concept of the project. We question cost-sharing as we understood the project was located on refuge lands.
Pool 8 Island Protection, WI:	Project has not been discussed with the State, but the Service concurs with the project concept. We question cost sharing as we understood the project was located on refuge lands.
Bussey Lake Rehab., IA:	This has been reviewed with the State, and the Service concurs with the project as now planned.
Whitewater Dike, MN:	Fish and Wildlife Service proposed project.

Several projects (listed below), have not been discussed with the states by the refuge field offices as the projects do not appear to be located on refuge system lands:

Blackhawk Park, WI
Goose Lake, MN
Indian Slough Rehab., WI
Drury Island, MN
Cold Springs, WI

The recreation project proposals in the First Annual Addendum have been reviewed. Most of these projects have been discussed with the respective states and no real concerns have surfaced at this time on specific projects. It is important, however, to analyze these projects on how they relate to one another and what the cumulative effect of all of them are on river resources. This also applies to the habitat projects and their cumulative effect on the river system.

Most of the habitat and recreation projects listed in the First Annual Addendum and all of the funded projects are State proposals. Although we support most of these projects, the Service submitted many valid and important resource related projects that should have received higher consideration for funding. If additional information is needed that could enhance prioritizing Service projects, please let us know.

Letter reports for the projects submitted in the First Annual Addendum should be available to the Service. Some were received, but not all of them, so we are requesting a copy of the final letter reports for our review and files. These should be sent to the attention of Chuck Gibbons.

Sincerely yours,

James C. Gritman
Acting Regional Director

JACKSON COUNTY

BOARD OF SUPERVISORS
319/652-3181

JACKSON COUNTY COURTHOUSE, 201 WEST PLATT, MAQUOKETA, IOWA 52060

Richard E. Dickinson

Patrick W. O'Rourke

Barbara A. Wright

October 6, 1986

The Honorable Tom Harkin
U.S. Senate
Washington, D.C. 20510

Dear Senator Harkin:

As I'm sure you're aware, Congress last year authorized the Corps of Engineers to proceed with lock and dam reconstruction at Alton, Illinois. The authorization included a $300 million expenditure. A provision of the bill stated that for every dollar spent on locks and dams, a matching dollar must be spent on the Mississippi River environment. This phase of the bill is called the Environmental Monitoring Program or EMP.

The Iowa Department of Natural Resources has listed a project which is located in Jackson County as a #1 priority. The project is designed for rehabilitation and protection of Brown's Lake, which is a major backwaters hunting and fisheries area, located approximately seven miles north of Sabula, Iowa in pool 13.

Last year the Iowa DNR met with USACE and proposed the following three phased approach.

Phase I: estimated cost $300,000 to $500,000
To build a 3/4 mile long defection dike from a point of intersection with the Green Island levee downstream along the west bank of Lainesville Slough. It will be designed to help deflect the silt loads from the main channel during high flows. This phase would be carried out by USACE.

Phase II: estimated cost $600,000
Design and build water control structures in the Smith Creek Watershed to reduce the annual sediment delivery into Brown's Lake. This would be handled by a dollar transfer to SCS. They would design and build all structures.

Phase III: estimated cost

Dredge fisherman access and overwinter survival trenches in the bed of Brown's Lake. This phase would be carried out by USACE.

The major obstacle to this project seems to be Phase II. USACE contends that they would spend the money to help stabilize Brown's Lake and protect it from future siltation. However, they questioned whether EMP monies can be used for expenditures out of the Mississippi River Floodplain. If Smith Creek is not funded, USACE feels that the diking and trenching will not be cost effective from an operations and maintenance standpoint.

Senator Harkin, we ask that you intervene in behalf of the Iowa DNR and eastern Iowa and work with USACE to secure this project.

If our office can provide additional information we are at your disposal. Thank you in advance for your assistance.

Sincerely,

Richard E. Dickinson
Jackson County Supervisor

TOM HARKIN
IOWA

(202) 224-3254
TTY (202) 225-1904

COMMITTEES
AGRICULTURE
APPROPRIATIONS

United States Senate

WASHINGTON, DC 20510

October 21, 1986

Lt. General Elvin R. Heiberg, III, Commander
U.S. Army Corps of Engineers
Casimir Pulaski Building
20 Massachusetts Avenue NW
Washington, D.C. 20314

Dear Lt. General Heiberg:

Enclosed is a letter I received from Richard Dickinson, Jackson County Supervisor concerning the lock and dam reconstruction at Alton, Illinois. Mr. Dickinson is concerned with the phase of the project under the Environmental Monitoring Program for rehabilitation and protection of Brown's Lake.

Mr. Dickinson believes that the major obstacle to the project is in Phase II. There appears to be some concern about whether EMP monies can be used to design and build water control structures in the Smith Creek Watershed to reduce the siltation into Brown's Lake.

The Iowa Department of Natural Resources has listed this project as the number one priority in the state. I would appreciate any assistance you could offer in helping to resolve the questions concerning Phase II of this project.

Thank you, in advance, for your attention to this matter. Please direct your correspondence on this to my Cedar Rapids office.

Sincerely,

Tom Harkin
United States Senator

TH/jbv
enclosure

STATE OFFICES:

307 FEDERAL BLDG.
BOX H
COUNCIL BLUFFS, IA 51502
(712) 325-5533

210 WALNUT ST.
ROOM 733 FEDERAL BLDG.
DES MOINES, IA 50309
(515) 284-4574

BOX 4489
LINDALE MALL
CEDAR RAPIDS, IA 52407
(319) 393-6374

131 E. 4TH ST.
314B FEDERAL BLDG.
DAVENPORT, IA 52801
(319) 322-1338

21 NOV 1986

DAEN-CWP-C

Honorable Tom Harkin
United States Senate
Washington, D. C. 20510-1502

Dear Senator Harkin:

This is in response to your letter of October 21, 1986, to Lieutenant General E. R. Heiberg III, which enclosed a letter from your constituent Mr. Richard E. Dickinson regarding the Brown's Lake Habitat Rehabilitation and Enhancement project. General Heiberg has asked me to respond on his behalf.

The Brown's Lake project is under study by the Corps of Engineers in cooperation with the Soil Conservation Service (SCS) and the Iowa Department of Natural Resources (DNR). Technical studies, which will help determine the feasibility of the three phases of the project, are being accomplished. To date, no recommendations have been made.

Preliminary studies of Phase II indicate that the average rate of sediment accumulation in Upper Brown's Lake poses no threat to the lake. If it does not appear to be feasible to proceed with Phase II upon completion of these studies, a post-construction monitoring program will be conducted to ensure that the lake is not being threatened. A final report on the Brown's Lake project is scheduled for completion early next fall.

I appreciate your interest in this matter.

Sincerely,

SIGNED

Galen H. Yanagihara
Colonel, Corps of Engineers
Assistant Director of Civil Works,
Upper Mississippi Basin & Great Lakes

CF:
NCD
Rock Island District

JACKSON COUNTY

JACKSON COUNTY COURTHOUSE, 201 WEST PLATT, MAQUOKETA, IOWA 52060

ɪRD OF SUPERVISORS
319/652-3181

Richard E. Dickinson

Patrick W. O'Rourke

Barbara A. Wright

October 6, 1986

The Honorable Charles E. Grassley
135 Hart Senate Office Building
Washington, D.C. 20510

Dear Senator Grassley:

As I'm sure you're aware, Congress last year authorized the Corps of Engineers to proceed with lock and dam reconstruction at Alton, Illinois. The authorization included a $300 million expenditure. A provision of the bill stated that for every dollar spent on locks and dams, a matching dollar must be spent on the Mississippi River environment. This phase of the bill is called the Environmental Monitoring Program or EMP.

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Phase I: estimated cost $300,000 to $500,000
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Phase II: estimated cost $600,000
Design and build water control structures in the Smith Creek Watershed to reduce the annual sediment delivery into Brown's Lake. This would be handled by a dollar transfer to SCS. They would design and build all structures.

Phase III: estimated cost $500,000
Dredge fisherman access and overwinter survival trenches in the bed of Brown's Lake. This phase would be carried out by USACE.

The major obstacle to this project seems to be Phase II. USACE contends that they would spend the money to help stabilize Brown's Lake and protect it from future siltation. However, they questioned whether EMP monies can be used for expenditures out of the Mississippi River Floodplain. If Smith Creek is not funded, USACE feels that the diking and trenching will not be cost effective from an operations and maintenance standpoint.

Senator Grassley, we ask that you intervene in behalf of the Iowa DNR and eastern Iowa and work with USACE to secure this project.

If our office can provide additional information we are at your disposal. Thank you in advance for your assistance.

Sincerely,

Richard E. Dickinson
Jackson County Supervisor

135 H[illegible] Senate Office Building
Washington, DC 20510
(202) 224-3744

Des Moines, IA 50309
(515) 284-4890

101 1st Street S.E.
Cedar Rapids, IA 52401
(319) 399-2555

United States Senate

103 Federal Courthouse Building
320 6th Street
Sioux City, IA 51101

531 Commercial Street
Waterloo, IA 50701

131 E. 4th Street
Davenport, IA 52801
(319) 322-4331

October 25, 1986

Mr. Robert K. Dawson
Assistant Secretary, Civil Works
Rm 2E570
Department of the Army
The Pentagon
Washington, DC 20310

Dear Bob:

Attached is a copy of a letter that I received from Mr. Richard E. Dickinson a Jackson County, Iowa Board of Supervisor member regarding his concerns with $300 million authorization for the lock and dam reconstruction at Alton, Ill.

I would appreciate it if you would review his concerns and see what can be done to be of assistance.

Sincerely,

Chuck

Charles E. Grassley
United States Senator

CEG/rer
Enclosure

Committee Assignments:
BUDGET FINANCE JUDICIARY LABOR AND HUMAN RESOURCES SPECIAL COMMITTEE ON AGING

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

5 DEC 1986

Honorable Charles E. Grassley
United States Senate
Washington, D. C. 20510-1501

Dear Senator Grassley:

This is in response to your letter of October 25, 1986, which enclosed a letter from your constituent Mr. Richard E. Dickinson, regarding the Brown's Lake Habitat Rehabilitation and Enhancement project.

The Brown's Lake project is under study by the Corps of Engineers in cooperation with the Soil Conservation Service (SCS) and the Iowa Department of Natural Resources (DNR). Technical studies, which will help determine the feasibility of the three phases of the project, are being accomplished. To date, no recommendations have been made.

Preliminary studies of Phase II indicate that the average rate of sediment accumulation in Upper Brown's Lake poses no threat to the Lake and hence, there would be no need to construct water control structures in the Smith Creek watershed to reduce sedimentation. If the full technical study confirms that it is not necessary to proceed with Phase II, a long term monitoring program to be carried out as an integral part of the Upper Mississippi River Plan authorized by Section 1103 of the Water Resources Development Act of 1986, will include monitoring of Brown's Lake to ensure that the lake is not being threatened. A final report on the Brown's Lake project is scheduled for completion early next fall.

I appreciate your interest in this matter.

Sincerely,

John Doyle Jr., Actg

CF:
NCD
Rock Island District

Robert K. Dawson
Assistant Secretary of the Army
(Civil Works)

cc: SASG
DAEN-CWP-G
SACW (File, read, sign)
JR/pb/19 NOV 86/retyped MR/lab 12/2/86
61.11 #138

IOWA CONSERVATION COMMISSION

Larry J. Wilson — Director
Wallace State Office Building, Des Moines, Iowa 50319
515/281-5145

An EQUAL OPPORTUNITY Agency

11-21-86

Dear John

I have sketched out an illustration of our control tube design at Green Island. Everything works fine except one thing. Our engineering section did not design heavy enough guide or slide rails and anchors. Floodwater pressure bends the rails and allows the caps to break off the end of the culvert. We have 3 36" tubes. And all 3 have suffered this type of pressure damage. The structure works fine if it is designed heavy enough. I encourage the use of stainless steel stems also. They are always operable.

The location of silt disposal is a bit critical at Browns Lake. If it were deposited at the mouth of Smith creek in a containment lagoon, the lagoon would soon be filled and we would be right into a high and dry floodplain reverting to maples. Much of it now is at leasta sagittaria bed slowly reverting to willows. It provides good mallard, wood duck and deer loafing cover.

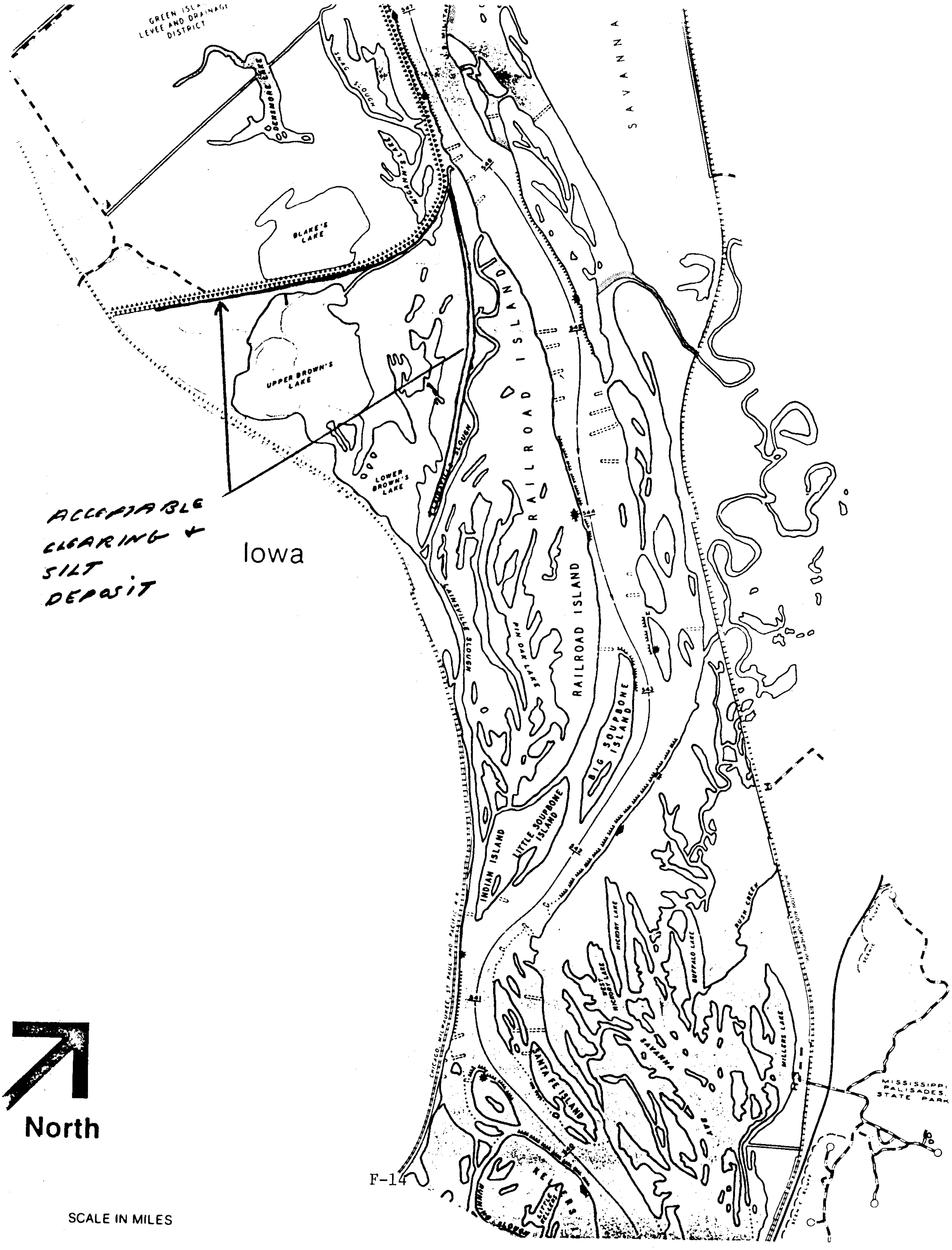
I would prefer to see the silt placed in an alignment along Lainesville Slough. It would not have to be tight against the edge of the Slough. But within 50-100' of the Slough. Much of the timber is pole stage and would clear easily. I have no concern over the length that may be needed to drop out the silt. As long as it basically followed the Slough's edge. We will protect the most area this way.

Let me know if you or others have ideas that need tossing about. I appreciate the teamwork approach to a project that should help fish and wildlife resources for many years.

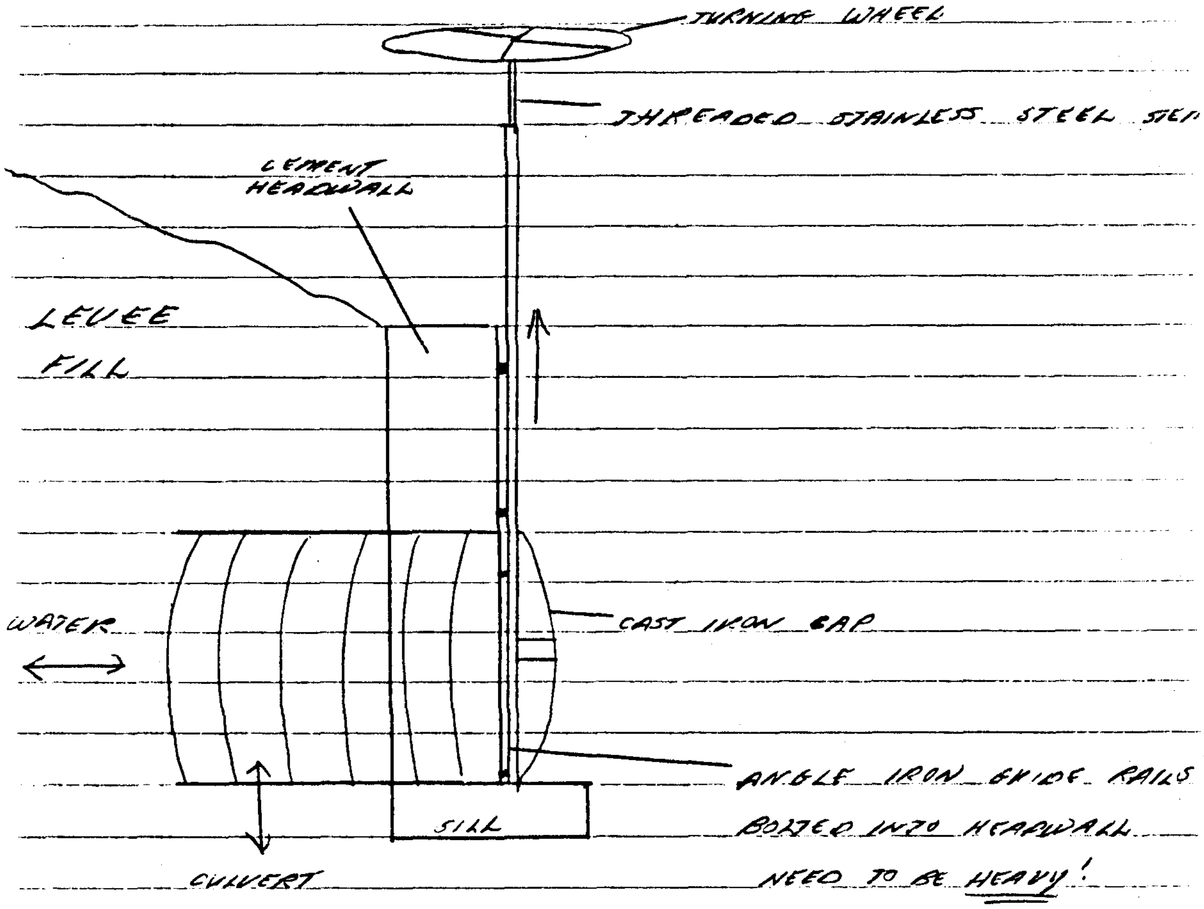
Sincerely,

Bob

BOB SHEETS WILDLIFE BIOLOGIST
Iowa Department of Natural Resources
CourtHouse - MAQUOKETA, IA 52060
Ph: (319) 652-3132


GREEN ISLAND LEVEE AND DRAINAGE DISTRICT
DENSMORE LAKE
SNAG SLOUGH
McGANN'S LAKE
BLAKE'S LAKE
UPPER BROWN'S LAKE
LOWER BROWN'S LAKE
SAVANNA
RAILROAD ISLAND
RAILROAD ISLAND
RAILROAD ISLAND
LAINESVILLE SLOUGH
PIN OAK LAKE
BIG SOUPBONE ISLAND
LITTLE SOUPBONE ISLAND
INDIAN ISLAND
HICKORY LAKE
WEST HICKORY LAKE
BUFFALO LAKE
RUSH CREEK
MILLERS LAKE
SAVANNA BAY
SANTA FE ISLAND
MISSISSIPPI PALISADES STATE PARK
ACCEPTABLE CLEARING + SILT DEPOSIT
Iowa
North
SCALE IN MILES

POSSIBLE CONTROL TUBE
FOR BROWNS LAKE DEFLECTION DIKE



JOE WELSH
STATE SENATOR
Dubuque and Jackson Counties
Seventeenth District

HOME ADDRESS
R.R. #2, Box 37
DUBUQUE, IOWA 52001

STATEHOUSE PHONE
515-281-3371

"OUR LIBERTIES WE PRIZE AND OUR RIGHTS WE WILL MAINTAIN"

The Senate
STATE OF IOWA
Seventy-Second General Assembly
STATEHOUSE
Des Moines, Iowa 50319

COMMITTEES

Appropriations, *Chair*
Business & Labor Relations
Commerce
State Government

February 2, 1987

Mr. Andy Bruzewicz
EMP Project Manager
Army Corps of Engineers
Clock Tower Boulevard
Rock Island, IL 61201

Dear Mr. Bruzewicz:

As the State Senator for Jackson County I would like to express my support for the Green Island soil erosion and backwater Mississippi River siltation project. This project, involving local, state and federal cooperation has the capacity to be a watershed project in terms of governmental interaction at differing levels for the 1980s and beyond.

As Chairman of the Iowa Senate Appropriations Committee, I am aware of the need to seek out new and innovative programs which hold the promise of improving the way government normally works. In this instance, attacking the soil erosion problem outside of the flood plain would allow the Corps to carry out its program in the most effective manner--dealing with the problem at its source.

I have been in contact with Congressman Neil Smith on this matter, and his interest in Corps and water projects has been extremely helpful. I appreciate your attention in this manner and would ask that you keep me informed of developments in this project. If you have questions or comments, please contact me.

Sincerely yours,

Joe J. Welsh

Joseph J. Welsh
State Senator

cc: Jackson Co. Board of Supervisors
JJW/rlb

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:

February 17, 1987

Planning Division

Honorable Joseph J. Welsh
Iowa State Senate
Statehouse
Des Moines, Iowa 50319

Dear Senator Welsh:

We are writing in response to your letter of February 2, 1987, regarding the Brown's Lake Habitat Rehabilitation and Enhancement Project.

The Brown's Lake project is under study by the Corps of Engineers in cooperation with the Soil and Conservation Service and the Iowa Department of Natural Resources. Technical studies, which will help determine the feasibility of the levee, dredging, and upland erosion control components of the project are currently being accomplished. No recommendations have been made at this time.

Preliminary studies indicate that the average rate of sediment accumulation in Upper Brown's Lake due to the Smith Creek watershed poses no threat to the Lake. Thus, there would be no need to proceed with water control structures in the watershed to reduce sedimentation. If the full technical study confirms that it is not necessary to proceed with the Smith Creek component, a long-term monitoring program to be carried out as an integral part of the Upper Mississippi River System - Environmental Management Program authorized by Section 1103 of the Water Resources Development Act of 1986, will include monitoring of Brown's Lake to ensure that the lake is not being threatened. A final report on the Brown's Lake levee and dredging project is scheduled for completion early this fall.

I appreciate your interest in this matter, and we will keep you informed of the status of the project.

If you have further questions pertaining to this matter, please call Mr. Andrew Bruzewicz of my staff at 309/788-6361, Ext. 203, or write to the following address:

District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Sincerely,

ORIGINAL SIGNED BY

Neil A. Smart
Colonel, Corps of Engineers
District Engineer

STATE OF
IOWA
TERRY E. BRANSTAD, GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

4-27-87

Dan Holmes- Engineering
U.S. Army Corps of Engineers
Clock Tower Bldg
Rock Island, Illinois

Dear Dan,

I am sending along profiles on the two silt stations that we have taken readings at for the past 3 years. I will enclose a map to illustrate their locations. I would bet that more has occurred since high water in Oct and Nov of 86. We walked the head end of railroad Island yesterday and noticed 2-3' berms of fresh sand that were thrown back into the island up to 100 yards from theriver bank.

It wasgood to meet with you. Tom Boland and I both feel more comfortable with the alternative dredge spoil containment berm along Lainesville slough. It makes more sense for future levee work if we learn that more protection for Browns Lake is needed.

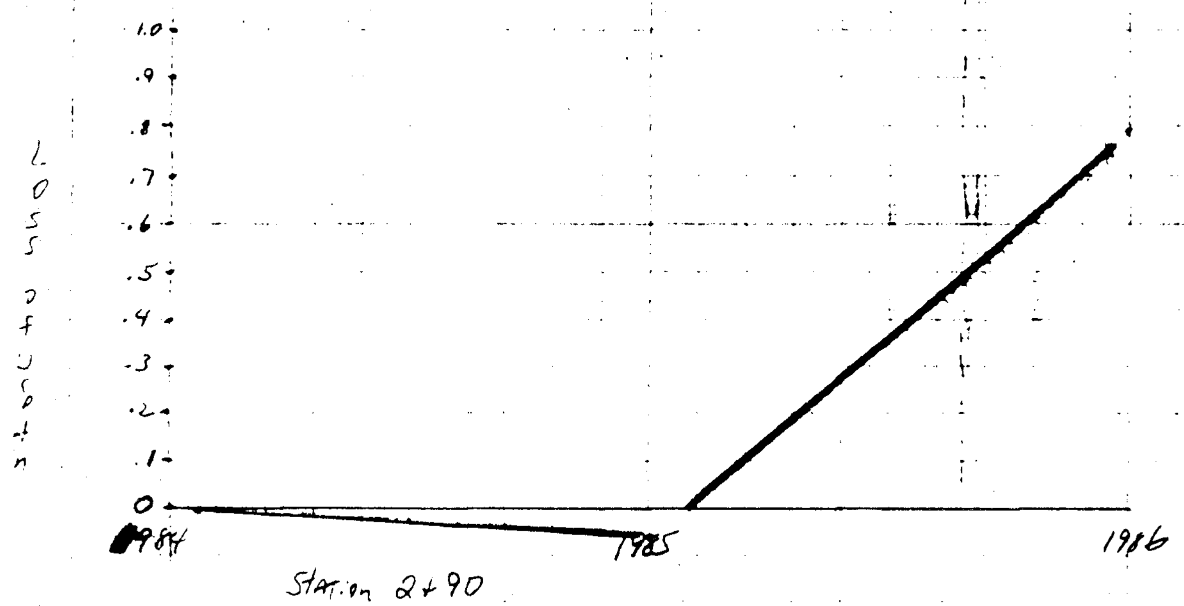
Let Tom or myself know if more is needed. We will help where we can.

Sincerely,

cc Tom Boland
file

BOB SHEETS WILDLIFE BIOLOGIST
Iowa Department of Natural Resources
CourtHouse - MAQUOKETA, IA 52060
Ph: (319) 652-3132

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145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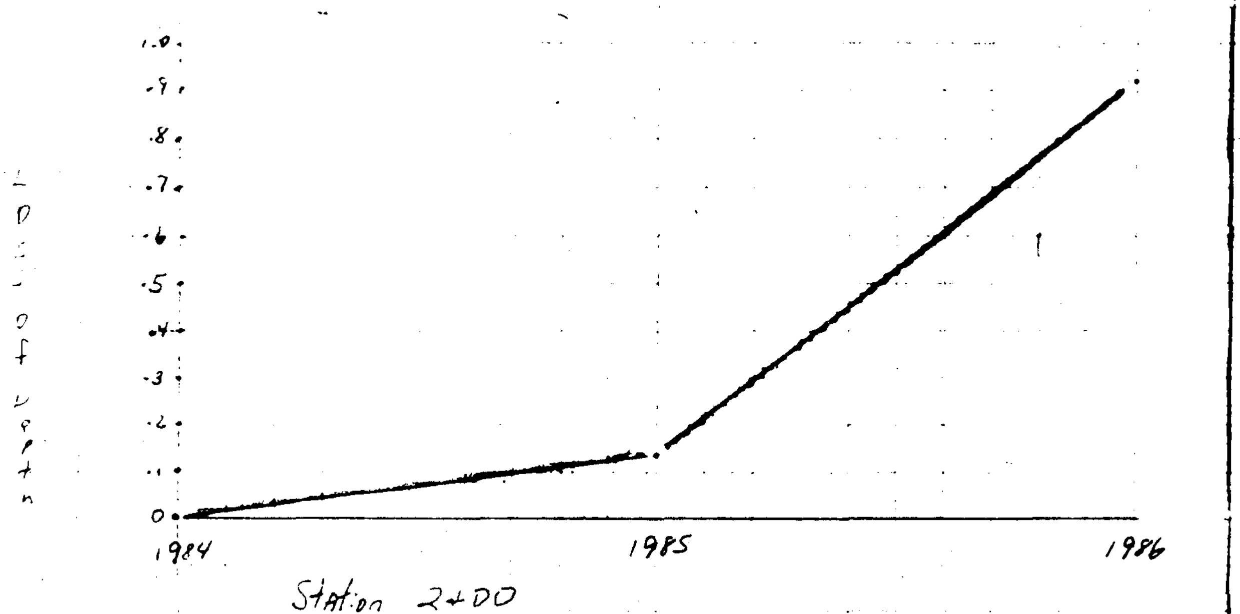
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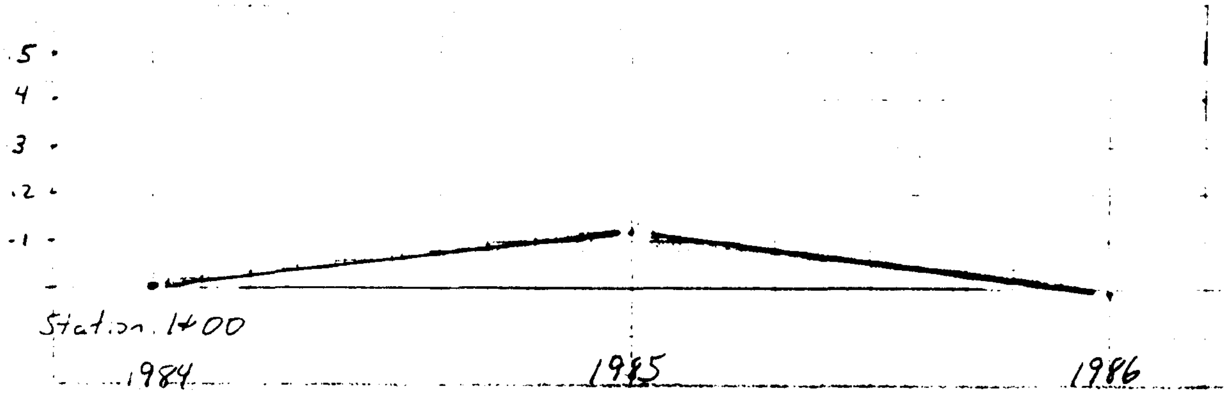
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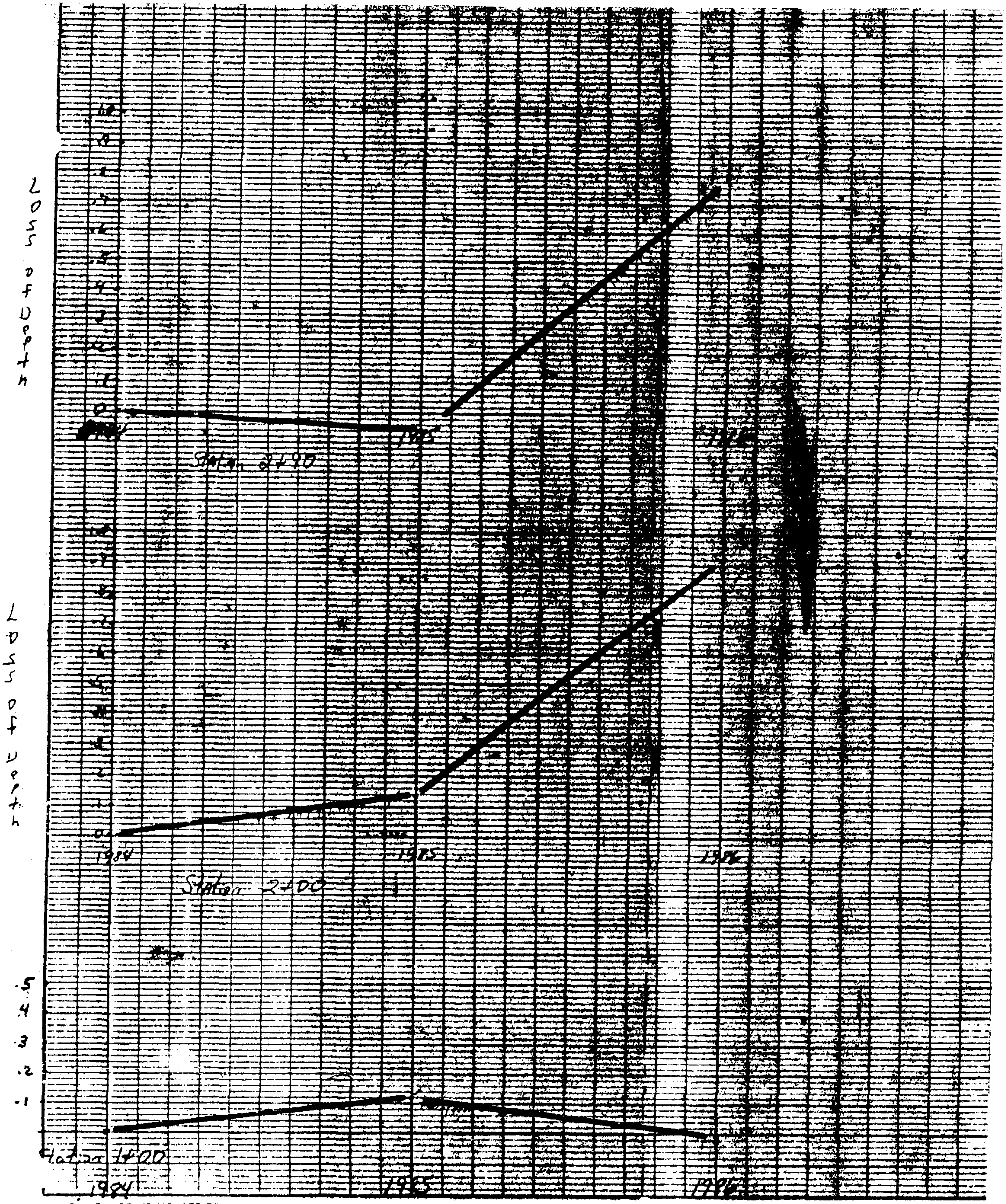

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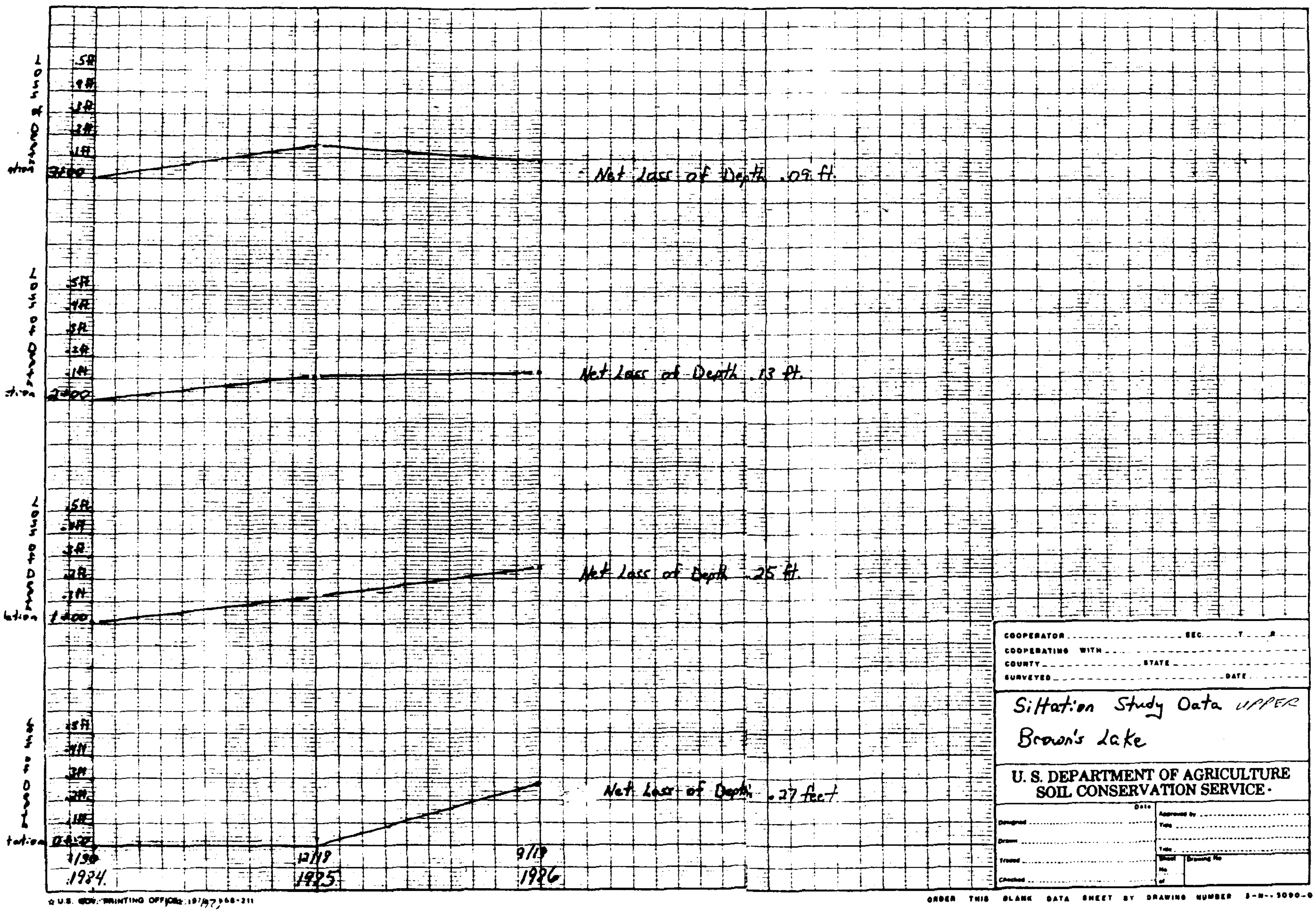
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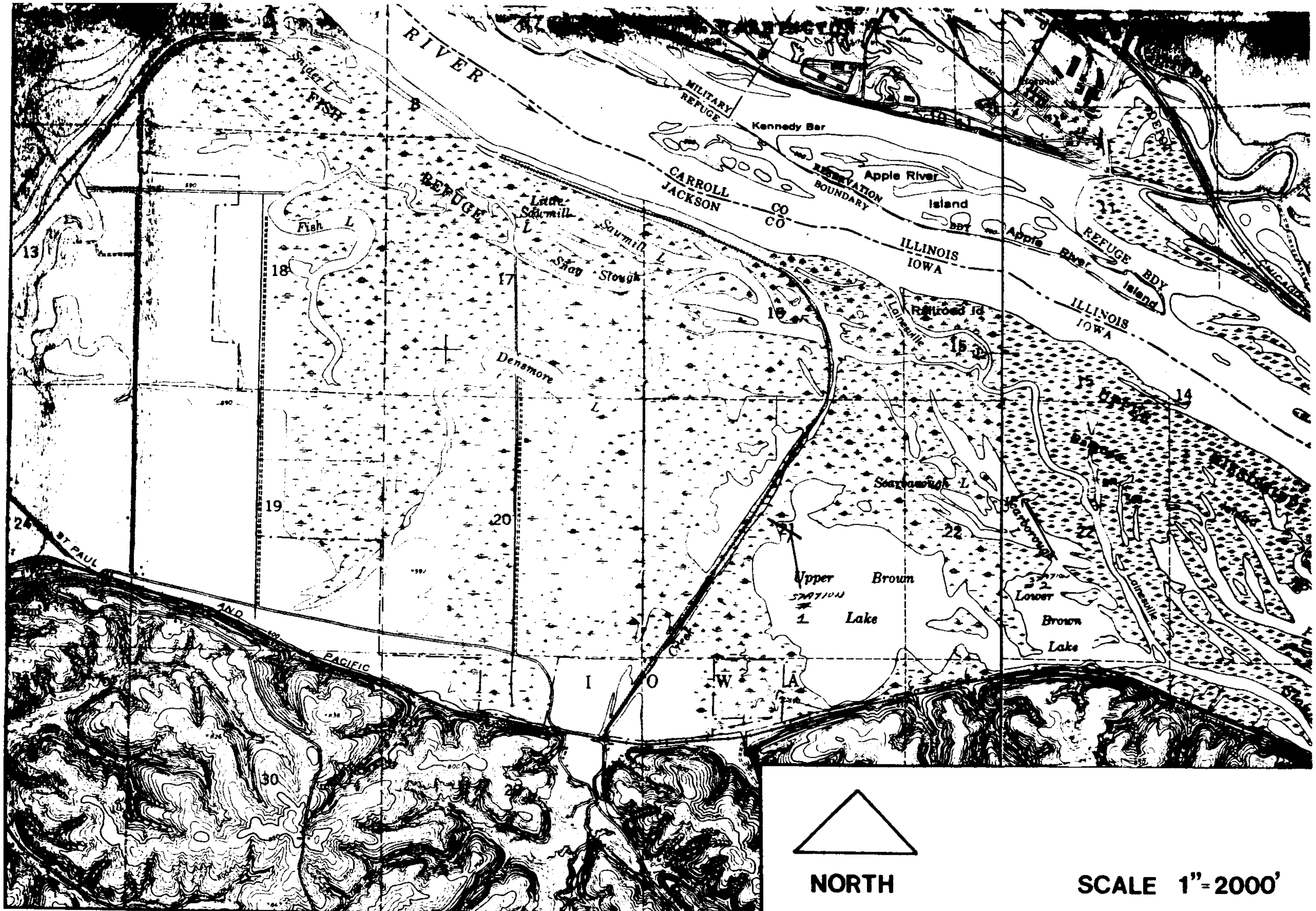
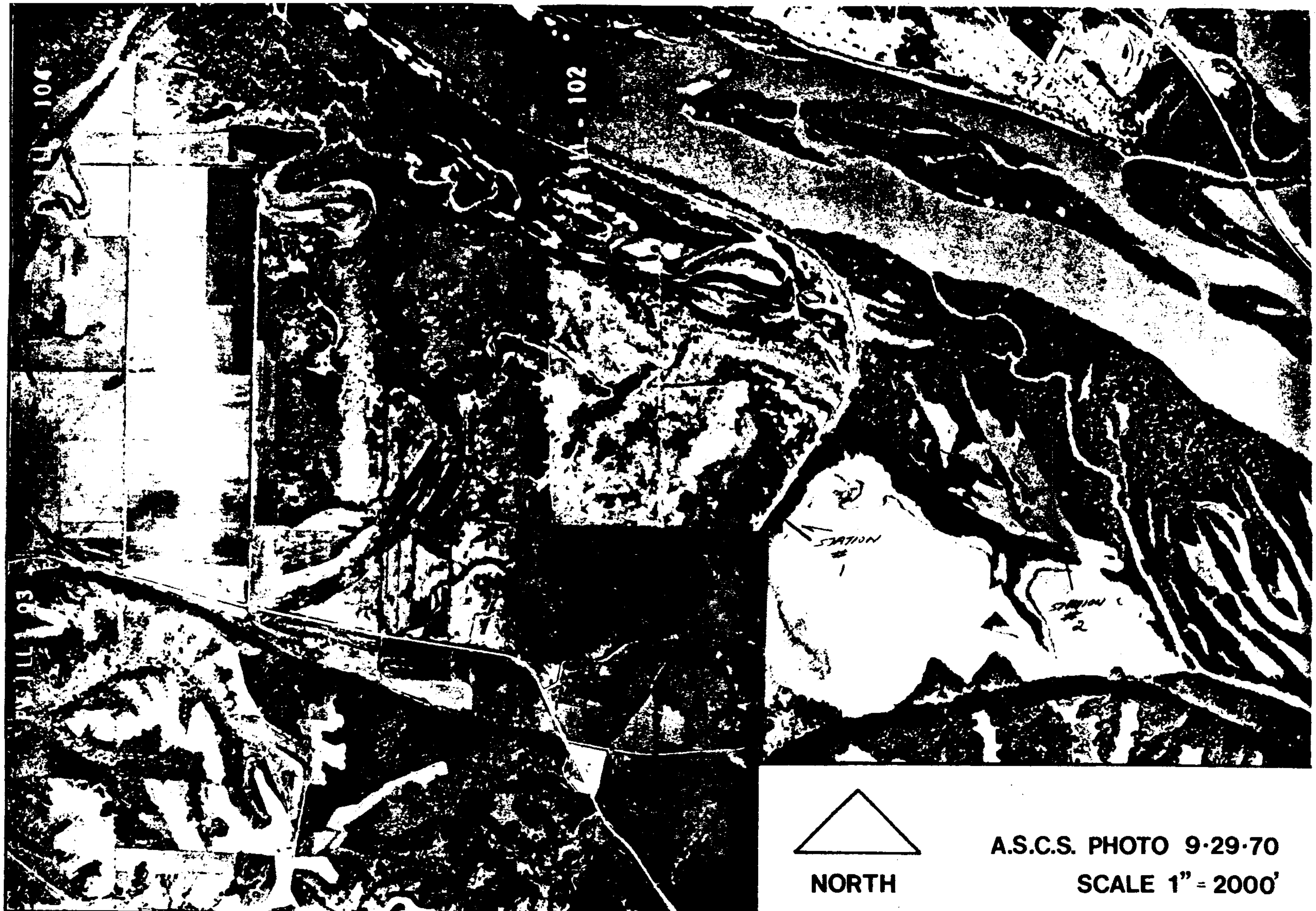
SOIL CONSERVATION SERVICE
ORDER THIS BLANK DATA SHEET BY DRAWING NUMBER



GREEN ISLAND WILDLIFE AREA

JACKSON COUNTY, IOWA

IOWA CONSERVATION COMMISSION
FISH AND WILDLIFE DIVISION



GREEN ISLAND WILDLIFE AREA

JACKSON COUNTY, IOWA

IOWA CONSERVATION COMMISSION
FISH AND WILDLIFE DIVISION

United States Department of the Interior
BUREAU OF MINES
P. O. BOX 25086
BUILDING 20, DENVER FEDERAL CENTER
DENVER, COLORADO 80225
Intermountain Field Operations Center

November 3, 1987

District Engineer
U.S. Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P. O. Box 2004
Rock Island, Illinois 61204-2004

Dear Sir:

Subject: Review of Definite Project Report and Environmental Assessment for the Brown's Lake Rehabilitation and Enhancement, Jackson County, Iowa (ER-87/1179)

Personnel of the Intermountain Field Operations Center, Bureau of Mines, have reviewed the subject report and environmental assessment (EA) for possible conflict with mineral resources and mineral-producing facilities as requested by the Director, Office of Environmental Project Review.

Known mineral resources in Jackson County are limited to sand and gravel and limestone, which are not known to occur within the proposed project area. Although we anticipate no significant conflict between the proposed project and mineral resources, we suggest that a statement be included in future versions of the report and EA that mineral resources would not be affected.

Sincerely yours,

William Cochran, Chief
Intermountain Field Operations Center

cc: Regional Environmental Officer, USDI,
Chicago, Ill.
Director, Office of Environmental Project
Review, USDI, Washington, D.C.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FEDERAL BUILDING, FORT SNELLING
TWIN CITIES, MINNESOTA 55111

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

FWS/ARW-WSS

NOV 5 1987

Colonel Neil A. Smart
District Commander
U. S. Army Engineer District
Rock Island
Clock Tower Building
Rock Island, Illinois 61201

Dear Colonel Smart:

The Fish and Wildlife Service has reviewed the Definite Project Report for the Browns' Lake, Iowa rehabilitation and enhancement project. This project is proposed under the Water Resources Act of 1986 as part of the Upper Mississippi River System Environmental Management Program.

The Browns' Lake project has been coordinated with the Fish and Wildlife Service and we approve and support the project as planned and described in the Definite Project Report. Concerning the Long-Term Resource Monitoring aspects, we recommend that responsibility for specific monitoring items be assigned during the coordinated preparation of the operation and maintenance plan, because the most cost-effective method for implementation of monitoring efforts may require interagency coordination.

The Service agrees with the preferred alternative action contained in the Environmental Assessment and has effected a Finding of No Significant Action (copy enclosed). The project is located within the Upper Mississippi River National Wildlife and Fish Refuge, and the project has been determined to be compatible with the purpose for which the refuge was established. Compatibility is based upon the current project description, and we request the opportunity to review final plans and specifications prior to construction. The Browns' Lake project involves Fish and Wildlife Service fee title lands, and the Corps of Engineers is authorized to construct the proposed project on these lands. When the project is complete, the Fish and Wildlife Service will assume operation and maintenance responsibilities as described in Table 12-1 of the Definite Project Report.

We look forward to our continued cooperative efforts in developing habitat rehabilitation and enhancement projects under the Environmental Management Program. If we can be of further assistance, please let us know.

Sincerely,

Acting Regional Director

Enclosure

FINDING OF NO SIGNIFICANT IMPACT

For the reasons presented below and based on an evaluation of the information contained in the supporting references, I have determined that the Environmental Management Program project of rehabilitating and enhancing Brown's Lake through backwater dredging for deepwater habitat and a deflection levee to keep out sediment-laden water in the Upper Mississippi River National Wildlife and Fish Refuge, is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons:

The U. S. Fish and Wildlife Service has adopted the environmental assessment prepared by the U. S. Army Corps of Engineers which considered ten alternatives. Several of the alternatives have the potential to meet the objective of the project, which is to restore and protect the shallow backwater complex important for several species of fish as well as waterfowl and furbearers, and some of the alternatives will be considered further for separate projects. The preferred alternative, however, appears to meet the objective with no or no measurable economic and social impacts and no adverse impacts on natural resources except the loss of up to fifty acres of bottomland forest which will be mitigated through replanting to species that provide better wildlife food.

Supporting References:

1. Environmental Assessment

John Popowski — 11/4/87

Acting Regional Director — Date

Distribution: AE (Master File)
ES/BEC--Washington, DC
RF--Washington, DC
WSS/FM--Twin Cities, MN
UMR through RF1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

November 12, 1987

Colonel Neil A. Smart, USA
U.S. Army Engineer District, Rock Island
ATTN: Environmental Review Branch
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Smart:

RE: Brown's Lake Rehabilitation and Enhancement

In accordance with our responsibilities under Section 309 of the Clean Air Act, we have reviewed the environmental assessment (EA) and Section 404(b)(1) evaluation report for the project referenced above. Because this project will enhance the wetland complex overall, we concur with your intent to issue a Finding of No Significant Impact. However, we would also like to take this opportunity to point out a deficiency in your Section 404(b)(1) Evaluation Report and EA which should be corrected in your future 404(b)(1)/EA documents.

Section 230.5(c) of the December 24, 1980, Guidelines for Specification of Disposal Sites for Dredged or Fill Material requires the applicant to "Examine practicable alternatives to the proposed discharge, that is, not discharging into the waters of the U.S. or discharging into an alternative aquatic site with potentially less damaging consequences." Executive Order 11990-Protection of Wetlands also suggests that the EA should address alternatives to destruction of a wetland. Inasmuch as we consider that the proposed dredge material disposal area is a forested wetland and that the only other disposal site considered was the wetland area located at the delta to Smith's Creek, we feel that neither of these requirements have been met.

Thank you for the opportunity to review and comment on these documents. Any questions on our comments can be directed to Mr. Mike Bronoksi of my staff at FTS 236-2823.

Sincerely yours,

Katherine Biggs

B. Katherine Biggs
Chief, Environmental Review Branch

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

November 19, 1987

Colonel Neil A. Smart
Rock Island Corps of Engineers
Clock Tower Bldg. - P.O. Box 2004
Rock Island, IL 61204-2004

ATTENTION: Planning Division

Dear Colonel Smart:

Iowa Department of Natural Resources staff reviewed the September 1987 Detailed Project Report (DPR) with Environmental Assessment (EA) for the Brown's Lake EMP project. We concur with the contents of the DPR and EA.

Interagency coordination has been very good during the project's proposal and design phases. Iowa DNR staff will continue their active role in coordination, with specific attention now being given to designing the long term resource monitoring elements of the project. We are providing input through our membership on the Ecological Advisory Team of the EMP's Long Term Resource Monitoring (LTRM) Program. DNR staff will also be instrumental in implementing the Brown's Lake LTRM since we are planning on providing these services through an agreement with the U.S. Fish and Wildlife Service.

Thank you for the opportunity to review the Brown's Lake DPR and EA. The Iowa DNR looks forward to continued implementation of the Brown's Lake project, as well as the other EMP elements.

Sincerely,

LARRY J. WILSON
DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145

ENVIRONMENTAL ASSESSMENT

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:

GENGR-PD-E

ENVIRONMENTAL ASSESSMENT

BROWN'S LAKE HABITAT REHABILITATION AND ENHANCEMENT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

NOVEMBER 1987

ENVIRONMENTAL ASSESSMENT

BROWN'S LAKE HABITAT REHABILITATION
AND ENHANCEMENT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

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ENVIRONMENTAL ASSESSMENT

BROWN'S LAKE HABITAT REHABILITATION
AND ENHANCEMENT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

I. PURPOSE AND NEED FOR ACTION

A. Project Authority. The 1985 Supplemental Appropriations Act (P.L. 99-88) and Section 1103 of the Water Resources Development Act of 1986 (P.L. 99-662) provide authorization and appropriations for an environmental management program for the Upper Mississippi River System that includes fish and wildlife habitat rehabilitation and enhancement.

B. Project Background. Public Law 95-502 (passed in October 1978) authorized the construction of a new dam and 1,200-foot lock at Alton, Illinois, and directed the Upper Mississippi River Basin Commission to prepare a Comprehensive Master Plan for the Management of the Upper Mississippi River System (Master Plan). The Commission completed the Master Plan report and submitted it to Congress on 1 January 1982. The Master Plan recommended construction of a second chamber, 600 feet in length, at the Locks and Dam 26 Replacement Project. It also recommended an initial 10-year environmental program to include habitat rehabilitation and enhancement projects, a long-term resource monitoring program with a computerized inventory and analysis system, a program to develop recreation projects, an assessment of economic benefits generated by recreational activities, and navigation system traffic monitoring. The FY 1985 Supplemental Appropriations Act (P.L. 99-88) and the Water Resources Development Act of 1986 (P.L. 99-662) contain authorization and appropriations for the Master Plan recommendations noted above. Construction of the second lock will be the responsibility of the Lower Mississippi Valley Division (LMVD). North Central Division (NCD) is responsible for the remaining program elements which are entitled the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

The Master Plan studies concluded that the natural environment of the Upper Mississippi River System is degrading at a rapid rate as a result of human-induced and natural forces. The continued existence of the diverse backwater areas depends on two necessary actions: reduction of sediment entering those areas and construction of remedial habitat projects. The States of the UMRS are pursuing, individually and through the Upper Mississippi River Basin Association (UMRBA), an erosion and sedimentation control strategy to reduce sedimentation and to complement the habitat projects to be implemented under the UMRS-EMP. This habitat rehabilitation and enhancement program consists of numerous projects to preserve, protect, and restore deteriorating habitat. This effort is programmed over a 10-year period; toward the end of that period, a recommendation will be made whether to continue the program, terminate it, or continue it in some modified form.

C. Problem. The Brown's Lake backwater complex is important reproduction and feeding habitat area for several fish species, some of the more important of which are bass spp., northern pike, crappie, bluegill, buffalo spp., and channel catfish. Many fishes depend on these areas for some stage of their life. Waterfowl and furbearers also rely heavily on these backwaters for food, shelter, and reproduction.

These shallow backwaters, however, are constantly being threatened by natural and man-made activities, and many are being lost at an accelerated rate. Modern demands from agriculture, industrialization, and urbanization have placed a heavy burden on the river basin. Much of the watershed's fertile cropland that is lost each year to water runoff eventually finds its way to the shallow backwater areas of the Upper Mississippi River.

The accumulation of silt in the Brown's Lake complex is causing accelerated rates of succession, dramatically shortening the life span of backwater areas. If remedial action is not taken to reduce sedimentation rates, aquatic habitat (i.e., shallow waters, emergent and submergent vegetation) will succeed toward bottomland forest (i.e., forested wetland of willow and silver maple). Productivity in terms of numbers of fish and other water-dependent fauna will decrease.

Besides accelerating undesirable succession, sedimentation exacerbates dissolved oxygen depletion. As depth decreases due to sedimentation, a smaller volume of water is left to retain dissolved oxygen which is absolutely vital to all aquatic life. Dissolved oxygen concentrations can fluctuate widely in shallow waters, causing stress or massive fish kills.

Sediment analysis and data from soil borings indicate that the majority of recent sediment in Upper Brown's Lake originates from suspended sediment in floodwaters of the main river channel. These floodwaters enter through a channel located at the northeastern corner of the Green Island Levee. Historical photographs of the mouth of this channel in Brown's Lake show the gradual growth of a delta into the lake. Sediment also has been accreting at the mouth of Smith's Creek, but the volume does not appear to be as great.

II. PROJECT DESCRIPTION AND LOCATION

A. Location. The project area is located in Mississippi River Pool 13, Jackson County, Iowa, approximately 10 miles south of Bellevue, Iowa, at River Mile 545 (plate 1).

B. Proposed Work. The recommended design consists of two major components:

1. Backwater dredging designed to provide deepwater habitat which now does not exist, and enhance the flow of oxygen-rich water from the main channel into the shallow backwaters. Deepwater is needed by all fish species who inhabit backwater lakes and sloughs. Shallow waters lose oxygen rapidly in summer, fall, and when ice covered in the winter. Fish kills frequently occur when fish cannot escape to deeper water. The deepened channels in Brown's Lake will increase the habitat value significantly.

2. A deflection levee which will prevent sediment-laden waters from the main channel from directly entering Brown's Lake. This feature is needed to prolong the productive life of the Brown's Lake complex. Unless the current rate of sedimentation is reduced, aquatic habitat will disappear and eventually be replaced by scrub/shrub wetland or bottomland forest.

The deflection levee will be 3,500 feet long with a 10-foot crown and 1 on 3 slope, originating from the Green Island Levee and running parallel to (and 200 feet from) the river shoreline, terminating at its intersection with Lainsville Slough. The levee will be constructed to approximately 8 feet high (50-year event) which is the same height as the Green Island Levee (594.0 feet MSL). Approximately 55,400 cubic yards of borrow material for the levee will come from the interior of the proposed dredged material disposal site (plate 2). Levee construction will require clearing of about 7 acres of bottomland forest.

The deflection levee is not designed to prevent flooding of Brown's Lake, but rather to redirect silt-laden waters toward the bottomland forest downstream of Lainsville Slough. Ideally, the velocity of water flowing through the broad zone of forest will decrease such that most of the sediment will settle out before backing into Brown's Lake. In addition, water entering Brown's Lake behind such a levee will become stagnant water and prevent a constant flow-through of sediment loads which now enter Brown's Lake at the upper end and exit (minus sediment) at the lower end. Theoretically, only one water column of diminished sediment load will enter the lake during each flooding, as opposed to multiple sediment-laden water columns which now enter with each event.

A turnaround structure also will be constructed at the end of the levee to facilitate maintenance and inspection. The levee terminus will be riprapped, as necessary, to prevent any possible erosion from floodwaters.

An integral and important part of the levee will be a water control structure which will allow regulation of main channel river flow into Brown's Lake backwaters. At present, water from the main channel flows directly into Brown's Lake. The channel which now allows silt-enriched waters to enter Brown's Lake also provides critically needed oxygen-rich water. The control structure will be closed during high river stages (mainly in spring) to prevent silt deposition, but will be opened during summer and winter months to allow oxygen-rich water to enter the backwaters at a time when fish encounter low oxygen levels (and when sediment loads are low). The control structure will consist of four 5-foot by 5-foot concrete box culverts with a bottom elevation of 577.0 feet MSL. The inlet channel to the water control structure will be realigned downstream to decrease accumulation of floating debris, which is a problem in the existing channel.

About 3.6 miles of backwater lake and sloughs also will be dredged to improve aquatic habitat. Deepwater areas provide fish refugia from stressful conditions (i.e., high heat and low dissolved oxygen) of shallow water habitats. Deeper water also will attract (and increase population levels of present species) new species to the area which currently are not present. In addition to providing deepwater habitat, the dredging is designed to enhance the flow of oxygen-rich water from the main channel to the shallow backwaters which have a high Biological Oxygen Demand (BOD) and Sediment Oxygen Demand (SOD).

Approximately 400,000 cubic yards of material (primarily silts and clays) will be dredged to a depth of 9 feet (elevation 574.0 feet MSL). Existing elevation of Brown's Lake is predominantly in the 582.0 to 583.0 elevation range. The width of the dredged channel will vary from 30 to 200 feet. The channel will be 50 feet wide over most of its length, with occasional "wide holes" up to 200 feet wide. Although the plan specifies 3.6 miles of channel, an additional length of channel would provide more deepwater habitat. The recommended channel length is the minimum amount of deepwater needed to increase the flow of water through Brown's Lake. Plate 3 shows an expanded dredging option would provide additional habitat improvement if the project were continued in a future phase.

Dredging will be accomplished by both mechanical (clamshell or dragline) and hydraulic methods. A clamshell will be used along channel portions close enough to shore for equipment to reach. A small hydraulic dredge will be used for the remaining channel sections. The primary disposal site will be located immediately east of Lainsville Slough. The disposal site is approximately 95 acres. All 95 acres, however, will not be needed unless the entire amount of optional dredging is implemented. It is much more likely that only a portion of this acreage will be required.

Because of the fine-grained nature of the dredged material, a containment dike will have to be constructed around the site perimeter to allow for settling. A 10-foot-high containment levee will be constructed from adjacent soils by earth-scraping equipment. Most trees within the perimeter of the disposal site will be cleared. For the basic dredging plan of 400,000 cubic yards, a 30- to 45-acre area is needed if material is placed to a maximum depth of 8 feet. Following disposal, the site will be planted with mast species such as swamp white oak, pin oak, shagbark hickory, and northern pecan in order to take advantage of the increased elevation. Seedlings (2 to 3 feet tall) will be planted on 10-foot by 10-foot spacing by machine, if possible. Use of herbicides may be necessary to assure survival. The planting of mast trees will provide a new food source which is not present in Brown's Lake bottomland forest. Populations of small game, wood ducks, deer, and possibly wild turkey will benefit.

Placement of the disposal site adjacent to Lainsville Slough and the deflection levee also will provide additional deflection of silt-laden floodwaters from Brown's Lake. Material excavated from the inlet channel adjacent to the Green Island levee will be placed on the levee to reinforce it against wave erosion.

III. ALTERNATIVES

To prevent sedimentation and/or to restore aggraded habitats, a limited array of alternatives is possible. The two major techniques of preventing sedimentation in a given area are to: (1) prevent the sediment from leaving its source or (2) construct a physical barrier (i.e., levee) around the entire area to be protected.

A. Upland Erosion Control. The concept of an upland control project is being investigated for the Smith's Creek watershed which enters Brown's Lake at the southwestern side of the lake. It is being studied as a possible separate EMP project. The Brown's Lake project could be enhanced by sediment control on Smith's Creek, but is not dependent upon it. Current survey information indicates that Smith's Creek deposits only 18.2 percent of the sediment entering Brown's Lake. Controlling Mississippi River sediment at its source is obviously beyond the scope of the EMP program.

B. Levee Surrounding Entire Brown's Lake Complex. The other alternative to prevent sedimentation would be to build a levee around the entire Brown's Lake complex. This plan would require a levee running from the Green Island Levee along Lainsville Slough and tying off to the railroad at the southern end.

C. Levee With Water Level Control. Two traditional techniques to restore habitat impacted by sedimentation are to raise water levels or to directly remove excess sediment by dredging. Raising the water level would require a levee of some type to retain water at a higher level than that of the Mississippi River. This type of project is usually implemented for waterfowl habitat improvement which often has management (practical and philosophical) conflicts relative to fishery objectives. For example, leveeing the entire lake presents a problem to fish ingress and egress to the lake systems. As an example of conflict between fish and waterfowl management, waterfowl managers usually prefer to draw water levels down in summer to promote vegetative growth, while fish managers prefer to leave water levels high to prevent heat and low oxygen stress.

Boland and Reetz 1/ studied the potential for such a levee around Brown's Lake and the associated impacts. They concluded that such a levee could enhance fish productivity if several conditions could be met. Their plan, although beyond the scope of the EMP project, is compatible with the recommended EMP project plan in this document. In fact, this project could be expanded at some future time to incorporate the design objectives discussed by the Iowa Department of Natural Resources (IDNR) report.

1/ Species Composition, Catch-Per-Unit-Effort, and Seasonal Distribution of the Fishes of Brown's Lake and the Green Island Drainage District. 1979. Thomas L. Boland and Gaylen F. Reetz. Iowa Department of Natural Resources Project No. 79-II-C-ADDED.

D. New Channel Between Lower Brown's Lake and Inlet Channel. A new channel between Lower Brown's Lake and the existing inlet channel is also under consideration. This new channel is also intended to provide a fresh flow of water into Brown's Lake. This new channel, however, might introduce new sediments into Lower Brown's Lake and/or cause erosion/scouring of the new streambank. At this time, the potential negative impacts seem to outweigh any benefits. If further analysis shows that these problems can be overcome, the new channel could be constructed at some future time.

E. Lengthened Deflection Levee. Various lengths of deflection dikes were evaluated, including extending it across Lainsville Slough. There appeared to be too many adverse hydraulic impacts associated with this option compared to the undetermined amount of sediment prevented from entering the backwaters. These impacts were loss of head in Upper Brown's Lake and the necessity for flow regulation in Lainsville Slough.

F. Alternative Dredge Cut Widths and Depths. The variety of designs for dredging the Brown's Lake complex is almost limitless considering the possible configurations, depths, and widths of dredge cuts. Biologically, there is practically no doubt that the increased depth will improve the quality of the aquatic habitat. The difficulty lies in determining at what point further dredging provides no additional benefits. Dredging in excess of the proposed plan (plus the expanded option) may not provide a concurrent increase in aquatic productivity.

The width of dredge cut is practically limited by the capability of the equipment used. The maximum amount of material moved per dollar is achieved by letting the dredge dig the maximum amount possible along a single pass through the sediment. For this reason, the majority of the cut is 50 feet wide; a narrower width would be inefficient and an increased width would require additional passes. The dredging depth of 574.0 feet MSL is 9 feet below the lowest possible pool elevation of 583.0 feet MSL. A shallower depth would increase risks of stress from BOD and SOD effects. The 574.0-foot elevation is about 1 foot deeper than what is probably needed to provide good deepwater habitat. However, the extra depth is needed in order to allow for sedimentation (some sedimentation is inevitable) over the next 100 years.

G. Alternative Disposal Sites. Alternative Disposal Site 1 is significantly lower in elevation than the preferred site. This would make construction of the containment berm more difficult because of the relatively high water table which would mire heavy equipment. In addition, it would not provide any deflection of sediment-laden waters as would the preferred site. This site may be used if the full extent of the expanded dredging option were to be implemented.

The practicality of constructing a disposal site at the mouth of Smith's Creek also was investigated. A dike could be constructed from the Green Island Levee to the railroad tracks, forming a triangular-shaped disposal area. In addition, this dike could be constructed to act as a sediment trap for Smith's Creek. As desirable as this option may appear, it was rejected for several reasons: (1) the area is a palustrine-emergent wetland that is very important to migratory waterfowl, (2) its distance from the dredging location would increase costs, and (3) the site's low elevation may not permit dike construction from an adjacent source which would significantly increase costs. The advantage of placing a structure on Smith's Creek for sediment control will be investigated during the Smith's Creek Watershed EMP study.

H. Lainsville Slough Dredging. The benefit of dredging upper Lainsville Slough also was investigated. Material would be used to construct a portion of the adjacent disposal site berm and concurrently leave a deeper channel for improved aquatic habitat. Current information, however, cannot predict if the channel will be stable, fill in quickly, or erode and increase siltation downstream. For this reason, this feature has been put in the Full Expansion plan as a possible project option.

I. No Action. The No Action alternative is a highly undesirable option because continued deterioration of aquatic habitat would result.

IV. AFFECTED ENVIRONMENT

The Brown's Lake project area is a complex of shallow backwater lakes, sloughs, bottomland forest, and several types of wetland habitats (i.e., palustrine, lacustrine, and riverine). For this project, the Brown's Lake complex consists of a triangular-shaped area bounded by the Green Island Levee, Lainsville Slough, and the Chicago, Milwaukee, St. Paul and Pacific railroad. This approximately 1,160-acre area contains 450 acres of shallow water, 190 acres of scrub/shrub and emergent wetland, 60 acres of vegetated mudflats (palustrine emergent), and 460 acres of bottomland forest.

The Brown's Lake unit forestry characteristics are typical of most river bottom areas. The predominant species is silver maple. Most of the timber stands are dominated by silver maple. Other tree species found within the area in numbers include green ash, willow, cottonwood, and elm. Species such as pin oak and black walnut are found within the area, but in very low numbers. The stands range in age from 29 to 84 years. Generally, most stands have average stocking levels, and very little natural regeneration is present in the area.

The Brown's Lake area is located on the Upper Mississippi River Wildlife and Fish Refuge. Along with the adjacent Green Island Wildlife Management Area (managed by the IDNR), the area is an extremely important migratory bird, fishery, and furbearer habitat.

At a flat pool elevation of 583.0 feet MSL, Upper and Lower Brown's Lakes average only 1 to 2 feet deep. Surveys indicate that sedimentation has been occurring at a rate of .5 to 1 inch per year. At that rate, it is most likely that all open water will succeed to upland in the next 50 years. The IDNR's 1979 fishery study showed a very diverse fish community of 39 species which included white crappie, black crappie, bluegill, largemouth bass, northern pike, walleye, and sauger. Important commercial species present were carp, buffalo, and channel catfish.

The area also has a high migratory waterfowl use in the fall and provides good reproductive habitat for wood ducks. Submergent (i.e., wild celery) vegetation in the lake is an especially important food source for diving ducks. High value submerged aquatics, such as wild celery, are very limited due to poor water clarity. In addition to submerged vegetation, a significant portion of Upper Brown's Lake is covered by American lotus and arrowhead (Saggitaria). Mudflats along the lake's shoreline support good growths of various smartweed spp. and other annuals. On slightly higher ground, are extensive stands of sedge (Carex sp.), particularly at the mouth of Smith's Creek and the inlet channel mouth connecting the lake and the main river. Evidence of muskrat and beaver is abundant in both of these areas. Other furbearers such as mink, raccoon, fox, and opossum are present to a lesser degree.

Endangered Species. Although its presence has not been documented, the IDNR describes the Brown's Lake area as good habitat for the river otter, which is a State endangered species. Otter tracks have been observed in the area as recently as the spring of 1987 (personal communication, IDNR).

The federally listed and endangered bald eagle is an occasional wintertime resident of the Brown's Lake area. When backwaters are not frozen, wintering eagles use the area for feeding and roosting. As the backwaters freeze, they tend to congregate more frequently around the open tailwaters of the locks and dams.

There are no other known State or federally endangered or threatened species known to be present in the immediate project area. The northern wild monkshood (Aconitum noveboracense) is listed as threatened and present in Jackson County. Individuals may be present along the northern bluff which lies just south of the railroad tracks outside the project area. However, the plant's specific habitat requirements almost certainly preclude any possibility that it is present in the project site.

In habitats similar to that of the northern wild monkshood, the Iowa pleistocene snail (Discus macclintocki) also may be found. The National Recovery Plan for the species describes it as inhabiting "... algific (cold producing) talus slopes in northeastern Iowa ...." Although the adjacent bluff area may provide such habitat, it is outside the area of any project effects.

Two State endangered species also are known from the nearby bluff areas: kitten-tails (Wulfenia bullii) and shooting star (Dodecatheon radicatum). Again, the habitat requirements of these two plants preclude their presence on the project site.

V. ENVIRONMENTAL IMPACTS OF THE PREFERRED ACTION

The effects of the preferred plan are summarized in table EA-1.

A. Economic and Social Impacts of Preferred Action. The project is located in Jackson County, Iowa, approximately 10 miles south of the small community of Bellevue, Iowa. Population trends for Jackson County indicate a slight loss in population during the past 5 years. It is expected to remain stable through 1990 (see table EA-2).

TABLE EA-1

Effects of the Preferred
Plan on Natural and Cultural Resources

Types of Resources	Authorities	Measurement of Effects
Air quality	Clean Air Act, as amended (42 U.S.C. 1657h-7, et seq.)	No effect.
Areas of particular concern with the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451, et seq.)	Not present in planning area.
Endangered and threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531, et seq.)	No effect.
Fish and wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.)	Increased longevity and productivity of existing aquatic habitat due to decreased siltation and increased deepwater habitat.
Floodplains	Executive Order 11988, Flood Plain Management	No effect.
Historic and cultural properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. 470, et seq.)	No effect.
Prime and unique farmland	CEQ Memorandum of August 1, 1980; Analysis of Impacts on Prime or Unique Agricultural Land in Implementing the National Environmental Policy Act	Not present in planning area.
Water quality	Clean Water Act of 1977, as amended (33 U.S.C. 1251, et seq.)	There will be a temporary increase in turbidity associated with dredging and disposal. See Section 404(b)(1) Evaluation.
Wetland	Executive Order 11990, Protection of Wetlands, Clean Water Act of 1977, as amended (42 U.S.C. 1857h-7, et seq.)	Transformation of up to 90 acres of forested wetland to upland in dredged material disposal site(s).
Wild and scenic rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271, et seq.)	Not present in planning area.

TABLE EA-2

Population Trends for the Project Area, 1980 through 1990

	1980	1985	1990	Percent Change 1980-1985	Percent Change 1985-1990
City of Bellevue, IA	2,500	2,300	2,200	-8.7	-4.3
Jackson County, IA	22,500	22,300	22,300	-0.9	0.0
State of Iowa	2,913,800	2,905,400	2,913,500	-0.3	0.3

1. Community and Regional Growth. No short-term or long-term impacts to the growth of the entire community would be realized as a result of the project. Long-term impacts to the immediate project area would be more pronounced than impacts to the community as a whole. The project would indirectly improve recreational opportunities at the Brown's Lake complex, increasing the attractiveness of the area as a destination for recreationists interested in fishing or hunting. The addition or expansion of campgrounds or other types of development might occur as a result. No significant impacts to regional growth would be expected.

2. Displacement of People. No residential displacements would be necessitated by the proposed environmental enhancement project.

3. Community Cohesion. The project site is located in a rural surrounding, with limited residential development in the vicinity. The site currently draws a large number of recreationists; while the project might indirectly increase the number of recreationists visiting the Brown's Lake complex, this increase is not expected to adversely impact area residents or property owners. Due to the nature of the project and its limited area of influence, no significant impacts to community cohesion would be noticed.

4. Property Values and Tax Revenues. The potential value of property within the project area might increase slightly as a result of the proposed project. This land is federally owned, however, so an increase in its value would not increase local tax revenues. A small increase in boat ownership and purchases might result. Tax revenues would rise as an outcome of increased sales tax and increased boat, fishing, and hunting license fee revenues.

5. Public Facilities and Services. The project site is federally owned and zoned for low density recreation. The project would positively impact public facilities by enhancing fish and wildlife habitat and by improving conditions for recreational boating. If no action is taken, recreational opportunities at the Brown's Lake complex will be greatly reduced and a once-important fishery, migratory fowl, and furbearer area will be transformed into lowland brush habitat.

6. Life, Health, and Safety. Currently, the Brown's Lake complex poses no threat to life, health, or safety of recreationists or others in the area. The project would not affect current conditions regarding these areas of concern.

7. Employment and Labor Force. Construction of the proposed project would slightly impact short-term employment in the project area. Based on the scale of the project, Jackson County has a large enough labor pool to absorb project needs without noticeable impact. The project would not directly affect the permanent employment or labor force in Jackson County. Indirect impacts to long-term employment would be related to any future commercial development in the area (e.g., campground construction or expansion).

8. Business and Industrial Development. Changes in business and industrial activity during construction of the project would not be noticed. Long-term impacts to business and industrial development would be related to tourism and recreational activities. The project would require no business relocations.

9. Farm Displacement. No farms would be affected by the proposed environmental enhancement project, as the project site is located entirely on federally owned land.

10. Noise Levels. Heavy machinery would generate an increase in noise during construction. This increase would disturb users at the Brown's Lake complex. However, the project site is located in an area with limited residential or other types of development. No significant long-term noise impacts would result.

B. Economic and Social Impacts of Nonpreferred Alternative.

1. No Action Alternative. The socio-economic impacts associated with the No Action alternative would not greatly differ from existing conditions. Without Federal action, the existing fish and wildlife habitat in the Brown's Lake complex will be damaged by the ongoing siltation process. This siltation-related damage will turn the area into lowland brush habitat and indirectly impact public facilities by greatly reducing the recreational opportunities available at the lake. This decrease in recreation activity at the complex might result in overcrowding at other nearby hunting and fishing areas. While noise levels at the Brown's Lake complex would decrease, noise levels at the substitute recreation sites would increase in proportion to the increase in their attendance.

2. Nonpreferred Action Alternatives. Alternatives involving variations of the dredging plan of the Preferred Alternative have been proposed. Socio-economic impacts associated with these alternatives would be nearly identical to those resulting from the preferred alternative.

C. Natural Resource Impacts of Preferred Action.

1. Man-Made Resources. Dredging the section of inlet channel which runs along the Green Island levee may result in a slight increase in water seepage through the levee. Soil borings indicate that this seepage would result in a negligible amount of water seepage into the levee district during flooding or loss of controlled water level during prolonged low river stages.

2. Natural Resources. The majority of project impacts revolve around the placement of dredged material fill or low quality bottomland hardwoods. As with most projects, there is a tradeoff of one type of resource (natural or man-made) for another. In this project, the tradeoff is the immediate loss of up to 50 acres of bottomland forest in return for improved aquatic habitat and establishment of upland type mast-producing trees which are not presently abundant in the project area. The acreage of bottomland forest impacted by the project is shown below.

Project Feature	Acres of Bottomland Forest Impacted
Realigned Inlet Channel	2.5
Deflection Levee	13.8
Main Disposal Site (if entire site is used)	95.0
Alternative Disposal Site 1	61.0

In return for the loss of forest, the following surface area and quantity of dredged material will be affected.

Project Feature	Acreage	Cubic Yards Material
Channel Dredging (Recommended Plan)	25	370,000
Full Expansion Option	25 from above	370,000 from above
Lainsville Slough	35 additional	500,000 additional
Total	60	870,000

3. Water Quality. Construction of the deflection levee, water control structure, and selective dredging will improve water quality necessary for maintaining a healthy and productive aquatic habitat. Reduced sedimentation from the deflection levee will increase water clarity (reduced turbidity) which is beneficial to submergent vegetation, all aquatic organisms and some semi-aquatic animals which feed in the water (i.e., muskrats, kingfishers). Reduced sedimentation should improve fish reproduction and growth, and will prolong the productive life of the backwater lake complex.

Dredging will provide deepwater areas that are attractive to several fish species. Deep water offers refuge from stressful conditions that often occur in shallow water (i.e., low dissolved oxygen in fall and winter). At present, there are no deepwater areas in the Brown's Lake complex.

The dredged channel will also enhance the flow of oxygenated water from the main channel into the lake complex at a time when lake oxygen levels are usually low. Improved water quality will improve and prolong the area as a valuable feeding and resting area for migratory waterfowl.

There will be temporary negative impacts (i.e., increased turbidity) associated with dredging and disposal. These impacts are discussed in detail in the Section 404(b)(1) evaluation (appendix C).

4. Terrestrial Habitat. Dredged material disposal sites will be replanted with species that provide better wildlife food. Species such as oak, walnut, hickory, and pecan now are almost totally absent from the project area, and their presence will benefit several game and non-game species. These tree species currently do not exist in the project area except for one or two individuals due to the low elevation. The increased elevation also will provide refuge from floodwaters, and may provide some nesting habitat for ground-nesting waterfowl. Establishment of food-producing mast trees, however, will not provide any significant food source for at least 15 to 20 years.

5. Air Quality. No effect.

6. Endangered Species. Eagles use the entire Brown's Lake area at various times during winter. Casual observation indicates that no areas in particular are used for feeding or roosting. The increased water depth and improved fishery could, at a minimum, increase the attractiveness of the area to eagles. Based on this evaluation and the fact that no other endangered species are known to be present, the Corps believes that the project will have no effect on wintering bald eagles or any other endangered species.

7. Cultural Resources. No evidence for archeological, historical, or architectural resources was found in the National Register of Historic Places inventory, relevant literature, or site files held by the Office of the State Archeologist. The area, as described in the previous section, was probably utilized extensively by prehistoric peoples. However, the complex of shallow backwater lakes, sloughs, bottomland forest and wetlands was dynamic. Thus, due to changes in the environmental setting, prehistoric peoples probably limited their occupations to short-term extractive camps. That is, small, temporary camps were likely established to exploit the lush bottomland resource base (deer, waterfowl, fish, mussels, plants), but larger permanent villages were located elsewhere.

The following historic maps were examined:

1) GLO's
2) 1881 Mississippi River Commission Maps
3) 1929-1930 Brown's Survey Maps
4) 1940s Plane Table Maps
5) 1978 U.S.G.S. Topographic Map

Comparison of these maps led to several conclusions. Changes in landscape configuration over the past 150 years have been significant. Prehistoric landscapes/contexts appear to have been eroded or deeply buried, or both. Thus, specific project features should not affect significant archeological contexts. The changes in water levels and the physiographic setting due to construction of the navigation system make it nearly impossible to begin any controlled search for remnants of prehistoric sites that may be present. Furthermore, no significant historic period remains or activities are documented for the Brown's Lake area.

VI. ENVIRONMENTAL IMPACTS OF NONPREFERRED ALTERNATIVES

A. No Action. As described in the Fish and Wildlife Coordination Act Report (appendix A) the following future without the project is likely to result:

> Without the proposed project, it is anticipated that sedimentation of this backwater complex will continue at a rate of 0.5 - 1.0 inch per year. Assuming the worst case condition (linear sedimentation and no reduction in sediment inputs), we would expect that the aquatic habitat would be converted to terrestrial habitat within 50 years. During this time, existing emergent wetland habitat would succeed to terrestrial habitat first as willows then to silver maples and cottonwoods. Additional wetlands and mudflats would be created annually which would also succeed to terrestrial habitat. Eventually, the area would be left with a few acres of wetland habitat associated with the Smith's Creek drainage.
>
> The current diversity of fish and wildlife would steadily decline until fish, waterfowl, and shorebird use would be almost nonexistent. Some fish species may use the area to spawn during high water periods; and perhaps, wood ducks would find some suitable nest cavities. Furbearer use would be minimal. On the other hand woodland wildlife species such as white-tailed deer, woodpeckers, and squirrels may increase.

Without the project there is little prospect for any increase in mast-producing species on the project site. Increased elevation from ongoing sedimentation, although enough to replace aquatic habitat, will not be enough to allow mast tree establishment through natural succession. This prediction is supported by the poor reproduction exhibited in most of the few remaining stands in the UMR bottomland. Mature trees are able to withstand moderately long periods of inundation, but very young seedlings cannot. Because of this, most mast trees in existing stands were already well established before the construction of the 9-foot channel project.

B. Full Expansion Plan. Effects of the full expansion plan shown in plate 3 would be essentially the same as the basic plan. There would be increased deepwater habitat for fishes, etc. The plan would not, however, provide any additional flow of water from the main channel or decrease sedimentation. On the negative side, additional woodland would be cleared for a larger disposal site of approximately 95 acres. Dredging the upstream portion of Upper Brown's Lake is likely to be ineffective because of the higher water content of the sediment. It may result in such severe slumping of the dredge cut that the actual increased depth may be less than one-third of the 9-foot cut. The layout of the dredge cut was chosen to maximize aquatic habitat productivity. Other designs are unlikely to increase benefits unless additional material is removed.

The option of creating a new channel between the existing inlet channel and the upper end of Lower Brown's Lake was seriously considered in order to provide a wintertime flow of fresh water into the lake. This is a desirable feature for the same reasons that flow is being enhanced for Upper Brown's Lake. There are two reasons why this feature was not recommended. The first is the difficulty of regulating the diverging flow of water from the channel downstream of the proposed water control structure. In order to split the flow of water between the two lakes with any degree of control, an additional water control structure would be necessary. Also, the apportioning of the flow between the two lakes may decrease the flow to Upper Brown's Lake such that there is little fresh water entering the two lakes.

The second and more serious problem is the uncertainty of the resulting hydraulic conditions. The new channel could, under flood conditions, open a new avenue for suspended sediment, or possibly sediment scoured from the new channel, to fill in the proposed dredge cut planned for the area.

C. Alternate Deflection Levee Lengths and Heights. Extending the deflection levee across Lainsville Slough was considered in the hope of further decreasing sedimentation in the Brown's Lake complex. Further study indicated that this was unnecessary because the location and height of the dredged material disposal site also would act to deflect sediment-laden floodwaters. Extending the levee would require another substantial water control structure because of the large volume of flow into Lainsville Slough during certain time periods. A longer levee may also cause a loss of head in Upper Brown's Lake with a concurrent decrease in water surface area.

The IDNR evaluated the possibility of extending a levee. There are other problems such as: (1) the difficulty of providing sufficient water inflows and outflows; (2) insufficient water depths in winter such that fish within the levee could not escape; and (3) negative effects on the seasonal ingress and egress of fish.

Various heights for the deflection levee were considered. Any height lower than the Green Island Levee could create undesirable hydraulic effects and, thus, this option was rejected. Any higher elevation also could threaten the structural integrity of the Green Island Levee.

VII. PROBABLE ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The clearing of 50 acres of bottomland forest for the deflection levee, realigned inlet channel, and disposal area is unavoidable. Temporary increases in turbidity during dredging also are unavoidable.

No significant historical, archeological, or architectural resources are known to be present in the project area. Archival and mapping studies have shown that landscape changes in the past 150 years have either eroded or buried (deeply) any remnant prehistoric or early historic contexts that may have been present. A field check by Corps staff, using silt probes and shovel tests, confirmed the fact that only fairly recent landscape features are present. Therefore, the project will have No Effect on significant cultural resources.

VIII. RELATIONSHIP BETWEEN SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The purpose of this project is to enhance and prolong the productivity of the aquatic and terrestrial habitat of the Brown's Lake complex. As a result of the project, both short-term and long-term productivity of the aquatic habitat will benefit. Short-term productivity of the forest land to be cleared will be sacrificed in exchange for long-range benefits from increased mast tree production on the disposal site. It will probably be a minimum of 20 years after planting before mast trees begin to produce enough food to significantly affect wildlife. The increased elevation will provide immediate benefits as a refuge from floodwaters.

IX. ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES WHICH WOULD BE INVOLVED IF THE PROPOSED PROJECT WERE IMPLEMENTED

Aside from the commitment of funds, labor, and construction materials, there will be no permanent loss of natural resources except for the 12 acres of forest replaced by the deflection levee.

X. RELATIONSHIP OF THE PROPOSED PROJECT TO LAND-USE PLANS

The present land use of the entire project area is the management of fish and wildlife resources. This project is compatible with this land use and is designed to enhance and promote these land-use plans.

XI. COMPLIANCE WITH ENVIRONMENTAL QUALITY STATUTES

The proposed project complies with all applicable regulations listed in table EA-3.

TABLE EA-3

Compliance of the Preferred Plan and WRC-Designated Environmental Statutes

Federal Policies	Compliance
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Full compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full compliance
Clean Water Act (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.	Full compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Estuary Protection Act, 16 U.S.C. 1221, et seq.	Not applicable
Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Full compliance
Land and Water Conservation Fund Act, 16 U.S.C. 1401, et seq.	Full compliance
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Full compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full compliance
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Not applicable

XII. COORDINATION

Extensive coordination has been maintained throughout this project with several State and Federal agencies. The following agencies have been actively involved in designing and planning the project:

Iowa Department of Natural Resources
U.S. Fish and Wildlife Service
U.S. Soil Conservation Service
Iowa State Historic Preservation Office (SHPO)

A report of the results of the cultural resources investigation conducted by Corps staff in December of 1987 was reviewed by the Iowa SHPO. By letter dated January 13, 1987, the Iowa SHPO recommended project approval.

The U.S. Fish and Wildlife Service made several recommendations in their Fish and Wildife Coordination Act Report (appendix A).

These recommendations and the Corps' response are shown below.

FWS Recommendation	Corps Response
1. Include mast tree habitat at the dredged material disposal site.	1. Mast tree development has been included in the project.
2. Include wetland habitat development in the dike excavation design.	2. Where possible and depending upon the equipment used in construction, wetland development may be attempted. The high water table (usually at or near the surface) makes this item difficult to implement.
3. Develop a habitat assessment plan to determine the relative benefits and success of the selected plan. (See appendix A for additional details.)	3. A Habitat Assessment Methodology is being developed for use on all EMP projects, but is not yet ready for field use. However, a habitat assessment of the project can be performed at some future date.
4. Complete a minimum of one year pre-construction data collection.	4. Data on the fishery resource of Brown's Lake is being gathered by the IDNR.
5. Complete a minimum of three years post-construction data collection.	5. It is anticipated that the IDNR and other EMP elements (the Long-Term Resource Monitoring Program) will collect such information. The Corps will also participate, as appropriate.

6. Complete a follow-up report addressing project objectives within five years of construction.	6. See response 5. above. The Corps will participate in the follow-up report, as appropriate.
7. Provisions should be made to monitor the engineered features of the selected plan... (see appendix A).	7. See response 5. above. The Corps will participate in project monitoring at a level not yet determined.
8. ... recommend that implementation of the erosion control measures in the Smith's Creek watershed be encouraged.	8. The feasibility of erosion control in the Smith's Creek watershed will be studied as a separate EMP project.

FINDING OF NO SIGNIFICANT IMPACT
FOR
BROWN'S LAKE HABITAT REHABILITATION AND ENHANCEMENT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

Having reviewed the information contained in this environmental assessment, I find that construction of the Brown's Lake Habitat Rehabilitation and Enhancement project will have no significant adverse impacts on the environment. This project is not a major Federal action and, therefore, preparation of an Environmental Impact Statement (EIS) is not required. This determination may be reevaluated if warranted by later developments. Factors that were considered in making this determination were:

1. The project will enhance and prolong the quality and quantity of aquatic habitat in the Brown's Lake complex.

2. Although there will be temporary and minor adverse impacts to water quality and bottomland forest, these resources will benefit in the long term.

Neil A. Smart
Colonel, U.S. Army
District Engineer

date 20 Nov 87

FISH AND WILDLIFE COORDINATION ACT REPORT

A P P E N D I X A

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ROCK ISLAND FIELD OFFICE (ES)
1830 Second Avenue, Second Floor
Rock Island, Illinois 61201

IN REPLY REFER TO:

COM: 309/793-5800
FTS: 386-5800

June 23, 1987

Colonel Neil A. Smart
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Smart:

The Fish and Wildlife Coordination Act (FWCA) Report for the Brown's Lake Habitat Rehabilitation and Enhancement Project is enclosed. It is submitted in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); the National Environmental Policy Act of 1969, as amended, and the Endangered Species Act of 1973, as amended. By copy of this letter, we are requesting that the Iowa Department of Natural Resources and the Illinois Department of Conservation comment to you directly.

You are reminded that this report does not fulfill the requirements of the National Wildlife Refuge System Administration Act of 1966 regarding compatibility determinations. However, we have coordinated this report with the Upper Mississippi River National Wildlife and Fish Refuge. The Refuge approves of the project at this stage of the planning process. The refuge manager must make a final compatibility determination before the final design is submitted for construction funding. Also at that time, the refuge manager must sign a letter of intent to take over the operation and maintenance of the completed facilities. These details should be addressed in the Definite Project Report.

We have been pleased with the extensive coordination on this project and look forward to it implementation. If you have any questions regarding the content of this report, call Gail Carmody or me.

Sincerely,

Richard C. Nelson
Field Supervisor

Fish and Wildlife Coordination Act Report

for

BROWN'S LAKE HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Prepared for:

U.S. Army Corps of Engineers
Rock Island District
Rock Island, Illinois

By:

Gail A. Carmody

U.S. Fish and Wildlife Service
1830 Second Avenue
Rock Island, Illinois 61201

June 1987

Table of Contents

INTRODUCTION

The Brown's Lake project is a habitat rehabilitation and enhancement project of the Upper Mississippi River System Environmental Management Program (UMRS-EMP) and is being conducted under the authority of the Upper Mississippi River Management Act of 1986 (Section 1103 of P.L. 99-662)

PROJECT AREA AND FISH AND WILDLIFE MANAGEMENT OBJECTIVES

The project area is between Upper Mississippi River miles 544.0 and 546.0 in Jackson County, Iowa (Figure 1). Most of the area is included in the Upper Mississippi River National Wildlife and Fish Refuge. Introduction of suspended sediments by UMR flooding and from the Smith's Creek watershed has severely reduced the water quality of this backwater area. In addition, the resulting sedimentation has reduced and degraded aquatic habitat. Correspondingly, fish and wildlife use of the project area has declined.

Fish and Wildlife Management

There is no active habitat management in the project area. The Fish and Wildlife Interagency Committee has identified the following potential fish and wildlife management objectives for the Brown's Lake backwater complex:

1. To reduce the adverse impact of sedimentation and turbidity.
2. To eliminate or reduce the adverse impacts of water quality degradation.
3. To maintain or improve the habitat of migratory birds.
4. To maintain and enhance the habitat for fish.
5. To maintain and enhance the habitat of other aquatic life.
6. To increase critical fish wintering, spawning, and nursery habitat.
7. To maintain and enhance habitat for furbearers.

Existing Conditions

The Brown's Lake project area (see figure 1) is composed of approximately 450 acres of aquatic backwater habitat, 190 acres of bottomland forest and 60 acres of palustrine emergent wetlands. The average depth of this backwater habitat is 1-2 feet. It has been significantly degraded due to sedimentation from the River and the Smith's Creek watershed. Fish spawning and rearing habitat have deteriorated. A 1979 fisheries survey conducted by the Iowa Conservation Commission (now Department of Natural Resources) documented a very diverse fish community of 39 different species. White crappie, black crappie, and bluegill are the major sport fish species in Upper and Lower Brown's Lake. Carp and buffalo are the major commercial fish species.

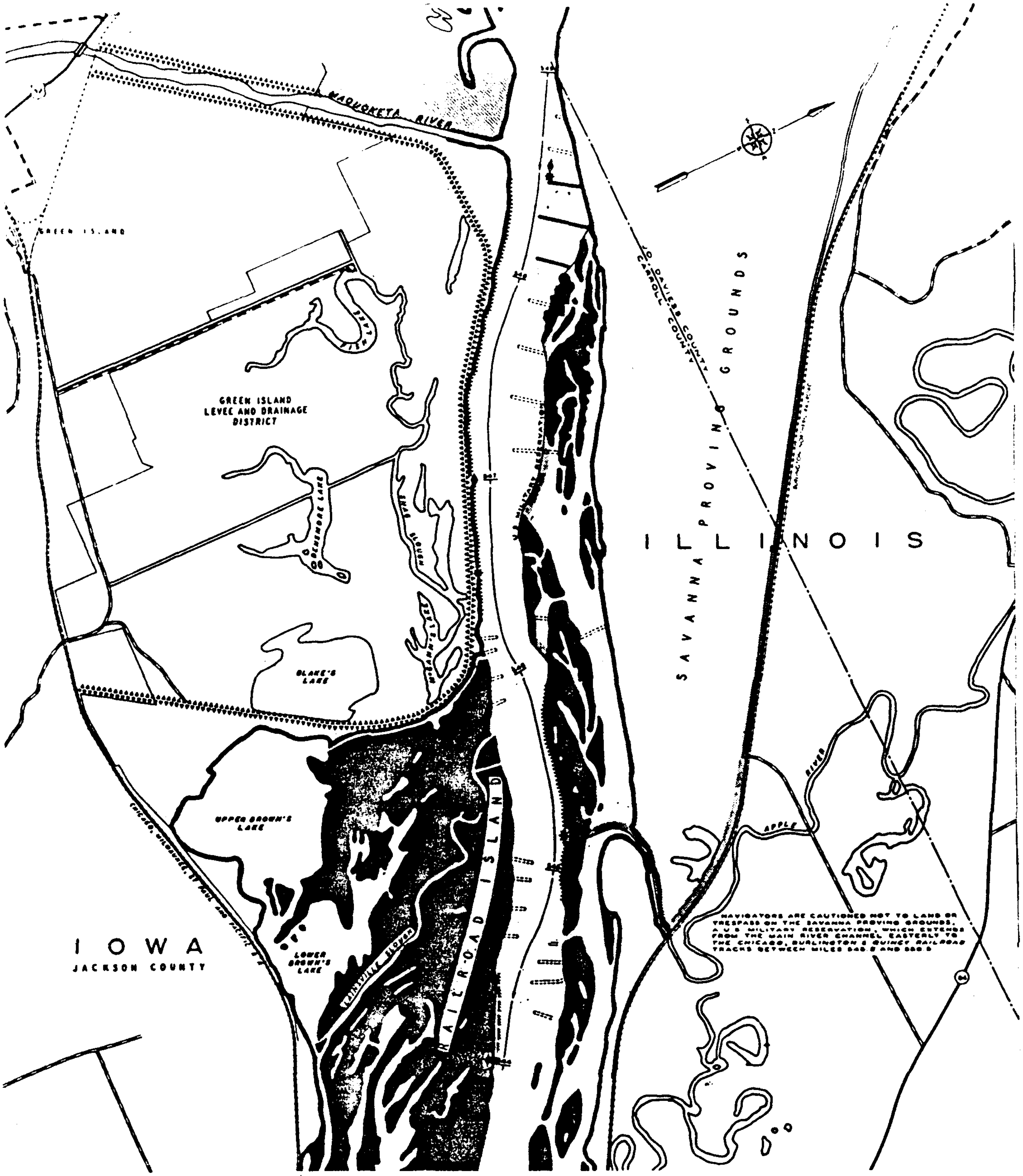


Figure 1. Project area of Brown's Lake habitat rehabilitation and enhancement.

The backwater complex also serves as an important resting area for fish, such as sauger, during periods of high current velocity in main channel and main channel border habitats.

The project area receives high migratory bird use which is enhanced by the proximity of the area to the Green Island Wildlife Management Area. Some of the deeper aquatic habitat supports submersed vegetation that is food for migratory diving ducks. The shallow areas are used extensively by dabbling ducks and shorebirds. Wood duck broods have also been noted in the area, although their exact nesting locations are unknown.

Furbearers use the Brown's Lake complex. Muskrat houses are common in the emergent wetland habitat of the project area. Mink, raccoon, fox, opossum, beaver and skunk use the area to a lesser extent. Although there are no documented sightings of the river otter, an Iowa threatened species, otter tracks have been observed in the Brown's Lake complex.

Future Without the Project

Without the proposed project, it is anticipated that sedimentation of this backwater complex will continue at a rate of 0.5 - 1.0 inch per year. Assuming a worst case condition (linear sedimentation and no reduction in sediment inputs), we would expect that the aquatic habitat would be converted to terrestrial habitat within 50 years. During this time, existing emergent wetland habitat would succeed to terrestrial habitat: first, as willows, then to silver maples and cottonwoods. Additional wetlands and mudflats would be created annually which would also succeed to terrestrial habitat. Eventually, the area would be left with a few acres of wetland habitat associated with the Smith's Creek drainage.

The current diversity of fish and wildlife would steadily decline until fish, waterfowl, and shorebird use would be almost nonexistent. Some fish species would use the area to spawn during high water periods; and perhaps, wood ducks would find suitable nest cavities. Furbearer use would be minimal. On the other hand, woodland wildlife species such as white-tailed deer, raccoon, woodpeckers, and squirrels may increase.

DESCRIPTION OF SELECTED PLAN AND OTHER ALTERNATIVES

Selected Plan

Briefly, the selected plan consists of a deflection levee, water control structure, and dredged side channels and backwaters with associated terrestrial disposal areas (figures 2 and 3).

The objectives of this project are:

* Retard the loss of fish and wildlife aquatic habitats by reducing sedimentation in Upper Brown's Lake and Lower Brown's Lake.

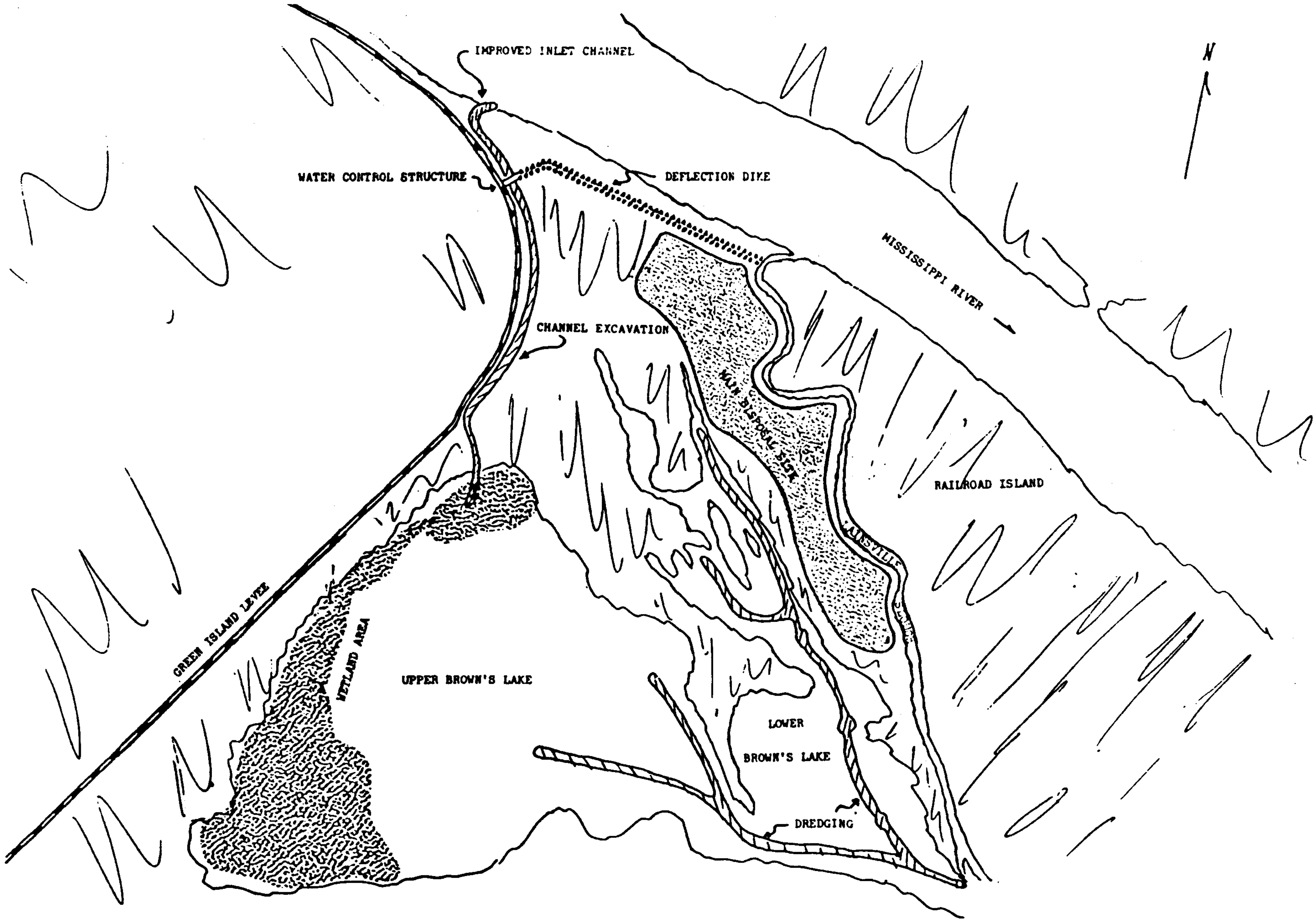
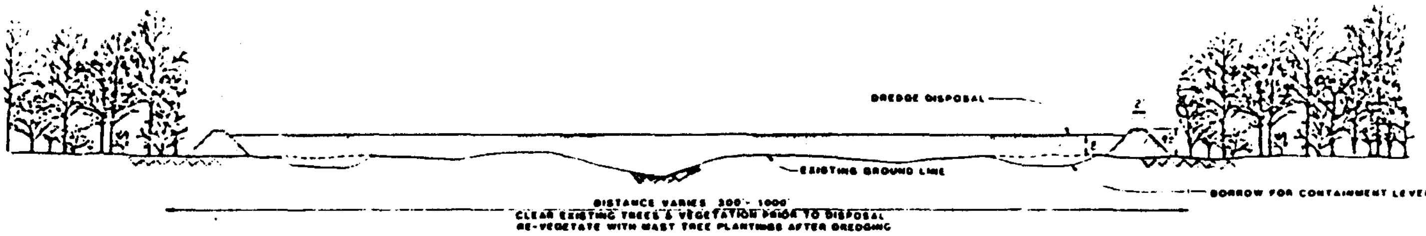
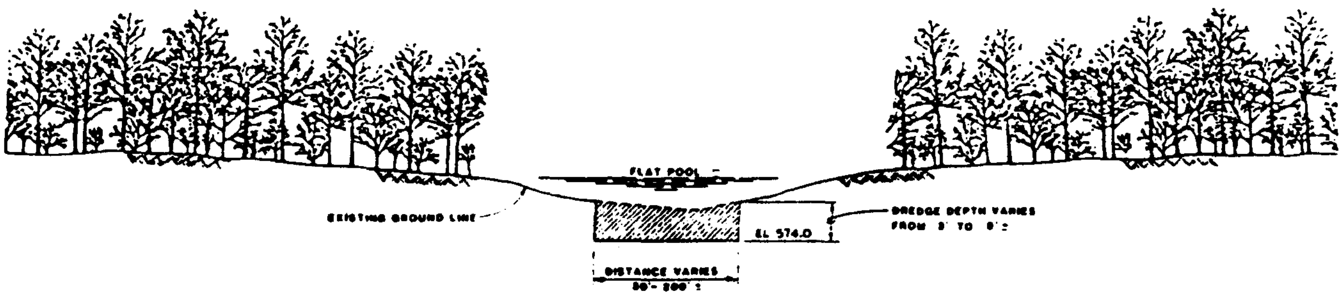


Figure 2. Selected plan for habitat rehabilitation and enhancement of Brown's Lake, Pool 13.

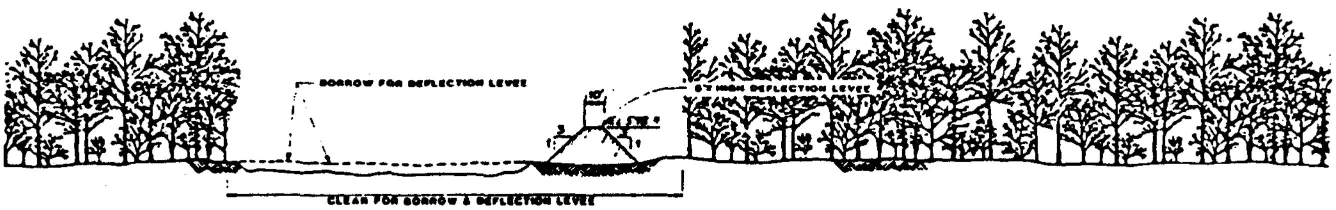


TERRESTRIAL DREDGED MATERIAL DISPOSAL

TYPICAL SECTION



LAKE DREDGING, TYPICAL SECTION



DEFLECTION LEVEE

Figure 3. Typical sections of selected plan for rehabilitation and enhancement of Brown's Lake, Pool 13.

* Improve water quality of Upper Brown's Lake and Lower Brown's Lake by decreasing suspended sediment concentrations and increasing winter dissolved oxygen concentrations.

* Increase aquatic habitat and diversity in Upper Brown's Lake and Lower Brown's Lake by dredging terrestrial habitat.

* Increase fish habitat quality and diversity by providing varied water depths.

* Increase critical overwintering habitat available to fishes by providing deeper and well oxygenated water areas.

* Increase bottomland hardwood diversity by increasing its elevation and reducing the frequency of flooding.

The description and purpose of each of the features of the selected plan are:

1. Deflection levee: the levee will be approximately 8 feet high and will extend from the Green Island levee to Lainesville Slough. It will be the same height as the Green Island levee and will shunt flood flows and suspended sediments (up to the 50 year event) away from the Brown's Lake complex. Flood waters will be forced to enter from the lower end of the complex or to filter across existing bottomland hardwoods. The levee will require clearing a 200 feet band along the alignment (14 acres). Construction material will be borrowed from within this zone. Riprap will be placed on the downstream end of the levee and when completed it will be seeded with native grasses.

2. Water control structure: this structure will be composed of four five-foot gated box culverts. It will allow river water to flow into Upper Brown's Lake during periods of low suspended sediment concentrations. This added flow will improve dissolved oxygen levels in the backwater complex.

3. Dredging: dredging will be accomplished as shown on figure 2 by hydraulic and/or mechanical dredge. Dredged channels will be 3-9 feet deep and 40-200 feet wide depending on location. Approximately 230,000 cubic yards of silts and clays will be dredged. The purpose of the dredging is to maintain a minimum water depth of 6 feet and to provide flowways to the backwater complex.

4. Dredged material disposal: Material excavated from the water control structure to Upper Brown's Lake will be deposited on the Green Island levee. The remainder of the dredged silts and clays will be deposited in a 60 acre bottomland forest site between the Lower Brown's Lake dredged channel and Lainesville Slough. The material will be contained by constructing 5-foot high containment dikes. Dike construction will require clearing a band 100 feet wide around a portion of the area. The disposal site will also serve to further shunt some flood flows away from Upper Brown's Lake.

Other Alternatives

During the course of project scoping, a number of alternatives for management of the fish and wildlife resources of the project area were discussed. These included alternative dredging configurations, alternative disposal sites, upland erosion control, increasing terrestrial elevations to enhance mast tree species, wetland development, and completely leveeing off the area. Specifically, the Corps of Engineers has identified an optional expanded plan for evaluation. This plan and the other alternatives are:

1. Expanded plan: this proposal is an expanded version of the selected plan (figure 3). Its objective is to increase deepwater fish habitat. It consists of dredging through Upper Brown's Lake to connect with the Lower Brown's Lake dredge cut. Dredging would also be done to connect to a natural spring in Upper Brown's Lake. Additionally, a channel would be excavated from the water control structure to the dredge cut in Lower Brown's Lake. This would provide a flow of water into the lower lake. Finally, the expanded plan includes dredging up to 1,000 feet of Lainesville Slough and an optional configuration of the inlet channel excavation. Up to 500,000 additional cubic yards would be dredged. Disposal would be either in the main disposal site or adjacent to Upper Brown's Lake.

2. Dredged material disposal at Smith's Creek: a disposal site at the mouth of Smiths Creek was considered, but this alternative was rejected due to the wetland impacts.

3. Upland erosion control: this proposal includes conservation measures to control erosion in the Smith's Creek watershed and to reduce sediment inputs to the Brown's Lake complex, most notably Upper Brown's Lake. This plan to being considered under a separate EMP proposal and will not be addressed here.

4. Mast and fruit tree production: this alternative consists of introducing mast and fruit tree seedlings to the area. This can be done in several ways. One is to clear several acres of bottomland forest in the main disposal area and raise the area's elevation 3-5 feet with dredged material. This increase should reduce frequent flooding and enhance the potential for successful growth of mast and fruit producing trees. Following disposal in the area, it would be planted with mast tree seedlings. A second alternative is to only plant the containment dike and cleared zone with seedlings following disposal.

5. Wetland development: this is an alternative to the design of the borrow sites for containment dike. It would increase available wetland habitat for migratory birds and fish cover and spawning. Rather than borrowing from the inside of the dike, borrow would be made outside of the dike. This can only be done where equipment can obtain access. If possible these borrow sites should be excavated to elevation 583 or less and should be connected to Lainesville Slough.

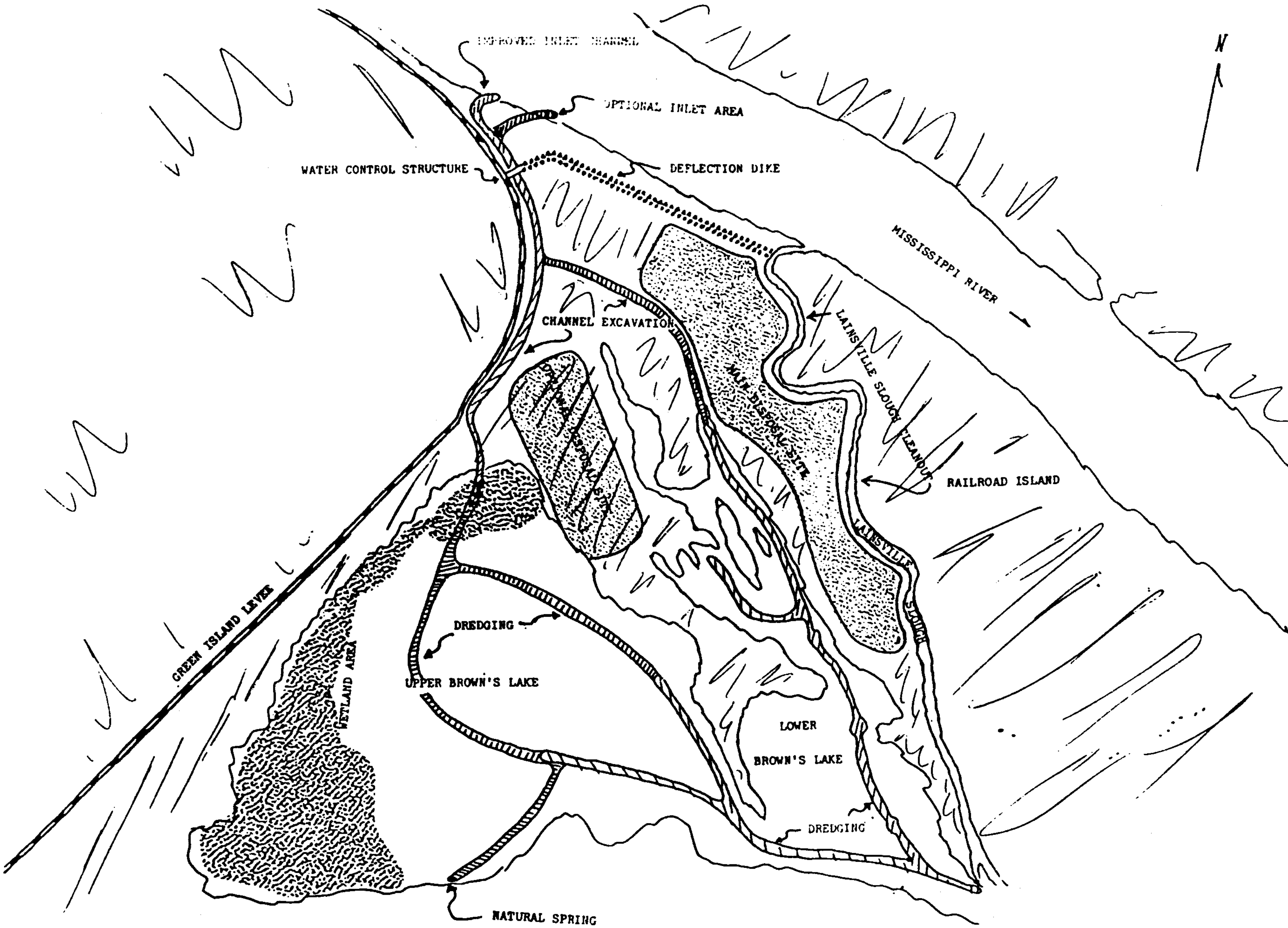


Figure 4. Expanded plan for habitat rehabilitation and enhancement of Brown's Lake, Pool 13

6. Complete levee: this alternative consists of extending the deflection levee along Lainesville Slough and connecting it with the railroad embankment with a water control structure. It would result in exclusion of most flood waters from the Brown's Lake backwater complex and further reduction in sedimentation and increased water quality. It would also allow for water level management within the area to enhance ~~fish and~~[1] waterfowl habitat.

7. Main Channel border dredging: material to construct the deflection levee could be obtained by dredging the main channel adjacent to the project site. This alternative was never seriously evaluated.

IMPACTS TO FISH AND WILDLIFE RESOURCES

As a habitat rehabilitation and enhancement project, the primary impacts of the selected plan and identified alternatives will be beneficial to fish and wildlife. However, with construction some adverse impacts are also likely to occur. Both positive and detrimental effects of the selected plan and possible alternatives are discussed below.

Impacts of Selected Plan

The primary benefit of the selected plan will be to reduce sedimentation in the Brown's Lake complex. Although some sedimentation will continue due to the Smith's Creek watershed drainage and high flood events, it is expected that most of the sediment now entering the Brown's Lake complex will be diverted downstream. This will result in increased water clarity and preservation of existing fish habitat. Improved water quality may allow for increased growth of aquatic vegetation that is valuable as food and cover for migratory birds and fish cover and spawning habitat. Reduction of the concentrations of suspended sediments will also benefit a number of fish species, such as black crappie, walleye and smallmouth bass, and may increase their use of the backwater complex.

The water control structure will allow for a continuous source of water to enter the backwater complex. This structure will be operated primarily to maintain desirable dissolved oxygen concentrations in the lakes during the critical months, thus increasing the suitability of fish habitat.

Dredging will increase aquatic habitat diversity by providing more varied and deeper water depths on approximately 25 acres. This is important in increasing fish diversity and providing fish overwintering areas. Deeper water combined with increased water clarity may also provide more available habitat for submersed aquatic vegetation important to diving ducks. Also, an increase in wetland habitat will benefit the river otter.

Benefits from the disposal of dredged material will result from increasing the elevation of up to 60 acres of bottomland forest, and reducing somewhat the frequency of flooding in the area. An increase in understory diversity may result, as well as the possible natural introduction of mast producing trees. Furthermore, the clearing necessary for dike construction and the

[1]Deletion per August 12, 1987, letter from Iowa Department of Natural Resources

dike itself will provide for increased edge within this bottomland forest. The increase edge accompanied with seeding of the dike to native grasses should result in increased songbird, reptile, invertebrate, furbearer and small mammal use of the area.

Adverse impacts that will result from the construction of the selected plan include loss of 14 acres of bottomland forest for the deflection levee, up to 23 acres of bottomland forest for the containment levee, and 12 acres of shallow aquatic habitat for the deep water dredging. All of these adverse impacts are outweighed by the potential benefits to be achieved by the selected plan.

Another unknown adverse impact may be the killing of trees within the disposal site. Death of these trees may result from the stress created by the saturated soil conditions that will exist within the disposal site. Although silver maple and cottonwood are relatively tolerant to flooding, loss would be anticipated if the saturated conditions last through the entire growing season. Hackberry trees in the area are not likely to survive, as extended flooding during the growing season usually results in significant mortality. Finally, the impact of diverting the suspended sediments downstream is unkown. Sedimentation in the Railroad Island backwater complex may increase.

<u>Impacts of Other Alternatives</u>

1. Expanded plan: the beneficial and adverse impacts of the expanded plan are the same as the selected plan except as noted here. Additional benefits will be realized by creating up to 20 acres of additional deepwater habitat in Upper Brown's Lake, 2 acres of channel excavation to Lower Brown's Lake, increasing bottomland forest diversity by another 40 acres, angling the inlet channel more downstream, and dredging Lainesville Slough. The increased dredging and channel excavation may help to ensure flow in Upper Brown's Lake, Lower Brown's Lake, and Lainesville Slough, further extending the benefits of increasing dissolved oxygen to this area. The optional inlet channel may further reduce the amount of suspended sediments entering the excavated channel. Connection of the dredge cuts to the natural spring will allow for warmer water to be introduced in the winter and cooler water in the summer. Both cases will benefit fish.

   Adverse impacts include the clearing required for containment dikes at the additional disposal site (13 acres). This disposal site is at a lower elevation than the selected plan disposal site. Its use may result in the filling of a few small wetlands and in the removal of flooded timber as available fish spawning habitat. An unknown adverse impact of the channel excavation may be the introduction of increased sedimentation in the northwest end of Lower Brown's Lake. This could be caused by either the flow from the water control structure or erosion of the excavated channel.

2. Dredged material disposal at Smith's Creek: Some benefits may be realized by increasing the elevation of the disposal site at the mouth of Smith's Creek and seeding the site in native grasses. However, this benefit does not outweigh the loss of wetland habitat important to migratory birds and fish.

3. Upland erosion control: not assessed in this report.

4. Mast and fruit tree production: the benefits of this alternative are increased diversity of the bottomland forest and increased food source for wood ducks, deer, raccoons, and squirrels. The loss of existing bottomland forest (cottonwood, silver, maple, and hackberry) habitat is outweighed by the potential benefits.

5. Wetland development: the benefits of this alternative is to increase the terrestrial and aquatic diversity in the project area. Fish, waterfowl, and shorebirds could be expected to use this habitat extensively. Optimistically, up to 10 acres of wetlands may be created by this borrow configuration. The adverse effect of the loss of existing bottomland forest would be offset by the higher overall value of wetland habitat.

6. Complete levee: the benefits of constructing a complete levee around the project area are decreasing sedimentation rates to protect existing aquatic habitat and water level control to enhance aquatic habitat. Additional benefits may be realized by planting the levee in native grasses and the increase in edge. Adverse effects that may be expected are loss of an additional 35 acres of bottomland forest, increased sedimentation in the Railroad Island backwaters, and possible prevention of fish movement into or out of the Brown's Lake backwater complex.

7. Main channel dredging: not assessed in this report.

ENDANGERED SPECIES

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Fish and Wildlife Service information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

Classification	Common Name	Scientific Name	Habitat
Endangered	Bald eagle	*Haliaeetus leucophalus*	wintering

The bald eagle winters along the Upper Mississippi River and is frequently seen in the project area. Eagles feed on open, ice free areas, perch in large riparian trees and roost in heavily forested, protected areas.

In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of a construction project that significantly affects the quality of the human environment, is required to conduct a biological assessment. The purpose of the assessment is to identify listed or proposed species likely to be adversely affected by its action, and to assist the Federal agency in making a decision as to whether consultation should be initiated.

RECOMMENDATIONS

We concur with the selected plan and have several recommendations regarding the final design, habitat assessment, and project monitoring.

Final Design

1. Include mast and fruit tree habitat development at the dredged material disposal site.

2. Include potential wetland habitat development in the dike excavation design.

Habitat Assessment

3. Develop a habitat assessment plan to determine the relative benefits and success of the selected plan. Data collection should focus on the objectives of this project and may include:

   - Sedimentation rates
   - Concentration of suspended sediments
   - Turbidity
   - Concentration of dissolved oxygen
   - Ambient velocities in the backwater at various river stages
   - Seasonal fish diversity and abundance
   - Winter fish use of the project area
   - Bird and small mammal diversity in bottomland forest habitats
   - Extent of submersed and emergent vegetation
   - Abundance of migratory waterfowl
   - Wood duck brood abundance
   - Furbearer abundance
   - Survival of bottomland forests in the disposal site
   - Survival of mast and fruit bearing trees and native grasses

   It is assumed that the habitat assessment will be conducted as a part of the Long-Term Resource Monitoring Program and will be consistent with assessments made for other projects.

4. Complete a minimum of one year pre-construction data collection.

5. Complete a minimum of three years post-construction data collection.

6. Complete a follow-up report addressing project objectives within five years of construction.

Project Monitoring

7. Provisions should be made to monitor the engineered features of the selected plan to determine their effectiveness relative to their stated purpose, and may include:

   - Sedimentation rates in the Brown's Lake complex and along the length of Lainesville Slough, and in the Railroad Island complex.

   - Scouring at the deflection levee, the containment dike, and Lainesville Slough

   - Flow relative to stage through the water control structure, the dredged side channel, and Lainesville Slough

   - Dissolved oxygen concentrations

   - Side sluffing of the dredged channels.

   - Bottomland forest survival relative to extent of flooding and disposal depths.

Overlap with the habitat assessment data collection is acknowledged. This engineering data is necessary to correct any design deficiencies in the selected plan, and will assist in better design of future projects.

Finally, we recommend that implementation of the erosion control measures in the Smith's Creek watershed be encouraged. This project is necessary in order to achieve the greatest fish and wildlife benefits in the Brown's Lake backwater complex.

CORRESPONDENCE

APPENDIX B

Iowa
State Historical Department

East 12th and Grand Avenue, Des Moines, Iowa 50319
(515) 281-5111

JAN 13 1987

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

RE: ENVIRONMENTAL MANAGEMENT PROGRAM FOR BROWN'S LAKE - JACKSON COUNTY

Dear Mr. Hanson:

Based on the information you provided, we find that there are no historic properties which might be affected by the proposed undertaking. Therefore, we recommend project approval.

However, if the proposed project work uncovers an item or items which might be of archeological, historical or architectural interest, or if important new archeological, historical or architectural data come to light in the project area, you should make reasonable efforts to avoid or minimize harm to the property until the significance of the discovery can be determined.

Should you have any questions or if we can be of further assistance to you, please contact Dr. Kay Simpson, Archeological Surveys, at 515-281-8744 or Mr. Ralph Christian, Architectural Surveys, at 515-281-8697.

Sincerely,

Carol L. Ulch

Dr. Carol L. Ulch
Deputy State Historic Preservation Officer

/md

August 27, 1987

Doyle W. McCully, P.E.
Chief, Engineering Division
Department of the Army
Rock Island District Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

SUBJECT: 401 Certification Request
Brown's Lake EMP Project
Upper Mississippi River Mile 545.8 (Jackson County)

Dear Mr. McCully:

The Water Quality Planning Section of this Department has reviewed the application (and supporting water quality data and draft project report) for State certification under Section 401 of the Clean Water Act. Section 401 Certification is this Department's finding that the proposed project will comply with Iowa Water Quality Standards.

Project Description

The project consists of the construction of an eight foot high deflection levee between the Green Island Levee and Lainesville Slough. The levee requires about 14 acres clearing of vegetation for construction. A series of four gated box culverts will also be placed for flow control purposes. Finally, a combination of hydraulic and mechanical (clamshell or dragline) dredging of nearly 370,000 cubic yards of silts and clay materials will be conducted within the backwater lake system. Material excavated from the water control structure to Upper Brown's Lake will be placed on the Green Island Levee. The remainder of the project dredged material is to be placed in a 60 acre bottomland hardwood site between the Lower Brown's Lake dredged channel and Lainesville Slough. The material will be kept in place by constructing five foot high containment basins.

Project Evaluation

There will be temporary negative impacts arising from dredging and spoil placement.

Elutriate tests show that total suspended solids will be 5 to 10 times greater than background levels, and summer NH_3-N levels will be slightly exceeded. The disposal site will consist of multiple cells so that turbidity is minimized. Effluent from the hydraulic dredging will be discharged to Lainesville Slough; there will essentially be no mixing zone for the effluent. These temporary disturbances are considered relatively minor in scope (and allowable) considering that the long term impact of the EMP project will be to decrease sediment influx to the system, increase dissolved oxygen levels, and facilitate improved fish and wildlife habitat.

Agency Action

This letter certifies, subject to the following conditions, that the DNR has determined that this project will be in substantial compliance with Water Quality Standards of the State of Iowa.

Conditions:

A. The final design must utilize a two-cell disposal area. One cell is to be used for immediate effluent containment at the time the other cell is settling and consolidating material. Required total detention time is a minimum of 14 hours with the objective that an increased detention time be achieved if possible during the dredging period.

B. The dredge disposal site is to be planted with swamp white oak, pin oak, northern pecan, and shell bark hickory seedlings after material consolidation and drying.

C. Long term monitoring of sediment and dissolved oxygen ranges in the Brown's Lake/Lainesville Slough complex shall be conducted as specified under the terms of the Environmental Management Program in order to assess effects of the proposed project.

Sincerely,

Keith Bridson

KEITH BRIDSON, P.E., SUPERVISOR
WATER QUALITY PLANNING SECTION

KB/mjt/M2387MJT.17

cc: Darrell Hayes
David Claman
Kevin Szcodronski

CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

A P P E N D I X C

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-E

CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

BROWN'S LAKE HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

NOVEMBER 1987

CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

BROWN'S LAKE HABITAT REHABILITATION
AND ENHANCEMENT PROJECT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

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SECTION 404(b)(1) EVALUATION

BROWN'S LAKE HABITAT REHABILITATION
AND ENHANCEMENT PROJECT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

SECTION 1 - PROJECT DESCRIPTION

LOCATION

The project, which is located in Pool 13, Mississippi River, Jackson County, Iowa. is situated in a backwater lake complex between river miles 544.0 and 546.0 (plate 1).

GENERAL DESCRIPTION

BASIC DEVELOPMENT PLAN

The basic development plan consists of the construction of a deflection levee, a water control structure, a relocated inlet side channel, side channel excavation, lake dredging, and associated terrestrial dredged material disposal. These features are shown on plate 2.

The deflection levee would consist of an earthen embankment fill levee constructed to a 50-year flood frequency event. A water control structure would be located at the junction of the new deflection levee and the existing Green Island Levee. The purpose of the deflection levee and water control structure is to prevent sediment in Mississippi River floodwaters from entering Brown's Lake.

The existing inlet channel to Upper Brown's Lake would be relocated to prevent river debris and sediment from entering Upper Brown's Lake. Additional side channel excavation would be performed adjacent to the existing Green Island Levee to provide water with high dissolved oxygen from the river to Upper Brown's Lake. Material from this excavation would be placed on the river side of the Green Island Levee.

Lake dredging would be performed as shown on plate 2. Approximately 400,000 cubic yards of fine-grained sediments would be hydraulically and mechanically dredged from the lake and placed in a terrestrial disposal site. A 30- to 45-acre terrestrial disposal site would be ringed by a containment levee built from adjacent borrow. The disposal site would consist of two settling ponds that would allow discharge of dredged material into one pond while the other is settling out suspended solids. An approximately 50- to 100-foot zone of woodland around the containment pond would be cleared for borrow and levee purposes and would subsequently be used to plant seedling hardwoods. The interior of the disposal site would not be cleared.

A more precise description of project design information is contained in the Environmental Assessment (EA) and in the Definite Project Report (DPR).

AUTHORITY AND PURPOSE

The project is authorized by the FY 1985 Supplemental Appropriations Act (P.L. 99-88) and Section 1103 of the Water Resources Development Act of 1986 (P.L. 99-662). Their purpose is "to ensure the coordinated development and enhancement of the Upper Mississippi River System."

GENERAL DESCRIPTION OF FILL MATERIAL

Material for the deflection levee and disposal area berm will originate from bottomland soil located within the boundary of the dredged material disposal site shown in plate 4. Material will be excavated using earth-moving equipment such as scrapers. Material excavated from the realigned inlet channel will be used to fill the present inlet channel above the proposed water control structure. Under the Basic Plan, approximately 400,000 cubic yards of material dredged from Brown's Lake will be placed in the disposal site to a depth of 6 to 8 feet. Soil borings of sediments from Brown's Lake were taken in February and June 1987 (see plates 5 and 6). Analysis of sediments in Upper Brown's Lake (Boring B2) indicates the presence of organic fat clays with a high *in situ* water content. Borings B4 and B5 in Lower Brown's Lake indicate a much more stable soil with *in situ* water contents approaching original river alluvium.

The water control structure will be constructed of sheetpile and concrete and will consist of four gated 5-foot by 5-foot culverts.

DESCRIPTION OF PROPOSED DISCHARGE SITES

Water from the main river channel now flows into Brown's Lake through a shallow channel which runs parallel to the Green Island Levee (see plate 2). The water control structure will be placed in this channel, which is approximately 100 feet wide. The substrate in this channel is predominantly sand and silt. The site of the deflection levee and dredged material disposal site consists of young to mature stands of silver maple bottomland forest. Scattered throughout the forested site are several relict stream channels whose bottom elevations are above 583.0 feet. Except during flooding or heavy rain, these channels are dry.

Material excavated from the inlet channel will be placed directly on the adjacent Green Island Levee. The existing levee is an earthen levee which is frequently damaged by erosion from wave wash.

Effluent from the proposed disposal site will enter the main channel or Lainsville Slough. At normal water levels, water depth is less than 3 feet along most of its length, except immediately downstream of its entrance from the main river channel. Bottom substrate is primarily sand and silt. Streambanks are wooded and steep, with several floating debris piles and snags along their length. Fishery populations in the slough fluctuate according to water level and season.

SECTION 2 - FACTUAL DETERMINATIONS

PHYSICAL SUBSTRATE DETERMINATIONS

The proposed water control structure and deflection levee are designed to block the direct flow of silt-laden water into Brown's Lake. During spring flooding when floodwaters have a heavy silt load, the gates of the structure will be closed. Over the life of the project, this will decrease the amount of sediment that settles out in Brown's Lake. This structure, however, is unlikely to change the existing bottom substrate composition of the lake.

SEDIMENT TYPE

The water control structure will be constructed of concrete and steel. Temporary fill consisting of rock, sand, or soil also may be used during construction for a cofferdam.

The dredged material that will be placed along 2,500 feet of the Green Island Levee consists predominantly of silts and clays with some sand. A description of the sediment type is given in appendix C of the DPR.

Operation of the disposal site will cause the release of effluent into the main channel or Lainsville Slough and/or Lower Brown's Lake which will receive this effluent after a settling time sufficient to meet State water quality guidelines. The effluent is unlikely to cause any change in the substrates of the receiving waters. The disposal site will be constructed in two or more cells, with a water control structure of some type to allow maximum settling of fine-grained sediments.

DREDGED/FILL MATERIAL MOVEMENT

It is anticipated that material placed on the Green Island Levee will remain as placed. Material placed in the disposal containment site is also expected to remain as placed.

PHYSICAL EFFECTS ON BENTHOS

It is predicted that all fill, including disposal site effluent, will have no adverse effect on benthos.

WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS

WATER

Salinity - Not applicable.

Water Chemistry - Elutriate testing (results are shown in appendix B of the DPR) indicates that dredging may cause an increase in ammonia nitrogen, but this will be temporary.

Clarity - Turbidity may increase temporarily in both the waters being dredged and the effluent-receiving waters. Water clarity may be lowered (increased turbidity) for several weeks. Mechanical dredging of the inlet channel will cause the greatest increase in turbidity. Elutriate testing showed that total suspended solids was 5 to 10 times above background levels (see appendix B of the DPR). Effluent from the disposal site will enter either the main channel or Lainsville Slough which has a very low volume of flow at normal fall and summer water levels. There may be essentially no mixing zone for the effluent. Because of this, turbidity may exceed background levels at some times during discharge. In order to minimize turbidity, the disposal site will be constructed of two cells so that material can be allowed to settle for several hours before effluent is discharged.

Color - No change anticipated.

Odor - It is unlikely that any change in odor will occur, except temporarily near active dredging areas.

Taste - Not applicable.

Dissolved Gas Levels - There will be no permanent change in dissolved gases as a result of the fill. There may be a temporary decrease in some dissolved gases during dredging. Resuspension of sediments which have a high Sediment Oxygen Demand (SOD) could cause such a temporary decrease.

Nutrients - There will be no change in nutrient levels.

Eutrophication - The influx of large amounts of sediment to the lake will decrease. However, this is unlikely to cause any significant change to the rate of eutrophication for two reasons. First, Brown's Lake already has such a large reservoir of nutrients that the decrease in sediments will have no effect on productivity (in terms of nutrient limitations).

Actually, increased water clarity is likely to enhance submergent aquatic and planktonic species; hence, an increased BOD is possible. The second reason is that Smith's Creek will continue to supply an abundance of waterborn nutrients. Overall, the eutrophication rate will likely remain the same, even though the quality of the habitat will increase. Decreased sedimentation does not necessarily affect eutrophication.

CURRENT PATTERNS AND FLOW

The water control structure will prevent the unregulated flow of water from the main river channel into the Brown's Lake complex. During high flows, the gates will be closed and waters will be forced to back up into Brown's Lake from the lower end. It is anticipated that this will cause the settling of sediments in the bottomland forest on Railroad Island before they reach the backwater lakes. During late fall and winter, the gates will be open so that water may flow directly into the lake.

Velocity - Due to the presence of the water control structure and deflection levee, there may be an increase in water velocities in Lainsville Slough at certain river stages. How this would affect erosion, substrates, etc., in the slough is uncertain.

Stratification - Not applicable.

Hydrologic Regime - The overall hydrologic regime of the project area will be changed as described above. Essentially, high water flows will be prevented from directly entering the lake, while low-flow conditions will remain the same.

NORMAL WATER LEVEL FLUCTUATIONS

Any changes in normal water level fluctuations are predicted to be negligible.

Salinity Gradients - Not applicable.

ACTIONS THAT WILL BE TAKEN TO MINIMIZE IMPACTS

With regard to fill, no special actions are necessary to minimize impacts.

SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

EXPECTED CHANGES IN SUSPENDED PARTICULATES AND TURBIDITY LEVELS IN VICINITY OF THE DISPOSAL SITE

There will be increased turbidity in the lakes for several weeks when dredging is under way. Over the life of the project, suspended particulates and turbidity should decrease in the lake as discussed previously; suspended solids in Lainsville Slough may be above background levels at times during discharge.

EFFECTS ON CHEMICAL AND PHYSICAL PROPERTIES OF THE WATER COLUMN

Light Penetration - Following construction, light penetration should increase as a result of decreased turbidity. The increased light should enhance the establishment of submerged aquatic plants throughout the lake. There will be some temporary decreases in light penetration in Lainsville Slough when effluent is discharged.

Dissolved Oxygen (DO) - DO levels are expected to increase as a result of the project, but not due to any filling activities.

Toxic Metals and Organics - No temporary or long-term changes are expected.

Pathogens - No temporary or long-term changes are expected.

Aesthetics - Applicable fill will not adversely affect aesthetics. Over the long term, existing aesthetics will be preserved as a result of the project since the lakes will not fill in as quickly.

EFFECTS ON BIOTA

Primary Production - The improved water quality resulting from the project may increase aquatic productivity. Indirectly, the water control structure will improve productivity. Effluent from the disposal site will have no effect.

Suspension/Filter Feeders - Improved water quality should benefit all aquatic life.

Sight Feeders - Fish, in particular, will benefit.

CONTAMINANT DETERMINATIONS

Results of the elutriate testing indicate that no contaminants are present in the sediments except for a small amount of cyanide (see appendix B of the DPR). The cyanide concentrations observed were quite low, approaching the detection limits of the analytical method employed. At this level, it is not felt that any environmental hazard will exist, especially since the dredging will be of short duration as oppossed to a continuous discharge.

AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

EFFECTS ON PLANKTON

No adverse effects from fill; overall, the project's improved water quality should be a benefit.

EFFECTS ON BENTHOS - Same as above.

EFFECTS ON AQUATIC FOOD WEB - Same as above.

EFFECTS ON SPECIAL AQUATIC SITES

Refuges - The project is located in the Upper Mississippi River Wildlife and Fish Refuge and will be beneficial.

Wetlands - The project will improve the quality and productivity of all wetlands in the project.

Mudflats - The formation of new mudflat acreage due to current sedimentation rates should be slowed.

Vegetated Shallows - The succession of vegetated shallows to a more upland type habitat will be slowed.

THREATENED AND ENDANGERED SPECIES

The American bald eagle is the only federally endangered species known to frequent the site during the winter months. The project will have no effect on this species.

The project will have a beneficial effect on waterfowl and furbearers (i.e., beaver, muskrat, mink).

PROPOSED DISPOSAL SITE DETERMINATION

MIXING ZONE DETERMINATION

Effluent from the disposal site will enter Lainsville Slough and/or Lower Brown's Lake. It is anticipated that effluent may be above background levels at some times during discharge. At low water levels, there is relatively little flow through the slough. The mixing zone will be practically nonexistent.

DETERMINATION OF COMPLIANCE WITH APPLICABLE WATER QUALITY STANDARDS

Results of the elutriate testing indicate that effluent will be in compliance with State of Iowa water quality standards (see appendix B of the DPR). Testing did, however, indicate a slightly higher level of cyanide and copper for Class "B" standards.

No numerical standards exist for Total Suspended Solids (TSS). The State of Iowa has requested elutriate TSS results when reviewing data prior to issuance of a Section 404(t) permit. These data are then compared to ambient TSS values in order to determine if the return water will adversely affect water quality of the receiving body. Since it is impossible to determine what ambient TSS concentrations will be at the time of dredging, the impact of any return water cannot be accurately predicted. It should be noted, however, that the ambient level observed (8 mg/l) was very low, and it is reasonable to assume that the ambient level will be higher at the time of dredging.

POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

Municipal and Private Water Supply - No effect.

Recreational and Commercial Fisheries - These resources will improve significantly.

Water-Related Recreation - No effect.

Aesthetics - Existing aesthetics will be preserved.

DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

No cumulative effects on the environment are anticipated.

DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

The secondary effects on the aquatic ecosystem will consist of overall improved water quality and decreased sedimentation. This will result in a prolonged life for the backwater lakes and increased habitat quality and productivity.

FINDING OF COMPLIANCE
FOR
BROWN'S LAKE HABITAT REHABILITATION
AND ENHANCEMENT PROJECT
POOL 13, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

1. No significant adaptations of the Section 404(b)(1) guidelines were made for this evaluation.

2. Alternative designs for the water control structure, deflection levee, and disposal sites were evaluated in the Environmental Assessment and Definite Project Report. Extending the deflection levee across Lainsville Slough was considered, but was eliminated because of potentially undesirable hydraulic secondary impacts. Alternative disposal sites, such as the mouth of Smith's Creek, also were considered. The recommended site was chosen because it is located in poor quality woodland, as opposed to the palustrine wetland of the Smith's Creek site, and it also will aid in the diversion of silt-laden floodwaters from Brown's Lake.

3. Results of water quality testing indicate that State water quality standards would not be violated, with the exception of Total Suspended Solids (TSS). Effluent will be discharged into the main channel or Lainsville Slough where there will be little or no mixing zone and TSS may be 5 to 10 times above background. Testing also indicates that the ammonia nitrogen standard may be slightly exceeded during summer or fall dredging. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. Filling activities will not harm any endangered species or their critical habitat.

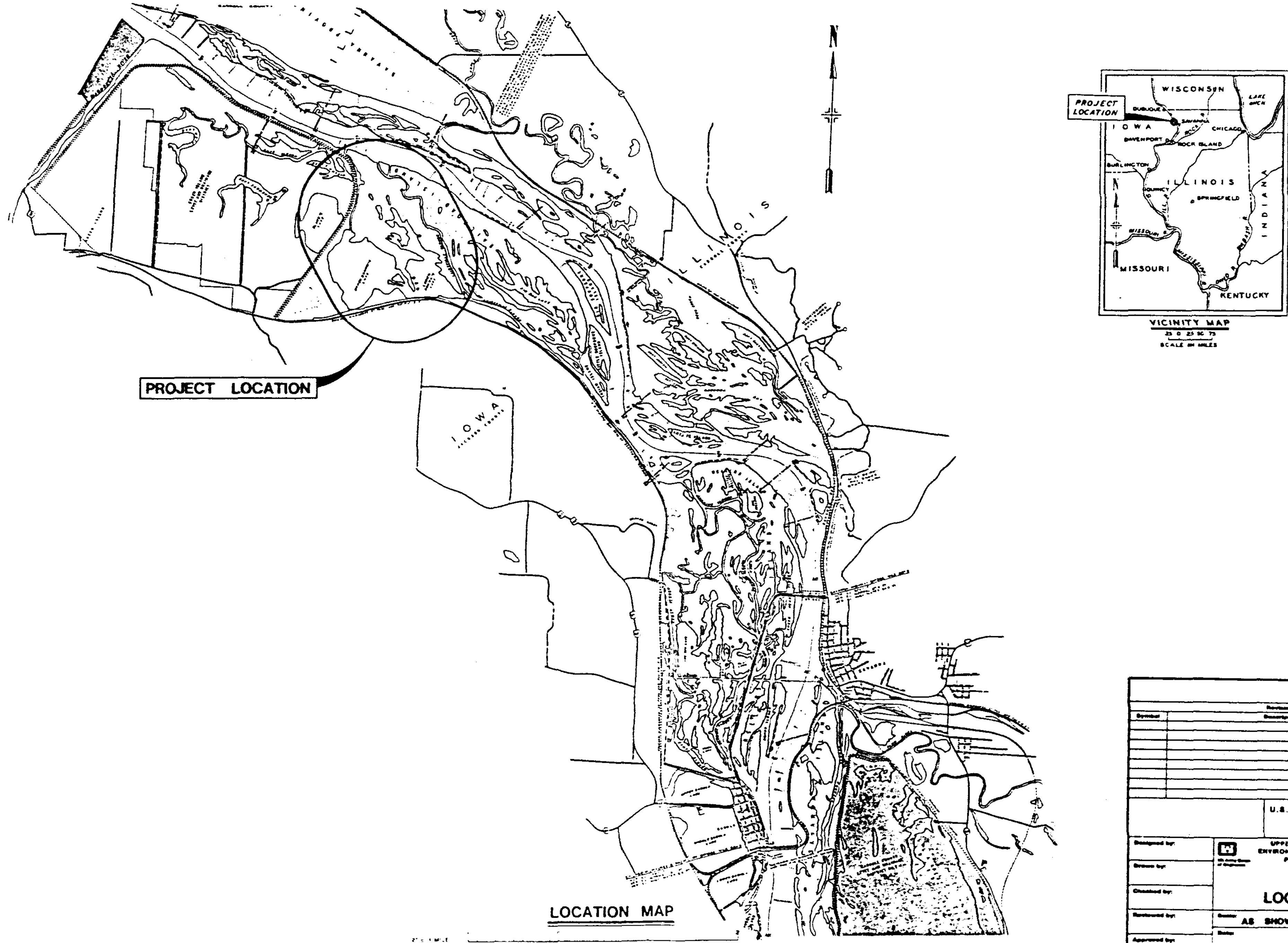
5. The proposed filling will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, and wildlife. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur.

6. The construction of a two-cell contained disposal site will allow maximum settling time to decrease suspended solids in disposal site effluent.

7. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as being in compliance with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

date 20 Nov 87

Neil A. Smart
Colonel, U.S. Army
District Engineer



LOCATION MAP

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 546.8

BROWN'S LAKE

LOCATION MAP

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Checked by:	
Reviewed by:	Scale: AS SHOWN
Approved by:	Date:
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Sheet _ of _

PLATE 1

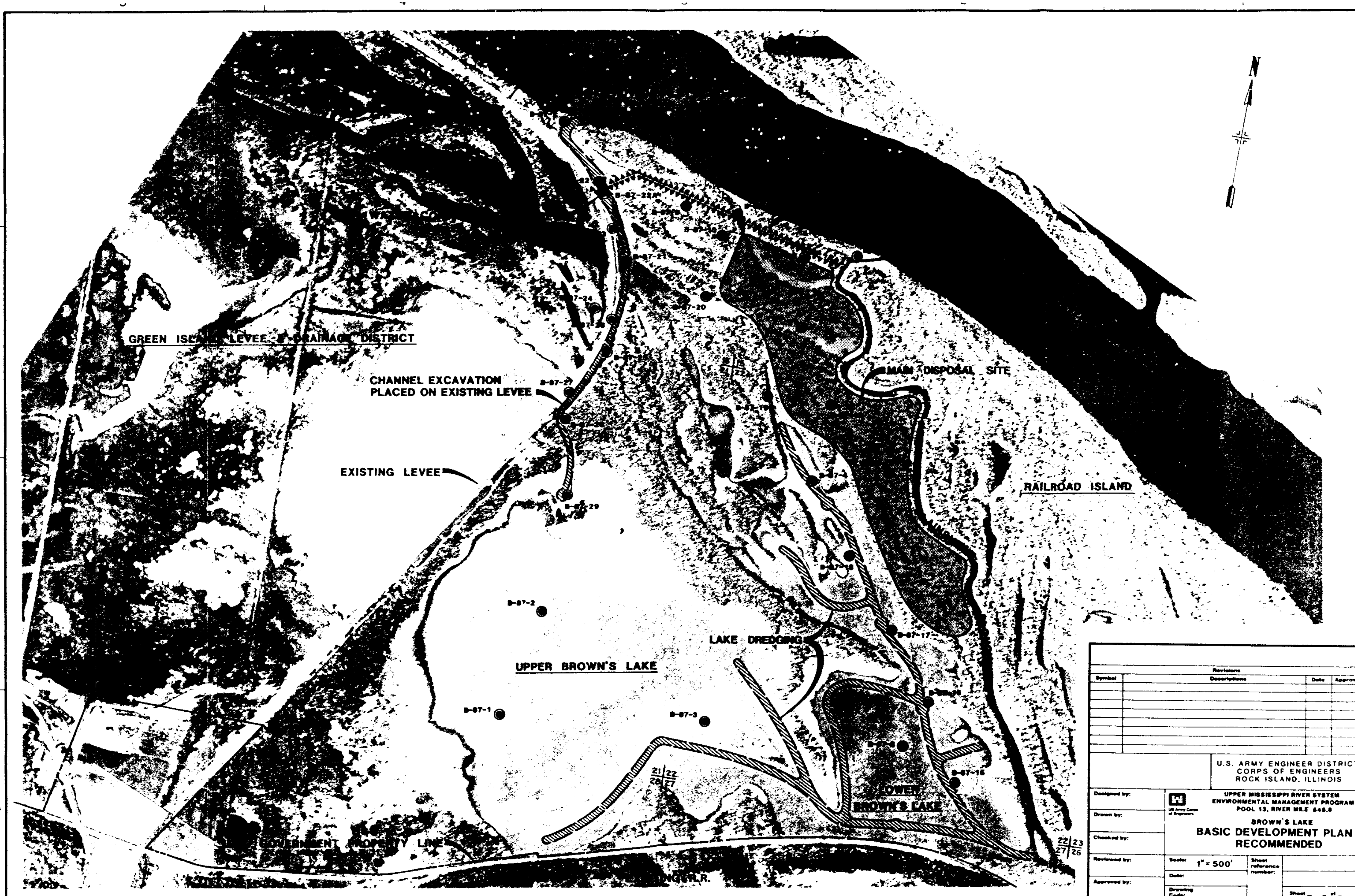
GREEN ISLAND LEVEE & DRAINAGE DISTRICT
CHANNEL EXCAVATION
PLACED ON EXISTING LEVEE
EXISTING LEVEE
MAIN DISPOSAL SITE
RAILROAD ISLAND
LAKE DREDGING
UPPER BROWN'S LAKE
LOWER BROWN'S LAKE
GOVERNMENT PROPERTY LINE
B-87-1
B-87-2
B-87-3
B-87-17
B-87-20
B-87-27
B-87-29
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Revisions
Symbol
Descriptions
Date
Approved
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
US Army Corps of Engineers
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 548.8
BROWN'S LAKE
BASIC DEVELOPMENT PLAN
RECOMMENDED
Scale: 1" = 500'
Date:
Drawing Code:
Sheet reference number:
Sheet _ _ of _

PLATE 2

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

US Army Corps of Engineers

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 548.8

BROWN'S LAKE

FULL EXPANSION PLAN

Designed by:
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Checked by:
Reviewed by:
Approved by:

Scale: 1" = 500'
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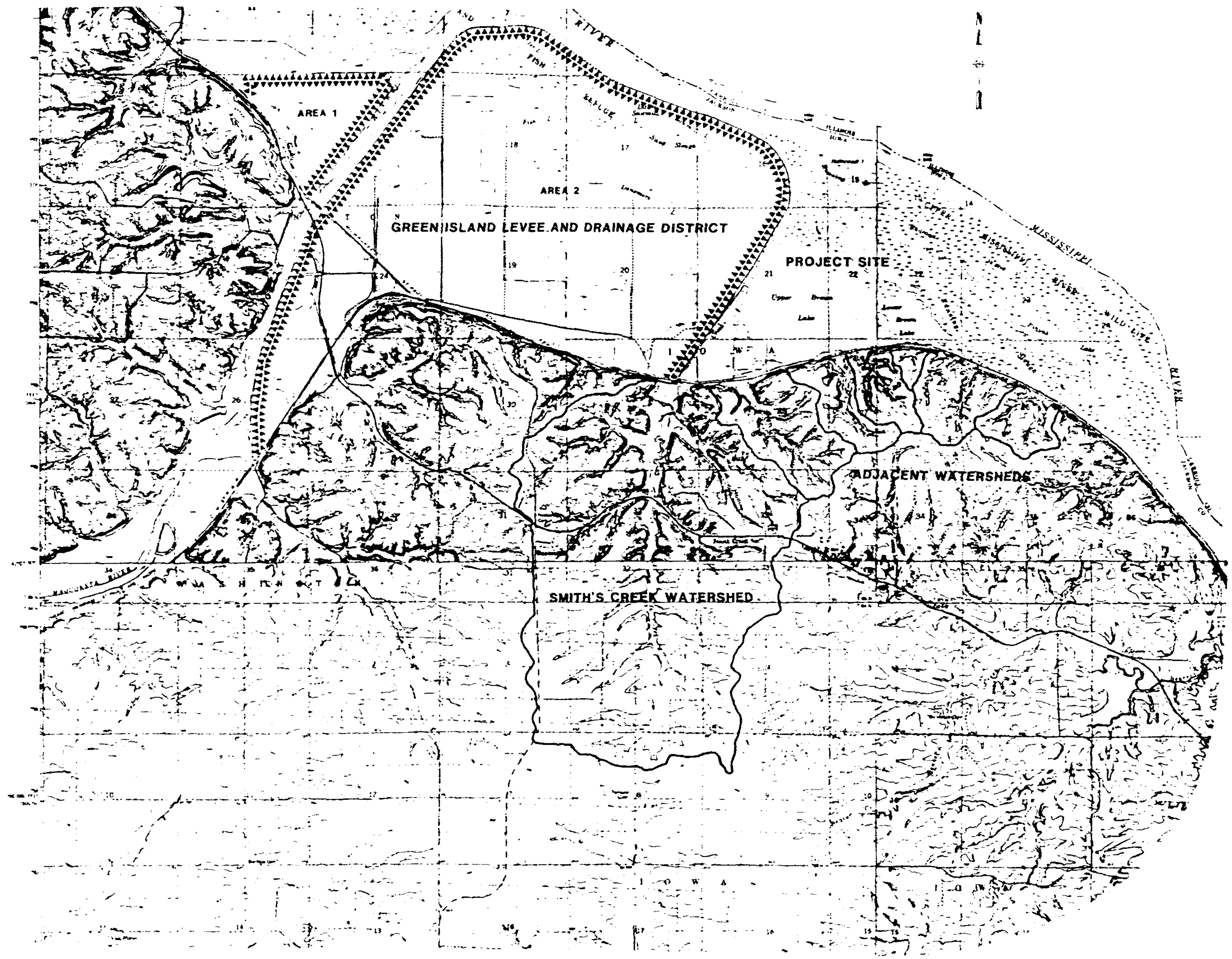
Sheet reference number:
Sheet _ _ of _

Revisions

Symbol	Descriptions	Date	Approved

PLATE 3



CONTRIBUTING WATERSHEDS

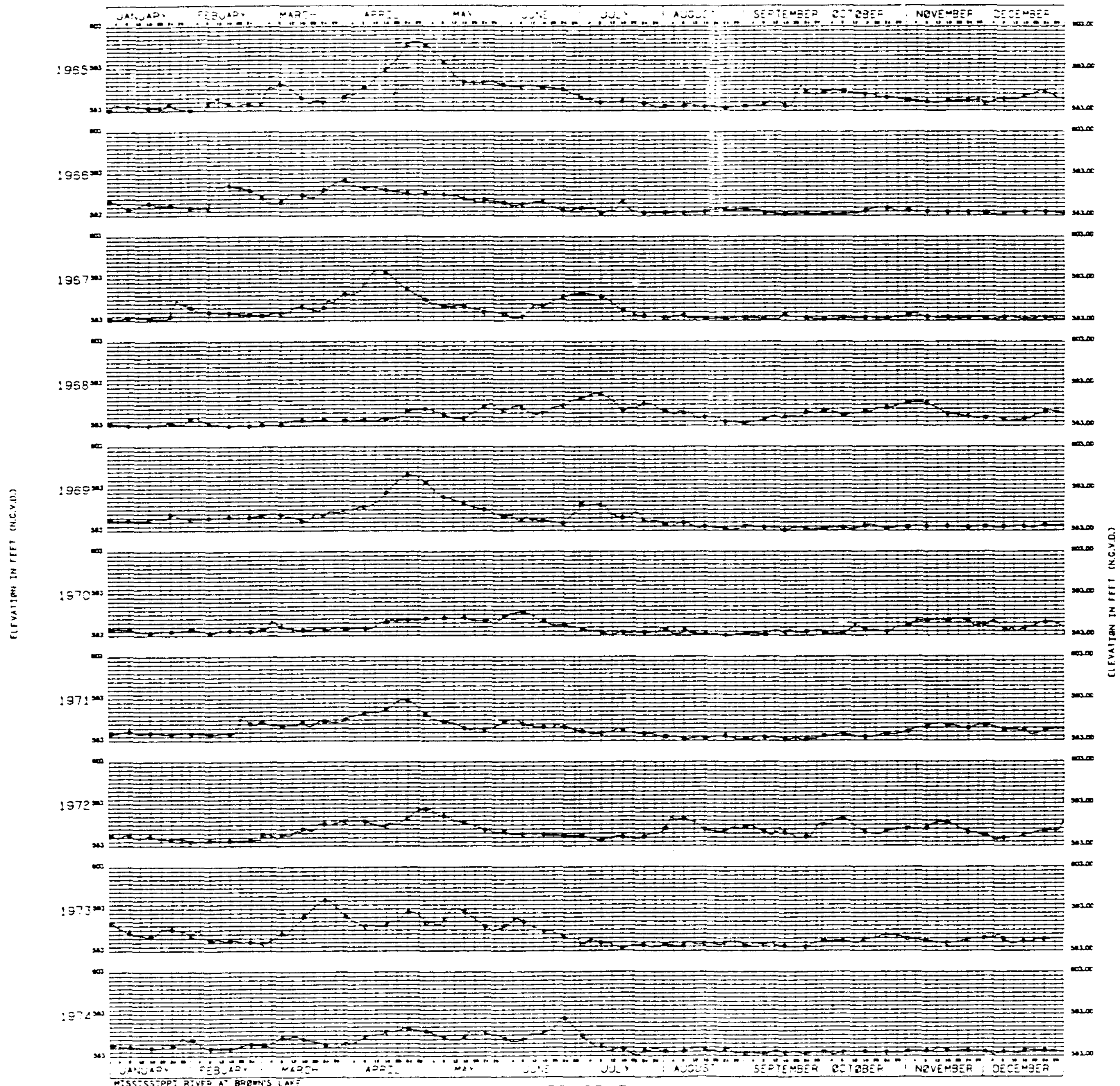
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 548.9

BROWN'S LAKE

CONTRIBUTING WATERSHEDS

Scale: AS SHOWN



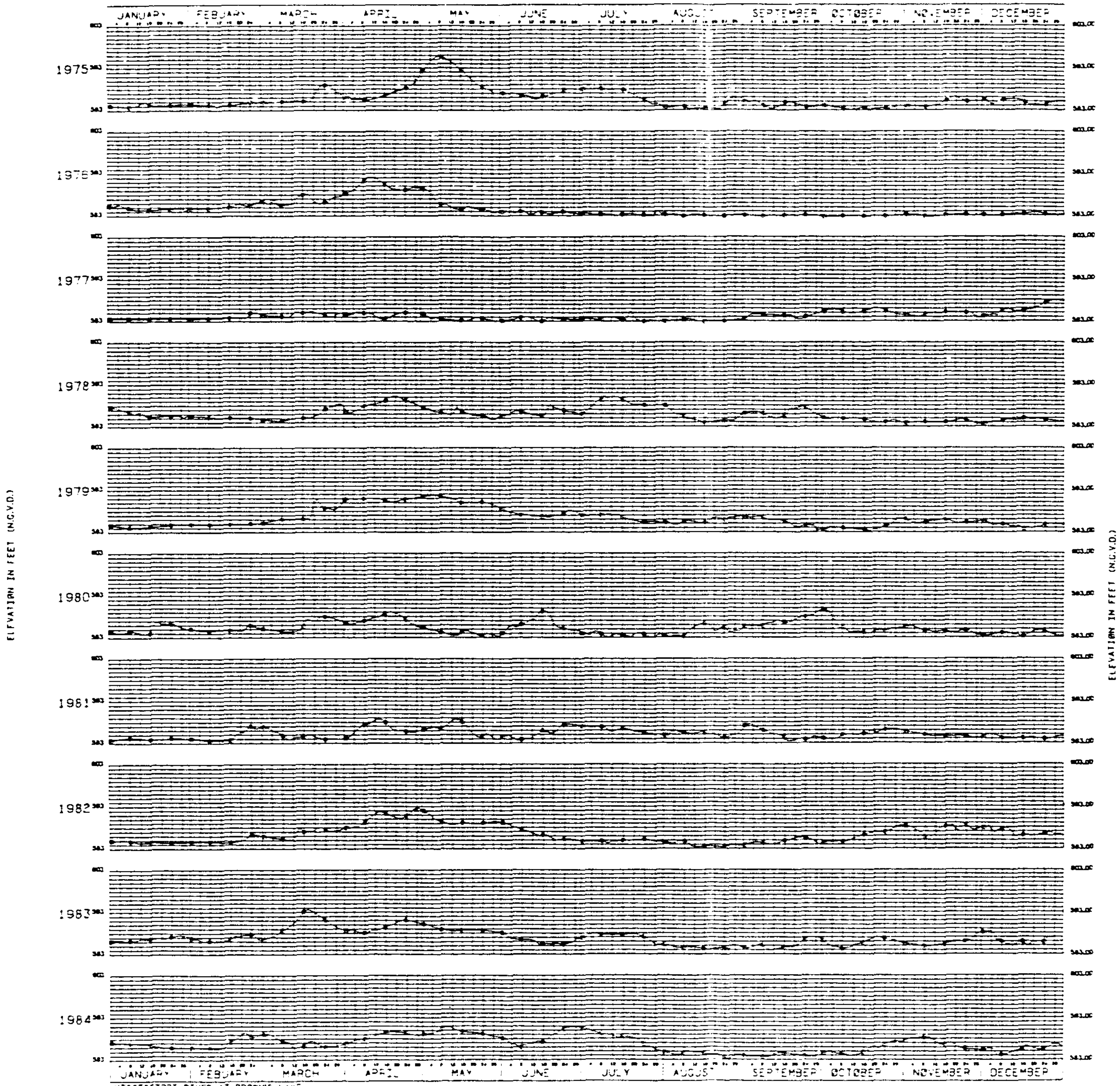
HYDROGRAPH - BROWN'S LAKE

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.9

BROWN'S LAKE

HYDRAULIC DATA I



NOTE-

HYDROGRAPH - BROWN'S LAKE

U.S. ARMY ENGINEER DISTRICT
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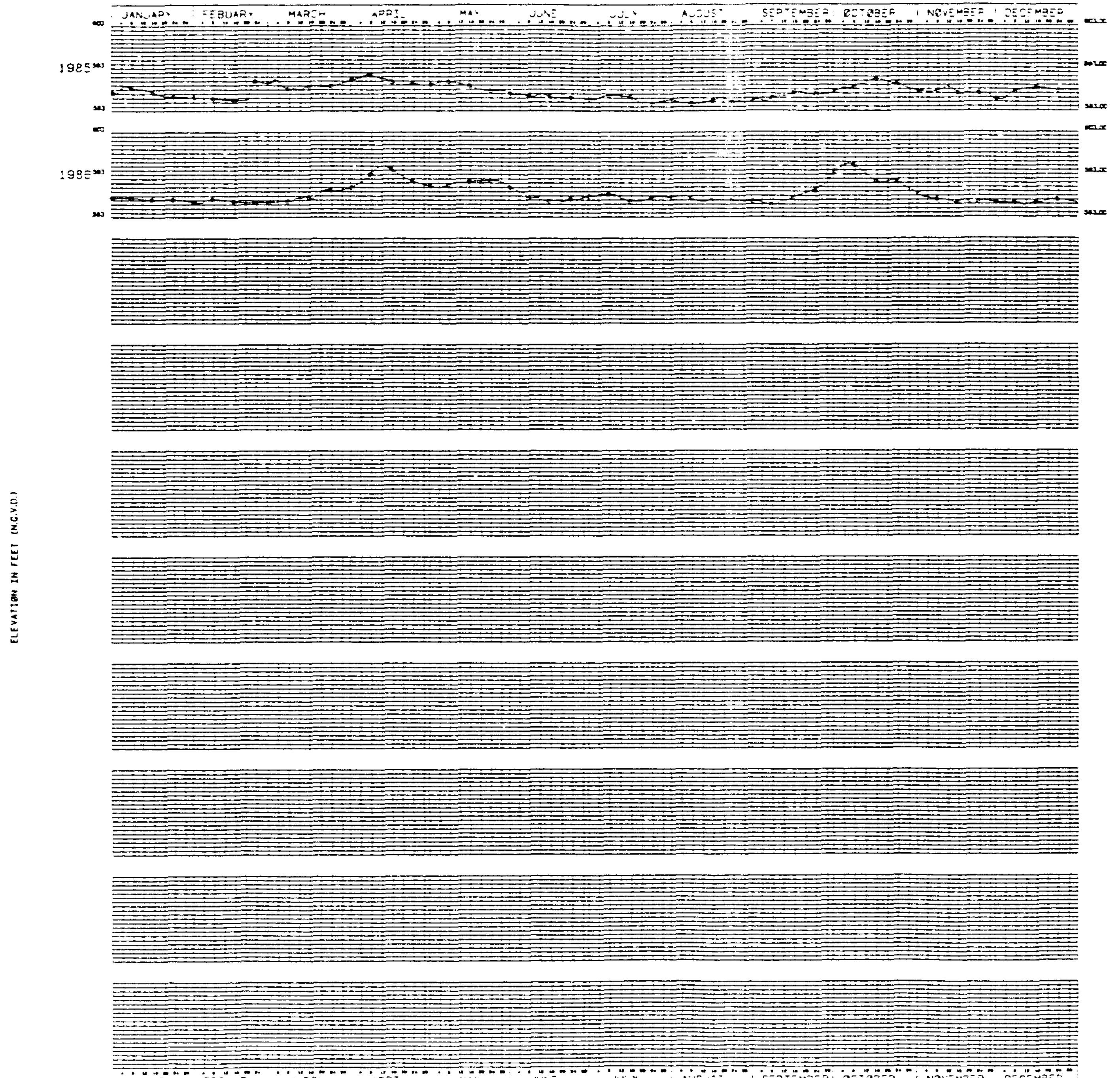
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.9

BROWN'S LAKE

HYDRAULIC DATA II

PLATE 6



MISSISSIPPI RIVER AT BROWN'S LAKE

NOTE:

HYDROGRAPH - BROWN'S LAKE

U.S. ARMY ENGINEER DISTRICT
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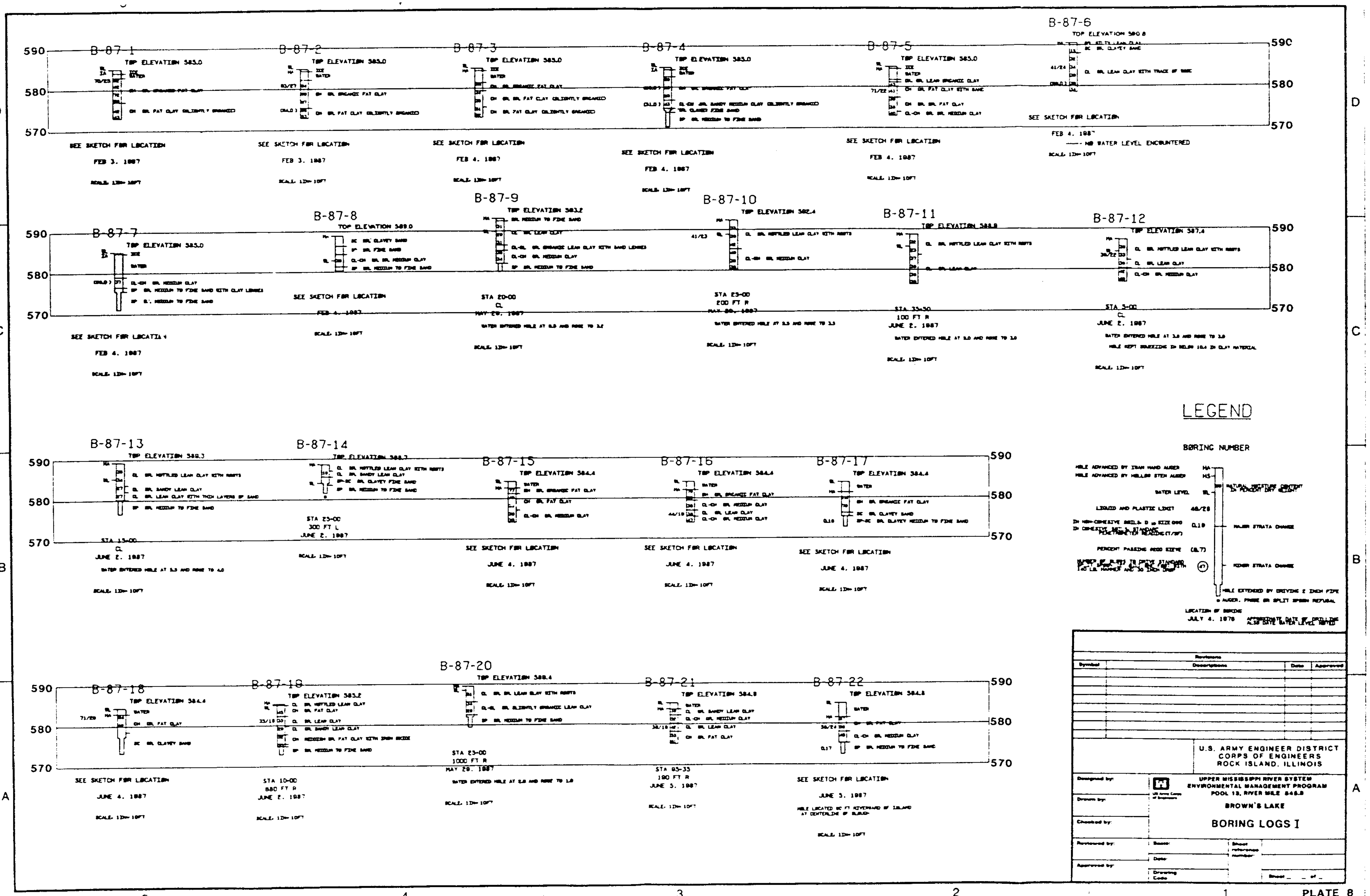
ROCK ISLAND, ILLINOIS

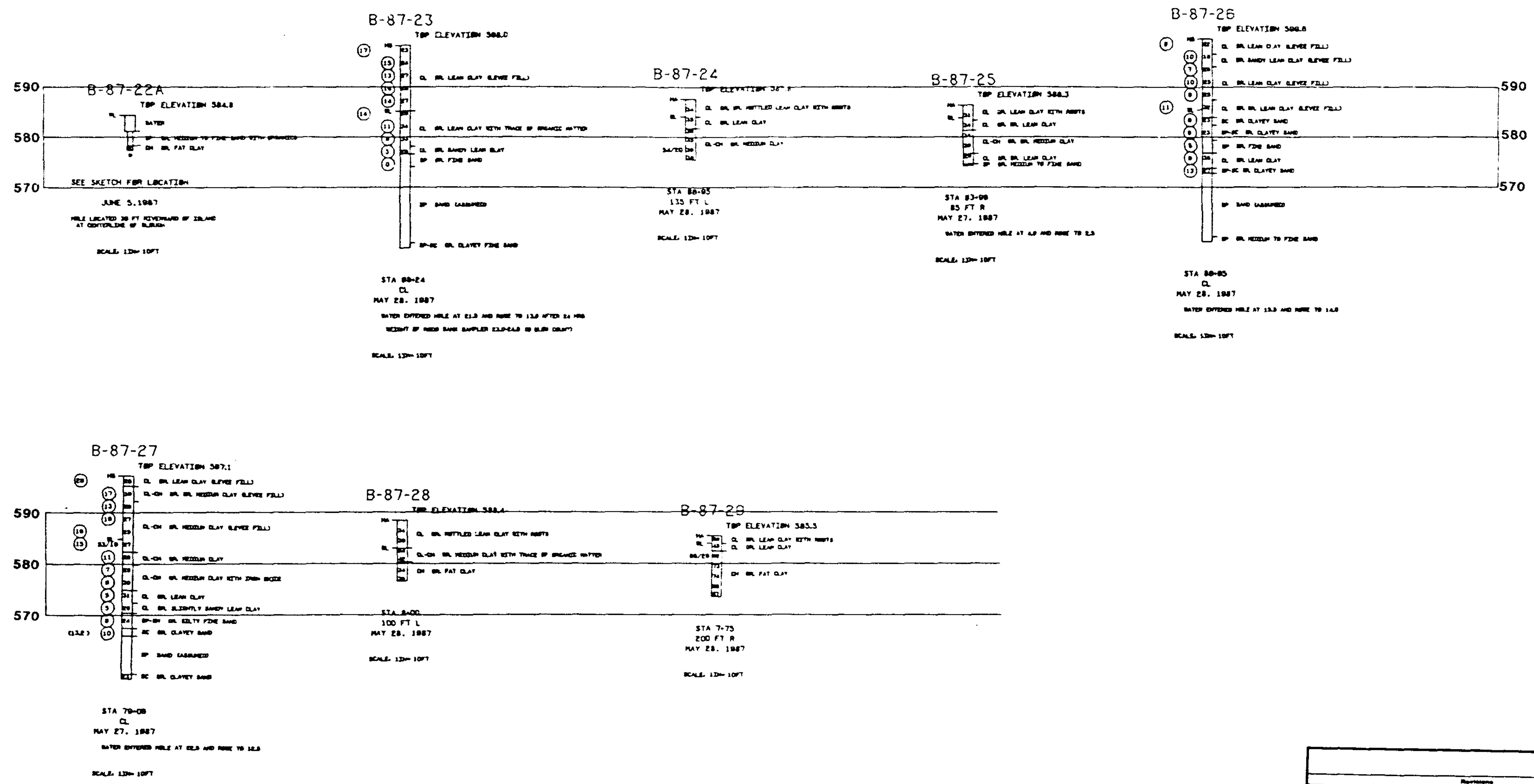
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.5

BROWN'S LAKE

HYDRAULIC DATA III

PLATE 7


B-87-1
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 3, 1987
B-87-2
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 3, 1987
B-87-3
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 4, 1987
B-87-4
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 4, 1987
B-87-5
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 4, 1987
B-87-6
SEE SKETCH FOR LOCATION
FEB 4, 1987
NO WATER LEVEL ENCOUNTERED
B-87-7
TOP ELEVATION 585.0
SEE SKETCH FOR LOCATION
FEB 4, 1987
B-87-8
TOP ELEVATION 589.0
SEE SKETCH FOR LOCATION
B-87-9
STA 20+00
CL
MAY 29, 1987
B-87-10
STA 25+00
200 FT R
B-87-11
100 FT R
JUNE 2, 1987
B-87-12
STA 5+00
CL
JUNE 2, 1987
B-87-13
STA 15+00
CL
JUNE 2, 1987
B-87-14
STA 25+00
300 FT L
JUNE 2, 1987
B-87-15
TOP ELEVATION 584.4
SEE SKETCH FOR LOCATION
JUNE 4, 1987
B-87-16
TOP ELEVATION 584.4
SEE SKETCH FOR LOCATION
JUNE 4, 1987
B-87-17
TOP ELEVATION 584.4
SEE SKETCH FOR LOCATION
JUNE 4, 1987
B-87-18
TOP ELEVATION 584.4
SEE SKETCH FOR LOCATION
JUNE 4, 1987
B-87-19
STA 10+00
JUNE 2, 1987
B-87-20
STA 25+00
1000 FT R
MAY 29, 1987
B-87-21
TOP ELEVATION 584.8
STA 95+35
190 FT R
JUNE 5, 1987
B-87-22
TOP ELEVATION 584.8
SEE SKETCH FOR LOCATION
JUNE 5, 1987
590
580
570
LEGEND
BORING NUMBER
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
BROWN'S LAKE
BORING LOGS I
PLATE 8



Symbol	Descriptions	Date	Approved

Revisions

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

BORING LOGS II

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Reviewed by:
Approved by:
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Date:
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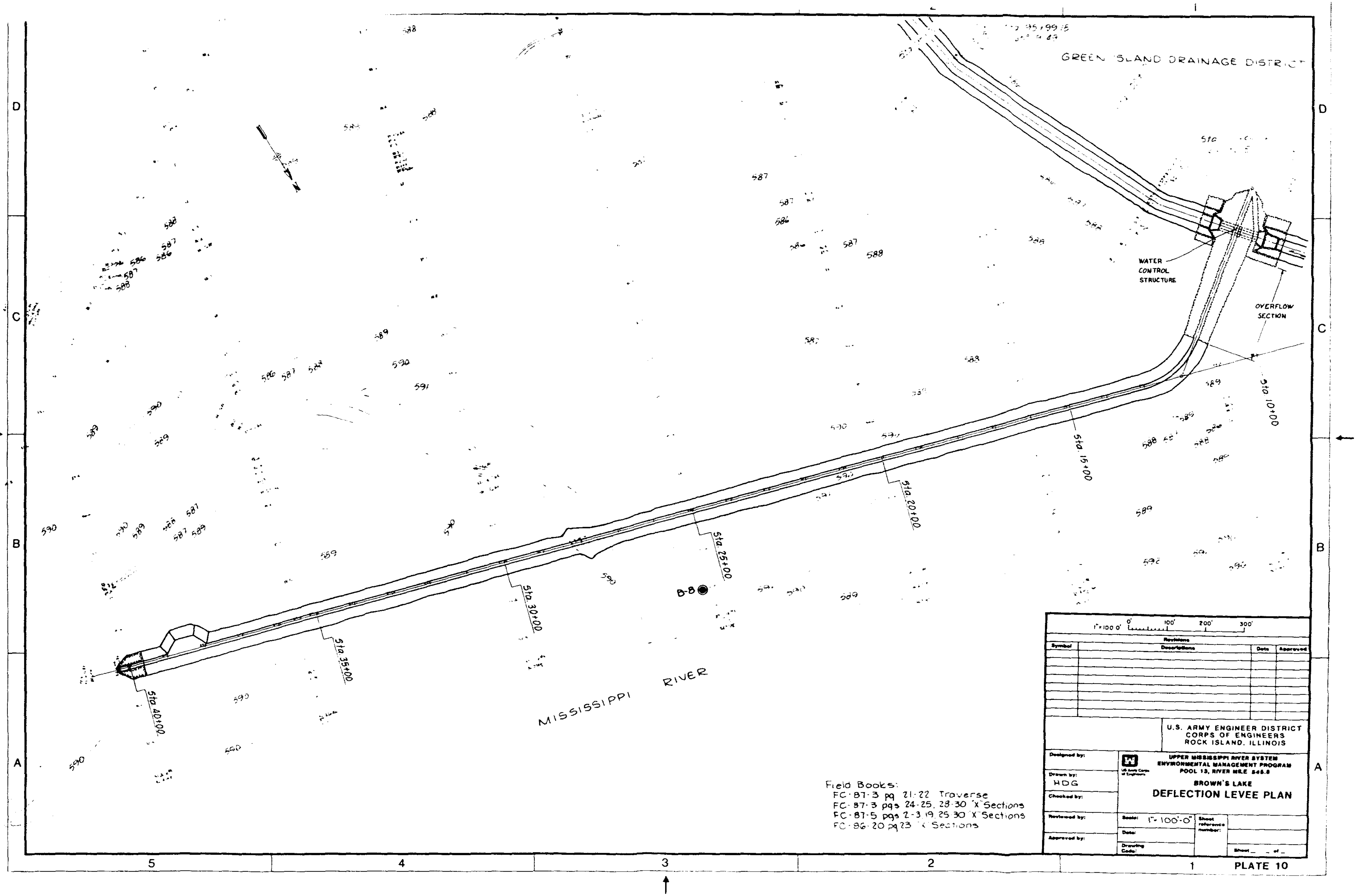
Sheet reference number:
Sheet _ of _

PLATE 9


GREEN ISLAND DRAINAGE DISTRICT
WATER CONTROL STRUCTURE
OVERFLOW SECTION
Sta 10+00
Sta 15+00
Sta 20+00
Sta 25+00
Sta 30+00
Sta 35+00
Sta 40+00
B-8
MISSISSIPPI RIVER
Field Books:
FC-87-3 pg 21-22 Traverse
FC-87-3 pgs 24-25, 28-30 "X" Sections
FC-87-5 pgs 2-3, 19, 25-30 "X" Sections
FC-86-20 pg 23 "X" Sections
1" = 100.0' 0' 100' 200' 300'
Revisions
Symbol
Descriptions
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by:
Drawn by: HDG
Checked by:
Reviewed by:
Approved by:
US Army Corps of Engineers
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
DEFLECTION LEVEE PLAN
Scale: 1" = 100'-0"
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _
PLATE 10

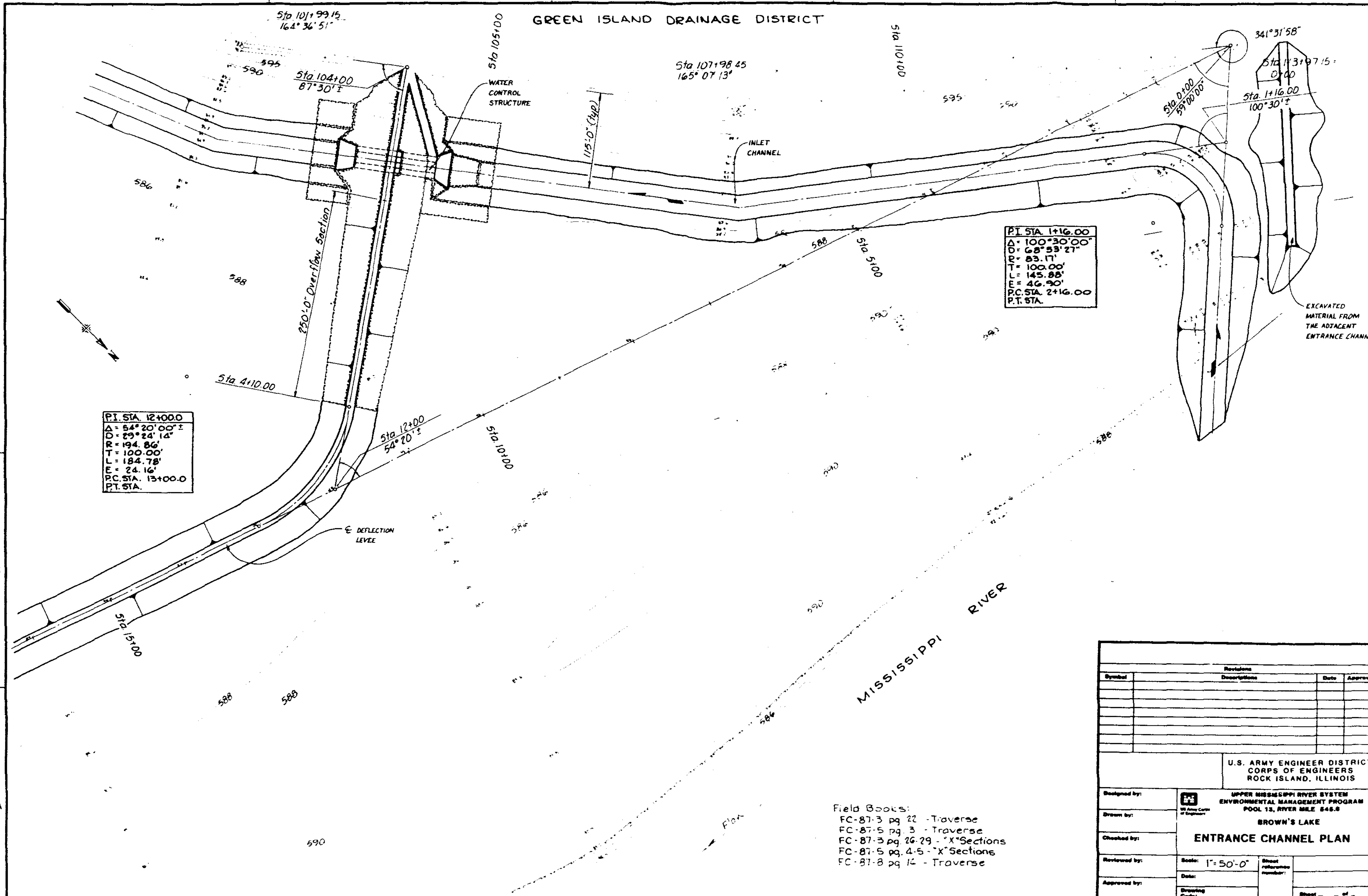
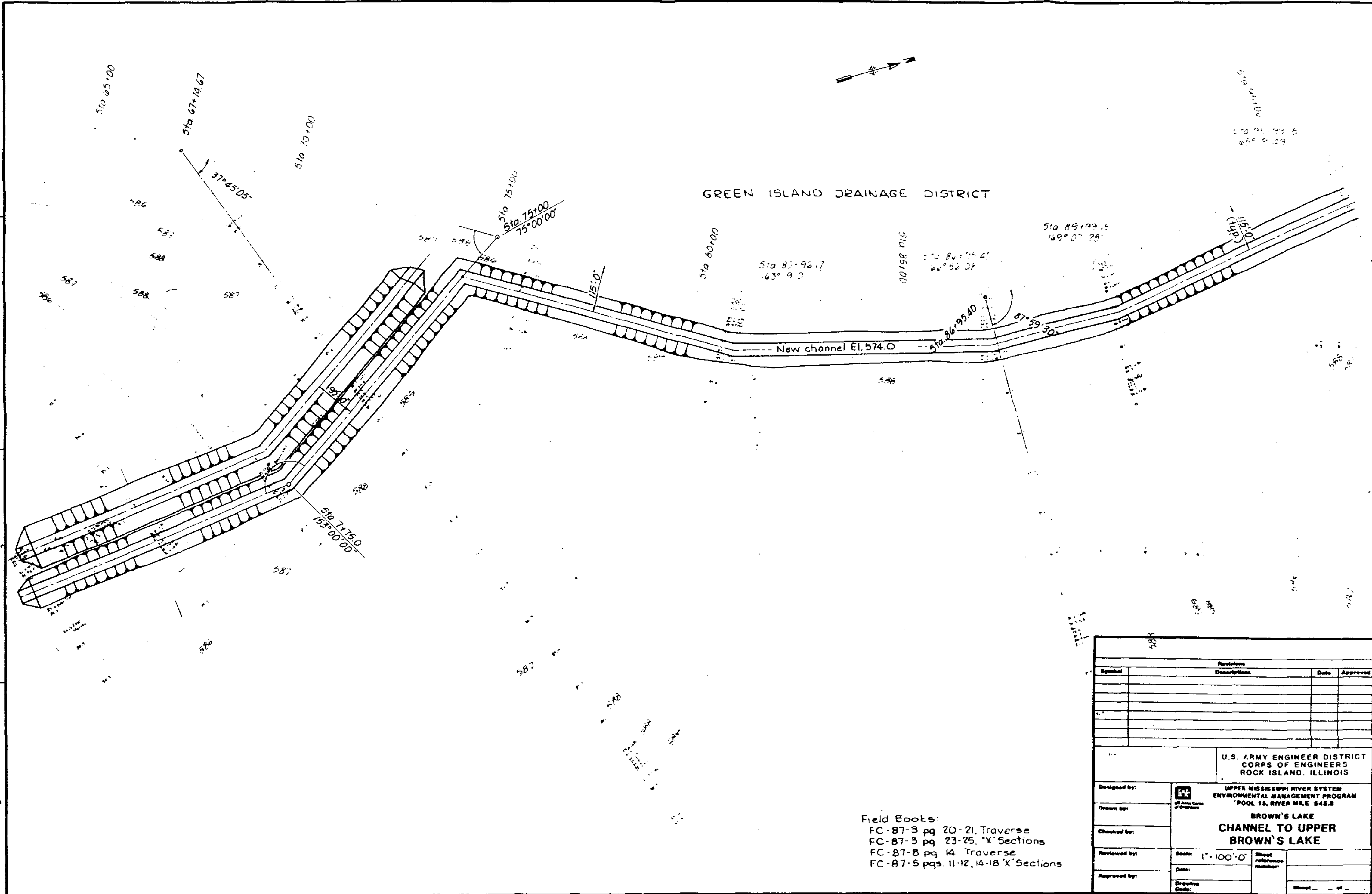

GREEN ISLAND DRAINAGE DISTRICT
Sta 101+99.15
164° 36' 51"
Sta 104+00
87°30' I
Sta 105+00
WATER CONTROL STRUCTURE
Sta 107+98.45
165° 07' 13"
115'-0" (typ)
INLET CHANNEL
Sta 110+00
341°31'58"
Sta 113+97.15 = 0+00
Sta 0+00
59°00'00"
Sta 1+16.00
100°30' I
P.I. STA. 1+16.00
Δ = 100°30'00"
D = 68°53'27"
R = 83.17'
T = 100.00'
L = 145.88'
E = 46.90'
P.C. STA. 2+16.00
P.T. STA.
EXCAVATED MATERIAL FROM THE ADJACENT ENTRANCE CHANNEL
250'-0" Overflow Section
Sta 4+10.00
Sta 5+00
P.I. STA. 12+00.0
Δ = 54°20'00" I
D = 29°24' 14"
R = 194.86'
T = 100.00'
L = 184.78'
E = 24.16'
P.C. STA. 13+00.0
P.T. STA.
Sta 12+00
54°20' I
Sta 10+00
℄ DEFLECTION LEVEE
Sta 15+00
MISSISSIPPI RIVER
Flow
Field Books:
FC-87-3 pg 22 - Traverse
FC-87-5 pg 3 - Traverse
FC-87-3 pg 26-29 - "X" Sections
FC-87-5 pg 4-5 - "X" Sections
FC-87-8 pg 14 - Traverse
Revisions
Symbol
Descriptions
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
US Army Corps of Engineers
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
ENTRANCE CHANNEL PLAN
Scale: 1" = 50'-0"
Date:
Drawing Code:
Sheet reference number:
Sheet __ of __

PLATE 11



Symbol	Descriptions	Date	Approved

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

CHANNEL TO UPPER BROWN'S LAKE

Designed by:
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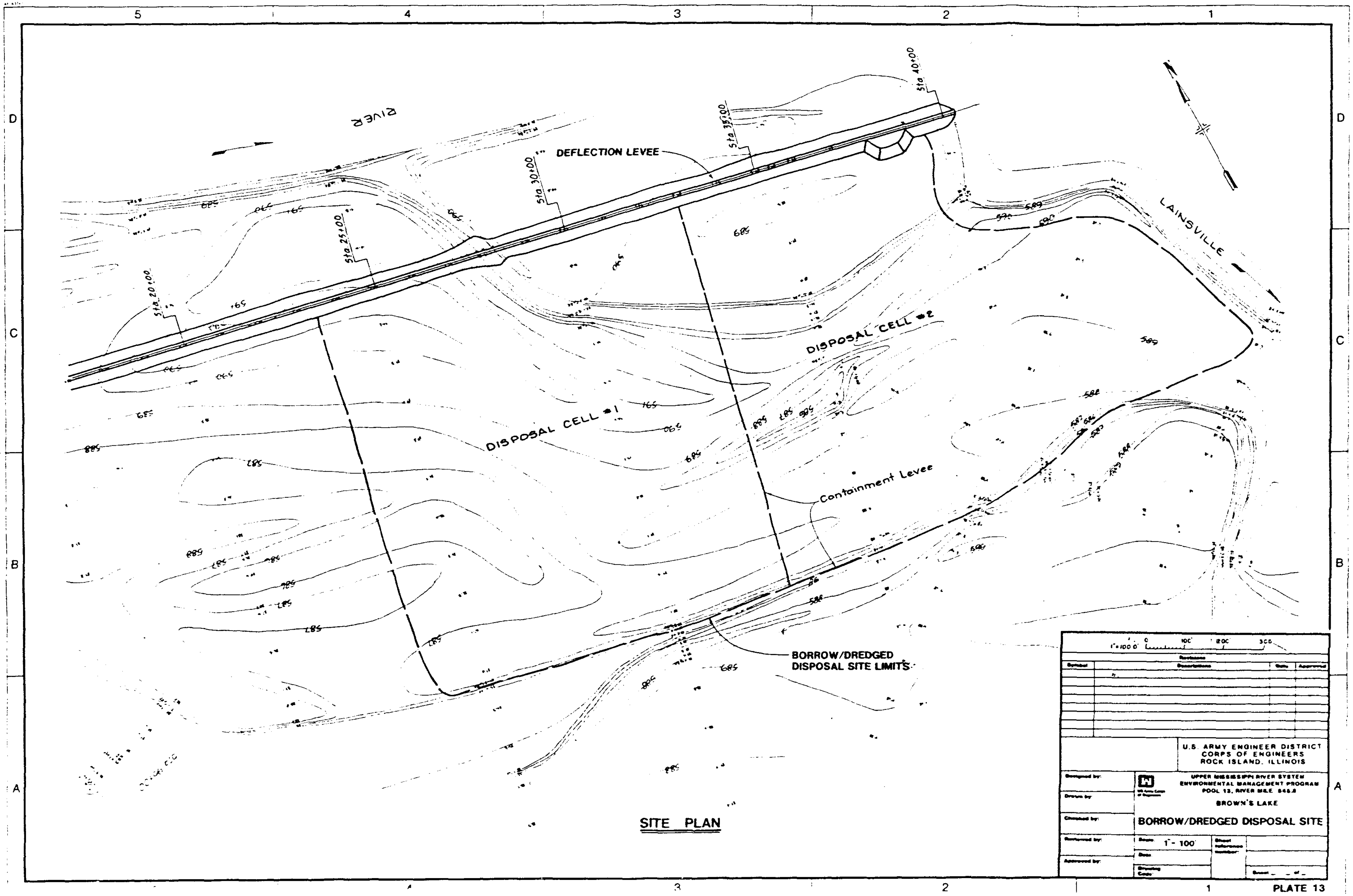
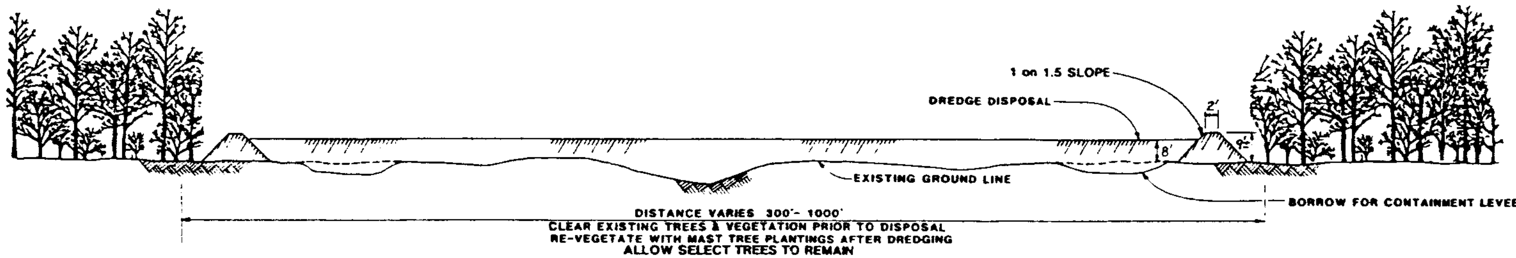
Reviewed by:
Approved by:

Scale: 1" = 100'-0"
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _

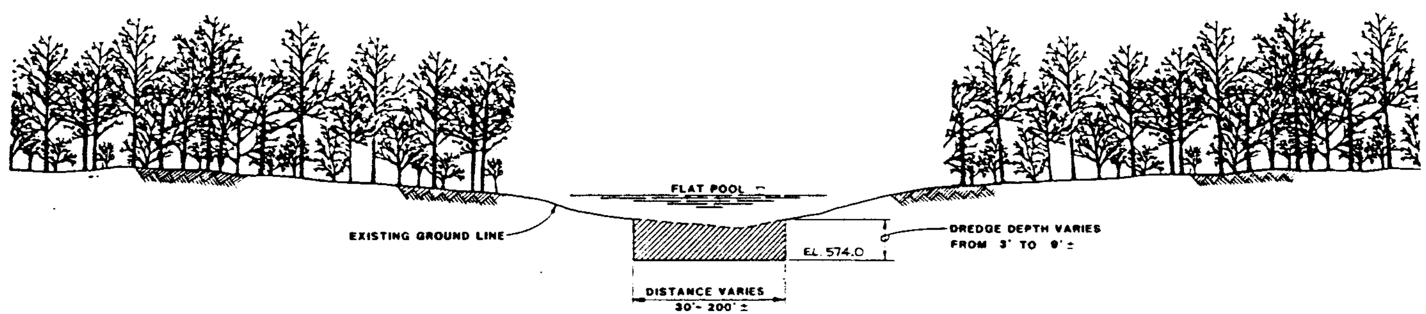
PLATE 12


RIVER
DEFLECTION LEVEE
Sta 20+00
Sta 25+00
Sta 30+00
Sta 35+00
Sta 40+00
LAINSVILLE
DISPOSAL CELL #1
DISPOSAL CELL #2
Containment Levee
BORROW/DREDGED DISPOSAL SITE LIMITS
SITE PLAN
1"=100.0'
0
100'
200'
300'
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 546.8
BROWN'S LAKE
BORROW/DREDGED DISPOSAL SITE
1" - 100'
PLATE 13



TERRESTRIAL DREDGED MATERIAL DISPOSAL

TYPICAL SECTION

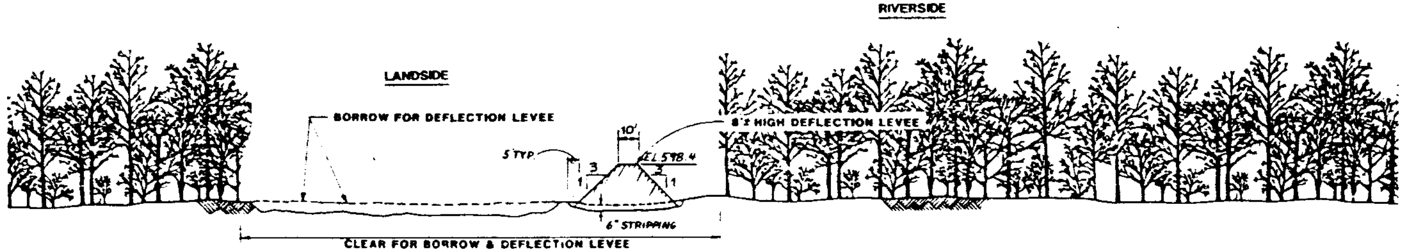


LAKE DREDGING, TYPICAL SECTION

WATER SURFACE ELEVATIONS FOR BROWNS LAKE
(RIVER MILE 545.5)

FLAT POOL ELEVATION 583.0

FREQUENCY	ELEVATION
5 YEAR	593.5
10 YEAR	595.3
50 YEAR	598.4
100 YEAR	599.5



DEFLECTION LEVEE

TYPICAL SECTION

Revisions			
Symbol	Descriptions	Date	Approved

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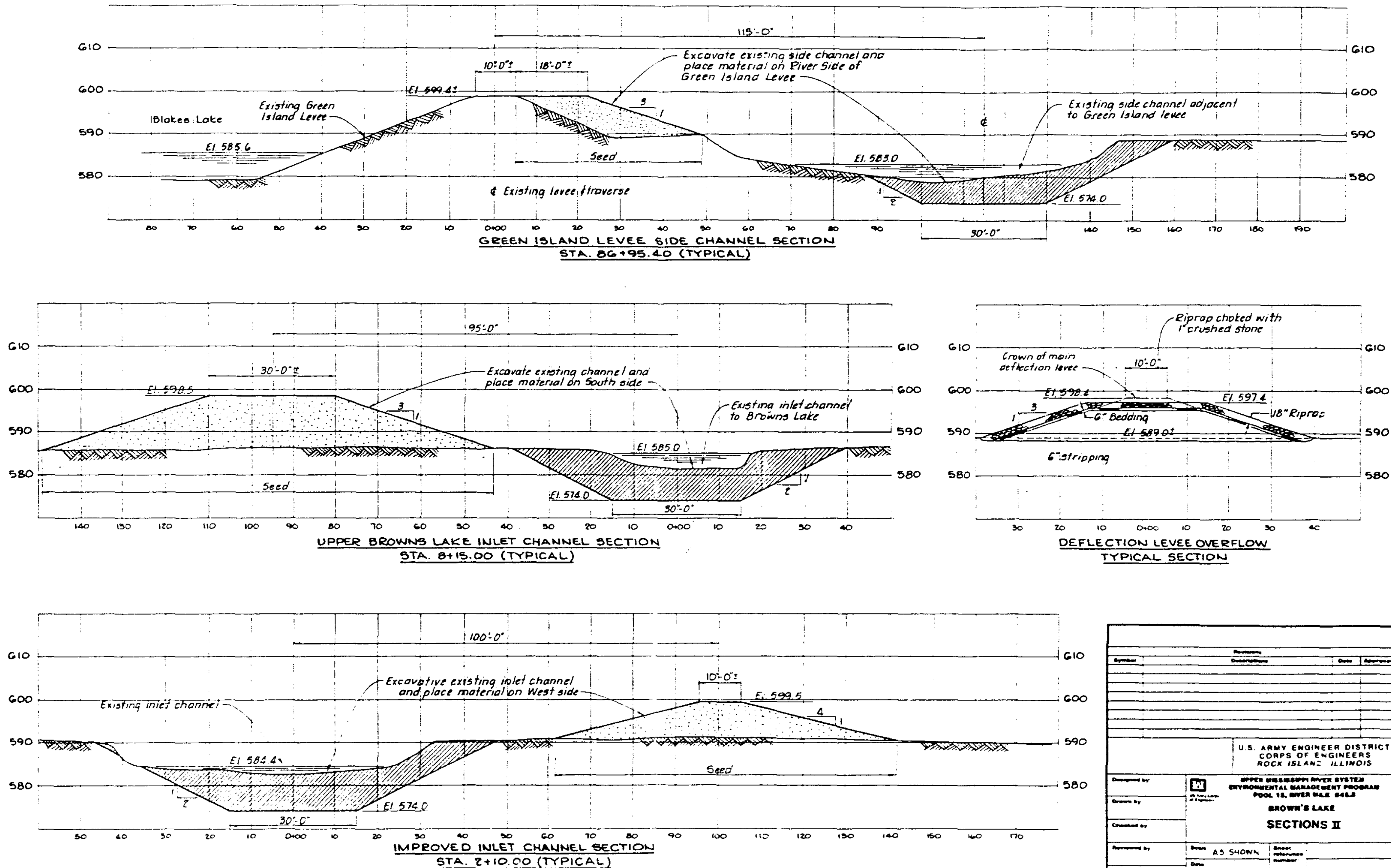
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 12, RIVER MILE 545.5

BROWN'S LAKE

SECTIONS I

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
Scale:
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _



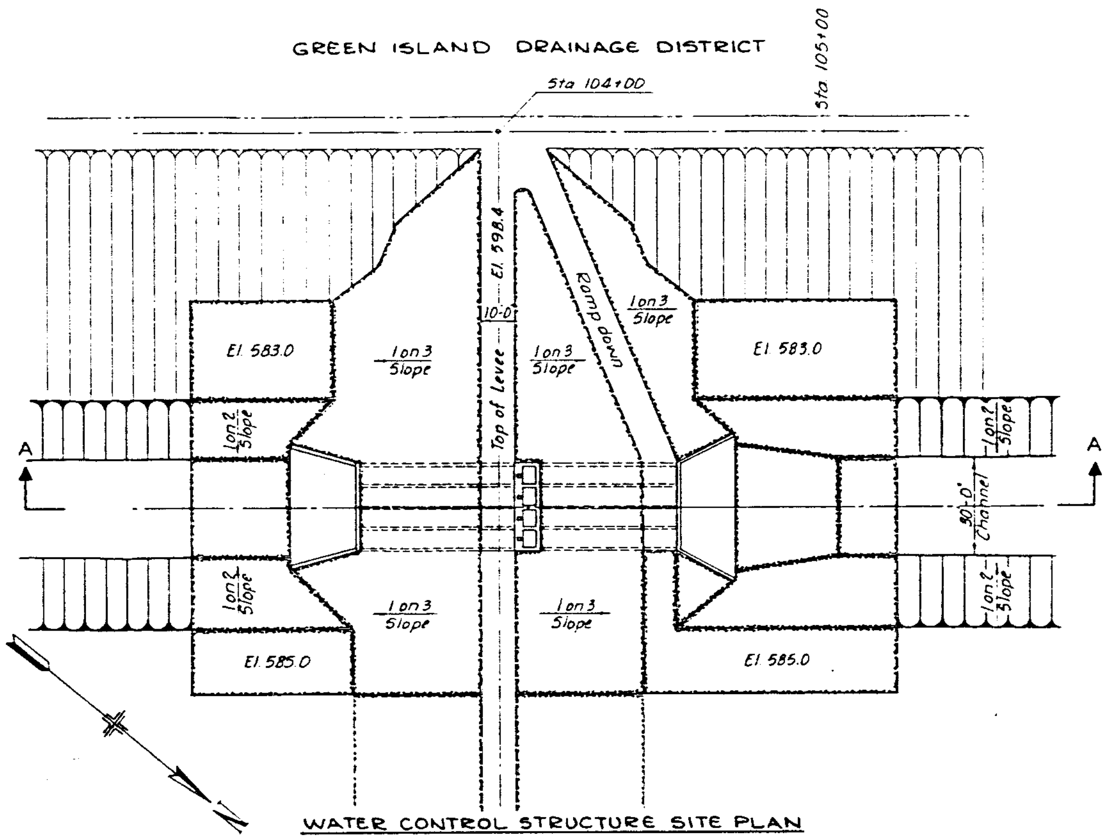
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

BROWN'S LAKE

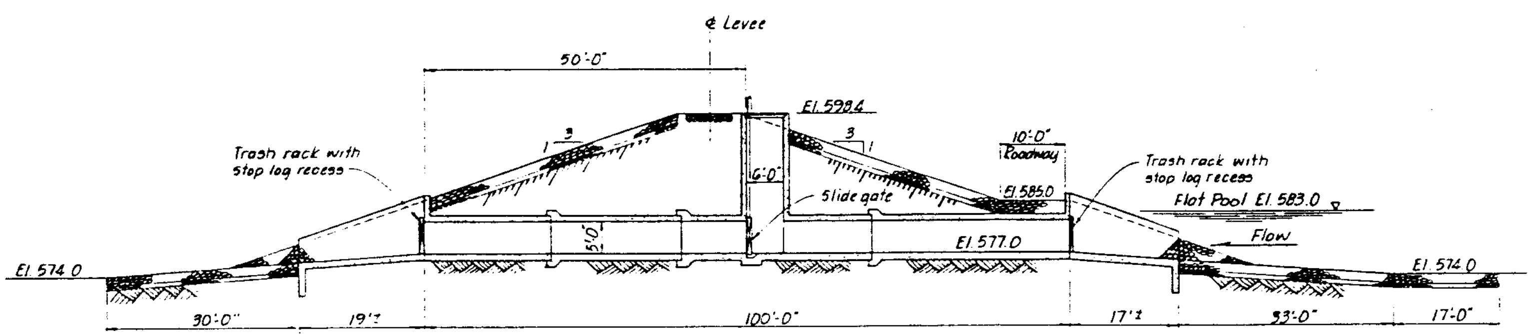
SECTIONS II

Scale: AS SHOWN

PLATE 15



WATER CONTROL STRUCTURE SITE PLAN



SECTION A-A

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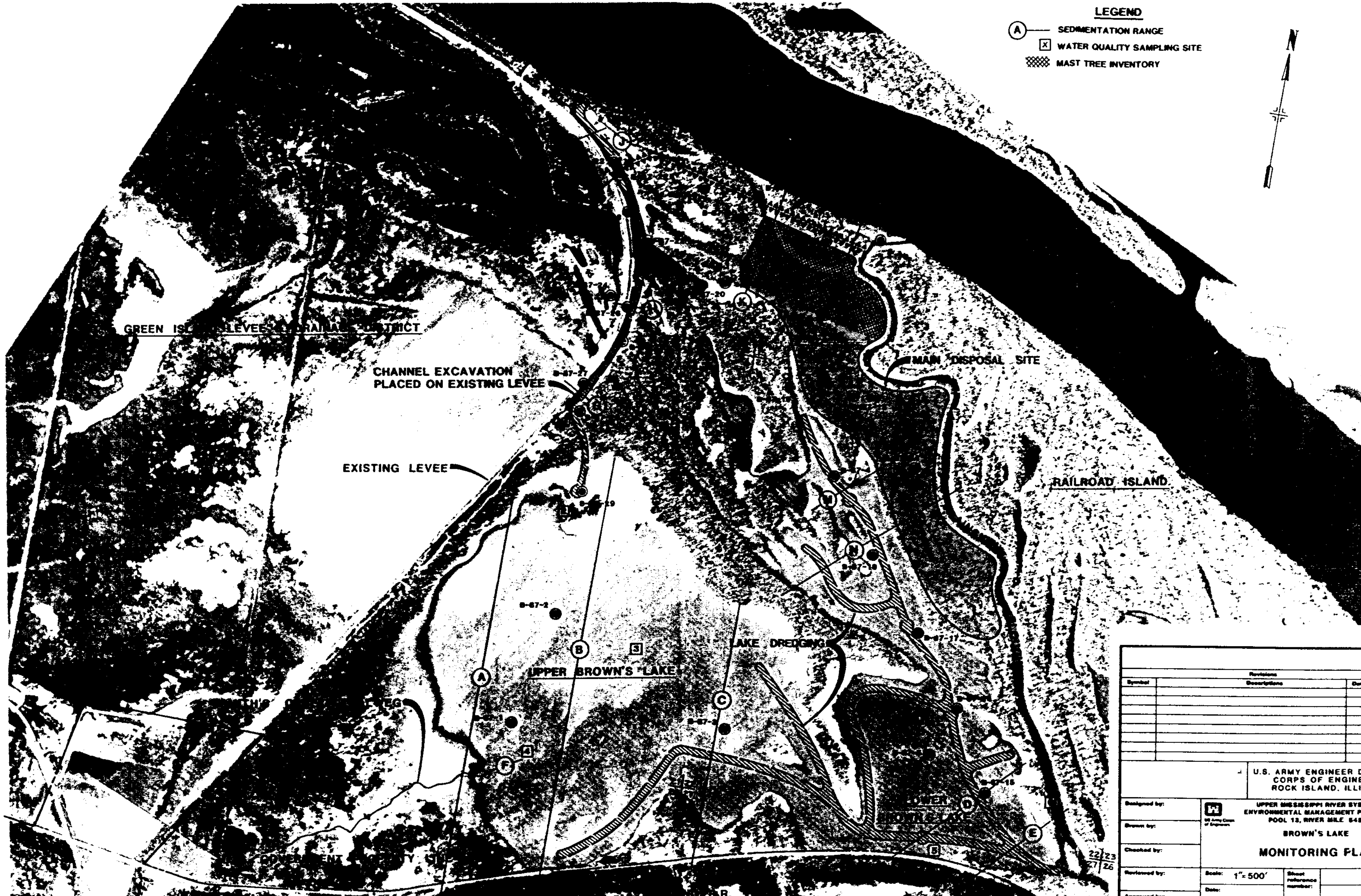
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 12, RIVER MILE 546.4

BROWN'S LAKE

WATER CONTROL STRUCTURE SITE PLAN

PLATE 16



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CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Revisions			
Symbol	Descriptions	Date	Approved

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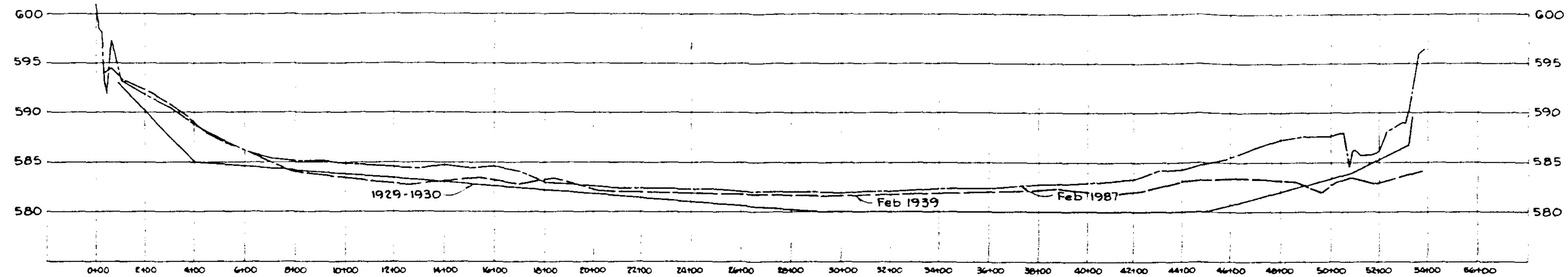
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8

BROWN'S LAKE

MONITORING PLAN

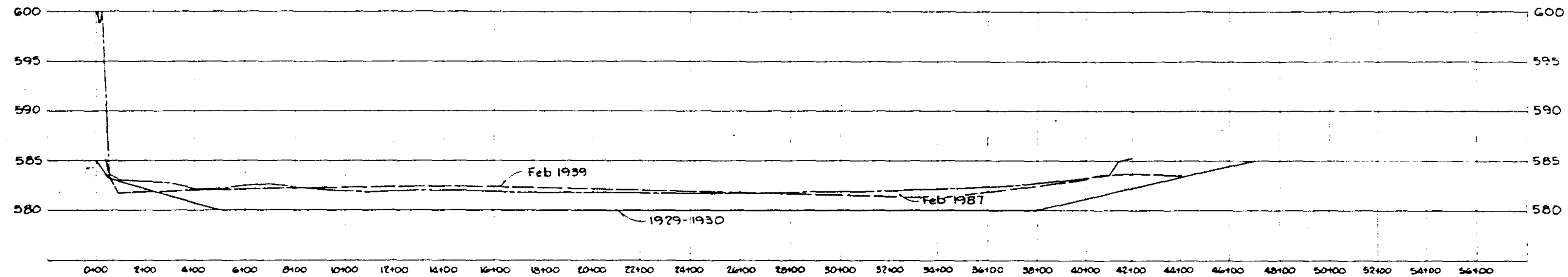
Scale: 1"= 500'
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _

PLATE 17



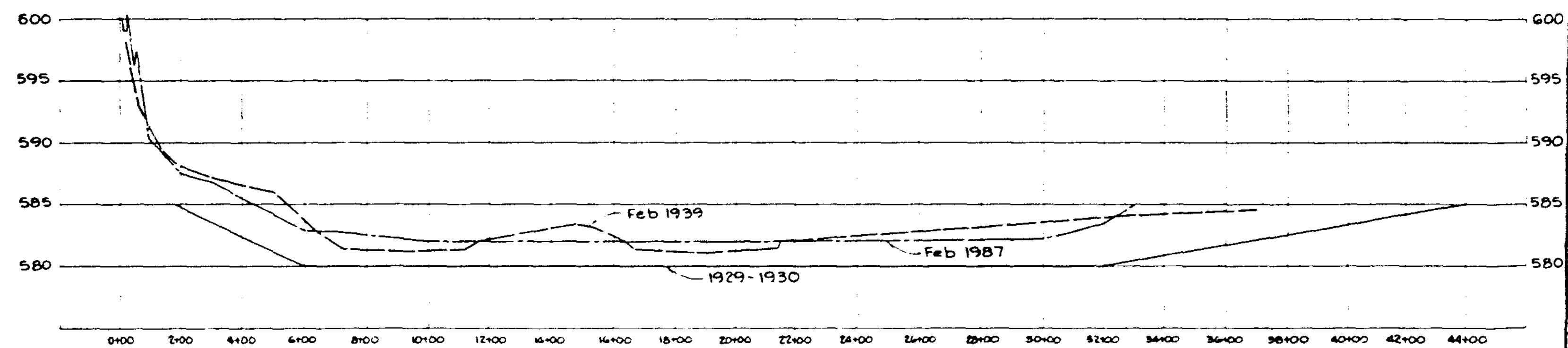
RANGE 6 - STA. 30+00.45

RANGE A



RANGE 8 - STA. 42+00.19

RANGE B



RANGE 11 - STA. 59+98.14

RANGE C

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ROCK ISLAND, ILLINOIS

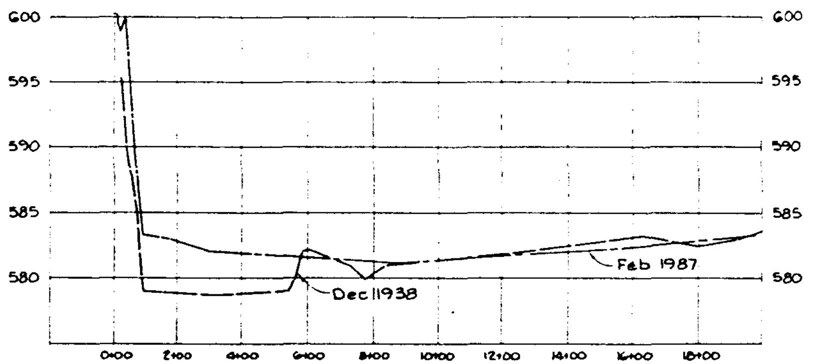
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 12, RIVER MILE

BROWN'S LAKE

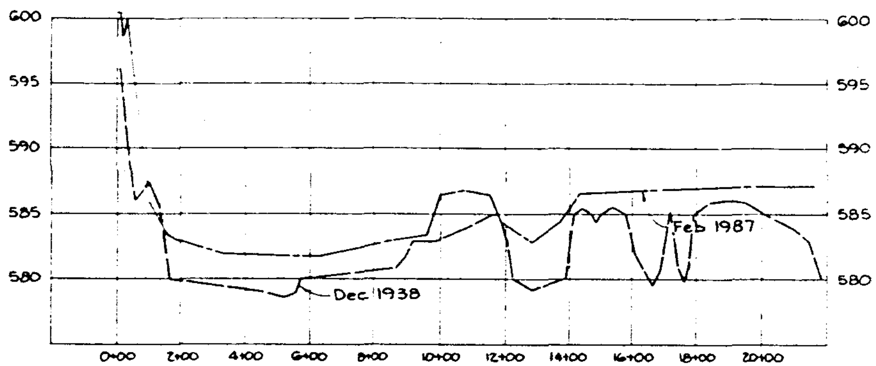
MONITORING RANGES
A, B, C

Scale: AS SHOWN

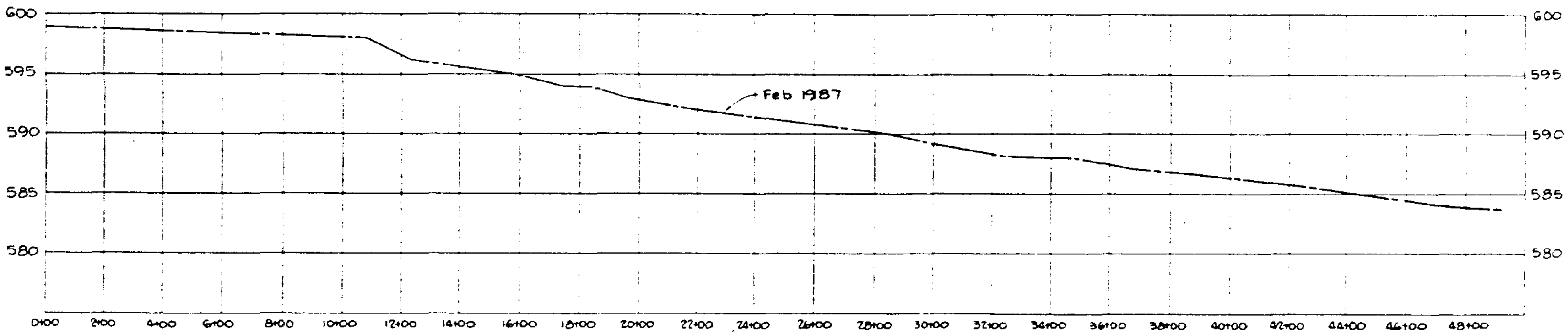
PLATE 18



STA. 82+95
RANGE D



STA. 93+30
RANGE E



SMITH'S CREEK THALWEG
RANGE F

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CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

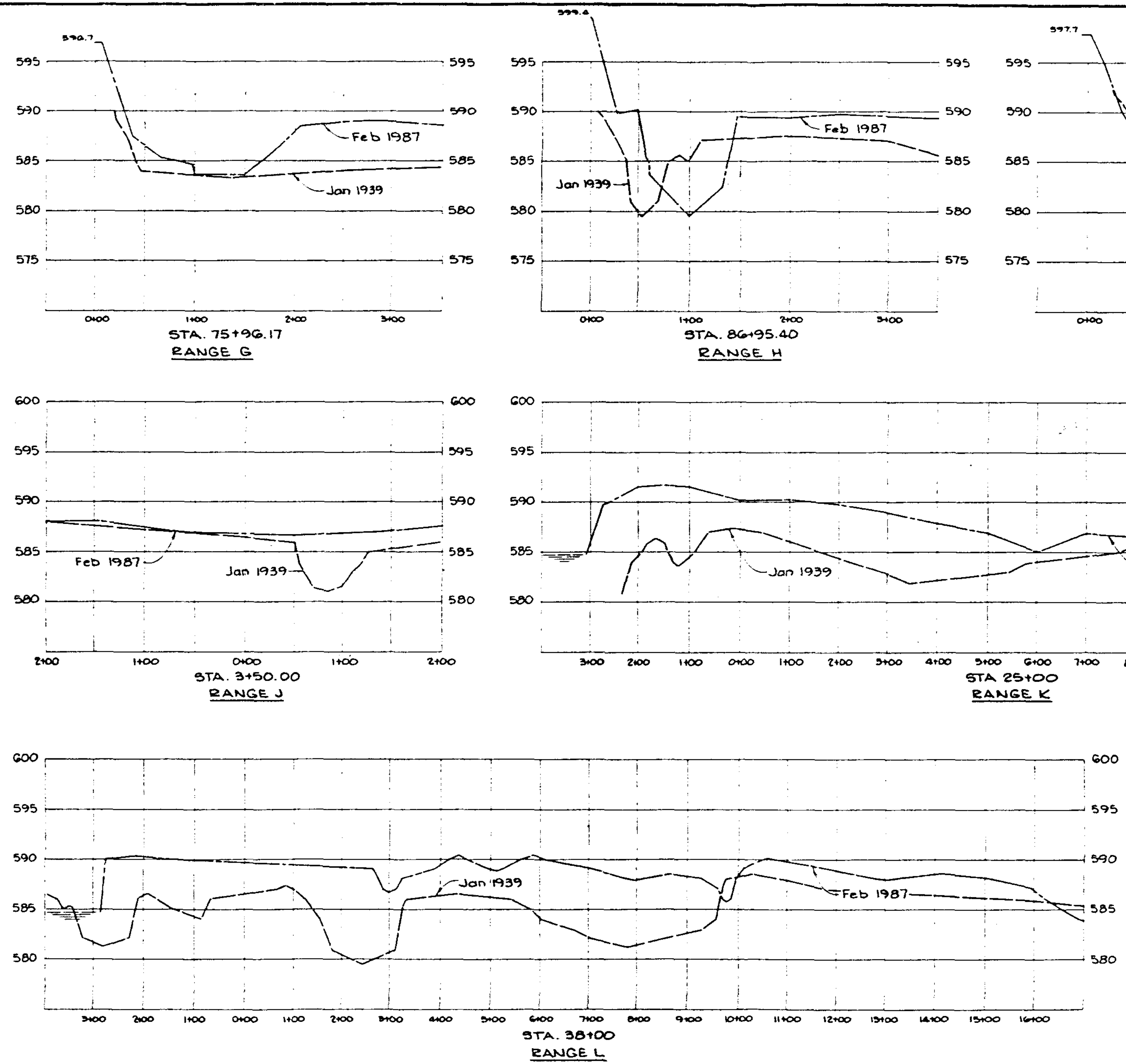
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE

BROWN'S LAKE

MONITORING RANGES
D, E, F

Scale: AS SHOWN

PLATE 19



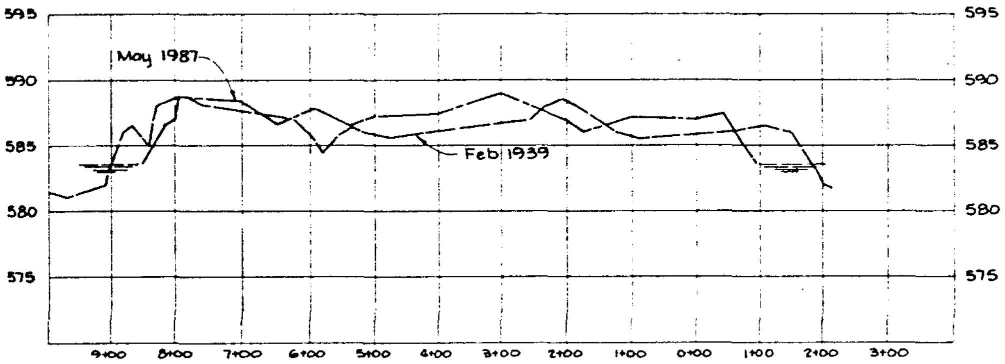
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

BROWN'S LAKE

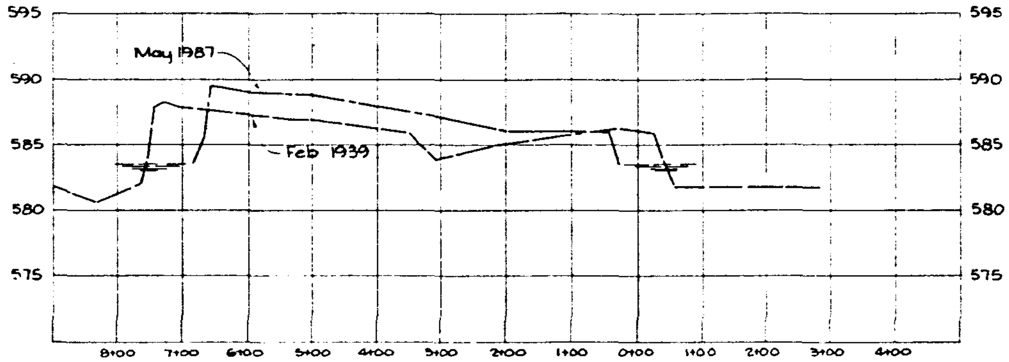
MONITORING RANGES
G, H, I, J, K, L

Scale: AS SHOWN

PLATE 20



STA. 25+00
RANGE M



STA. 30+00
RANGE N

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 546.8

BROWN'S LAKE

MONITORING RANGES M, N

Scale: AS SHOWN

PLATE 21

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DEFINITE PROJECT REPORT (R-2)
BROWN'S LAKE REHABILITATION AND ENHANCEMENT
POOL 13, RIVER MILE 545.8, UPPER MISSISSIPPI RIVER
JACKSON COUNTY, IOWA

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