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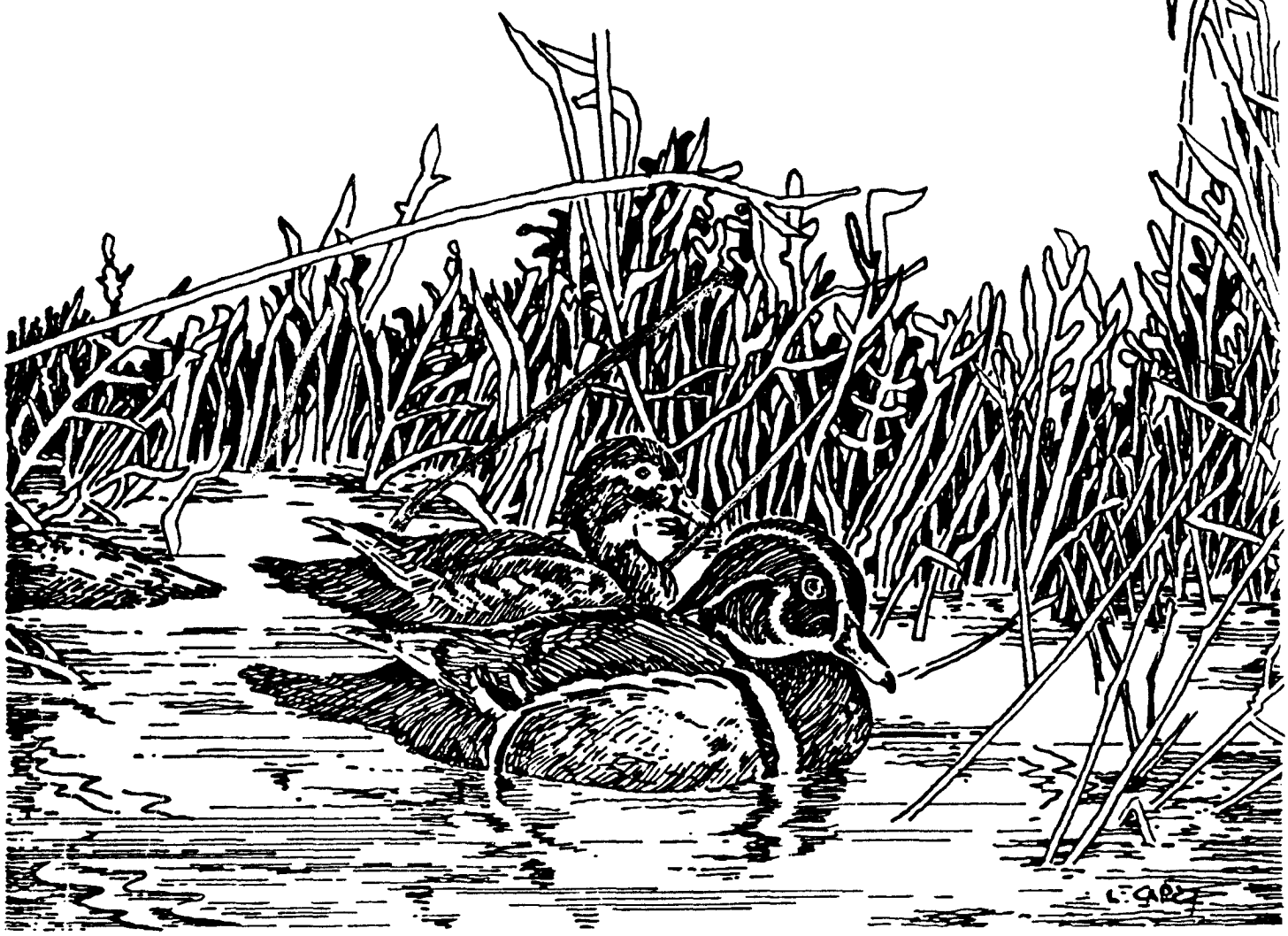
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-8)
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

BAY ISLAND, MISSOURI
REHABILITATION AND ENHANCEMENT



MARCH 1990

US Army Corps
of Engineers
Rock Island District

POOL 22

UPPER MISSISSIPPI RIVER

MARION COUNTY, MISSOURI

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

REPLY TO
ATTENTION OF:

CENCR-PD-W

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
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WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-8)

BAY ISLAND, MISSOURI
REHABILITATION AND ENHANCEMENT
POOL 22, MISSISSIPPI RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

MARCH 1990

ACKNOWLEDGEMENT

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EXECUTIVE SUMMARY

The Bay Island complex, encompassing approximately 650 acres of aquatic, wetland, and terrestrial habitat, is located on the Missouri side of the navigation channel between river miles (RM) 311 and 312, approximately 1 mile north of the city of Hannibal (see plate 2). All habitat enhancement features will be located on General Plan lands owned by the U.S. Army Corps of Engineers and managed under a Cooperative Agreement between the Department of Interior (USFWS) and the Corps of Engineers. The Missouri Department of Conservation (MDOC) has assumed management responsibilities for these lands through a successive Cooperative Agreement with the USFWS.

The quality, extent, and diversity of this area's wetland habitat is rapidly decreasing. The migratory waterfowl and other wetland species which currently depend upon and utilize this habitat type for resting and feeding, as well as reproduction and brooding, are being adversely affected by its declining availability. Pool 22 and its environs currently lack sufficient wetland habitat to maintain the levels of waterfowl, shorebird, and furbearer use previously experienced in this area. Prior to establishment of the extensive system of agricultural drainage districts adjacent to this pool, prime forested wetlands were readily available throughout the area during annual migrations. Recognition of an ongoing loss of quality wetlands along this reach of the river prompted the development of the Bay Island project for waterfowl habitat enhancement. Other locations within or adjacent to Pool 22 conducive to habitat rehabilitation and enhancement have been investigated with several projects, focusing primarily upon aquatic habitat benefits, being proposed for this pool.

In order to accomplish the project goal of enhancement of wetland habitat for migratory waterfowl, the following design objectives have been established: (1) provide controlled water levels over forested and non-forested areas during migration periods; (2) increase mast tree dominance; and (3) increase total wetland values for migratory waterfowl as described by a Habitat Suitability Index (HSI), and resultant changes in Habitat Units (HU's). Interagency application of the Wildlife Habitat Appraisal Guide (WHAG) methodology determined that potential improvement of 360 percent for migratory waterfowl is possible for the project site. Project action alternatives considered for the purpose of accomplishing the project's design objectives included: (B) water level management through the construction of wetland management units (WMU's) to include levees, water control structures, and a pump station; (C) building of a sediment deflection levee; (D) dredging of Clear Creek; (E) deepening of selected areas of the interior; (F) cover management such as planting of mast tree species, clearing and passive vegetation management, and clearing and active vegetative management. Alternative A was the No Action alternative.

To evaluate the proposed project alternatives, the study team established existing conditions and potential improvements using the WHAG habitat value quantification method. This numeric system was derived by the MDOC and the U.S. Soil Conservation Service from the Habitat Evaluation Procedures (HEP)

developed by the USFWS. With this as a planning tool, the study team determined existing waterfowl habitat values, identified potential improvements in the habitat, and developed objectives relative to those measurable values in the WHAG system. Waterfowl values were examined using the mallard as a species of emphasis.

This evaluation approach resulted in Alternatives B and F being recommended and Alternatives A, C, D, and E being rejected. Alternative A, no action, would allow the transition of this site from wetland to terrestrial to continue unimpeded. This alternative was not selected since it would result in the eventual loss of existing wetland habitat from an already limited inventory. Sediment reduction revealed no significant benefits for the target species. Therefore, Alternative C, sediment deflection levee, was not included in the proposed project. Alternative D, the dredging of Clear Creek, was not chosen due to projected future channel maintenance requirements, associated tree clearing, and higher costs of levee construction resulting from use of this material. Also, due to water level fluctuations in Clear Creek resulting from South River Drainage District (SRDD) pumping, minimal additional HU's would be realized from this action. Alternative E, deepening existing low interior areas, is basically a construction alternative for levee fill. It was not selected since this action would reduce wetland habitat values, could result in potential fish attraction and entrapment during flood recession, and would result in higher costs of levee construction than other borrow sources.

Alternative B, the construction of two WMU's adjacent to one another, would provide over 400 acres of manageable wetland area. The upper unit of approximately 240 acres would be forest-dominated, while the lower 165-acre unit would be primarily open. This two-unit design will provide tremendous habitat diversity to the benefit of migratory waterfowl, shorebirds, furbearers, and other wetland species. Earthen perimeter levees 4 to 6 feet in height will delimit the WMU's. A 6,000-gpm pump station will be constructed adjacent to Ziegler Slough for pumping water into the units. Three stop log structures placed within the levee system will allow for independent water level maintenance within the two units, thereby assuring habitat appropriate for the targeted species during peak utilization periods (specifically, spring and fall migration seasons). Dewatering of the units will be by gravity flow through channels created during levee construction.

Alternative F, cover management, was selected due to its potential to increase the wetland habitat value of the project area as determined by application of WHAG. Establishing pin oaks as the dominant species on 30 acres within the confines of the forested WMU was found to provide the greatest HU return by diversifying the existing bottom land monoculture and providing valuable food resources for wood ducks and other wildlife species.

Potential enhancement of the project area resulting from full implementation of the selected project features will include: increasing reliable water level control during migration periods by over 400 acres; increasing

the project area's total wetland value of 99 HU's by more than 420 HU's; and establishing 30 acres dominated by selected mast tree species. The project has been designed to provide habitat benefits for a minimum of 50 years.

Improved site access for project operation and maintenance activities will be provided by upgrading an existing road and replacing the bridge across Clear Creek. Annualized costs for operating and maintaining the project have been estimated at $9,400 per year. The USFWS has agreed to ensure that operation and maintenance will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986.

The collection of post-construction quantitative physical and chemical parameter measurements has been proposed to evaluate project performance with respect to the stated project objectives. In addition, field observations would be gathered by the USFWS and submitted to the Corps of Engineers both for the project performance evaluation and reporting as described in the UMRS-EMP Fourth Annual Addendum and as part of the Annual Management Report for Cooperative Agreement Lands. Collection of quantitative data, to include a WHAG analysis within the first year after construction and at 5, 15, and 50 years thereafter; vegetation and areal surveys of the project site within 1 year following construction and quinquennially thereafter; and quinquennial timber inventories and cross-sectional surveys, would be the responsibility of the Corps of Engineers.

The District Engineer has reviewed the project outputs and determined that implementation of the identified plan is justified and in the Federal interest. The project area is managed as a National Wildlife Refuge within the meaning of Section 906(e) of the 1986 Water Resources Development Act. Therefore, approval for construction of the Bay Island, Missouri, Habitat Rehabilitation and Enhancement project at a 100 percent Federal cost is recommended by the Rock Island District Engineer. The Federal construction cost for this project is estimated at $1,075,000. The District Engineer further recommends that funds in the amount of $50,000 be allocated as quickly as possible for the preparation of plans and specifications.

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REHABILITATION AND ENHANCEMENT
POOL 22, MISSISSIPPI RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

TABLE OF CONTENTS

Section		Page
1.	INTRODUCTION	1
	a. Purpose	1
	b. Resource Problems and Opportunities	1
	c. Scope of Study	1
	d. Format of Report	2
	e. Authority	2
2.	GENERAL PROJECT SELECTION PROCESS	3
	a. Eligibility Criteria	3
	b. Project Selection	4
	c. Specific Site Selection	5
3.	ASSESSMENT OF EXISTING RESOURCES	6
	a. Resource History	6
	b. Land Use	7
	c. Aquatic Resources	7
	d. Terrestrial and Wetland Resources	8
	e. Endangered Species	9
	f. Cultural Resources	9
	g. Adjacent Water Projects	10
	h. Sedimentation	10
4.	PROJECT OBJECTIVES	10
5.	ALTERNATIVES	10
	a. Alternative A, No Federal Action	10
	b. Alternative B, Water Level Control Through Wetland Management Unit Construction	10
	c. Alternative C, Sediment Deflection Levee	12
	d. Alternative D, Clear Creek Dredging	12

TABLE OF CONTENTS (Cont'd)

Section		Page
	e. Alternative E, Interior Excavation	12
	f. Alternative F, Cover Management	12
6.	EVALUATION OF ALTERNATIVES	12
	a. Alternative A, No Federal Action	14
	b. Alternative B, Water Level Control Through Wetland Management Unit Construction	14
	c. Alternative C, Sediment Deflection Levee	14
	d. Alternative D, Clear Creek Dredging	14
	e. Alternative E, Interior Excavation	17
	f. Alternative F, Cover Management	17
7.	SELECTED PLAN WITH DETAILED DESCRIPTION	17
	a. General Description	17
	b. Water Level Control Through Wetland Management Unit Construction	17
	c. Cover Management	22
8.	DESIGN AND CONSTRUCTION CONSIDERATIONS	22
	a. Existing Site Elevations	22
	b. Foundations of Structures	23
	c. Borrow Sites/Construction Materials	23
	d. Erosion Control	23
	e. Permits	23
9.	ENVIRONMENTAL EFFECTS	23
	a. Summary of Effects	23
	b. Economic and Social Impacts	24
	c. Natural Resource Effects	25
	d. Cultural Resources	26
	e. Adverse Effects Which Cannot Be Avoided	27
	f. Short-Term Use Versus Long-Term Productivity	27
	g. Irreversible or Irretrievable Resource Commitments	27
	h. Compliance With Environmental Quality Statutes	27
10.	SUMMARY OF PLAN ACCOMPLISHMENTS	30
11.	OPERATION AND MAINTENANCE CONSIDERATIONS	31
	a. Project Data Summary	31
	b. Operation	31
	c. Maintenance and Rehabilitation	32

TABLE OF CONTENTS (Cont'd)

Section		Page
12.	PROJECT PERFORMANCE ASSESSMENT	33
13.	COST ESTIMATES	35
14.	REAL ESTATE REQUIREMENTS	40
	a. General	40
	b. Local Cooperation Agreements/Cost-Sharing	40
15.	SCHEDULE FOR DESIGN AND CONSTRUCTION	41
16.	IMPLEMENTATION RESPONSIBILITIES AND VIEWS	42
	a. Corps of Engineers	42
	b. U.S. Fish and Wildlife Service	42
	c. Missouri Department of Conservation	42
17.	COORDINATION, PUBLIC VIEWS, AND COMMENTS	42
	a. Coordination Meetings	42
	b. Environmental Review Process	42
18.	CONCLUSIONS	43
19.	RECOMMENDATIONS	43
LITERATURE CITED		
FINDING OF NO SIGNIFICANT IMPACT		

List of Tables

Number	Title	Page
3-1	Existing Features	7
4-1	Project Goal, Objectives, and Enhancement Potential	11
7-1	Water Depths Versus Height	19
9-1	Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements	28
11-1	Project Data Summary	31
12-1	Monitoring Plan	33
12-2	Annual Post-Construction Field Observations	34
12-3	Post-Construction Quantitative Measurements	35
13-1	Detailed Estimate of Cost	36
13-2	Estimated Annual Operation, Maintenance, and Rehabilitation Costs	39

TABLE OF CONTENTS (Cont'd)

List of Tables (Cont'd)

Number	Title	Page
13-3	Estimated Annual Monitoring Costs	40
15-1	Project Implementation Schedule	41

List of Figures

Number	Title	Page
3-1	Bay Island Existing Conditions	6a
6-1	Bay Island HREP Mallard Impacts With Water Control	15
6-2	Bay Island HREP Mallard Incremental Costs	16
6-3	Bay Island - Mallard	18
7-1	Bay Island Recommended Plan	18a

List of Plates

Number	Title
1	Vicinity Map, Location Map, and Index
2	Pool 22 Map
3	Recommended Plan
4	Alternative Plans
5	Hydraulic Data I
6	Hydraulic Data II
7	Boring Logs I
8	Boring Logs II
9	Levee Plan & Profile Sta. 0+00C to Sta. 17+00
10	Levee Plan & Profile Sta. 17+00 to Sta. 46+51.46
11	Levee Plan & Profile Sta. 46+51.46 to Sta. 72+00
12	Levee Plan & Profile Sta. 72+00 to Sta. 101+19.55
13	Levee Plan & Profile Sta. 101+19.55 to Sta. 124+74.37
14	Levee Plan & Profile Sta. 0+00B to Sta. 29+00B
15	Levee Plan & Profile Sta. 29+00B to Sta. 56+00B
16	Levee Plan & Profile Sta. 56+00B to Sta. 72+16.96B
17	Levee Plan & Profile Sta. 0+00A to Sta. 28+00A
18	Levee Plan & Profile Sta. 28+00A to Sta. 45+87.25A
19	Typical Sections I
20	Typical Sections II
21	Typical Sections III
22	Perimeter Levee Water Control Structures
23	Intermediate Levee Water Control Structure
24	Access Bridge
25	Pump Station Site Plan

List of Plates (Cont'd)

Number	Title
26	Pump Station Details
27	Electrical
28	Sedimentation & Monitoring Plan
29	Sedimentation & Monitoring Cross Sections

List of Appendices

A - Correspondence
B - Clean Water Act, Section 404(b)(1) Evaluation
C - Letters of Intent and Draft Memorandum of Agreement
D - Distribution List

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1. INTRODUCTION.

a. Purpose. The purpose of this report is to present a detailed proposal for the rehabilitation and enhancement of the Bay Island, Missouri, project. 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.

b. Resource Problems and Opportunities. Sedimentation is the primary aquatic and wetland resource problem throughout the Upper Mississippi River and is believed to be responsible for the decline in the quality and quantity of these habitat types, as well as in the commercial fishery of the pooled portions of the river. In the study area, which includes surrounding habitats as well as the specific project site, there has been a decline of both forested and non-forested wetlands. This degradation is indicated by minimal measurable habitat values for both resident species and migratory waterfowl.

Resource quality in the study area was estimated using habitat requirements for migratory waterfowl, specifically the mallard, as an indicator of habitat value. Habitat values which result from interspersion of habitat types, food plant production, and timely water level changes appear to be negatively affected primarily by lack of water level control.

Based on the analyses presented in this report, the opportunity exists at this project location to restore wetland habitat value through water level control and resultant food plant availability. Overland sediment transport, water level effect, and cover management strategies were studied in connection with habitat requirements for migratory waterfowl.

c. Scope of Study. The geographical scope of the study area is shown on plates 1 and 2. Emphasis was placed on developing project features which were located on existing State or Federal lands. Although additional land could be purchased by non-Federal interests, alternatives with major land acquisition were generally not pursued due to policy, scheduling, and funding reasons. Alternatives involving upland erosion control were not studied in detail. The U.S. Soil Conservation Service has primary jurisdiction for these programs.

Field surveys were performed in developing sedimentation estimates, assessing effects near project boundaries and Government property lines,

and estimating excavation and embankment quantities. Surveyed sections will be used to evaluate post-construction performance.

Soil borings were taken to assess sediment types, to verify foundations of proposed structures, and to determine excavation difficulty and suitability of borrow materials.

d. Format of Report. The report is organized to follow a general problem solving format. The purpose and problems are presented in Section 1. Section 2 provides an overview of how and why Bay Island, Missouri, was selected as a project within the Environmental Management Program. Section 3 establishes the baseline for existing resources. Section 4 provides the objectives of the project. Sections 5 and 6 propose and evaluate project alternatives. Sections 7 and 8 describe the selected plan. Section 9 is an assessment of environmental effects of the proposed plan. Section 10 provides a summary of project accomplishments or benefits. Sections 11, 12, and 13 describe estimated operation and maintenance considerations, performance monitoring, and detailed costs estimates for both initial construction and annual operation, maintenance, and monitoring. Sections 14, 15, 16, and 17 provide a summary of implementation requirements and coordination. Sections 18 and 19 present the conclusions and recommendations. The Finding of No Significant Impact and literature cited follow Section 19.

Drawings (plates) have been furnished to provide sufficient detail to allow review of the existing features and the proposed plan. Plates 1 and 2 show the project location and the Pool 22 environs, respectively. Plates 3 and 4 show the recommended plan and alternatives plans. Plates 5 and 6 provide 15 years of hydrographic record of the Mississippi River at the proposed project site. These hydrographs provide the relationship between river flood events and proposed levee heights. Plates 7 and 8 provide soil borings which were used to evaluate foundation effects and excavation/fill methods. Plates 9 through 18 show plan and profiles of the proposed levees. Plates 19 through 21 provide section views for the selected plan. Plates 22 and 23 show plans and sections for the proposed water control structures. The new access bridge is shown on plate 24. Plates 25 through 27 show site plans, details, and electrical diagrams for the proposed pump station. Plates 28 and 29 show and provide a basis for future monitoring ranges.

e. 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 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;

(f) (1) implementation of a program of recreational projects;

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

(h) (1) monitoring of traffic movements on the system.

2. GENERAL PROJECT SELECTION PROCESS.

a. Eligibility Criteria. A design memorandum did not exist at the time of the enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for the implementation of the UMRS-EMP in January 1986. The U.S. Fish and Wildlife Service (USFWS), Region 3, and the five affected states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addendums.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addendums led to an examination of the Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Master Plan, completed by the Upper Mississippi Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan Report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below:

(1) First Annual Addendum. The Master Plan report ... and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. For habitat projects, the main eligibility criteria should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan, i.e., the sedimentation of backwaters and sidechannels of the UMRS. Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance ....

(2) Second Annual Addendum. The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:

- backwater dredging
- dike and levee construction
- island construction
- bank stabilization
- side channel openings/closures
- wing and closing dam modifications
- aeration and water control systems
- waterfowl nesting cover (as a complement to one of the other project types)
- acquisition of wildlife lands (for wetland restoration and protection) Note: By letter of February 5, 1988, the Office of the Chief of Engineers directed that such projects not be pursued.

A number of innovative structural and nonstructural solutions which address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects which include such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and recommended only after consideration of system-wide effects.

b. Project Selection. Projects are nominated for rehabilitation and enhancement by their respective State conservation agencies and the USFWS based on agency management objectives. To assist in the project formulation process, the Fish and Wildlife Interagency Committee convened a series of meetings in 1986 to consider critical habitat needs along the Mississippi River. At these meetings, biologists who are responsible for river management evaluated the available habitat on a pool-by-pool basis. This analysis revealed deficiencies, such as feeding, resting, and loafing areas for migratory waterfowl; absence of deep water habitat off the main channel for fish and diving ducks; as well as types of habitat in abundant supply (e.g., mature bottom land hardwood). With this information,

projects being considered will most accurately reflect broader regional needs in addition to representing the best site-specific choices.

Rock Island District assists the State and the USFWS management agencies through use of an in-house task force with members from the Design, Hydraulics, Channel Maintenance, Natural Resource Management, Environmental, and Waterway Systems Branches. As projects are being conceptualized, this group meets on-site with State and USFWS personnel to examine as fully as possible what site-specific benefits would be both desirable and engineeringly feasible.

To assist the District in the final selection of projects to be included in the program, the Fish and Wildlife Interagency Committee (FWIC) ranks projects according to the biological benefits that they could provide. This group, composed of biologists who work at projects along the Mississippi River and Illinois Waterway, considers each project nominated for inclusion and also suggests project alternatives to increase habitat benefits for fish, waterfowl, and other wildlife. Each project is ranked according to the benefits provided as high, medium, or low.

The FWIC rankings are forwarded to the District and to the River Resources Coordinating Team (RRCT), an interagency policy group which meets to coordinate Mississippi River activities. The RRCT examines the FWIC rankings and considers the broader policy perspectives of the agencies submitting the projects. The RRCT-recommended rankings also are submitted to the District. The District then formulates and submits a recommended program to the EMP program manager at North Central Division.

Projects consequently have been screened by State, USFWS, and Corps of Engineers biologists closely acquainted with the rivers. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available was used to optimize the habitat benefits created at the most suitable locations.

c. Specific Site Selection. The Bay Island site, an area encompassing approximately 650 acres of aquatic, wetland, and terrestrial habitat on the Missouri side of the navigation channel between river miles (RM) 311 and 312, was selected for enhancement and rehabilitation through the ranking and recommendation process elucidated in Section 2.b. of this document. Although it is recognized that this project was ranked category "B," medium importance, by the FWIC, other judgment and program management considerations influenced the decision to initiate design of this project at this time. These influencing factors included the geographic distribution of projects within the District, the presence of strong, unified State support for this project, and a recognized need to maintain relative balance between fisheries and waterfowl projects with respect to the District habitat development program. Its location was found to possess the areal extent, channel adjacency, property ownership/management status, accessibility, and other qualifications that are basic to the program's project and site selection processes. The site's topography will

accommodate the construction of two WMU's wherein water levels may be manipulated independent of river elevations for the purpose of providing reliable water level control and subsequent dependable wetland habitat and associated food resources and resting opportunities for migratory waterfowl and other wetland species. Nearly 400 surface acres would be inundated during operation of the units. Within the units, selected mast tree species will be planted to further enhance the project area's habitat diversity and productivity.

Other projects that have been considered for implementation within the Pool 22 environs, including the Orton/Fabius Islands, Texas Chute/Goose Island, and Beebe/Armstrong/Turtle/Whitney Islands projects (see plate 2) have as their primary enhancement goal the improvement and/or addition of fisheries habitat through selective dredging. One other project, Lower Pool 22, proposes the revegetation of several dredged material placement sites for the purpose of terrestrial habitat enhancement. Bay Island is the only project currently proposed for Pool 22 that focuses upon the need for additional wetland habitat along this reach of the river.

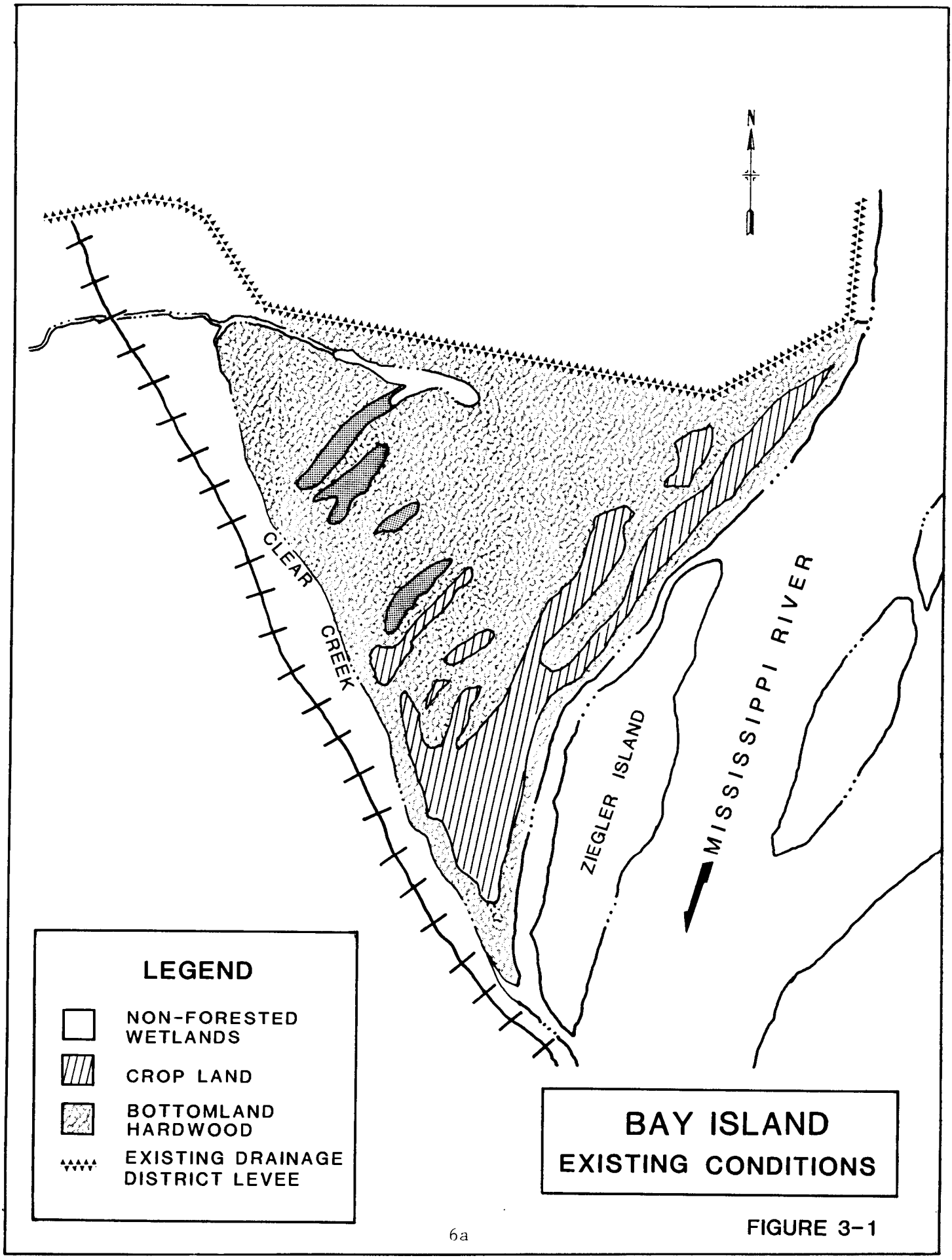
Limited opportunities exist to protect, restore, and improve waterfowl habitat within or adjacent to Pool 22. The extensive system of agricultural levees and drain tiling that was put in place prior to or constructed since Pool 22 was formed has removed vast acreages of wetlands from that which was previously available in this area. From approximately RM 308 to Lock and Dam 22, few natural backwater complexes exist, and privately held lands and large agricultural drainage districts dominate the floodplain. These factors preclude cost-effective development of wetland habitat along most of middle and lower Pool 22. Also, commercial and urban development on the Missouri side of the navigation channel from approximate RM 308 to 310, associated with the city of Hannibal, has removed that reach of the river from consideration (see plate 2).

3. ASSESSMENT OF EXISTING RESOURCES.

a. Resource History. The project area consists of about 650 acres of the Mark Twain National Wildlife Refuge, which is currently managed by the State of Missouri under terms of a cooperative agreement with the USFWS.

The project site is a large, triangular area at the downstream end of Bay de Charles Island. Bay de Charles Island has been extensively leveed for agriculture, leaving only the southernmost tip of the island available for wildlife management. The site includes open water, emergent wetland, bottom land forest, and cultivated areas, as portrayed on figure 3-1.

With the exception of the surrounding Mississippi River and the lower portion of Clear Creek, open water and emergent wetlands are extremely limited at Bay Island. Any water remaining open within the Bay Island boundary is isolated from the main river and Clear Creek. The South River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CLEAR CREEK
ZIEGLER ISLAND
MISSISSIPPI RIVER
LEGEND
NON-FORESTED WETLANDS
CROP LAND
BOTTOMLAND HARDWOOD
EXISTING DRAINAGE DISTRICT LEVEE
BAY ISLAND
EXISTING CONDITIONS

FIGURE 3-1

Drainage District (SRDD) maintains a pump station on Bay de Charles with a pumping capacity of 500 cubic feet per second (cfs). The relationship of the project site to Bay de Charles, Clear Creek, SRDD, and the Mississippi River is depicted on plate 2.

Emergent wetlands variably occupy about 21 acres of the project site, surrounding the only open water pockets that remain following high water events or pump station output. During SRDD pump station events, water is drained from Bay de Charles and discharged to Clear Creek. Discharges generally follow the Clear Creek channel to the river. However, due to interconnecting low areas within Bay Island, some discharge flows in various directions overland throughout the northwest section of the site. The volume of overland flow varies with river stage and Clear Creek discharge. This likely serves to maintain the remaining water pockets and wetland areas. See table 3-1 for an inventory of existing features.

TABLE 3-1

Existing Features

Aquatic Conditions	Area, Acres
Main Channel	N/A
Main Channel Border	N/A
Side Channel	N/A
Open Water (occasional/ephemeral)	20
Small Stream/Slough	1
Total Aquatic	21
Terrestrial/Wetland Conditions	**Area, Acres**
Forested Wetland	519
Non-Forested Wetland/Mudflat	1/
Agriculture (small grain/row crop)	110
Total Wetland/Terrestrial	629
Total Aquatic and Wetland/Terrestrial Resources	650

1/ Dependent on water level.

b. Land Use. The Bay Island area was acquired by the U.S. Army Corps of Engineers for navigation purposes prior to completion of Lock and Dam 22 in 1937. The area remains in fee title ownership by the Corps. As noted above, wildlife and fish management is the responsibility of the State of Missouri. These lands are administered by the USFWS as part of the Mark Twain National Wildlife Refuge under the terms of a Cooperative Agreement between the Department of the Army and the Department of the Interior dated February 14, 1963.

Current management of the area involves regulation as public land open to hunting and fishing under the Missouri Wildlife Code. Sharecropping practices are employed to provide winter wildlife food and cover.

c. Aquatic Resources. Permanent, year-round aquatic habitat within the project boundary is extremely limited and shallow, less than 6 feet deep in all remaining pockets in the project area. As with most of the Mississippi River wetland and aquatic habitats, those of the Bay Island area are being lost to sedimentation. Overland flows during flood events carry sediments into isolated areas and have turned occasionally flooded remnants of channels or sloughs into ephemeral wetlands.

The surrounding aquatic resources are those of the Mississippi River and its channel border and side channel environs. The lower portion of Clear Creek occupies the former downstream end of Bay de Charles. It provides backwater slough-like habitat adjacent to the main channel depending on SRDD pump events and creek discharges.

Other aquatic values of the area are related to seasonal flood events of the Mississippi River. Flooded bottom lands provide low velocity refuge during high flows, and often serve as spawning areas for a wide variety of sport and commercial fish, depending on the depth and duration of flooding. As floodwaters recede, fish larvae and fry are either carried into slough, side channel, or channel border habitats or are trapped in permanent isolated waters or ephemeral ponds. These habitats can be beneficial during summer months as brooding cover, in spite of wide diurnal swings in dissolved oxygen levels. Generally during the summer, fish are eliminated from isolated waters by a combination of elevated temperature and low dissolved oxygen.

With winter ice cover, any areas still holding water display very little habitat value due primarily to reduced oxygen levels brought on by decaying vegetation and low light conditions. In low or no velocity habitats, decaying vegetation creates oxygen demands beyond levels that can be replaced through photosynthesis or inflow. In areas where fish cannot escape these conditions, winter fish kills result.

d. Terrestrial and Wetland Resources. Terrestrial habitat is the main component of the total project area and consists of silver maple association forest. Typical to river bottom lands, the silver maple forest is considered wetland by definition of soils, hydrology, and plant species.

Typical emergent wetland habitat is limited throughout the project area and consists of vegetated shallows containing smartweed, cutgrass, and arrowhead. Temporary shallows or mudflats are dominated by smartweed. Wetlands, including those invaded by willows, vary in areal extent with precipitation and river levels. Wetland area rarely exceeds 40 acres.

Wildlife values associated with the above habitat include feeding, resting, and nursery cover for furbearers and a variety of birds and mammals.

Migratory waterfowl use of the area occurs primarily as flood conditions permit access to row crops and forest mast. Waterfowl food production varies annually according to water level fluctuations, but is generally limited.

Low water levels during the migrations, coupled with sedimentation, reduce the total water surface area available to migratory waterfowl at Bay Island. Unless flooded, much of the food production from the bottom land forest and cultivated areas cannot be used by waterfowl.

e. Endangered Species. Two federally listed endangered species were considered for this project: the bald eagle (Haliaeetus leucocephalus) and the Higgins' eye pearly mussel (Lampsilis higginsi). The bald eagle is generally a winter migrant in the project area, but has been known to nest in Pike County, Illinois, adjacent to the project area. The Higgins' eye is known from collections within 2 miles downstream of the construction site.

Recent occurrences of Federal and State-listed endangered species, including species of concern, for the project area were provided by the MDOC. Two plant species are generally excluded from the project site by habitat requirements. The bald eagle, great blue heron, great egret, and Higgins' eye pearly mussel are all known from the project area. It is anticipated that construction activity may temporarily affect foraging activities for avian species, but their mobility and the availability of other foraging sites nearby should prevent any significant effect to result from project construction. It is expected that the completed project will benefit these avian species.

f. Cultural Resources. There are no previously recorded archeological sites or historic properties in the immediate area to be affected by the proposed project. However, the Bay de Charles area played an important role throughout the entire historic period in this region of Missouri. Two major multicomponent prehistoric archeological sites (23 MA 1 and 23 MA 2) are located in the uplands immediately west of the project area. The sites are known to have Archaic, Woodland, and Mississippian components.

The earliest documented landing in the Pool 22 area was by Father Louis Hennepin, a French Franciscan priest. Beset by floating ice while paddling up the Mississippi River in April 1680, he and two companions landed at what they took to be a stream of considerable magnitude. After a brief exploration, they learned that it was a bay, and Hennepin called it Bay de Charles. Here a crucifix was erected and mass celebrated. The party fraternized with the Indians, and after 2 days resumed its journey northward (Missouri Historical Records Survey 1941:116 referenced in Anderson, et al. 1989). Because of its position on an active floodplain and the temporary nature of the encampment, it is highly unlikely that any archeological remnant of Hennepin's landing remains today.

Mathurin Bouvet was among the first European settlers in the Mississippi River Pool 22 area. In 1781, he received a land grant for a parcel of

property located immediately south of Clear Creek on Bay de Charles (plate 30). This was the locus of an early settlement on Bay de Charles, including a trading post, warehouse, log cabins, fields, and gardens. Allegedly, the settlement had a population of 25 individuals in 1795. In the spring of 1800, the settlement was destroyed by the Sauk and Fox Indians, and Bouvet was reportedly killed (Anderson, et al. 1989). Bouvet's settlement is thought to be immediately adjacent to the present project area. It is likely that Bay Island itself served as a resource procurement area for this settlement, although no recorded historic sites from this period have been found on the island.

Another early site in the project area was Campbell's trading post established in 1814 near the confluence of Bay de Charles and the Mississippi River. Kuhn (1963) describes the location as south of the Schultz farmhouse "on the west side of a road, in a field south of this house," and that "this field has yielded quantities of Indian Relics."

The Bay Island project area was purchased by Charles Gratiot in 1800. The 1881 Mississippi River Commission Map (Chart 129) shows no structures or other cultural features within the proposed project area. However, by 1930 four structures are shown to have been present on or near the proposed western levee alignment for this project. Acquisition photographs on file at the Rock Island District show that three of these structures were frame cottages and one was a frame bungalow. None of the structures is standing today.

g. Adjacent Water Projects. The proposed Bay Island, Missouri, project is adjacent to the Mississippi River 9-Foot Channel, as authorized by the River and Harbor Act of July 3, 1930. Proposed project features of this report will not affect navigation.

h. Sedimentation. A study was conducted to evaluate sedimentation in the Bay Island area. The scope of this study consisted of determining net deposition from 1938 (pre-lock and dam) through 1977. The average total sedimentation rate for the overall Bay Island area has been approximately 7.0 acre-feet/year. Sediment-laden Mississippi River flood flow is the predominant source of sedimentation.

4. PROJECT OBJECTIVES.

The project goal, objectives, and enhancement potentials are presented in table 4-1.

5. ALTERNATIVES.

a. Alternative A, No Federal Action. No Federal action would consist of no Federal funds being provided to meet the project purposes.

TABLE 4-1

Project Goal, Objectives, and Enhancement Potential

Goal	Objective	Unit of Measure	Potential Enhancement Feature	Enhancement Potential	
				Existing	Target
Enhance Wetland Habitat for Migratory Waterfowl	Provide controlled water levels during waterfowl migration - forested and non-forested	Acres	WMU's	40 (currently uncontrolled wetland)	400
	Increase mast tree dominance - forested wetland	Acres	Mast Tree Plantings	6.9	36.9
	Increase total wetland values for migratory waterfowl	Habitat 1/ Suitability Indices & Habitat Units	All	.14	.62-.64
				99.1	420.5-434.0

1/ See Section 6.

b. Alternative B, Water Level Control Through Wetland Management Unit (WMU) Construction. This alternative consists of construction of earthen levees and water control structures for the purpose of controlling interior water levels to support resting and feeding migratory waterfowl. Subalternatives of varying WMU size also were considered.

c. Alternative C, Sediment Deflection Levee. This alternative would consist of an earthen embankment levee parallel to the Mississippi River bank line constructed to provide a 10-year flood event level of protection. The purpose of this levee is to prevent Mississippi River flood flows and associated continuous sediment loads from directly entering the Bay Island project area.

d. Alternative D, Clear Creek Dredging. Clear Creek dredging would include clearing all debris and blockages and excavating a uniform channel section for the portion of Clear Creek adjacent to the management unit perimeter levee as shown on plate 4. The excavated material would be used for perimeter levee fill.

e. Alternative E, Interior Excavation. This alternative would consist of clearing and deepening of existing low interior areas for levee borrow. This excavation could potentially create aquatic habitat.

f. Alternative F, Cover Management. In addition to other habitat improvement measures, consideration was given to modification of vegetative cover. The project area displays typical silver maple association forest cover. Silver maple is the dominant species, with mast producing species such as oak or pecan present in limited numbers. Three approaches to cover modification were investigated: mast tree planting, clearing selected areas to allow natural development of non-forested wetland plants, and clearing selected areas with subsequent planting and annual maintenance of millet or other moist soil species.

6. EVALUATION OF ALTERNATIVES.

Alternatives were evaluated based on engineering considerations, local restrictions or constraints, and on their contribution to project goals and objectives. Alternatives which were eliminated due to engineering considerations or to local restrictions were not subject to further evaluation. However, all remaining alternatives were further evaluated using the following approach.

The MDOC and the Soil Conservation Service have developed a numerical habitat appraisal system, based on the USFWS HEP, which may be used in evaluating existing habitat conditions and planning habitat management strategies. This system is referred to as the Wildlife Habitat Appraisal Guide (WHAG) method.

WHAG is a field evaluation procedure designed to measure habitat quality and to account for land management practices. The method produces Habitat Suitability Indices (HSI's) for areas classified into broad land-use types such as wetland-forested, wetland-nonforested, wetland-crop field, and wetland-grassland. WHAG is based on the assumption that habitat can be numerically described by HSI's calculated from species-habitat models (Urich, et al., 1984).

WHAG involves the utilization of checklist-type appraisal guides for each land-use type. Appraisal guides exist for both upland and wetland habitats. After completion of all appropriate appraisal guides in the field, values are entered into a computer program which rates habitat types based on life requisite requirements for a variety of game and nongame birds and mammals.

Computer results are provided for estimated total HU's, HSI's, and animal numbers. After existing conditions are determined, a manager or study team reviews the habitat appraisal guides to determine where habitat quality can be improved. HU's are annualized for target years in order to evaluate changes in project features over time. As an example, pin oak plantings initially will have little value as forest habitat, but gain value over the 50-year period of analysis. As the overall project matures, forest evaluation characteristics such as stems per acre, percent canopy closure, snags per acre, and cavity trees per acre are assumed to change in a relatively predictable succession. It is the rate of succession that is then used to select target years for project evaluation.

In the case of the subject project, water control will be provided to cropped areas, forested wetlands, and non-forested wetlands. Cropland, which will show no succession over time, was not considered for target year selection. Forested wetlands, including mast species plantings, are assumed to show definite successional changes, but not within the first several years. Non-forested wetlands are likely to remain held in a wetland stage and also were not assumed to significantly change over short time periods due to the sediment reduction effect of the eastward project berm. Evaluation target years therefore were selected by the study team to be 0 (existing conditions), 1 (post-construction), 15, and 50 (project life).

Habitat quality ratings can be improved by: 1) increasing acreage for particular habitat types that may be limited or lacking; 2) altering a limiting factor, such as unpredictable water levels; 3) altering a management strategy such as cropping practice or cover crop composition; or 4) a combination of the preceding, depending on management goals, target species requirements, or available funds.

For the Bay Island HREP, the project goal was enhancement of wetland values for migratory waterfowl. Therefore, the study team selected the appraisal guides for wetland habitats and chose the mallard as a target species or species of emphasis. The WHAG study team was comprised of staff from the MDOC, the USFWS, and the Corps of Engineers. Prior to site sampling, the

study team reviewed aerial photography, topographic maps, and preliminary design drawings to select representative sample sites for WHAG application.

During site sampling, assumptions were developed regarding existing conditions and projected post-project conditions, relative to limiting factors and management practices.

a. Alternative A, No Federal Action. This alternative would not meet the project goal of enhancing wetland habitat.

b. Alternative B, Water Level Control Through Wetland Management Unit Construction. Construction of the WMU's would create over 400 acres of manageable wetland habitat, thereby meeting project objectives of increasing reliable food production, resting, and feeding area for wetland-dependent species, as well as increasing wetland habitat value. The optimum levee heights were chosen based on optimization of the area of impounded water 12 to 18 inches deep as well as other engineering considerations as presented in Section 7 of this report. The levee alignments were selected by setting a traverse which minimized clearing requirements and took advantage of existing high ground to minimize embankment quantities.

Analysis of three potential WMU configurations using WHAG indicated that tandem operation of two WMU's provides greater HU output than operation of either lower or upper unit individually. (Reference figure 6-1.) Further comparison of WMU cost versus habitat unit gain is portrayed in figure 6-2.

c. Alternative C, Sediment Deflection Levee. This alternative was analyzed using WHAG. No significant benefits were revealed for the mallard with similar or negligible benefit for other wetland species, despite over 90 percent reduction in sedimentation with the 10-year levee height. Reference figure 1 in the amendment to the USFWS Coordination Act Report (CAR) dated December 15, 1989, in Appendix A - Correspondence. Sediment reduction with levee heights lower than the 10-year elevation could not be discerned from existing conditions. Because sediment reduction does not provide significant measurable improvement in habitat suitability, no further consideration of Alternative C was given.

d. Alternative D, Clear Creek Dredging. This is primarily a construction alternative for a source of levee fill material. However, increased costs associated with tree clearing and obtaining levee borrow from Clear Creek do not yield any measurable contribution to wetland value. Also, because this section of Clear Creek is often subject to natural blockages caused by fallen trees, debris, and beaver dams, periodic channel maintenance would be required to maintain post-construction hydraulic function throughout the project life. Although some potential benefit to aquatic resources in terms of volumetric expansion of habitat would result from clearing, this alternative was not selected due to engineering and operation and maintenance considerations mentioned above.

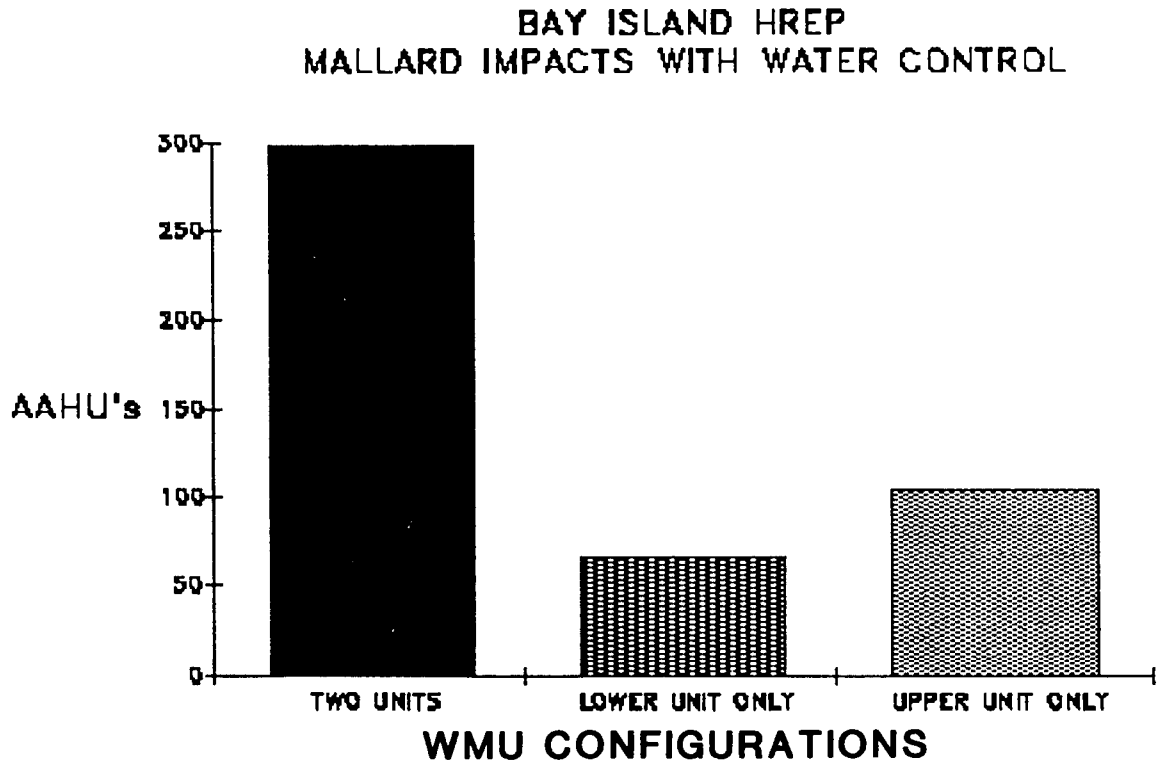
BAY ISLAND HREP
MALLARD IMPACTS WITH WATER CONTROL
AAHU's
300
250
200
150
100
50
0
TWO UNITS
LOWER UNIT ONLY
UPPER UNIT ONLY
WMU CONFIGURATIONS

FIGURE 6-1.

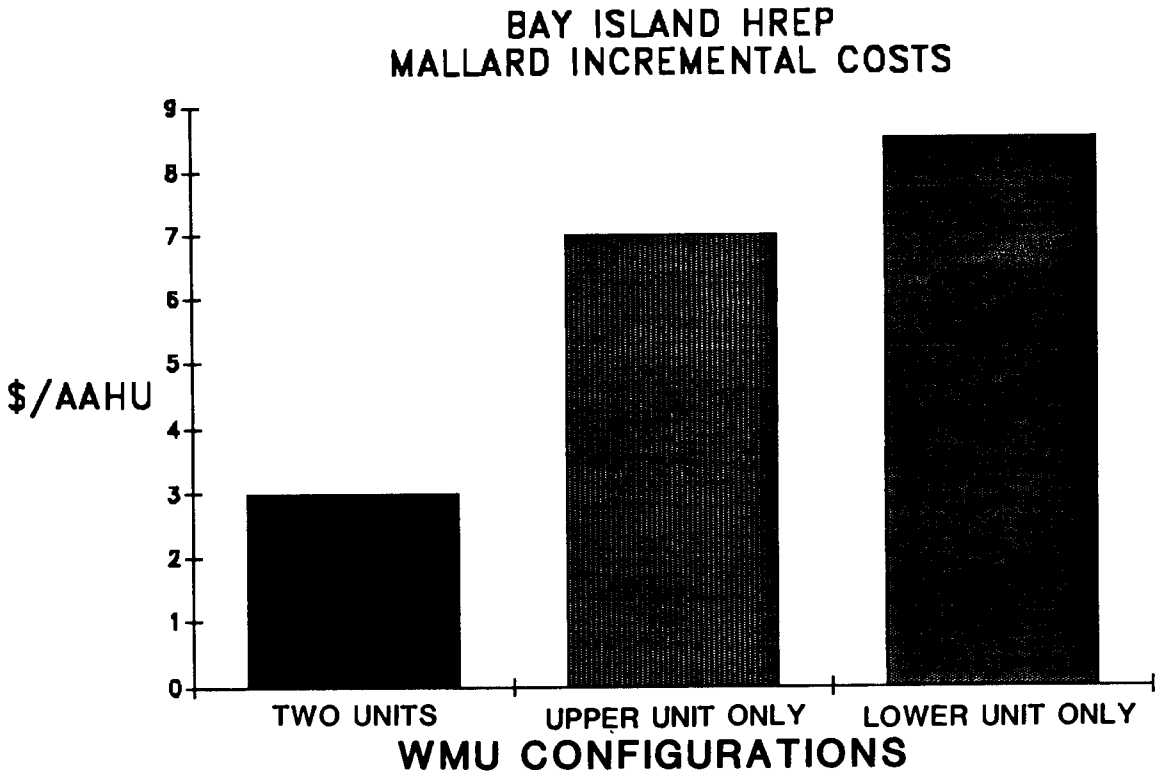
BAY ISLAND HREP
MALLARD INCREMENTAL COSTS
$/AAHU
9
8
7
6
5
4
3
2
1
0
TWO UNITS
UPPER UNIT ONLY
LOWER UNIT ONLY
WMU CONFIGURATIONS

FIGURE 6-2

e. Alternative E, Interior Excavation. This is also a construction alternative for levee fill material. This alternative was examined for incidental aquatic or wetland benefits. However, interior excavation was considered to result in potential fish attraction and entrapment during flood recession. From a wetland evaluation standpoint, this alternative would require non-forested wetland acreages to be converted to open water areas, which leads to subsequent reduced values for migratory waterfowl as represented by the mallard. Therefore, due to the lack of contribution to the project goal and objectives and the elevated costs in levee material, Alternative E was not pursued further.

f. Alternative F, Cover Management. WHAG analysis resulted in gains in HU's as portrayed in figure 1 in the amendment to the USFWS CAR. As individual cover strategies or increments, successively higher gains are realized from mast tree planting to clearing, to clearing and annual planting. However, based on comparison of HU gains versus cost, mast tree (pin oak) planting provides the greatest return in HU (see figure 6-3).

7. SELECTED PLAN WITH DETAILED DESCRIPTION.

a. General Description. Alternatives B and F were selected to be recommended for project construction. The construction of the WMU's to provide water level control (Alternative B) and the cover management (Alternative F) meet the project objectives and are cost effective (see figure 7-1).

b. Water Level Control Through Wetland Management Unit Construction. Over 400 acres of the Bay Island project area can be impounded by the construction of earthen levees and associated water control structures to create a 240-acre forested north WMU and a 165-acre non-forested south WMU as shown in plate 3.

(1) Water Control Plan. During impoundment, the water surface elevation in the north WMU will be 464.0 feet mean sea level (MSL) and the water surface elevation in the south unit will be 466.0 MSL. Table 7-1 shows the areas of incremental water depths for various flooding heights for each WMU. The selected operating water levels are those that maximize the area with water less than 2 feet deep. Migratory waterfowl, in particular dabbling ducks, require water depths of 12 to 18 inches for access to food plants. The proposed water surface elevations represent those elevations which will give the greatest areal average of 12- to 18-inch depth with both management units. The selected water surface elevations represent maximum levels for design purposes; actual operation levels may be lower if desired.

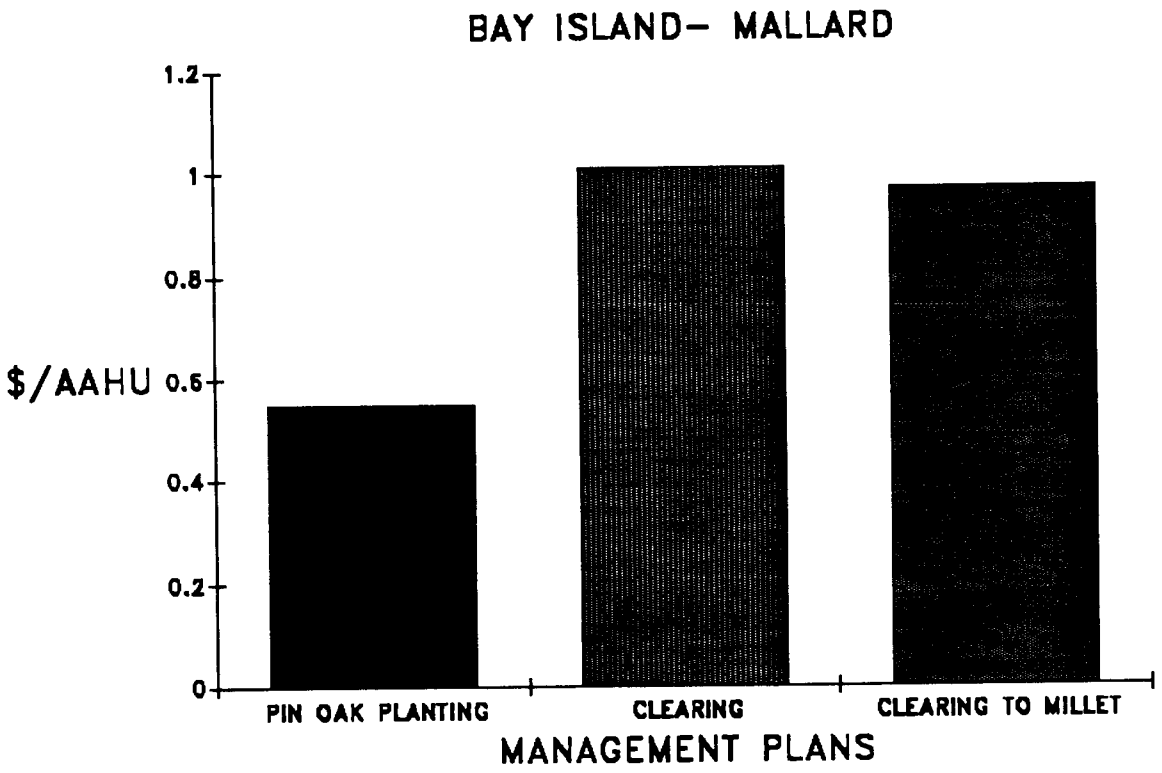
BAY ISLAND- MALLARD
1.2
1
0.8
$/AAHU 0.6
0.4
0.2
0
PIN OAK PLANTING
CLEARING
CLEARING TO MILLET
MANAGEMENT PLANS

FIGURE 6-3

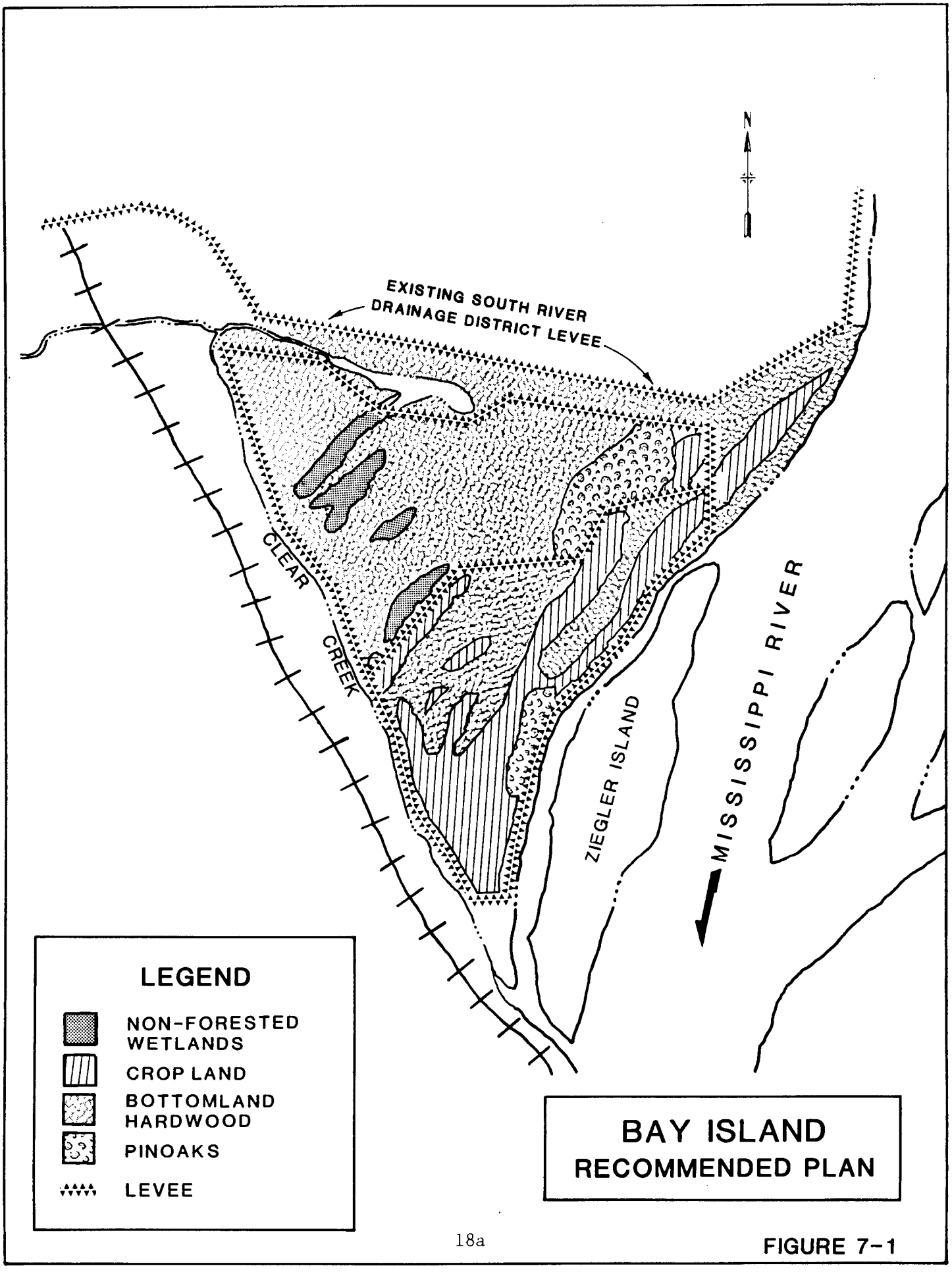
N
EXISTING SOUTH RIVER
DRAINAGE DISTRICT LEVEE
CLEAR
CREEK
ZIEGLER ISLAND
MISSISSIPPI RIVER
LEGEND
NON-FORESTED WETLANDS
CROP LAND
BOTTOMLAND HARDWOOD
PINOAKS
LEVEE
BAY ISLAND
RECOMMENDED PLAN

FIGURE 7-1

TABLE 7-1

Water Depths Versus Height

South WMU

Top Elevation	Acres <1' Deep	Acres 1'-2' Deep	Acres 2'-3' Deep	Acres 3'-4' Deep	Acres >4' Deep	Total Acres Flooded
462	0.3	0	0	0	0	0.3
463	9.3	0.3	0	0	0	9.6
464	9.3	9.3	0.3	0	0	18.9
465	35.0	9.3	9.3	0.3	0	53.9
466	34.9	35.0	9.3	9.3	0.3	88.8
467	30.2	34.9	35.0	9.3	9.6	119
468	31.0	30.2	34.9	35.0	18.9	150

North WMU

Top Elevation	Acres <1' Deep	Acres 1'-2' Deep	Acres 2'-3' Deep	Acres 3'-4' Deep	Acres >4' Deep	Total Acres Flooded
460	9.8	0	0	0	0	9.8
461	29.4	9.8	0	0	0	39.2
462	29.5	29.4	9.8	0	0	68.7
463	35.3	29.5	29.4	9.8	0	104
464	35.0	35.3	29.5	29.4	9.8	139
465	29.0	35.0	35.3	29.5	39.2	168
466	30.0	29.0	35.0	35.3	68.7	198

The water source intake for flooding the WMU's will be located in the south WMU. To flood the north WMU, water will enter through the intermediate levee stop log water control structure. A drainage ditch adjacent to the perimeter levee will be constructed to allow water to flow directly from the water source to the intermediate levee water control structure and then into the north WMU without flooding the south WMU if desired. Both units will gravity drain independently through separate perimeter levee stop log water control structures into Clear Creek. This will allow for completely independent operation (i.e., flooding and draining) of the two WMU's.

Consideration also was given to placing the water intake in the north WMU rather than in the south WMU. However, this would require over-filling the forested unit by 2 feet in order to achieve the optimum top elevation in the south unit. Also, filling the south unit without flooding the north

unit would not be possible in this instance without the construction of an above-grade channel or header canal.

(2) Water Source. The water source for flooding the units will be Ziegler Chute. To accommodate WMU management strategies, a minimum pumping capacity of 6,000 gpm is required. Because Ziegler Chute is a part of the Mississippi River, its water surface levels will fluctuate minimally and can easily supply water for a surface intake pump. The average depth of Ziegler Chute in the vicinity of the proposed pump station is 3 feet.

Clear Creek was considered as a water source. However, since this portion of Clear Creek also is used as a discharge channel for the 200,000 gpm adjacent levee district pump station, the creek flows vary greatly. During normal low-flow conditions, when the drainage district is not pumping, Clear Creek discharge is only approximately 500 gpm. Site visits have revealed that the low-flow channel meanders and has not yet reached stability. Armoring would be required to ensure that channel migration in the vicinity of the intake structure would not occur.

The possibility of using water wells in lieu of a surface intake pump also was investigated. Wells have the potential of providing a clean, low maintenance source of water. Well log information from water wells tapping the alluvial aquifer approximately 8 river miles upstream from Bay Island were obtained from the State of Missouri, Department of Natural Resources. These logs indicate that to achieve a pumping rate of 6,000 gpm, a minimum of 3 wells would be required. This would not be as cost effective as a single-surface intake pumping unit.

(3) Pump Station. The pump station has been sized to fill the north WMU in 15 days. This is the site management filling criterion which requires the greatest pumping capacity. Pump station plans and details are shown on plates 25 and 26.

The pump station will be provided with a 6,000-gpm submersible propeller-type pump. This pump has the capacity to fill the forested unit in 15 days and to fill both units in 23 days total. The pumps will be housed in a vandal-resistant cast-in-place housing. The intake entrance will be equipped with a trash rack. Underground electrical power will be provided to the site, and all necessary electrical equipment will be located on an overhead platform in the vicinity of the pump station, as shown on plate 27.

(4) Water Control Structures. Operation of the WMU's will require the construction of three concrete stop log water control structures as shown on plates 22 and 23. The perimeter levee water control structures are sized to preclude the need for an armored levee overflow section. During a Mississippi River flood event, the opening width in the water control structures were sized to be sufficient to allow the WMU's to rapidly fill with Mississippi River backwater from Clear Creek such that at the point of overtopping, the head differential between the exterior and interior of the WMU's will be 0.7 foot. This will preclude the need for

additional scour protection. The perimeter levee water control structures will have four 5-foot stop log bays. The intermediate levee water control structure will have two 3-foot stop log bays. All of the water control structures will have a steel grate deck to allow for vehicle passage overhead.

(5) Levee Heights. To accommodate the water control plan, the minimum top elevation for the WMU perimeter and intermediate levee system is 468.0 MSL. During filling operations, when water is flowing over the stop logs into the north WMU, the water level elevation in the south WMU will be 466.7. Therefore, a minimum freeboard of 1.3 feet will be provided during filling operations.

From a flood protection standpoint, the proposed perimeter levee will provide slightly more than a 2-year level of protection. To minimize scour potential, the perimeter levee profile parallel to the Mississippi River is sloped upstream to provide for gradual overtopping during flood events greater than 2 years. Also, the water control structures are designed to allow sufficient inflow into the units such that head differential will be only 0.7 foot when overtopping does occur.

Higher levee heights also were considered. From an operation standpoint, no additional shallow water areas would be gained since the proposed levee height of 468.0 will contain the optimized ponding heights with adequate freeboard. Also, because the levee system has features to safeguard against damage from overtopping, and considering that occasional overtopping is acceptable given the nature of the project and management objectives, the increased cost of raising levee heights is not justified.

(6) Levee Borrow. Borrow for the perimeter levee and intermediate levee will come from adjacent ditch excavations or scraped from adjacent cropland as shown on plates 19 through 21. Plans and profiles for ditch excavations are shown on plates 9 through 18. These ditches will serve as an internal drainage system for the WMU's and facilitate the water control plan as described previously.

(7) Site Access. Access to project features requires the construction/upgrading of a crushed stone access road. The majority of the eastern segment of the access road will follow an existing access road alignment from the county road west of the project site to the proposed west perimeter levee. The remainder of the access road, within the project area, will be located on the perimeter levee as shown on plates 19 through 21. The access road will be 10 feet wide and surfaced with 6 inches of crushed stone. The road will be used by MDOC personnel for operation and maintenance activities, as well as by share croppers to access crop areas. The access road also will facilitate delivery of materials for construction of the pump station and water control structures.

The majority of the upgrading work required on the existing access road involves providing a new bridge across Clear Creek. The present bridge is in poor condition and is structurally unfit for future project access. Two

crossing types were considered, a low-flow culvert crossing and a bridge. The low-flow crossing construction would involve building an embankment across the creek. The embankment would have culverts with enough capacity to pass the drainage district outflow plus Clear Creek flow without significantly raising water levels upstream at the drainage district outflow structure. In order to accommodate these conditions without overtopping, culverts with a cross-sectional area larger than the existing channel section would be required. This would require either putting the culvert inverts lower than the existing channel floor and creating a sediment trap or constructing additional embankment to raise the access road. A low-flow crossing also would be a maintenance intensive item.

Hydraulic studies revealed that the construction of a new bridge would allow the passage of flows without significantly raising head upstream. A bridge also would accommodate any future channel maintenance work undertaken by the drainage district.

The new bridge will have a prefabricated deck set on concrete abutments. The span length will be 42 feet and the deck width will be 15 feet. The bridge will be designed to carry an H20 loading. The bottom elevation of the bottom chord of the bridge will be 464.0 feet MSL. This will allow passage of Clear Creek 100-year flow plus the drainage district outflow with 1 foot of clearance.

Access to the site will be controlled by MDOC to prevent public vehicular access to the refuge area and minimize consequent disturbance.

c. Cover Management. Mast tree planting associated with this project will consist of selectively thinning 20 acres to plant pin oak trees in the north WMU and planting 10 acres of pin oaks in the cropped areas of the south WMU, as shown on plate 3. State and District foresters recommended the pin oak planting sites. In the northern WMU, areas with the poorest existing stock and possessing the most mature pecan trees were selected for underplanting with the chosen mast specie. Sites possessing the highest natural elevations, thereby minimizing inundation periods, were selected for pin oak planting in the southern WMU. The planting scheme will consist of 4 acres of balled and burlapped trees, 23 acres of seedlings, and 3 acres of acorns.

8. DESIGN AND CONSTRUCTION CONSIDERATIONS.

a. Existing Site Elevations. The entire Bay Island project area is located within the floodplain of the Mississippi River. Existing ground elevations for the perimeter levees range from 460 to 468 MSL. During the normal dry season (June through December), levee construction can be completed using conventional excavating and earth-moving equipment. The cost estimate (see table 13-1) for the project features reflects this assumption.

b. Foundations of Structures. Due to the relative compressibility of the soils in the vicinity of the stop log structures, consideration during plans and specifications will be given to building the levee higher than final grade and allowing foundation materials to consolidate for a period of time before excavation of the structures begins.

c. Borrow Sites/Construction Materials.

(1) Borrow Sites. Borrow material for the perimeter and intermediate levees will come from adjacent ditch excavation and from the adjacent agricultural fields.

(2) Construction Materials. Only common construction materials are required for this project. Access to the pump station and water control structures will be provided by the access road construction. Crushed stone and bedding materials are available from area quarries and most likely will be trucked to the site. Once the access road is complete, construction materials, including concrete for the water control structures, can be transported using conventional equipment.

d. Erosion Control. An estimated width of 100 feet of existing mature timber will remain between the eastern perimeter levee and Ziegler Chute. This undisturbed zone will provide a natural buffer from Mississippi River high flood events and should adequately protect the perimeter levee.

Seeding will be required immediately following levee and drainage ditch construction to ensure stability from erosion forces.

e. Permits. A Section 401 Water Quality Certification has been obtained from the Missouri Department of Water Resources and is contained in appendix A. A Section 404(b)(1) Evaluation is contained in appendix B.

9. ENVIRONMENTAL EFFECTS.

a. Summary of Effects. The effects of construction involve the conversion of existing habitat, which is subject to periodic, uncontrolled inundation, into habitats which can be subjected to controlled inundation for the purposes of providing food resources and resting habitat for migratory waterfowl.

About 9 acres of cultivated land, 14 acres of forested wetland, 1 acre of shallow water, and 1 acre of emergent wetland will be converted to grassed berm or levee. The interior of the WMU's will contain bottom land forest, wetland, and moist soil species. In the lower unit, water level control will be provided to approximately 105 acres of cropped area and 40 acres of non-forested wetland, facilitating operation as moist soil units. In the upper unit, water level control will be provided to approximately 203 acres of forested wetland, 14 acres of non-forested wetland, and 6 acres of

cropland, allowing primary operation as a green tree reservoir (Fredrickson and Taylor, 1982). This practice allows seasonal impoundment within forested areas without damage or inhibition of normal tree growth.

b. Economic and Social Impacts. This analysis examines the socio-economic effects associated with the proposed habitat rehabilitation project, as required by Public Law 91-611.

(1) Community and Regional Growth. No impacts to the growth of the community or region would be realized as a result of the project.

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

(3) Community Cohesion. No significant impacts to community cohesion would be noticed due to the nature of the project and its limited area of influence. The project site is located in a rural setting adjacent to the city of Hannibal, Missouri.

(4) Property Values and Tax Revenues. The potential value of property within the project area could increase slightly as a result of the proposed project. This land is in Federal ownership, however, so an increase in its value would not increase local tax revenues.

(5) Public Facilities and Services. The proposed environmental enhancement project would maintain and enhance natural resources within Pool 22, which are held in public trust by the Federal Government. The project site, which is federally owned and zoned for wildlife management, serves as a public fishing and hunting site and is managed by the MDOC.

(6) Life, Health, and Safety. Currently, the Bay Island area poses no threats to life, health, or safety of recreationists or others in the area. The proposed project would not impact current conditions in regard to these areas of concern.

(7) Employment and Labor Force. Project construction would slightly increase short-term employment opportunities in the project area. The project would not directly affect the permanent employment or labor force in Marion County.

(8) Business and Industrial Development. Changes in business and industrial activity during construction of the project would not be noticed. The project would require no business relocations.

(9) Farm Displacement. No farms would be affected, as the project site is located entirely on federally owned land.

(10) Noise Levels. Heavy machinery would generate a temporary increase in noise during the construction period. This increase would disturb wildlife and recreationists at the complex. However, the project site is located in an area with limited residential or other development. No significant long-term impacts would result.

(11) Aesthetics. No significant impacts to area aesthetics would result from the project.

c. Natural Resource Effects.

(1) Aquatic System. Due to minimal anticipated change, effects to the aquatic resource were not quantified.

Because the construction alignment is primarily nonaquatic, the proposed project will have minimal direct effect on aquatic habitat. By altering the project area's flood storage capacity for discharges from Clear Creek SRDD, and 2-year frequency events on the Mississippi, some minor changes in the flow regime will result in Clear Creek from higher periodic flow in the channel cross section between the new berm and the corresponding landward elevation. However, hydraulic studies show that the proposed project construction will not significantly raise water levels at the SRDD pump station. Aquatic resources in Clear Creek now exist under irregular fluctuation in this cross section and would likely adjust to a new flow regime in a short period.

Consideration was given to the area's value to the fishery resource of the Mississippi River. It is known that periodically flooded bottom land forest has value as cover, spawning, and nursery habitat, and that such wetlands import, produce, store, recycle, and export biotic and abiotic materials that are used in food chains on-site or at sites downstream (Crance 1988).

A design objective is to avoid sedimentation of structures at the site; therefore, it is necessary that the resulting project not become a sediment trap. The project should avoid entrapment of nutrients and aquatic organisms. Water control structures have been designed to minimize trapping of adult and early life stage fish, as well as allowing off-site transport of other food chain components. Therefore, no significant adverse effects to fish production or the aquatic food chain are expected to result from project construction and operation.

(2) Terrestrial/Wetland System. Effects of the project on terrestrial and wetland resources have been quantified using methodology referred to as the Wildlife Habitat Appraisal Guide (WHAG) methodology (Urich, et al., 1984). WHAG was used during project planning to evaluate various alternative features in terms of an anticipated output of HU's per feature. WHAG application allowed selection of those features and management options which optimize HU's for target species in relation to project costs.

Because the main project objective is enhancement of wetland values for migratory waterfowl, the mallard was selected as a target species for WHAG application. Other non-target species used for evaluation of wetland values included the green heron, wood duck, beaver, northern parula warbler, and prothonotary warbler. Results of WHAG application are discussed in Section 6 - Evaluation of Alternatives.

In addition to WHAG application for output optimization, review of possible effects to the overall wetland system were considered. Species such as the green heron and warblers reflect year-round conditions, as opposed to conditions during waterfowl migration. A consideration during the planning of improvements to migratory waterfowl habitat is to avoid impacts to those species whose life requisites involve habitat for nesting and brooding. No significant detrimental effects to non-target species were revealed during project planning and design; in fact, the WHAG application projected improvements for the green heron and northern parula.

(3) Mineral Resources. No effects to the mineral resources of the area are expected to result from project construction or operation.

d. Cultural Resources. In order to assess the potential impact of the proposed project on significant historic properties, a contract was awarded to Donohue and Associates to conduct a geomorphological assessment, archival review, and archeological survey of the proposed levee alignments and borrow locations. Because borrowing activities in most areas will be restricted to a depth no greater than 4 feet, the assessment was predominantly limited to areas with archeological potential less than 4 feet below the present surface.

The geomorphological assessment indicated that the majority of the project area was blanketed by between 29 and 49 inches of historic alluvium. Based on hand coring, only two discrete areas along the proposed construction area were determined to be sufficiently free of historic alluvium to expose prehistoric surfaces. The archeological survey failed to locate any prehistoric features or artifacts. Furthermore, it was determined, due to deep historic alluvium or the absence of a well-developed buried surface, that the vast majority of the project area had little or no potential to contain buried prehistoric deposits within the proposed impact zone.

However, along portions of the intermediate levee corridor a somewhat better developed buried soil exists below historical deposits which range in thickness between 75 and 105 cm. These areas would have been higher and drier than much of the surrounding lands during portions of the prehistoric past. This area has a moderate potential to contain prehistoric deposits. Due to the depth of alluvium covering this soil horizon, it was not possible to rigorously test the soil using conventional Phase I survey methods. Construction plans are being developed to avoid borrowing activities which could impact this buried soil horizon. Alternatively, an archeologist will monitor all earthmoving in this area during construction. If archeological deposits are encountered, construction will cease

immediately and the Missouri State Historic Preservation Officer (SHPO) will be notified so that appropriate data recovery can proceed.

In terms of historic archeological resources, the remains of four structures were located within the proposed construction right-of-way. Archival data indicate that all four sites date after 1900, are not associated with significant persons, and are not likely to contain archeological data which would increase our understanding of this era of the past. Therefore, the sites are not considered eligible for listing on the National Register of Historic Places.

Based on the detailed archival, geomorphological, and archeological evaluation, no significant historic properties will be impacted by the proposed Bay Island EMP project. In a letter dated September 22, 1989, the Missouri SHPO concurred with this determination. Therefore, the project may proceed in full compliance with the National Historic Preservation Act. However, construction avoidance or archeological monitoring of the sensitive buried landform will be required during project construction.

e. Adverse Effects Which Cannot Be Avoided. The loss of trees and understory associated with levee construction and filling is unavoidable. Temporary elevations in dust, noise, and equipment exhaust also are unavoidable.

f. Short-Term Use Versus Long-Term Productivity. The project is intended to increase the long-term ecological productivity of the Bay Island area of the Mark Twain National Wildlife Refuge. Therefore, the short-term effects resulting from project construction are considered to be acceptable.

g. Irreversible or Irretrievable Resource Commitments. Time, labor, fuel, and other necessary construction materials are considered irretrievable. The conversion of bottom land elevations resulting from levee construction and filling will be irreversible, considering the shift in vegetational components and wildlife value.

h. Compliance With Environmental Quality Statutes. Compliance is summarized in table 9-1.

(1) Endangered Species. The Fish and Wildlife CAR, dated October 23, 1989, noted the bald eagle (Haliaeetus leucocephalus) and the Higgins' eye pearly mussel (Lampsilis higginsi) as federally listed endangered species present in the project area. The CAR indicated that no impacts to the bald eagle or Higgins' eye are anticipated for this project.

The following discussion constitutes the Biological Assessment (BA) for this project.

Bald eagles are generally limited to winter residency in the project area. Eagle use in the project area varies from winter to winter, depending on ice conditions. Temporary disruption of eagle foraging behavior is the

TABLE 9-1

Relationship of Plans to Environmental Protection
Statutes and Other Environmental Requirements

Federal Policies	Compliance
Archeological 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
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
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. 460/-460/-11, 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
National Wildlife Refuge System Administration Act (16 U.S.C. 668DD-668EE)	Full compliance
River and Harbors Act, 33 U.S.C. 403, et seq.	Full compliance
UMR Wildlife and Fish Refuge Act, 16 U.S.C. 721, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Not applicable
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Full compliance
Flood Plain Management (Executive Order 11988)	Full compliance
Protection of Wetlands (Executive Order 11990	Full compliance
Environmental Effects Abroad of Major Federal Actions (Executive Order 12114)	Not applicable
Farmland Protection Act	Full compliance
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)	Full compliance

NOTES:

a. Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or postauthorization).

b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning. Partial compliance entries should be explained in appropriate places in the report and referenced in the table.

c. Noncompliance. Violation of a requirement of the statute. Noncompliance entries should be explained in appropriate places in the report and referenced in the table.

d. Not applicable. No requirements for the statute required; compliance for the current stage of planning.

primary potential effect of construction activity around the project sites. There are no records of eagle nesting in the project area. Given the mobility of the species and the proximity of available foraging habitat throughout the study area, it is anticipated that disturbance of foraging birds will not affect the wintering bald eagle population.

Higgins' eye pearly mussels have been documented in the study area by their presence in a mussel bed downstream of the project area. Their actual presence at the project site is unlikely. Potential effects to mussel species are limited by the nature and location of most project activities.

Mussel bed locations were taken from the USFWS's Resources Inventory for the Upper Mississippi River, Guttenberg, Iowa, to Saverton, Missouri (1984), and the report prepared by Ecological Analysts, Inc., entitled Survey of Freshwater Mussels (Pelecypoda: Unionacea) at Selected Sites in Pools 11 Through 24 of the Mississippi River (1981).

State endangered species information was solicited from the MDOC by the Rock Island District, Corps of Engineers. MDOC staff responded in a letter dated February 8, 1988, that the great blue heron, great egret, Higgins' eye pearly mussel, amethyst shooting star, and red-berried elder were known from the project area. It was noted that no effects to nesting bird species are likely, but that some temporary disruption of feeding opportunity may occur. The noted plant species are recorded from wooded north-facing limestone bluffs and are therefore not likely to be affected by the proposed project. The Higgins' eye pearly mussel has been reported within 2 miles downstream of the construction site, but should not be affected by the project.

In consideration of the foregoing information, the proposed project is expected to have no effect on State or federally listed endangered species.

(2) National Historic Preservation Act and Archeological and Historic Preservation Act. Construction of the preferred plan will not affect any significant historic properties. This action has been fully coordinated with the Missouri SHPO. The project, therefore, may proceed in full compliance with all appropriate historic preservation laws.

(3) Federal Water Project Recreation Act. The construction of the proposed project would have no effect on provisions of this act.

(4) Fish and Wildlife Coordination Act. The project is being coordinated with the USFWS, the MDOC, and other interested agencies and organizations. The Fish and Wildlife CAR, dated October 23, 1989, is located in appendix A. Included is an amendment to the CAR, dated December 15, 1989.

The CAR concurred that the type of work proposed should have no effect on federally listed endangered species and indicated that the proposed work should have no significant adverse effects to fish and wildlife resources

in the project area(s). Also, no mitigation features were recommended for this action.

(5) Wild and Scenic Rivers Act. No rivers listed as "wild and scenic" or rivers in the inventory for listing as "wild and scenic" will be affected by the project.

(6) Executive Order 11988 (Flood Plain Management). Executive Order 11988 directs Federal agencies to: (1) avoid development in the floodplain unless it is the only practical alternative; (2) reduce the hazards and risks associated with floods; (3) minimize the impact of floods on human safety, health, and welfare; and (4) restore and preserve the natural and beneficial values of the floodplain. The proposed action is in accordance with Executive Order 11988.

(7) Executive Order 11990 (Protection of Wetlands). Executive Order 11990 directs Federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when a practicable alternative exists. Wetland definitions apply to the entire project area. Post-construction elevations are not proposed to exceed wetland regulatory elevations for the project area; therefore, no net loss of wetlands is anticicpated.

The proposed project is intended to increase the wetland value, as measured by HSI's and HU's of the Bay Island management area. The proposed levee alignment will affect less than 2 acres of shallow, ephemeral aquatic habitat, but will result in ground elevations suitable for establishment of flood-tolerant wetland vegetation species. The resultant effects of levee construction and management of water levels are not expected to adversely affect the value of the area in terms of ecosystem functions.

Functions considered include hydrology, water quality, food chain support, and maintenance of natural biotic diversity at the site-specific and cumulative levels. Also, no construction activities will proceed without concurrence of Federal and State agencies in support of all applicable permits.

10. SUMMARY OF PLAN ACCOMPLISHMENTS.

The selected plan is projected to optimize wetland enhancement within geographical and funding constraints.

The proposed project is estimated to increase wetland habitat values, as measured in HSI's and HU's, from 10 percent of optimum to 72 percent of optimum for migratory waterfowl. These percentages coincide with habitat quality scores of .1 and .72, respectively. The projected increase in habitat value for migratory waterfowl is not expected to significantly decrease habitat values for other species currently utilizing the project area. Using WHAG descriptors, the project as proposed will raise habitat

rating from poor to good. Habitat quality scores and ratings are: 0.75-1.0, excellent; .50-.75, good; .25-.50, fair; and 0-0.25, poor, respectively.

11. OPERATION AND MAINTENANCE CONSIDERATIONS.

a. Project Data Summary. Table 11-1 presents a summary of project data.

b. Operation. To inundate the WMU's, the pump must be activated manually. The pump also must be deactivated manually once the desired interior water elevations are achieved. Pumping to maintain interior elevations during WMU operation also will be by manual activation/-deactivation. To recover a 0.5-foot drop in interior water level, approximately 5 days of pumping will be required. Once initial flooding is completed (by November 1), total water level drops during the impoundment period (November through February) due to seepage, infiltration, and evaporation are not expected to exceed 0.5 foot. The pump station and water control structures will be equipped with staff gages to easily determine water levels in the WMU's.

During periods when the WMU's are not in operation, the stop logs should be removed from the water control structures. Also, prior to any major Mississippi River flood event, when overtopping of the perimeter levee is anticipated, the stop logs should be removed. This is necessary to facilitate rapid floodwater inflow into the units in order to minimize the differential head between the exterior and interior of the WMU's, thereby minimizing scour damage caused by overtopping of the perimeter levee.

TABLE 11-1

Project Data Summary

Wetland Management Units

Perimeter Levee		
Embankment Fill	55,000	Cubic Yards
Length	19,194	Feet
Top Width	10 or 12	Feet 1/
Top Elevation	469.0	MSL, Station 0+00 to Station 46+50
	469.0 to 468.0	MSL, varies from station 46+50 to station 121+00 and from station 67+17B to station 6+04B
	468.0	Station 121+00 to station 124+50

TABLE 11-1 (Cont'd)

Side slopes	4:1	Horizontal: Vertical
Intermediate Levee		
Embankment Fill	10,165	Cubic Yards
Length	4,800	Feet
Top Width	10	Feet
Top Elevation	468.0	MSL
Side slopes	4:1	Horizontal: Vertical
Pump Station		
Submersible Pump	1	6,000 gpm at 10.1 TDH
Operating Elevations		
Unit Maximum Elevation	466.0	MSL
Sump Floor Elevation	453.0	MSL
Electric Power Source		
Primary Supply	7,200	V, 1 phase
Transformer Size	37.5	kVA, 1 phase
Secondary Supply	120/240	V, 1 phase
Power Converter	30	hp, 3 phase
Inflow Pipe	24	RCP
Perimeter Levee Water Control Structures		
Concrete	54	Cubic Yards
Weir Length	20	Feet
Invert Elevation	462.0	South Unit
	462.5	North Unit
Intermediate Levee Water Control Structures		
Concrete	40	Cubic Yards
Weir Length	6	Feet
Invert Elevation	463.0	MSL
Access Road		
Length	6,150	Feet
Width	10	Feet with crushed stone surface
Tree Plantings		
Area	30	Acres

1/ As shown on plates 19 through 21.

c. Maintenance and Rehabilitation. The proposed features have been designed to ensure low annual maintenance requirements. The estimated annual maintenance and rehabilitation costs are presented in table 13-2. These quantities and costs may change during final design. The principal maintenance features consist of levee inspection and mowing, pump station maintenance, stone replacement for the access road, bridge inspection, and maintenance of tree plantings. The Rock Island District will prepare an operation and maintenance manual for the MDOC.

12. PROJECT PERFORMANCE ASSESSMENT.

The purpose of this section is to summarize monitoring of the project and present proposed data collection for the purpose of evaluating project performance. The principal types, purposes, and responsibility of project monitoring and data collection are presented in table 12-1. The plan for post-construction field observations and quantitative measurements are presented in tables 12-2 and 12-3, respectively.

TABLE 12-1

Monitoring Plan

Type of Activity	Purpose	Responsibility	Instructions
Pre-Project Monitoring	Establish need of proposed project features	Sponsor	-
Baseline Monitoring and Data Collection for Design	Establish baseline monitoring consistent with goals and objectives and meet specific requirements	Corps of Engineers	See plates 28 & 29 and Appendix L
Construction Monitoring	Continue monitoring, assess construction impacts, and meet permit requirements	Corps of Engineers	To be included in construction contract documents
Performance Evaluation Monitoring	Continue monitoring and assess performance of project relative to goal and objectives	1. Sponsor (field observations) 2. Corps of Engineers (quantitative)	1. Table 12-2 2. Table 12-3
Analysis of Biological Responses	Evaluate predictions and assumptions made during initial WHAG analysis	USFWS	1/

1/ Annual waterfowl census data will be obtained from the USFWS to determine waterfowl response to the project.

TABLE 12-2

Annual Post-Construction Field Observations 1/

Goals	Objective	Unit of Measure	Enhancement Feature	Field Observation
Enhance Wetland Habitat for Migratory Waterfowl	Provide controlled water levels during waterfowl migration - forested and non-forested	Acres	Wetland Management Units - forested and non-forested	Presence of waterfowl
	Increase mast tree dominance - forested wetland	Acres	Mast tree plantings	Survival of plantings
	Increase total wetland values for migratory waterfowl	Habitat Suitability Indices & Habitat Units	All	Annual presence of waterfowl

1/ To be submitted to the Corps of Engineers by the USFWS with the annual management report for Cooperative Agreement Lands.

TABLE 12-3

Post-Construction Quantitative Measurements

Goals	Objective	Unit of Measure	Enhancement Feature	Monitoring Plan	Monitoring Intervals (Years)
Enhance Wetland Habitat for Migratory Waterfowl	Provide controlled water levels during waterfowl migration - forested and non-forested	Acres	Wetland Management Units - forested and non-forested	Perform Areal Surveys	5 1/
	Increase mast tree dominance - forested wetland	Acres	Mast tree plantings	Timber Inventory	10
	Increase total wetland values for migratory waterfowl	Habitat Suitability Indices & Habitat Units	All	WHAG analysis ↑ PD-E	1, 15, 50

1/ First monitoring activity to occur in the first year after construction.

13. COST ESTIMATES.

A detailed estimate of initial construction costs is presented in table 13-1. A detailed cost estimate for operation, maintenance, and rehabilitation costs is presented in table 13-2. Quantities may vary during final design and construction. Table 13-3 shows estimated annual monitoring costs for the project.

TABLE 13-1

Detailed Estimate of Cost
(December 1989 Price Levels)

Account Code	Item	Quantity	Unit	Unit Price ($)	Amount ($)	Contingency ($)
06.	Fish and Wildlife Facilities					
06.3.-.-	Wildlife Facilities & Sanctuaries (Perimeter Levee)					
06.3.A.-	Mob and Demob	1	LS	10,000.00	10,000	3,500
06.3.1.B	Clearing and Grubbing	37	AC	2,300.00	85,100	8,510
06.3.1.B	Embankment Fill	55,000	CY	3.50	192,500	19,250
06.3.1.B	Seeding	37	AC	1,200.00	44,400	4,440
	Subtotal, Perimeter Levee				332,000	35,700
06.3.-.-	Wildlife Facilities & Sanctuaries (Intermediate Levee)					
06.3.1.B	Clearing and Grubbing	17	AC	2,300.00	39,100	3,910
06.3.1.B	Embankment Fill	10,200	CY	3.50	35,700	3,570
06.3.1.B	Seeding	17	AC	1,200.00	20,400	2,040
	Subtotal, Intermediate Levee				95,200	9,520
06.3.-.-	Wildlife Facilities & Sanctuaries (Pump Station)					
06.3.N.B	Excavation	175	CY	5.00	875	438
06.3.N.B	Dewatering	1	LS	5,000.00	5,000	2,500
06.3.N.B	Backfill	50	CY	10.00	500	250
06.3.N.C	Structural Concrete	65	CY	400.00	26,000	13,000
06.3.G.B	24-Inch RCP	116	LF	25.00	2,900	725
06.3.N.E	Trash Rack, Ladder, M.H.'s, Etc.	1	LS	6,000.00	6,000	1,800
06.3.N.Q	Pump, Motor, Dis. Pipe	1	LS	37,000.00	37,000	11,100
06.3.N.R	Power Supply	1	LS	15,000.00	15,000	4,500
	Subtotal, Pump Station				93,275	34,313

TABLE 13-1 (Cont'd)

Account Code	Item	Quantity	Unit	Unit Price ($)	Amount ($)	Contingency ($)
06.3.-.-	Wildlife Facilities & Sanctuaries (Water Control Structure, North. Per. Levee)					
06.3.5.B	Sheet Pile Cutoff	1,085	SF	15.00	16,275	3,255
06.3.5.C	Structural Concrete	66	CY	400.00	26,400	7,920
06.3.5.E	Grating	276	SF	25.00	6,900	2,070
06.3.5.E	Steel Guardrail	88	LF	25.00	2,200	1,100
06.3.5.-	Stop Logs	240	LF	2.00	480	120
06.3.3.C	Riprap	75	TN	25.00	1,875	375
	Subtotal, North Water Control Structure				54,130	14,840
06.3.-.-	Wildlife Facilities & Sanctuaries (Water Control Structure, South. Per. Levee)					
06.3.5.B	Sheet Pile Cutoff	1,085	SF	15.00	16,275	3,255
06.3.5.C	Structural Concrete	66	CY	400.00	26,400	7,920
06.3.5.E	Grating	276	SF	25.00	6,900	2,070
06.3.5.E	Steel Guardrail	88	LF	25.00	2,200	1,100
06.3.5.-	Stop Logs	240	LF	2.00	480	120
06.3.3 C	Riprap	60	TN	25.00	1,500	300
	Subtotal, South Water Control Structure				53,755	14,765
06.3.-.-	Wildlife Facilities & Sanctuaries (Water Control Structure, Intermediate Levee)					
06.3.5.B	Sheet Pile Cutoff	800	SF	15.00	12,000	2,400
06.3.5.C	Structural Concrete	50	CY	400.00	20,000	6,000
06.3.5.E	Grating	96	SF	25.00	2,400	720
06.3.5.E	Steel Guardrail	60	LF	25.00	1,500	750
06.3.5.-	Stop Logs	50	LF	2.00	100	25
06.3.3.C	Riprap	40	TN	25.00	1,000	200
	Subtotal, Intermediate Water Control Structure				37,000	10,095
06.3.-.-	Wildlife Facilities & Sanctuaries (Access Road)					
06.3.C.B	Crushed Stone Surface	2,000	TN	18.00	36,000	18,000
	Subtotal, Access Road				36,000	18,000

TABLE 13-1 (Cont'd)

Account Code	Item	Quantity	Unit	Unit Price ($)	Amount ($)	Contingency ($)
06.3.-.-	Wildlife Facilities & Sanctuaries (Access Road Bridge)					
06.3.C.B	Prefabricated Deck & Wearing Surface	1	LS	20,000.00	20,000	5,000
06.3.C.B	Structural Concrete	54	CY	400.00	21,600	6,480
06.3.C.B	Granular Backfill	675	TN	18.00	12,150	6,075
06.3.C.B	Steel Guardrail	180	LF	25.00	4,500	2,250
	Subtotal, Access Bridge				58,250	19,805
06.3.-.-	Wildlife Facilities & Sanctuaries (Tree Plantings)					
06.3.3.B	Hypo-hatchet treatment	20	AC	500.00	10,000	1,000
06.3.3.B	Acorns	3	AC	175.00	525	52
06.3.3.B	Seedlings	23	AC	250.00	5,750	575
06.3.3.B	Balled and Burlapped	4	AC	5,000.00	20,000	2,000
06.3.3.B	Fertilize/Prep.	20	AC	100.00	2,000	200
	Subtotal, Tree Plantings				38,275	3,827
	Subtotal, Construction Costs				797,885	
	Subtotal, Contingencies (17.8%)					160,865
06.	Total, Fish and Wildlife Facilities				958,750	
30.	Planning, Engineering and Design					
	Definite Project Report				228,000	
	Plans and Specifications				50,000	
	Engineering During Construction				2,000	
	Total				280,000	
31.	Construction Management				63,750	
	TOTAL PROJECT COST				1,302,500	

TABLE 13-2

Estimated Annual Operation, Maintenance, and Rehabilitation Costs

(December 1989 Price Levels)

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Operation				
Pump station power	15,130	kWh	0.07	1,059
Pump operation	20	Hr	17.00	340
Stop log operation	16	Hr	17.00	272
Subtotal - Operation				1,671
Maintenance				
Levee inspection	40	Hr	17.00	680
Levee mowing (1 mowing per year)	50	Ac	30.00	1,500
Levee erosion	60	CY	15.00	900
Pump station maintenance (debris and sediment removal, mechanical/ electrical)	40	Hr	30.00	1,200
Stop log replacement	10	Ea	10.00	100
Access road crushed stone	20	Tn	20.00	400
Bridge inspection	20	Hr	30.00	600
Planting maintenance (mowing and/or herbicide, tree replacement)	30	Ac	35.00	1,050
Subtotal - Maintenance				6,430
Rehabilitation				1/
Subtotal				8,101
Contingencies (16%)				1,299
TOTAL PER YEAR				9,400

1/ Rehabilitation cannot be accurately estimated. Rehabilitation is reconstructive work that significantly exceeds the annual operation and maintenance requirements identified above and which is needed as the result of major storm or flood events.

TABLE 13-3

Estimated Annual Monitoring Costs
(December 1989 Price Levels)

Monitoring Type	Monitoring Activity	Average Annual Cost ($)
Data Collection for Design		1/
Construction		1/
Performance Evaluation		
a. Quantitative	Areal Survey	50
	Timber Inventory	325
	WHAG Analysis	95
b. Field Observations 2/		0
Subtotal Monitoring		470
Contingencies		130
Total Per Year		600

1/ These costs are incorporated in project planning, design, and construction costs.

2/ To be included in USFWS annual management report for Cooperative Agreement lands; no significant increase in cost is identified.

14. REAL ESTATE REQUIREMENTS.

a. General. All habitat enhancement features are located on Corps of Engineers-owned General Plan lands. These lands are managed under a Cooperative Agreement between the Department of Interior, USFWS, and the Corps of Engineers dated February 14, 1963. Management of these project lands is administered by the MDOC under a successive Cooperative Agreement between the USFWS and MDOC.

b. Local Cooperation Agreements/Cost-Sharing. Funding for the initial construction of the proposed project will be 100 percent Federal. Since the project lands are all managed as part of the Mark Twain National Wildlife and Fish Refuge system, the Water Resources Development Act of 1986 (Public Law 99-662) is the basis for the first cost Federal funding and provides:

Section 906. FISH AND WILDLIFE MITIGATION
(e) . . . the first cost of such enhancement shall be a Federal cost when - such activities are located on lands managed as a national wildlife refuge.

A draft memorandum of agreement between the Corps of Engineers and the USFWS has been included in this report as appendix C. Estimated operation and maintenance costs are presented in table 13-2.

15. SCHEDULE FOR DESIGN AND CONSTRUCTION.

Table 15-1 presents the schedule of project completion steps.

TABLE 15-1

Project Implementation Schedule

Requirements	Scheduled Date
Submission of Draft DPR to Corps of Engineers, North Central Division and participating agencies for Review	Sep 89
Formal distribution of DPR for Public and Agency Review	Jan 90
Submit Final and Public Reviewed DPR to North Central Division	Mar 90
Receive Plans and Specification Funds	Jun 90
Obtain construction approval by Assistant Secretary of the Army (Civil Works)	Sep 90
Submit final plans and specifications to North Central Division and participating agencies for review and approval.	Dec 90
Obtain approval of the plans and specifications	Jan 91
Advertise contract	Jul 91
Contract award	Sep 91
Complete construction	Sep 92

16. IMPLEMENTATION RESPONSIBILITIES AND VIEWS.

a. Corps of Engineers. The Corps of Engineers, Rock Island District, is responsible for project management and coordination with the USFWS, the State of Missouri, and other cooperating agencies. The Rock Island District will submit the subject DPR; program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and inspection.

b. U.S. Fish and Wildlife Service. The USFWS, the Federal sponsor, will ensure that all proposed features are compatible with Refuge objectives and management strategies and ensure that operation and maintenance described in table 13-2 of this report is performed in accordance with Section 906(e) of the Water Resources Development Act of 1986.

c. Missouri Department of Conservation. The MDOC, the non-Federal proponent, is responsible for all pre-project monitoring necessary to establish the need for the proposed project features. As a proponent of the project, MDOC has provided technical and other advisory assistance during all phases of project development and will continue to provide assistance during project implementation. In accordance with Section 906(e) of the Water Resources Development Act of 1986, the MDOC is responsible for the non-Federal share of operation and maintenance, as estimated in table 13-2.

17. COORDINATION, PUBLIC VIEWS, AND COMMENTS.

a. Coordination Meetings. Close coordination between Corps of Engineers, USFWS, and MDOC personnel was effected during the planning period. A listing of meeting follows:

(1) August 13, 1986 - Onsite meeting to discuss objectives and scope.

(2) October 18, 1988 - Onsite meeting to further scope project and define objectives.

(3) October 17, 1989 - Meeting to review/revise draft report.

(4) This project was fully coordinated with the Missouri SHPO. By letter dated September 22, 1989, the SHPO concurred that the project will not affect significant historic properties.

b. Environmental Review Process. This project meets the requirements of the National Environmental Policy Act, as evidenced by the

Environmental Assessment which is an integral part of this report and the Finding of No Significant Impact.

18. CONCLUSIONS.

The Bay Island, Missouri, habitat rehabilitation and enhancement project represents an outstanding opportunity to gain about 400 acres of manageable wetlands, benefitting migratory waterfowl and other wetland species. The availability of this habitat type at other locations within or adjacent to Pool 22 has been severely limited by the establishment of extensive drainage districts and the levee construction and drain tiling associated with such reclamation practices.

Forested and non-forested WMU's have been proposed and designed for this site. Water level management on over 400 acres would be accomplished by the construction of approximately 24,000 feet of levees, 3 stop log structures, and a pump station.

In addition to the development of the WMU's, the project would include the planting of approximately 30 acres of mast trees in order to diversify the existing lowland forest and increase available food resources over time.

When considered in conjunction with other local, State, and Federal projects in support of wetlands and waterfowl resources, cumulative benefits to waterfowl in the Upper Mississippi River System are anticipated as a result of the construction and operation of this project. Therefore, expenditure of public funds for the finalization of plans and specifications and future construction is justified.

19. RECOMMENDATIONS.

I have weighed the accomplishments to be obtained from this environmental rehabilitation and enhancement project against its cost and have considered the alternatives, impacts, and scope. In my judgement, this project, as proposed, justifies expenditure of Federal funds. I recommend that the Secretary of the Army approve construction of two WMU's at the Bay Island, Missouri, site.

Construction will include: approximately 24,000 feet of low elevation (4 to 6 feet) levees; 3 stop log structures; a 6,000-gpm pump station; planting of 30 acres with mast trees; and access improvements as specified in this document. Complete implementation of this project as designed will

provide over 400 acres of manageable wetlands to the benefit of migratory waterfowl, shorebirds, and other species endemic to this habitat type. The estimated general design and construction costs of this project are $228,000 and $1,075,000, respectively. This project qualifies for 100 percent Federal funding of first costs according to Section 906(e)(3) of Public Law 99-662. In addition, I recommend that funds in the amount of $50,000 be expeditiously allocated for the preparation of plans and specifications.

John R. Brown
Colonel, U.S. Army
District Engineer

LITERATURE CITED

Adamus, P.R., and L.T. Stockwell. 1983. A method for wetland functional assessment: Vol I and II. U.S. Department of Transportation Report Nos. FHWA-IP-82-23 and 24.

Crance, J.H. 1988. Relationships between palustrine wetlands of forested riparian floodplains and fishery resources: a review. U.S. Fish and Wildlife Serv. Biol. Rep. 88(32). 27 pp.

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Fredrickson, L.T., and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Serv. Res. Publ. 148. 29 pp.

Grubaugh, J.W., and R.V. Anderson. 1988. Spatial and temporal availability of floodplain habitat: long term changes at Pool 19, Mississippi River. Am. Midl. Nat. 119 (2): 402-411.

Urich, D.L., et al. 1984. Habitat appraisal of private lands in Missouri. Wildl. Soc. Bull. 12:350-356.

U.S. Fish and Wildlife Service. 1984. Resources Inventory for the Upper Mississippi River, Guttenberg, Iowa, to Saverton, Missouri.

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the information provided by this Environmental Assessment, along with data obtained from Federal and State agencies having jurisdiction by law or special expertise, and from the interested public. I find that the proposed habitat enhancement project at Bay Island will not significantly affect the quality of the human environment. Therefore, it is my determination that an Environmental Impact Statement is not required. This determination will be reevaluated if warranted by later developments.

Alternatives considered include: (a) no Federal action; (b) wetland management unit development; (c) sediment deflection levee construction; (d) and (e) dredging existing or proposed water areas; and (f) cover management. The proposed project will consist of a combination of alternatives b and f.

Factors considered in making a determination that an Environmental Impact Statement was not required were as follows:

a. The project is anticipated to improve the value of the Bay Island area for migratory waterfowl.

b. Aside from temporary disturbance, no long-term adverse impacts to natural or cultural resources are anticipated. No endangered species, either State or Federal, will be affected by the project action.

c. Land use after the project should remain unaltered, and no economic impacts to the project area are anticipated.

d. The project is in compliance with Sections 401 and 404 of the Clean Water Act.

23 March 1990
Date

John R. Brown
Colonel, U.S. Army
District Engineer

APPENDIX A

CORRESPONDENCE

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS:
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION:
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

February 8, 1989

Mr. Dudley M. Hanson
Chief, Planning Division
Rock Island District, Corps of Engineers
Clock Tower Bldg.
P. O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Hanson:

This responds to your request for information regarding threatened or endangered species which may be impacted by the proposed Habitat Rehabilitation Project located on Bay Island, Pool 22, approximate river miles 310.5 - 312R.

An examination of our Heritage database revealed the following occurrences relative to this project area:

Great blue heron (Ardea herodias) and great egret (Casmerodius albus) occur on McDonald Island (IL), within 1.0 mile of Bay Island. These birds are not listed by the federal government (U. S. Fish and Wildlife Service) or Missouri (Department of Conservation); they are, however, species of concern to both agencies.

The project is not expected to impact nesting activity of the heron. Assuming that some feeding activity occurs on Bay Island, it is possible that project construction may temporarily alter or impact feeding activity. The completed project should, however, benefit these birds.

Amethyst shooting star (Dodecatheon amethystinum) occurs within 1.0 mile of the project area. This plant is rare in Missouri. The record is from 1987.

Red berried elder (Sambucus pubens) occurs within 1.0 miles of the project area. This plant is endangered in Missouri. The record is from 1987.

These two plants occur on wooded, north-facing limestone bluffs and should not be impacted by this project.

Higgins' eye pearly mussel (Lampsilis higginsi) has been reported within two miles downstream of the construction site. This species is listed as endangered at both federal and state levels.

The project is not expected to impact this species.

If you have questions or wish to further discuss this matter, please contact Mr. Norman P. Stucky at the above address.

Sincerely,

Dan F. Dickneite

DAN F. DICKNEITE
ENVIRONMENTAL ADMINISTRATOR

cc: U. S. Fish and Wildlife Service (Nelson)
Rock Island, Illinois

U. S. Fish and Wildlife Service (Stratton)
Mark Twain Refuge
Quincy, Illinois

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Division of Parks, Recreation,
and Historic Preservation

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS, RECREATION, AND HISTORIC PRESERVATION
P.O. Box 176
Jefferson City, MO 65102
314-751-2479

September 22, 1989

Mr. Dudley Hanson
Chief, Planning Division
Department of the Army
Rock Island District,
Corps of Engineers
P.O. Box 2004
Rock Island, Missouri 61204-2004

RE: Proposed Low Level Water Retentionl Levee Project (COE), Bay Island, Marion County, Missouri

Dear Mr. Hanson:

The Historic Preservation Program has reviewed the August 1989 report entitled "Phase I Archaeological Survey, Bay Island, Marion County, Missouri" by Joseph Nixon, et al. Based on this report, it is evident that an adequate cultural resource survey has been made of the project area.

We agree with the investigator's recommendations as outlined on pages 50-54 of the report that no significant cultural resources are located within the proposed project area. Therefore, we have no objection to the initiation of project activities.

However, if the currently defined project area or scope of project related activities is changed or revised, or cultural materials are encountered during construction, the Missouri Historic Preservation Program must be notified and appropriate information relevant to such changes or revisions be provided for further review and comment, in order to ascertain the need for additional investigations.

If I can be of further assistance, please write or call 314/751-7860.

Sincerely,

HISTORIC PRESERVATION PROGRAM

Michael S. Weichman
Senior Archaeologist

MSW:nc

cc: Kenneth Barr
Joseph Nixon

JOHN ASHCROFT
Governor

J. TRACY MEHAN III
Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176
Jefferson City, MO 65102

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Division of Parks, Recreation,
and Historic Preservation

Marion 3.000

October 6, 1989

Mr. Robert Kelley, P.E., Chief Engineering Division
U.S. Army Engineer District, Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, IL 61204-2004

Dear Mr. Kelley:

The Department of Natural Resources, Water Pollution Control Program, has reviewed your request for water quality certification for the proposed Bay Island habitat rehabilitation and enhancement project at Pool 22, Upper Mississippi River, miles 311 through 312 in Marion County, Missouri. This office certifies that the proposed activity apparently will not cause the general or numeric criteria to be exceeded nor impair beneficial uses established in Water Quality Standards, 10 CSR 20-7.031.

The certification is being issued under Section 401 of Public Law 95-217, the Clean Water Act of 1977.

Sincerely,

MISSOURI CLEAN WATER COMMISSION

Charles A. Stiefermann, P.E.
Director of Staff

CAS:jhk

cc: Ms. Barbara Kimber, Rock Island District, Corps of Engineers

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

October 16, 1989

Colonel John R. Brown
District Engineer
Rock Island District
U.S. Army Corps of Engineers
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

RE: Review of Draft Definite Project Report with EA for the Bay Island, Missouri Habitat Rehabilitation and Enhancement Project

Thank you for your letter, dated September 21, 1989, requesting our review comments. In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act, we have reviewed the proposed project and provide the following comments:

The cooperative effort between the U.S. Fish and Wildlife Service, the Missouri Department of Natural Resources and the Corps has led to the planning and completion of many habitat enhancement projects along the Mississippi River. We support these projects and would be pleased to become a working partner in the scoping and planning procedures of future projects.

As you are aware, the Environmental Protection Agency (EPA) has a policy of "no net loss" on wetlands. We are concerned, therefore, about the apparent losses inherent in this project proposal. We recognize the enhanced values gained and the forested wetland management unit, which would be managed to gain the maximum use by waterfowl and other aquatic species. However, the loss of existing wetland acres due to construction of the water control structures will result in the continued reduction of the resource and will suggest to others that if habitat values are increased, then reduction is justified.

However, we also recognize that without the control structures designed into the project, the area would eventually silt in to the extent that wetlands would naturally diminish and their associated values would disappear. Because wetland losses incurred in this project are necessary in order to halt the siltation of the resource, we concur with the draft report and environmental assessment. We encourage you and other involved agencies to consider wetland losses in future projects of this nature and to work toward the "no net loss" goal.

Thank you for the opportunity to comment. If you have any questions, please write to me, or call Mr. Dewayne Knott at (913) 236-2823.

Sincerely,

Lawrence M. Cavin
Chief, Environmental Review
and Coordination Section

cc: U.S. Fish and Wildlife Service, Columbia, Missouri
U.S. Fish and Wildlife Service, Minneapolis (Chuck Gibbons)
Missouri Department of Natural Resources
Missouri Department of Conservation (Norm Stucky)

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

October 23, 1989

Colonel John R. Brown
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This constitutes our Fish and Wildlife Coordination Act report on the Bay Island Habitat Rehabilitation and Enhancement Project, Mississippi River Pool 22, Marion County, Missouri. The project is a component of the Upper Mississippi River System Environmental Management Program authorized by the 1985 Supplemental Appropriation Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The authority for this report is contained in Section 2 of the Fish and Wildlife Coordination Act of 1958 (Public Law 85-624).

The area proposed for the Bay Island project is United States property currently managed by the Missouri Department of Conservation (MDC). The tract was acquired for the Upper Mississippi River Navigation Project and is included in the Mark Twain National Wildlife Refuge (NWR) by means of a cooperative agreement between our agencies. Therefore, provisions of the National Wildlife Refuge Administration Act require that a compatibility statement, finding of no significant impact and a special use permit be approved by our Regional Director prior to construction. The project planning process dictates that our statement be completed at the same time as your final report and environmental statement. It is for this reason that we have been designated as a cooperating agency for the purposes of compliance with the National Environmental Policy Act.

BACKGROUND

The goal of the Upper Mississippi River System Environmental Management Program is to implement "...numerous enhancement efforts...to preserve, protect, and restore habitat that is deteriorating due to natural and man-induced activities." The objective of these enhancement efforts is to recover some of the

riparian habitat diversity that has been lost due to construction of the navigation project and the effects of sedimentation.

PROJECT DESCRIPTION

The Bay Island project is located on a triangular 700-acre tract at the downstream end of Bay de Charles Island. The area, acquired by the Corps of Engineers in 1937, contains mainly bottomland hardwoods and cultivated fields. The MDC manages the fields as wildlife food plots by sharecropping small grains and/or row crops; 25% of the crops are left unharvested in the fall. Emergent wetland habitat is limited on the site, and there is currently no way to control water levels for management purposes. Several isolated emergent wetlands are located in the forested portion of the area, and these are showing signs of sedimentation, characterized by extensive woody invasion.

The proposed project would involve construction of 13,000 linear feet of earthen levees that would divide the area into a 240-acre forested wetland unit and a 165-acre non-forested unit. Water level manipulation would be accomplished by pumping from Clear Creek or the Ziegler Island side channel. The objective would be to flood the units during the fall migration to provide feeding and resting habitat for migratory waterfowl, particularly mallards. The units could be operated independently, thus providing management options for moist soil management in the non-forested unit. Thus future management plans could be established to provide habitat for species such as shorebirds or other nongame species.

A sediment deflection levee would be constructed along the river side of the area in order to retard the rate of sediment deposition in the management units. One small portion of each unit would also be planted to pin oak, a species of high food value to mallard ducks.

METHODOLOGY

In order to quantify the existing habitat and the impacts of the proposed features on the Bay Island project area a habitat evaluation was performed at the site. The methodology selected was the Missouri Habitat Appraisal Guide (WHAG) procedures developed by the MDC and the Soil Conservation Service. A list of variables for each habitat are measured on site which provide habitat units for several wildlife species. Once the existing habitat values are established the values for variables affected by the project are modified to calculate impacts to the selected evaluation species. In order to provide a standard of comparison for the 50-year analysis target year conditions were established at years 0 (existing), 1, 15 and 50, and average annual habitat units were calculated for selected evaluation species. Mallard and wood duck were selected as the primary species of concern for

this project, which is in keeping with the established goals of the Mark Twain NWR.

We wish to acknowledge the WHAG team efforts provided by Bob Clevenstine and Gary Swenson of your staff, and Troy LaRue, Norm Stucky and Dave Urich of the MDC.

EXISTING FISH AND WILDLIFE RESOURCES

Aquatic resources at the Bay Island site are limited to the stream habitat in Clear Creek along the western boundary of the area, and the Mississippi River (Zieglar Chute) on the eastern boundary. The features proposed in the selected plan will not affect those aquatic resources.

The terrestrial resources at Bay Island are outlined in the following table.

Table 1- Bay Island, Missouri- Existing conditions.

HABITAT	ACRES
Forested wetland.....	530
Non-forested (emergent) wetland.....	40
Cultivated fields (small grain/row crops).....	120
TOTAL.....	700

White-tailed deer, wild turkey, rabbits, raccoons, squirrels and opossums are among the more common species found on the site. Waterfowl and other migratory birds are attracted to the area when water conditions provide appropriate habitat.

Bald eagles and Indiana bats are the only federally listed threatened or endangered species that would be expected to utilize habitat at Bay Island. There are no eagle nesting sites on the area, and potential feeding and roosting sites for bats will not be affected. Therefore the proposed project features would have no effect on these species. Several species of federally listed threatened and endangered mussels could inhabit river habitats adjacent to the project, but the proposal will have no impact on aquatic resources.

FUTURE WITHOUT THE PROJECT

Terrestrial habitat conditions at Bay Island should gradually improve over time for most wildlife species, although a gradual deposition of sediment during periods of high water will slowly reduce the quantity and quality of emergent wetlands. Forested wetlands will continue to encroach on the non-forested segments, and an active forestry management program will result in 75% of the area being rejuvenated over the 50-year. The number of snags

per acre will also increase, providing improved habitat for wood ducks and other cavity-nesting species. The food plot management techniques currently employed on the area would not be expected to change in the absence of water control features.

FUTURE WITH THE PROJECT.

Three structural increments were analyzed over the 50-year project life. The first increment (Plan B) includes construction of the water control dikes, pumps and sediment deflection levee. The dike and levee construction will permanently convert approximately 25 acres of the site to grassland. Plan C includes the features of Plan A plus 30 acres of pin oak plantings in two locations, using a mixture of acorns, seedlings and balled and burlaped trees. Plan D would include all the previous features, plus conversion of 40 acres of forested wetland to emergent marsh. Plan E would differ from Plan D in that the same 40 acres of forested wetland would be converted to cropland instead of marsh. Table 2 indicates the acreage assigned to each habitat type in each plan. The attached charts show the average annual benefits for selected species for each increment.

Table 2- Bay Island EMP- Alternative Plan Habitats (acres).

PLAN:	A	B	C	D	E
NON-FORESTED WETLAND	50	48	48	88	48
FORESTED WETLAND	530	516	526	486	486
CROPLAND	120	111	101	101	141
GRASSLAND	0	25	25	25	25

A WHAG analysis was performed on the five alternative futures, and the results for selected evaluation species are described in table 3.

Table 3- Bay Island EMP- Average Annual Habitat Units for Selected Species (50-year project life).

PLAN:	A	B	C	D	E
MALLARD	98	422	439	442	452
CANADA GOOSE	17	27	26	34	34
WOOD DUCK	205	227	225	205	213
PARULA WARBLER	272	274	260	242	250

The chart below indicates the percent change from the without project condition (i.e., loss or gain in average annual habitat units) assignable to each plan increment for three evaluation species. The first increment, the levee and pump system for water level control would provide over a three-fold increase in average annual benefits for mallards. Increment two, the 30-acre plantings of pin oaks, would provide an additional 11 percent increase in value for mallards. The third increment, clearing of

bottomland timber for open marsh management, provides virtually no additional benefits for mallards, but clearing for crop fields (Plan E) would produce a 13% improvement for the species. It is important to note, however, that Plan E has significant adverse impacts to wood ducks.

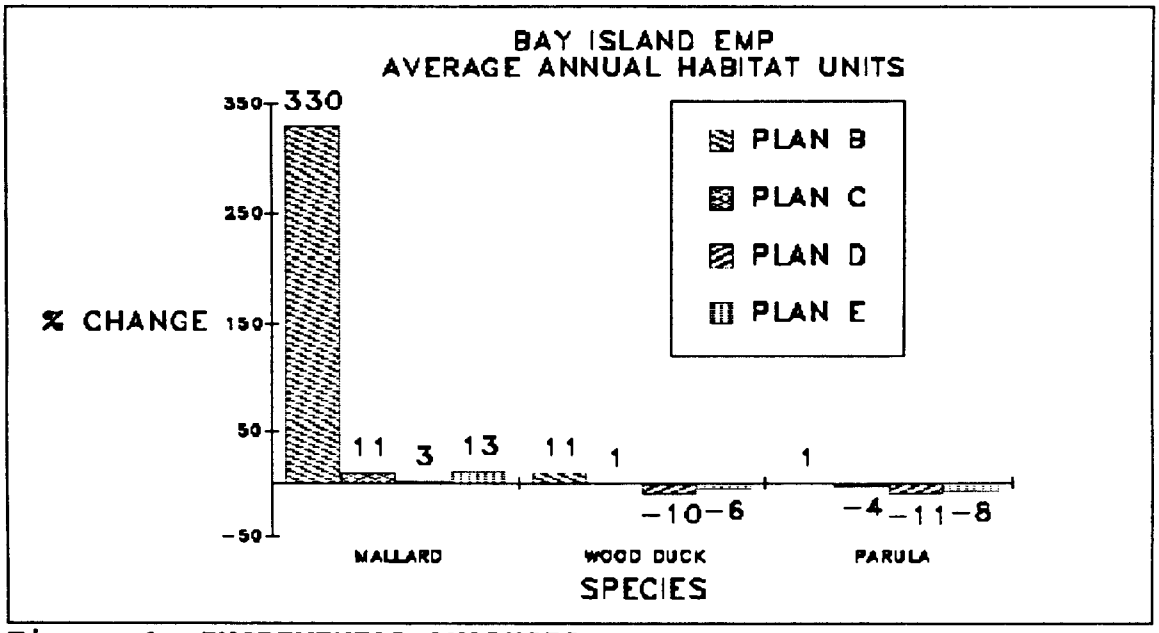


Figure 1 INCREMENTAL ANALYSIS

Average annual habitat units indicate the potential value of an area for a selected species on an average use day during the life of the project. The WHAG mallard model is designed to measure migration use, whereas wood duck and parula warbler values are based largely on parameters that affect conditions for nesting and/or rearing of young. The WHAG software can provide the potential evaluation species population that one could expect to find during a site visit. In the case of mallards this value would reflect a visit during the three-month fall or two-month spring migration. Figure two on the next page indicates the incremental changes for each plan as reflected in average annual mallard use based on 150 days per year.

CONCLUSIONS AND RECOMMENDATIONS

Water level control structures will provide the potential for significant enhancement of the area for mallards and other migratory waterfowl. The addition of two pin oak groves will further enhance the area for mallards during the fall migration. Conversion of forested wetland to either emergent marsh or cropland does not result in significant improvements for waterfowl, and in fact would conflict with the management goals of the Mark Twain NWR because of adverse impacts to wood ducks.

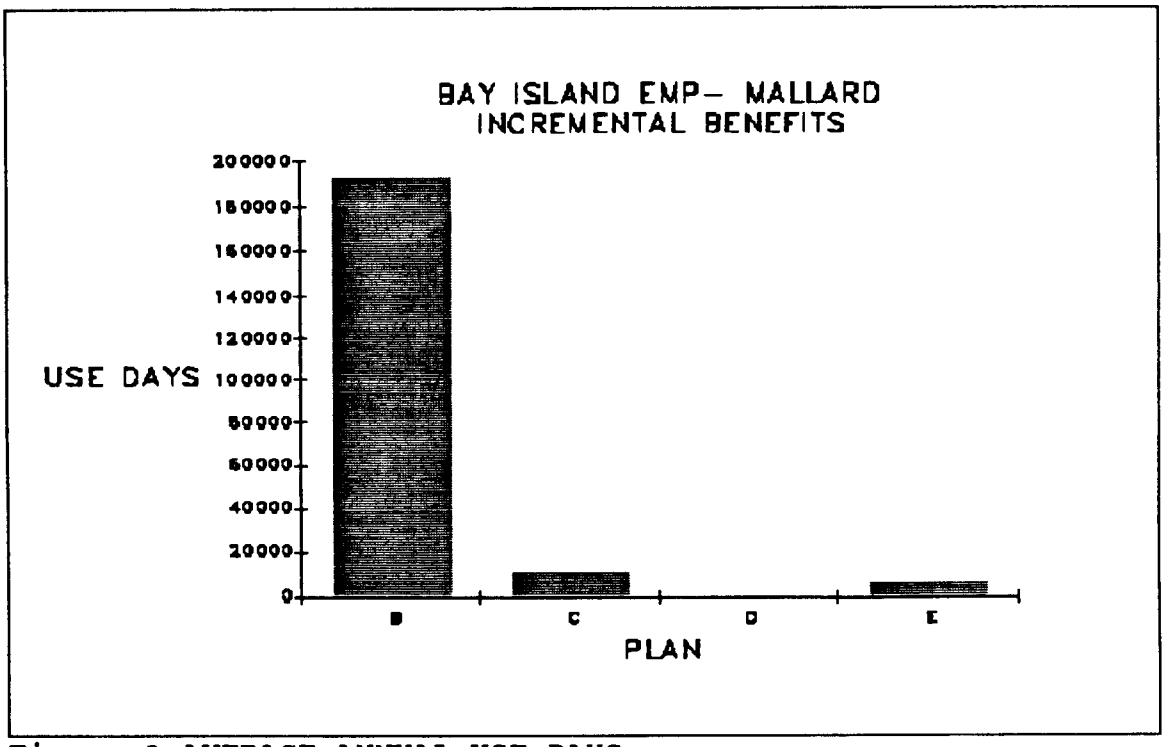


Figure 2 AVERAGE ANNUAL USE DAYS

Based on the results of the foregoing analysis, we recommend that the Bay Island project include the water control features and the pin oak plantings. The proposed project will result in a net increase in wetland values in Mississippi River Pool 22. If you have any questions regarding these comments please do not hesitate to contact me.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: Mark Twain NWR
MDC Jefferson City
RD (AFWE)
RD (AWR)

United States Department of the Interior

Fish and Wildlife Service
Mark Twain National Wildlife Refuge
Great River Plaza
311 N. 5th Street, Suite 100
Quincy, Illinois 62301

TAKE PRIDE IN AMERICA

October 24, 1989

Colonel John R. Brown, District Engineer
U.S. Army Engineer District Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

I am providing a copy of the compatibility determination for the Bay Island HREP for your review and information.

Please let me know if you or members of your staff have any questions.

Sincerely,

Robert H. Stratton, Jr.
Project Leader

cc: EMP Coordinator Sowl

COMPATIBILITY DETERMINATION

Station Name: Mark Twain National Wildlife Refuge Complex, (Bay Island HREP).

Site Established: Designated as a unit of the National Wildlife Refuge System in 1958.

Establishing Authority: Fish and Wildlife Coordination Act, Section 3 (48 Stat. 401 as amended by 60 Stat. 1080 and 72 Stat. 563; 16 U.S.C. 661-667e.).

Purpose for Which Established: Area established for conservation, maintenance, and management of wildlife resources and their habitats (16 U.S.C., Sect. 663(a)).

The primary objectives of the Mark Twain National Wildlife Refuge are to (1) provide migrating waterfowl with food,, water, and protection during fall and spring months, and (2) to improve and maintain existing habitat to perpetuate optimum annual production of wood ducks.

Secondary objectives are to (1) provide, food, water, and protection to wintering waterfowl, (2) maintain balanced populations of all resident wildlife species, (3) maintain portions of the refuge river bottom habitat in its natural virgin state, and (4) to provide limited day-use recreation where and when such activities are compatible with primary objectives of the refuge.

This area, managed by the State of Missouri under cooperative agreement, has value to the natiohal migratory bird program (16 U.S.C., Sect 664).

Description of Proposed Use: This habitat rehabilitation and enhancement project will rehabilitate 500 acres of bottomland habitat. The project is on general plan land at Bay de Charles adjacent to Hannibal, MO. This project will be built by a contractor of the Corps of Engineers. It is rescheduled for completion in 1991.

The project will consist of (1) a deflection levee along Ziegler Chute and the Main Channel of the Mississippi River constructed to provide a minimum 10-year flood event protection (2) three levees and three stop log structures to facilitate water management, (3) 100 surface acres of shallow water for migrant waterfowl, and (4) 30 acres of additional pin oaks.

Anticipated Impacts on Refuge Purposes: The project will provide habitat for migrating waterfowl to compensate for habitat lost through siltation by producing 100 acres of moist soil plants, and the capability to flood pecan and pin oak mast.

The selection of a well as a water source will provide a surer water source than Clear Creek and will contain fewer agricultural contaminants. Maintaining the timber along Clear Creek in its present state will insure that bat habitat will be maintained. There may also be fishery benefits associate with this project as currently designed. Deflection levee will be built on land currently used for agriculture and large cottonwoods along Ziegler Chute will be maintained for use by wintering eagles.

Stipulations that Would Make a Use Compatible with Refuge Purposes: No stipulations are required if project does not depart significantly from current design concept.

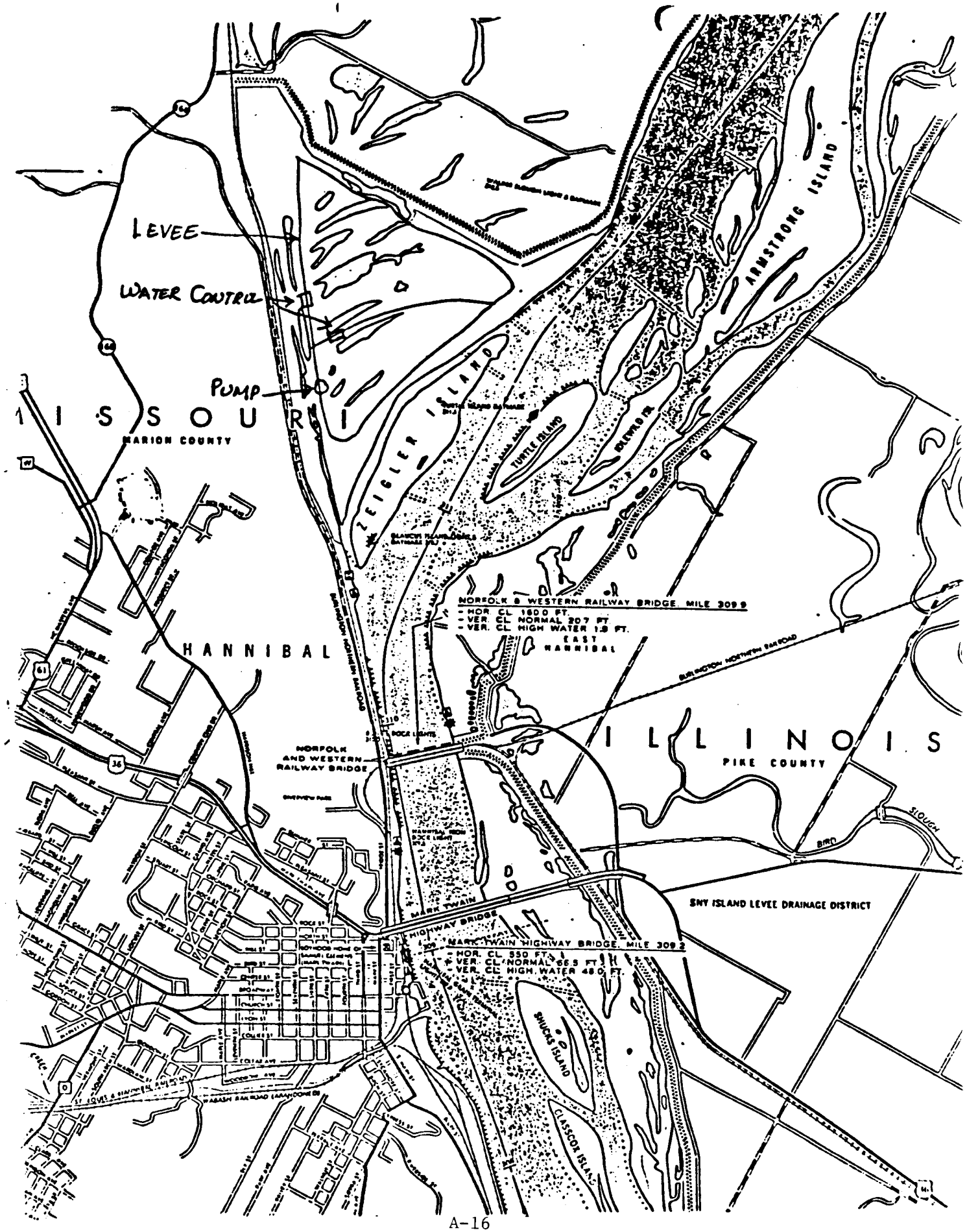
Justification: This project facilities the attainment of both primary management objectives of the refuge on this unit. It also contributes to each of the four secondary objectives and maintains current habitats utilized by endangered species. It does not, so far as can be determined, have incompatible aspects.

Determination: The proposed use is compatible with the purposes for which the refuge was established.

Determined by: _____ Project Leader Date: June 12, 1989

Reviewed by: _____ Associate Manager Date: June 15, 1989

Concurred by: Acting _____ Regional Director Date: 6/22/89


LEVEE
WATER CONTROL
PUMP
MISSOURI
MARION COUNTY
HANNIBAL
ZEIGLER ISLAND
ARMSTRONG ISLAND
TURTLE ISLAND
NORFOLK & WESTERN RAILWAY BRIDGE, MILE 309.9
- HOR. CL 1600 FT.
- VER. CL NORMAL 207 FT.
- VER. CL HIGH WATER 1.9 FT.
EAST HANNIBAL
BURLINGTON NORTHERN RAILROAD
NORFOLK AND WESTERN RAILWAY BRIDGE
ILLINOIS
PIKE COUNTY
SLOUGH
BIRD
SNY ISLAND LEVEE DRAINAGE DISTRICT
MARK TWAIN HIGHWAY BRIDGE
MARK TWAIN HIGHWAY BRIDGE, MILE 309.2
- HOR. CL 550 FT.
- VER. CL NORMAL 66.5 FT.
- VER. CL HIGH WATER 48.0 FT.
SHUCKS ISLAND
CLASSCOE ISLAND

United States Department of the Interior

Fish and Wildlife Service
Mark Twain National Wildlife Refuge
Great River Plaza
311 N. 5th Street, Suite 100
Quincy, Illinois 62301

TAKE PRIDE IN AMERICA

October 24, 1989

Colonel John R. Brown
District Engineer
U.S. Army Engineer District Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

We have reviewed the draft definite project report for the habitat rehabilitation and enhancement project at Bay Island Refuge and offer the following comments.

The linkage between paragraph 16.b. (page 34) and Table 13-2 (page 32) requires that the Fish and Wildlife Service ensure a maintenance practice which is ecologically unsound. Grass clipping studies have shown repeatedly that the shorter the cutting height and the shorter the cutting interval the greater the loss of root weight and the greater the reduction in food reserves. Every time more than 40% of the above ground plant growth is removed in a single cutting root growth stops. As the severity of the clipping increases the number of roots that do not resume growth increases and the vigor of the grass stand in reduced accordingly.

If the levee is not mowed brush will encroach on it. If the grass is mowed frequently the root system will not be strong enough to resist encroachment of intrusive vegetation including shrubs. What is required is adequate mowing to keep the brush down but not do serious injury to the grass cover. It would seem that one or two mowings a year would accomplish this objective without being counterproductive.

With respect to cost sharing for operations and maintenance the statement on page C-3 should be changed to read "the FWS shall obtain a minimum 25% of all costs...". This would reflect the true situation and be consistent with the wording in the Fourth Annual Addendum, III.A.1. page 9.

Thank you for the opportunity to comment on this draft.

Sincerely,

Robert H. Stratton, Jr.
Project Leader

cc: Matt Kerschbaum, WAM-2

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

December 15, 1989

Colonel John R. Brown
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This letter amends our Fish and Wildlife Coordination Act report on the Bay Island Habitat Rehabilitation and Enhancement Project, Mississippi River Pool 22, Marion County, Missouri, dated October 23, 1989. The project is a component of the Upper Mississippi River System Environmental Management Program authorized by the 1985 Supplemental Appropriation Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662).

Our report used the Missouri Department of Conservation's Wildlife Habitat Appraisal Guide (WHAG) procedures to analyze the benefits and losses associated with the features proposed for the project. As a result of that study we concluded that a water control structure, sediment deflection levee, and planting of two groves of pin oaks would provide significant benefits to mallards.

Subsequent to release of our report comments were received from your division headquarters that prompted reanalysis of several project features. Our incremental analysis was modified to investigate the habitat benefits of:

- sediment deflection as a separate feature
- separate operation of upper and lower water control units, and
- pin oak planting benefits versus clearing for crops or moist soil management.

Table 1 describes the plans evaluated in this reanalysis. The total acres impacted was also reduced from 700 to 650 acres, based on recalculation of the study area size.

Table 1. Bay Island Habitat Rehabilitation Project-
Plans Investigated.

PLAN A- No action
PLAN B- Water control: two units
B1- Lower unit only
B2- Upper unit only
PLAN C- Sediment deflection levee
PLAN D- Clear Creek dredging [NOT EVALUATED]
PLAN E- Interior dredging [NOT EVALUATED]
PLAN F- Pin oak planting
F1- Clearing for marsh
F2- Clearing for millet

Plans D and E were not evaluated in our studies because neither would address our objectives for Bay Island, which are to improve habitat for migratory birds (mallard ducks in particular).

Figure 1 displays the average annual habitat unit (AAHU) improvements for mallards associated with the evaluated features.

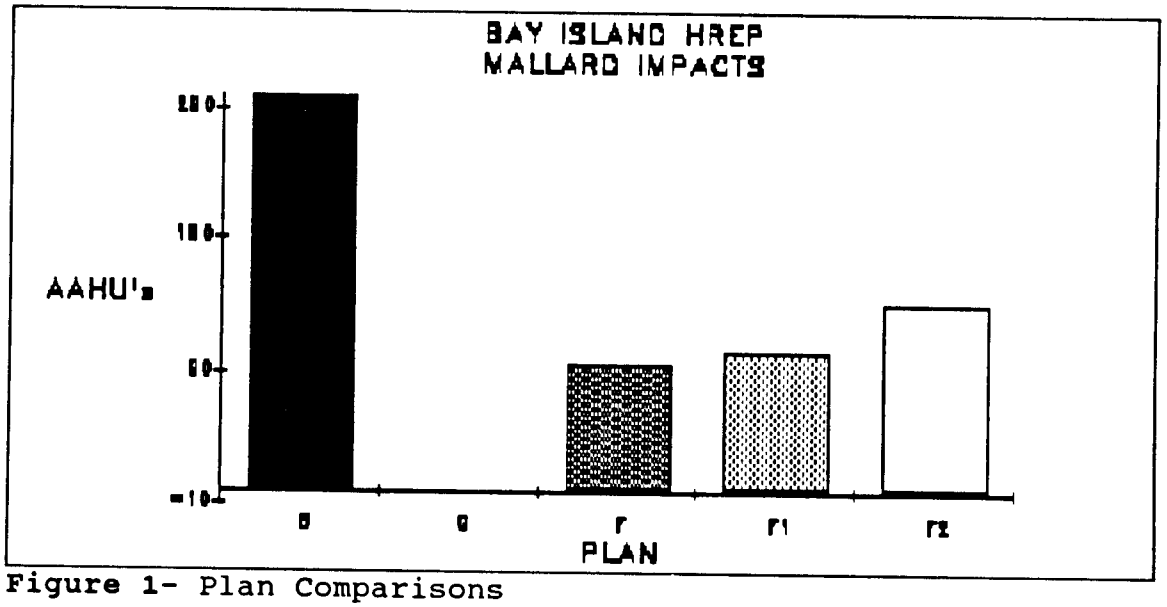


Figure 1- Plan Comparisons

Note that Plan C (sediment deflection) would provide essentially no benefits to mallard habitat values. Plan B (water control) provides significant improvements for mallards over without project conditions. Figure 2 displays a comparison between the construction of both units versus separate single units.

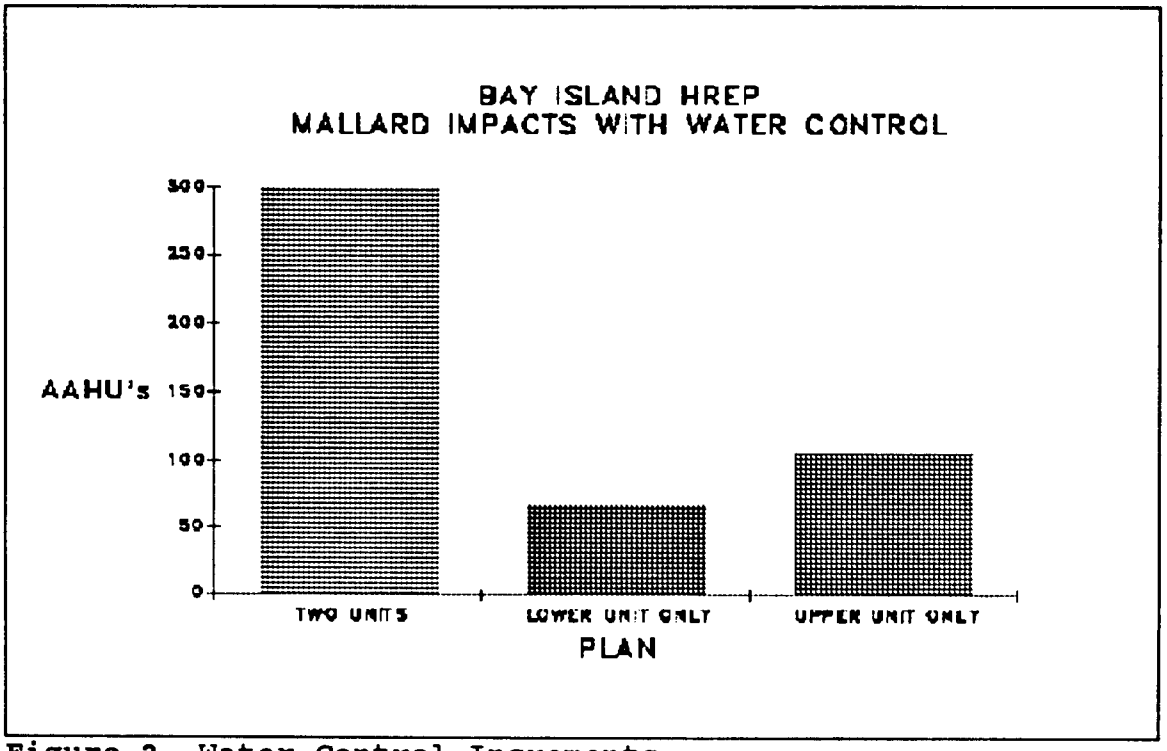


Figure 2- Water Control Increments

Our studies also compared the proposed pin oak planting feature with clearing forested areas for marsh management or crop (millet). Figure 3 displays the mallard benefits for each alternative, and indicates that average annual habitat units for mallards will be greater with the two clearing proposals.

As a result of these studies we conclude that a sediment deflection levee as a feature of the Bay Island project is not justified from a biological perspective when mallard management is the prime objective. Sedimentation will cause the conversion of nonforested wetland to forested wetland over time, but both habitat types have high value to the key evaluation species. The sedimentation rate is not great enough to significantly reduce the benefits of any of the proposed management plans over the life of the project.

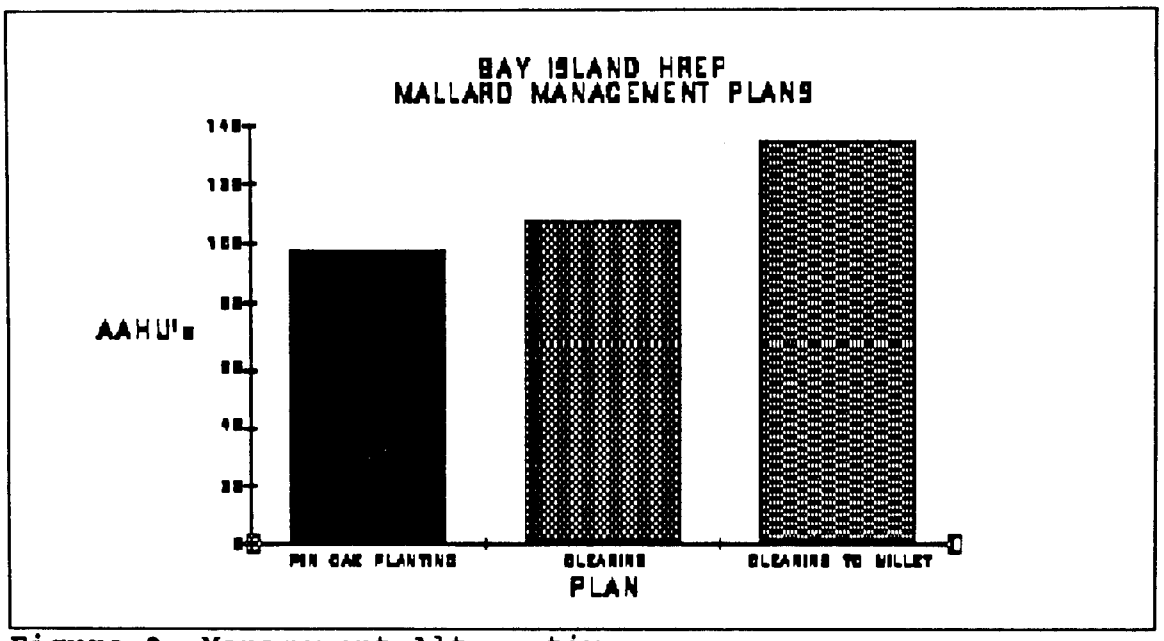


Figure 3- Management Alternatives.

The data displayed in figure 3 indicates that the clearing options for management would produce greater habitat units benefits for mallards. However, as indicated in your Detailed Project Report, the unit costs for the clearing alternatives would be greater over the life of the project than the unit costs for pin oak planting. The clearing of bottomland hardwood forests also would conflict with our overall management goals on the Mark Twain National Wildlife Refuge. Therefore, our recommendation in favor of the pin oak planting alternative is retained.

In summary, our support for the Bay Island Habitat Rehabilitation Project remains unchanged, though the sediment deflection levee feature no longer seems justified from the standpoint of mallard management. If you have any questions concerning this amendment please do not hesitate to contact Mr. Chuck Davis of my staff.

Sincerely,

Richard E. Nelson
Field Supervisor

cc: ARD-AWR
ARD-FWE
Mark Twain NWR
MO Dept. of Consr. (Stucky)
MO Dept. of Consr. (LaRue)

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:

FEB 5 1990

FWS/ARW-SS

Colonel John R. Brown
District Engineer
U. S. Army Engineering District, Rock Island
Clock Tower Building
Post Office Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

We are pleased to respond to your notice of January 19, 1990 with comments on the Bay Island Rehabilitation and Enhancement Project. This project is sponsored by both the U.S. Fish and Wildlife Service (Service) and the State of Missouri under the Upper Mississippi River System - Environmental Management Program. The project will benefit waterfowl and other wildlife and is an excellent example of a cooperatively planned project between the U.S. Army Corps of Engineers and other agencies.

The purpose of the Bay Island project is to enhance wetland habitat which has been lost through siltation, by removing 2 to 4 feet of silt. Components of the project include; 1) perimeter and internal levees to create two wetland management units; 2) electric pump for both a water source and for water level management; 3) three water control structures; 4) a new bridge and upgrading of access routes; and 5) 30 acres of pin oak trees.

We would suggest that the description of Plates 30 and 31 as presented on pages 2 and 10 of the report be corrected to conform to the actual Plates 30 and 31 as included in the report.

All land within the project area is owned by the U.S. Army Corps of Engineers and managed by the Missouri Department of Conservation under terms of a cooperative agreement wherein the Service maintained an interest in migratory birds. The project is compatible with refuge purposes as confirmed in the appendix to the report. The Service has no Federal action in this project and thus, will not be issuing its own finding of no significant impact or other environmental document. We will sign the Memorandum of Agreement for operation, maintenance, and rehabilitation upon receipt of the final version although in accordance with the Fourth Annual Addendum the State of Missouri will cover all operation and maintenance costs. The U.S. Fish and Wildlife Service supports the project and will assure that operation and maintenance,

as described in the definite project report dated January 1990, will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986.

This report illustrates the cooperation evident between the U.S. Army Corps of Engineers and the Service. We note, for example, how the report addresses our concern about a maintenance practice that would have been ecologically unsound. These efforts at working together on this project as well as the environmental management program as a whole help ensure the success of mutual concerns for improvements on the Upper Mississippi River system.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

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

February 8, 1990

Department of the Army
District Engineer
Rock Island District, Corps of Engineers
Clock Tower Building
P.O.Box 2004
Rock Island, Illinois 61204-2004

Dear Sir:

Subject: Review of Environmental Assessment for Bay Island, Rehabilitation and Enhancement Project, Marion County, Missouri (ER 90/57)

Personnel of the Bureau of Mines have reviewed the subject document for possible impacts upon mineral resources and/or mineral production facilities, as requested by the Director, Office of Environmental Affairs, Department of the Interior. The Bay Island Project is planned to improve the wetland habitat for migratory waterfowl. The project would be constructed on a 400-acre parcel of land and includes construction of about 24,000 feet of low levees, building a 6,000 gpm pumping station, installation of three stop log structures and the planting of pin oak in the project area.

Known mineral resources in the general project region are limited to deposits of limestone and sand and gravel. Lime and cement production occur outside the project area. From a mineral resources standpoint, the project would have no significant impact on mineral resources or existing mineral-production facilities. Although we have no objection to the proposed project, we suggest that future versions of the document state that mineral resources and mineral production facilities would not be significantly impacted.

William Cochran

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

February 20, 1990

Colonel John R. Brown
District Engineer
U.S. Army Engineers District, Rock Island
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

RE: Draft of the Draft Definite Project Report with Integrated Environmental Assessment for Bay Island

Thank you for your letter of January 19, 1990. We have reviewed the subject documents and have no comments at this time. We refer you to our previous comment letter of October 16, 1989, and remind you that we look forward to becoming a part of future projects involving habitat rehabilitation and enhancement.

If you have any questions, please write to me, or call Mr. Dewayne Knott at (913) 551-7299. Thank you for the opportunity to comment.

Sincerely,

Lawrence M. Cavin
Chief, Environmental Review
and Coordination Section

cc: U.S. Fish and Wildlife Service, Columbia, Missouri
U.S. Fish and Wildlife Service, Minneapolis (Chuck Gibbons)
Missouri Department of Natural Resources
Missouri Department of Conservation

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

February 21, 1990

Colonel John R. Brown
District Engineer
Rock Island District, Corps of Engineers
Clock Tower Building
P. O. Box 2004
Rock Island, Illinois 61201

Dear Colonel Brown:

Members of my staff have worked closely with the Rock Island District, Corps of Engineers in preparation of the Definite Project Report for the Upper Mississippi Environmental Program, Bay Island Habitat Rehabilitation Project. We are confident that construction of this project will result in a significant increase in both the quantity and quality of wetland habitat in the Bay Island area.

The Department is prepared to serve as the non-federal sponsor and will cooperate with the U. S. Fish and Wildlife Service to assure that operation and maintenance activities, as described in the final Definite Project Report and any mutually agreed upon rehabilitation, will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986.

We look forward to a construction start on this project at the earliest possible date. To that end, members of my staff are available to lend assistance. Please do not hesitate to contact Mr. Norman P. Stucky at the above address to further discuss this matter.

Sincerely,

Jerry J. Presley

JERRY J. PRESLEY
DIRECTOR

cc: Mr. G. Tracy Mehan III
Department of Natural Resources

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

February 27, 1990

Mr. Willis Tait
Chief, Real Estate Division
Rock Island District, Corps of Engineers
Clock Tower Building
P. O. Box 2004
Rock Island, Illinois 61201

Dear Mr. Tait:

Per conversation between staff member Norman Stucky of this office and Barb Kimler of your Engineering Division, this letter addresses access needs for performing operation and maintenance activities on Bay Island following completion of the proposed Habitat Rehabilitation and Enhancement Project.

Since assuming management responsibilities for the Bay Island tract in the early 1950s, the private roadway crossing at M.P. 122.24 has served well as an access to the island. The Burlington Northern Railroad has agreed to the continued future use of this crossing to perform operation and maintenance functions as described in the final Definite Project Report. Therefore, additional land access to Bay Island is not needed.

Please direct further coordination on this matter to Norman P. Stucky at the above address.

Sincerely,

Dan F. Dickneite

DAN F. DICKNEITE
ENVIRONMENTAL ADMINISTRATOR

cc: Barb Kimler ✓

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

A

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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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-8)

BAY ISLAND, MISSOURI
REHABILITATION AND ENHANCEMENT
POOL 22, MISSISSIPPI RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

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

MARCH 1990

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-8)

BAY ISLAND, MISSOURI
REHABILITATION AND ENHANCEMENT
POOL 22, MISSISSIPPI RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

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

TABLE OF CONTENTS

Subject	Page
SECTION 1 - PROJECT DESCRIPTION	B-1
Location	B-1
General Description	B-1
Authority and Purpose	B-2
General Description of the Dredged and Fill Material	B-2
Description of the Proposed Discharge Sites	B-2
Description of Placement Method	B-3
SECTION 2 - FACTUAL DETERMINATIONS	B-3
Physical Substrate Determinations	B-3
Water Circulation, Fluctuation, and Salinity Determinations	B-4
Water	B-4
Current Patterns and Circulation	B-4
Normal Water Level Fluctuations	B-4
Salinity Gradients	B-5
Actions Taken to Minimize Impacts	B-5
Suspended Particulate/Turbidity Determinations	B-5
Contaminant Determinations	B-5
Aquatic Ecosystem and Organism Determinations	B-6
Proposed Placement Site Determinations	B-7
Determination of Cumulative Effects on the Aquatic Ecosystem	B-7
Determination of Secondary Effects on the Aquatic Ecosystem	B-7
SECTION 3 - FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE	B-8

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-8)

BAY ISLAND, MISSOURI
REHABILITATION AND ENHANCEMENT
POOL 22, MISSISSIPPI RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

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

SECTION 1 - PROJECT DESCRIPTION

LOCATION

The proposed project is located at approximate Mississippi River mile 311R, Marion County, Missouri. The site is located adjacent to the municipal boundaries of Hannibal, about 11 miles upstream of Lock and Dam 22. See plates 1 and 2 in the Definite Project Report (DPR), preceding.

GENERAL DESCRIPTION

The project site is a roughly triangular-shaped 650-acre area at the lower end of a former island bounded by the Mississippi River and the Bay de Charles side channel. The island is extensively leveed for agriculture, with a portion of the levee cutting off the lower end of the Bay de Charles side channel. Aquatic habitat in the former lower end of Bay de Charles is now provided by Clear Creek. The project site is the only remaining island portion outside the South River Drainage District (SRDD) levee.

By definition and Federal regulatory jurisdiction, the entire site is a wetland contiguous to the Mississippi River. Therefore, the proposed construction activities are subject to evaluation under Section 404 of the Clean Water Act.

With the exception of minor bridge access improvement and the conversion of 1 to 2 acres of shallow emergent wetland or mudflat habitat to levee, the proposed project involves no fill in aquatic habitat.

The proposed project involves wetland enhancement by development of water level control and forest cover management. Water level control will be provided by construction of low levee segments which will be used to impound water during seasonal waterfowl migrations. Water will be provided

by a pump station, located along a river side channel. Forest cover management will consist of thinning and planting to increase the quantity of mast-bearing tree species. (See DPR plate 3 for project features.)

A total of about 25 acres of bottom land forest, emergent wetland, and cropped ground will be converted to grass-covered levee. As proposed, 20 acres of bottom land forest will be selectively thinned to improve pecan production or planted to pin oak. About 10 acres of cropland will be planted to pin oak.

AUTHORITY AND PURPOSE

The authority for this action 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). Section 1103 is summarized in the DPR which precedes this appendix.

The purpose of this project, under Section 1103, is "to ensure the coordinated development and enhancement of the Upper Mississippi River (UMR)". The project is the result of a planning effort undertaken by the State of Missouri, the U.S. Fish and Wildlife Service (USFWS), and the U.S. Army Corps of Engineers.

GENERAL DESCRIPTION OF DREDGED AND FILL MATERIAL

Project construction materials are considered to be fill for the purpose of this evaluation and consist primarily of island soils developed from fine sediments accreted in the project area between UMR river miles 310 and 311. Typically, these sediments are transported through flooding or normal fluvial processes and deposited in slack water areas throughout the pooled portions of the UMR. Because construction materials are extant soils and are not proposed to be introduced to the aquatic ecosystem, no sediment samples or contaminant analyses results were pursued. Fill material will be generated on-site for levees and will be constructed of bottom land soils bulldozed and compacted to the elevations portrayed on plates 9 through 18 of the project DPR.

DESCRIPTION OF THE PROPOSED DISCHARGE SITES

Considering project construction as discharge in a wetland, the proposed discharge sites consist of bottom land forest, willow shrub/sapling thickets, shallow emergent wetland, and cropland, where levee berms will be constructed. (Reference the Affected Environment Section of the DPR, preceding.) Of the area proposed for levee construction, 10 acres display typical bottom land vegetation associated with the silver maple-elm forest

type, 4 acres are field edge willow thicket, 1 to 2 acres are variable emergent wetland or mudflat, and about 9 acres are row cropped. The understory is dominated by nettle, poison ivy, and ragweed.

DESCRIPTION OF PLACEMENT METHOD

Levee construction materials will be bulldozed, transported, and compacted from soils available along the levee alignment. As noted on plate 3, water control structures will be placed to provide drainage and independent impoundment capability in each management unit. These structures will consist of open concrete culverts with dividers between stop log sections. Stop logs will consist of wood planking.

A new access bridge will be built approximately 100 feet downstream from the existing bridge. This bridge will have a prestressed concrete deck and will be founded on concrete abutments with wing walls. The existing bridge abutments will remain in place.

Installation of the pump station will involve site preparation using standard construction equipment, casting of a concrete pump pad, and installation of the pump, inlet pipe, and discharge pipe.

SECTION 2 - FACTUAL DETERMINATIONS

PHYSICAL SUBSTRATE DETERMINATIONS

Geomorphological information obtained under contract with the Rock Island District indicates that the majority of the project will be constructed on recently deposited alluvial soils from 7 to 59 inches thick. Recent deposition refers to that occurring during the historic or post-settlement period.

Aquatic substrate to be affected also consists of alluvium which lies in a shallow area intersecting an old borrow pit for the SRDD levee. As viewed on plate 3, the subject site appears as a T-shaped body of water. The area to be affected currently is subject to variable inundation and drying, depending on river stage and SRDD pumping activities.

WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS

WATER

Aquatic values of the project site are realized only during flood events and periodic pump station discharge. The project area is subject to flooding from both the Mississippi River and Clear Creek. Depending on duration, SRDD pump station events fill the Clear Creek channel and overflow into low portions of the project area. Certain areas display limited groundcover in the northwest portion of the project area, which may be related to periodic inundation from SRDD.

The proposed project may be considered terrestrial in that most project activities do not involve the aquatic ecosystem. The project is intended to enhance forested and non-forested wetland habitat values.

CURRENT PATTERNS AND CIRCULATION

Current patterns in the project area are seasonal and vary with river stages or discharges. During non-flood periods, current patterns are nonexistent at the project site. Adjacent currents in Clear Creek and the Ziegler Island side channel will not be affected by the project. A certain amount of circulation is achieved over the project area during flood events and flow exchange with adjacent waters in Clear Creek and the Ziegler Island side channel. Also, a limited amount of circulation occurs during pumping events from SRDD. During flood events, flows are carried overland through the project area, and current patterns follow an eddy pattern through the project area. The buildup of ground surface elevations close to the Ziegler Island side channel indicates a tendency for flood-borne sediments to drop out over the eastern portion of the project site.

Implementation of the proposed project is planned to provide shallow water in the project site during seasonal waterfowl migrations. Also, the proposed levee will result in protection from direct overland flows occurring with a 2-year flood frequency. Floodwater will be diverted toward the river during high flows, but not prevented from entering the project area from the opening to Clear Creek and lower Bay de Charles.

It is anticipated that, by deflecting direct overland flow, the sedimentation rate in the project area will be reduced.

NORMAL WATER LEVEL FLUCTUATIONS

Normal fluctuations occur as a result of discharge changes and the response rate of the lock and dam system. Ordinarily, daily fluctuations are

limited to 5 tenths of a foot over or under an established pool elevation at each dam. Seasonal fluctuations vary widely with weather conditions in the UMR watershed. As previously mentioned, pump events from SRDD also contribute to water level fluctuations in the project area. SRDD pumping is generally on an as-needed basis and is relatively unpredictable.

Based on cross-sectional hydraulic analysis, the proposed project will have no effect on normal Mississippi River stages or flood heights.

SALINTIY GRADIENTS

The UMR is an inland freshwater system; therefore, salinity was not considered.

ACTIONS TAKEN TO MINIMIZE IMPACTS

The avoidance of aquatic fill, the use of chemically stable materials, and the stabilization of levee material by revegetation are actions intended to reduce impacts to the riverine system. The project purpose is to enhance habitat values in a riverine system.

SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

Due to the isolation of most of the project area from permanently flowing water, suspended particulates and turbidity elevations from construction will be limited to the immediate location of the bridge access, the wetland crossing, the water control structures, and the pump station inlet tube. These effects all will be temporary during the period of construction.

CONTAMINANT DETERMINATIONS

No construction material contaminants which require special handling or treatment beyond that currently proposed for the project were found during soil exploration.

Contaminants likely to occur would be limited to those that are part of the modern riverine system and are commonly suspended, transported, and deposited through normal fluvial processes in the Mississippi River.

AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

Review and consideration of 40 CFR, Section 230, Subparts D, E, F, and G involved analysis of the following effects:

A. Effects on Plankton.
B. Effects on Benthos.
C. Effects on Nekton.
D. Effects on Aquatic Food Web (refer to Section 230.31)
E. Effects on Special Aquatic Sites Found in Project Area or Disposal Site.
   (1) Sanctuaries and Refuges (refer to Section 230.40)
   (2) Wetlands (refer to Section 230.41)
   (3) Mud Flats (refer to Section 230.42)
   (4) Vegetated Shallows (refer to Section 230.43)
   (5) Coral Reefs (not found in Project Area)
   (6) Riffle and Pool Complexes (refer to Section 230.45) were not considered for this project.
F. Threatened and Endangered Species (refer to Section 230.30)
G. Other Wildlife (refer to Section 230.32)

By location of the project, no effects on A through E above are anticipated. The purpose of the project is to enhance wetland habitat values.

E (1) through (4) are found in the project area. The project site is part of the Mark Twain National Wildlife Refuge (MTNWR). Refuge compatibility is a project planning requirement for actions taken on the MTNWR. The project was coordinated with MTNWR staff and has been found to be compatible with Refuge objectives. (Reference the Compatibility Report found in Appendix A - Correspondence of the DPR.)

Corps wetland regulatory jurisdiction applies to the project site, as the three-parameter (soils, vegetation, and hydrology) wetland analysis reveals the entire project area to be a Mississippi River adjacent wetland.

In the project area, existing wetland types include palustrine forested (silver maple-elm association forest), emergent (smartweed, arrowhead and lotus-vegetated shallows), and mudflats (shorelines and dried shallow aquatic areas).

Direct impacts from construction involve conversion of about 25 acres of bottom land habitat to grassed levee and a pump station. Impounded water will return to the Mississippi via weir/stop log structures designed to allow free exchange during flood events. This is therefore not expected to alter the palustrine forested wetlands within the leveed area.

Through the planning, coordination, and design process, negative wetland impacts were considered and minimized to the extent possible. The proposed project will increase measurable wetland habitat values for migratory

waterfowl. Because the project will not raise ground surfaces above elevations used for wetland regulatory purposes, no net loss of wetlands is foreseen.

PROPOSED PLACEMENT SITE DETERMINATIONS

The proposed project does not involve actual dredging and placement per se, but does involve construction in a regulated wetland of the Mississippi River. With the exception of materials used for constructing the access bridge and abutments, the water control structures, the pump station, and the access road surface, all construction materials will be obtained on-site.

One site for water control structure placement and the access bridge construction is the bankline of Clear Creek, formerly Bay de Charles. This site consists of fine soils and displays no unique wetland or aquatic value.

The site for shallow aquatic/wetland crossing would typically support a variety of invertebrate life depending on water depths. This type of fine-substrate habitat is common to the project area; therefore, conversion of 1 to 2 acres to grassed levee is considered insignificant given the overall wetland enhancement projected.

DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

The primary goal of this project is to enhance wetland values. During project design, consideration was given to wetland function and values, especially those values associated with the fishery of the Mississippi River. Areas such as Bay Island provide low-velocity refuge, spawning, and brood habitat for a variety of commercial and sport fish during flood events. The proposed project was designed to meet the primary project goal without compromising these values. Water control structures will allow unrestricted ingress and egress of fish during flood events. A certain amount of fish trapping occurs under current conditions and is not expected to significantly increase following project construction.

DETERMINATION OF THE SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

By reducing direct overland flood flows and deflecting some portion of flood-born sediment away from the project site, some patterns of sediment accretion may be affected. These effects are anticipated to be insignificant over the project life.

SECTION 3 - FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the guidelines were made relating to this evaluation.

2. Evaluation of Practicable Alternatives. Alternatives which were considered for the proposed action were as follows:

A. No Federal Action. This alternative was not chosen due to nonresponse to Public Law 99-662.

B. Wetland Management Units (WMU). This feature involved three alternatives based on engineering considerations relative to impoundment capability. Two WMU subunits were evaluated as single components and in tandem operation. Application of habitat-based evaluation methodology, described in the DPR in Section 6, revealed the greatest benefits to result from tandem operation. Therefore, Alternatives B_1 - Lower WMU and B_2 - Upper WMU were not selected in favor of Alternative B - Tandem WMU Operation.

C. Sediment Deflection Levee. This alternative was not selected due to lack of measurable habitat benefits.

D. Clear Creek Dredging. This alternative was not selected alone or in conjunction with other features. No contribution to the primary project goal of wetland enhancement was identified.

E. Interior Dredging. This alternative was not selected due to anticipated minimal contribution to overall wetland values in relation to associated costs.

F. Cover Management. This feature involved three alternatives based on existing and potential vegetation management strategies. Alternative F_1 considered clearing a portion of the forested wetland to provide additional non-forested wetland acreage. Alternative F_2 considered clearing with subsequent annual planting and maintenance of moist soil food plant species. Alternative F involved pin oak planting and was selected based on a combination of habitat-based evaluation and cost. While both Alternatives F_1 and F_2 provided slightly greater measurable benefits, their costs were higher and thus reduced their value relative to F.

The selected plan is a combination of Alternatives B and F and is described in Section 1 - Project Description, preceding, and in Section 7 - Selected Plan With Detailed Description and Section 10 - Summary of Accomplishments in the DPR.

3. Certification or waiver of certification under Section 401 of the Clean Water Act will be obtained before construction begins. The project will thus be in compliance with the water quality requirements of the State of Missouri.

4. The project would not introduce toxic substances into nearby waters or result in appreciable increases in existing levels of toxic materials.

5. No significant impact to federally listed endangered species will result from this project. This determination is supported by a letter received from the USFWS, dated October 23, 1989.

6. The project is located along a freshwater inland river system. No marine sanctuaries are involved or would be affected.

7. No municipal or private water supplies would be affected. There will be no adverse impact to recreational fishing and no unique or special aquatic sites are located in the project location. No long-term adverse changes to the ecology of the river system will result from this action.

8. Project construction materials consist primarily of on-site soils and alluvium. As such, any contaminants contained in on-site materials are normal constituents of the riverine environment. Other materials used in construction will be chemically and physically stable. No contamination of the river is anticipated.

9. The placement of construction material into the water is necessary to fulfill the project objectives of habitat enhancement. No other practical alternatives have been identified. The proposed project is in compliance with the guidelines for Section 404(b)(1) of the Clean Water Act, as amended.

The proposed project will not significantly impact water quality or the integrity of the aquatic ecosystem.

23 March 1990
Date

John R. Brown
Colonel, U.S. Army
District Engineer

APPENDIX C

LETTERS OF INTENT AND DRAFT MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT
BETWEEN
THE UNITED STATES FISH AND WILDLIFE SERVICE
AND
THE DEPARTMENT OF THE ARMY
FOR
ENHANCING FISH AND WILDLIFE RESOURCES
OF THE
UPPER MISSISSIPPI RIVER SYSTEM
AT BAY ISLAND, MISSOURI

I. PURPOSE

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

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features on the Bay Island, Missouri, are 100 percent Federal, and all operation, maintenance, repair, and rehabilitation costs are to be cost shared, 75 percent Federal and 25 percent non-Federal.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of creating a reliable food supply for migratory waterfowl; providing water level control on 400 acres of wetland; and providing 30 acres of mast tree dominance at Bay Island, Missouri.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction: Construction of the project which consists of creating a reliable food supply for wetland dependent species, including migratory waterfowl; providing water level control on 400 acres of wetland; and providing 30 acres of mast tree dominance at Bay Island, Missouri.

2. Major Rehabilitation: Any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements

identified in the Definite Project Report and that is needed as a result of specific storm or flood events.

3. Construction Management: Subject to and using funds appropriated by the Congress of the United States, DOA will construct the Bay Island, Missouri, Fish and Wildlife Enhancement project as described in the Definite Project Report, "Bay Island Refuge Rehabilitation and Enhancement," dated December 1989, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the project, DOA will promptly notify USFWS of such delays.

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

B. USFWS is responsible for:

1. Operation, Maintenance, and Repair: Upon completion of construction as determined by the District Engineer, Rock Island, the USFWS shall accept the project and shall operate, maintain, and repair the project as defined in the Definite Project Report entitled "Bay Island Refuge Rehabilitation and Enhancement," dated December 1989, in accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662.

2. Non-Federal Responsibilities: In accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662, the USFWS shall obtain a minimum of 25 percent of all costs associated with the operation, maintenance, and repair of the project from the MDOC.

V. MODIFICATION AND TERMINATION

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

VI. REPRESENTATIVES

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

USFWS: Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

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

EFFECTIVE DATE OF MOA

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

THE DEPARTMENT OF THE ARMY

BY: _____
COLONEL JOHN R. BROWN
District Engineer
U.S. Army Engineer District,
Rock Island
Corps of Engineers

DATE: _____

THE U.S. FISH AND WILDLIFE SERVICE

BY: _____
JAMES C. GRITMAN
Regional Director
U.S. Fish and Wildlife
Service

DATE: _____

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:

FEB 5 1990

FWS/ARW-SS

Colonel John R. Brown
District Engineer
U. S. Army Engineering District, Rock Island
Clock Tower Building
Post Office Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

We are pleased to respond to your notice of January 19, 1990 with comments on the Bay Island Rehabilitation and Enhancement Project. This project is sponsored by both the U.S. Fish and Wildlife Service (Service) and the State of Missouri under the Upper Mississippi River System - Environmental Management Program. The project will benefit waterfowl and other wildlife and is an excellent example of a cooperatively planned project between the U.S. Army Corps of Engineers and other agencies.

The purpose of the Bay Island project is to enhance wetland habitat which has been lost through siltation, by removing 2 to 4 feet of silt. Components of the project include; 1) perimeter and internal levees to create two wetland management units; 2) electric pump for both a water source and for water level management; 3) three water control structures; 4) a new bridge and upgrading of access routes; and 5) 30 acres of pin oak trees.

We would suggest that the description of Plates 30 and 31 as presented on pages 2 and 10 of the report be corrected to conform to the actual Plates 30 and 31 as included in the report.

All land within the project area is owned by the U.S. Army Corps of Engineers and managed by the Missouri Department of Conservation under terms of a cooperative agreement wherein the Service maintained an interest in migratory birds. The project is compatible with refuge purposes as confirmed in the appendix to the report. The Service has no Federal action in this project and thus, will not be issuing its own finding of no significant impact or other environmental document. We will sign the Memorandum of Agreement for operation, maintenance, and rehabilitation upon receipt of the final version although in accordance with the Fourth Annual Addendum the State of Missouri will cover all operation and maintenance costs. The U.S. Fish and Wildlife Service supports the project and will assure that operation and maintenance,

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

February 21, 1990

Colonel John R. Brown
District Engineer
Rock Island District, Corps of Engineers
Clock Tower Building
P. O. Box 2004
Rock Island, Illinois 61201

Dear Colonel Brown:

Members of my staff have worked closely with the Rock Island District, Corps of Engineers in preparation of the Definite Project Report for the Upper Mississippi Environmental Program, Bay Island Habitat Rehabilitation Project. We are confident that construction of this project will result in a significant increase in both the quantity and quality of wetland habitat in the Bay Island area.

The Department is prepared to serve as the non-federal sponsor and will cooperate with the U. S. Fish and Wildlife Service to assure that operation and maintenance activities, as described in the final Definite Project Report and any mutually agreed upon rehabilitation, will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986.

We look forward to a construction start on this project at the earliest possible date. To that end, members of my staff are available to lend assistance. Please do not hesitate to contact Mr. Norman P. Stucky at the above address to further discuss this matter.

Sincerely,

Jerry J. Presley

JERRY J. PRESLEY
DIRECTOR

cc: Mr. G. Tracy Mehan III
Department of Natural Resources

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1830 SECOND AVENUE, ROCK ISLAND IL 61201

MR LEROY SOWL, US FISH AND WILDLIFE SERVICE
1830 SECOND AVE, ROCK ISLAND IL 61201

US FISH & WILDLIFE SERVICE, NORTH CENTRAL REGL OFFICE
ATTN CHUCK GIBBONS, FEDERAL BLDG-FORT SNELLING
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KANSAS CITY KS 66101

DIRECTOR, FEDERAL EMERGENCY MANAGEMENT AGENCY
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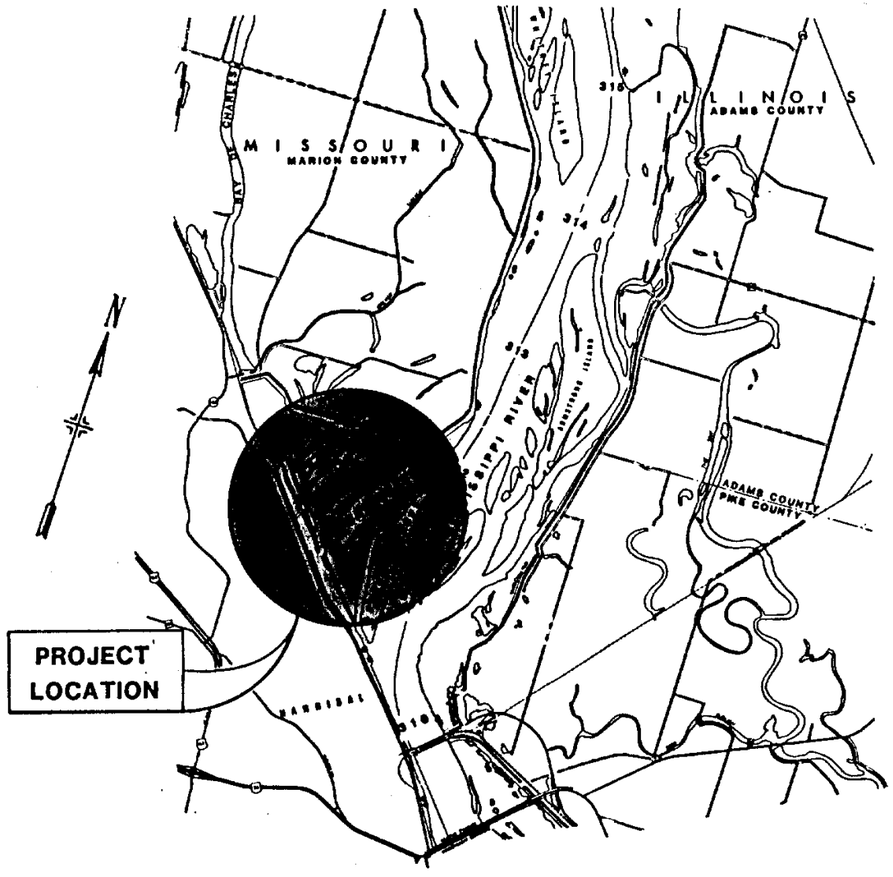

LOCATION MAP

SCALE IN MILES

INDEX	
PLATE NO.	DESCRIPTION
1	VICINITY MAP, LOCATION MAP AND INDEX
2	POOL 22 MAP
3	RECOMMENDED PLAN
4	ALTERNATIVE PLANS
5	HYDRAULIC DATA I
6	HYDRAULIC DATA II
7	BORING LOGS I
8	BORING LOGS II
9	LEVEE PLAN & PROFILE STA. 0+00C TO STA. 17+00
10	LEVEE PLAN & PROFILE STA. 17+00 TO STA. 46+51.46
11	LEVEE PLAN & PROFILE STA. 46+51.46 TO STA. 72+00
12	LEVEE PLAN & PROFILE STA. 72+00 TO STA. 101+19.55
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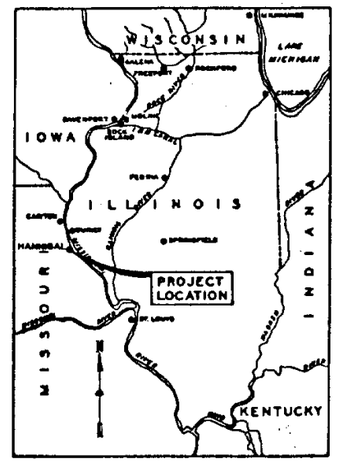
18	LEVEE PLAN & PROFILE STA. 28+00A TO STA. 45+87.25A
19	TYPICAL SECTIONS I
20	TYPICAL SECTIONS II
21	TYPICAL SECTIONS III
22	PERIMETER LEVEE WATER CONTROL STRUCTURES
23	INTERMEDIATE LEVEE WATER CONTROL STRUCTURE
24	ACCESS BRIDGE
25	PUMP STATION SITE PLAN
26	PUMP STATION DETAILS
27	ELECTRICAL
28	SEDIMENTATION & MONITORING PLAN
29	SEDIMENTATION & MONITORING CROSS SECTIONS



VICINITY MAP

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VICINITY MAP, LOCATION MAP AND INDEX

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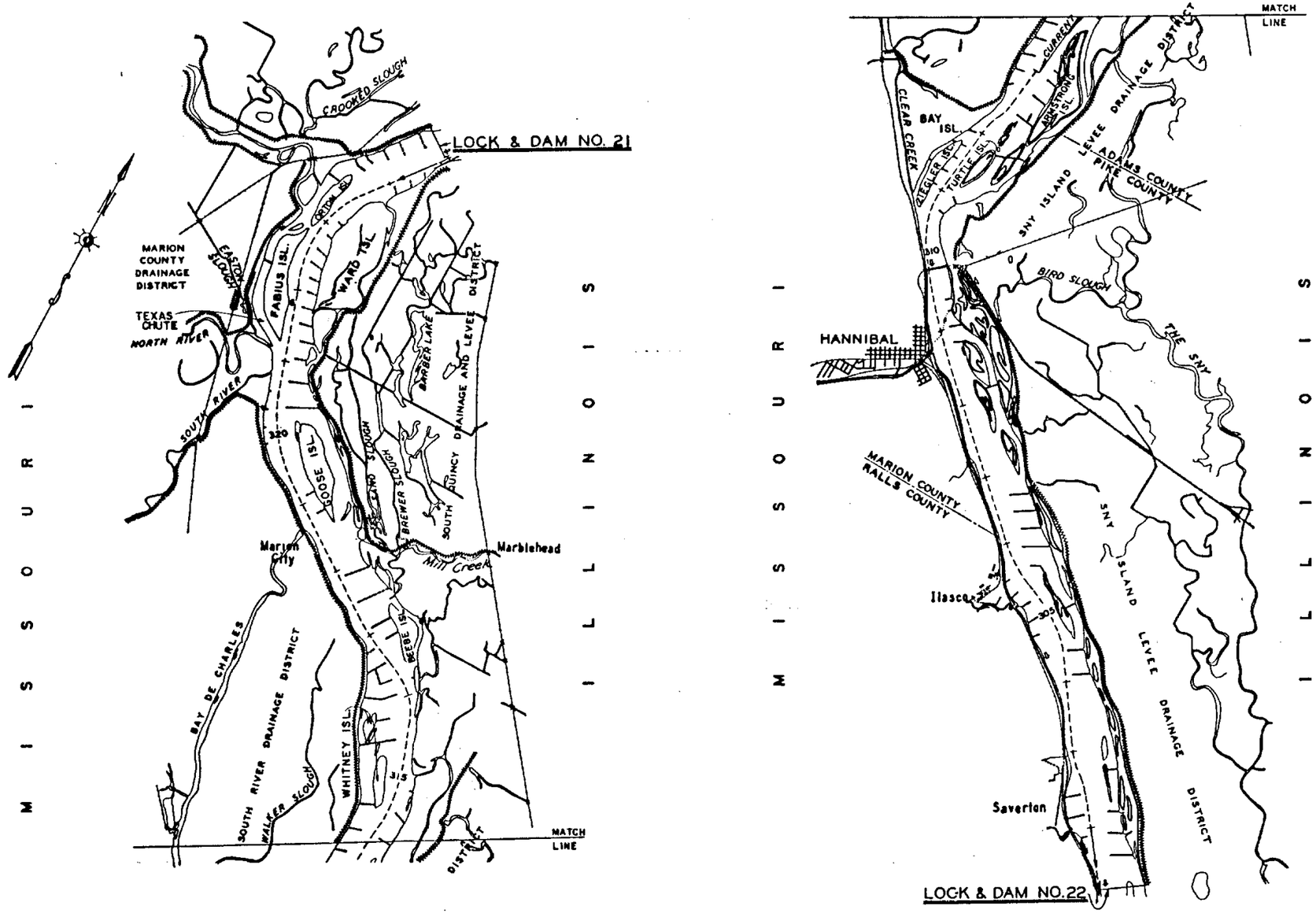
PLATE 1



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POOL 22 MAP

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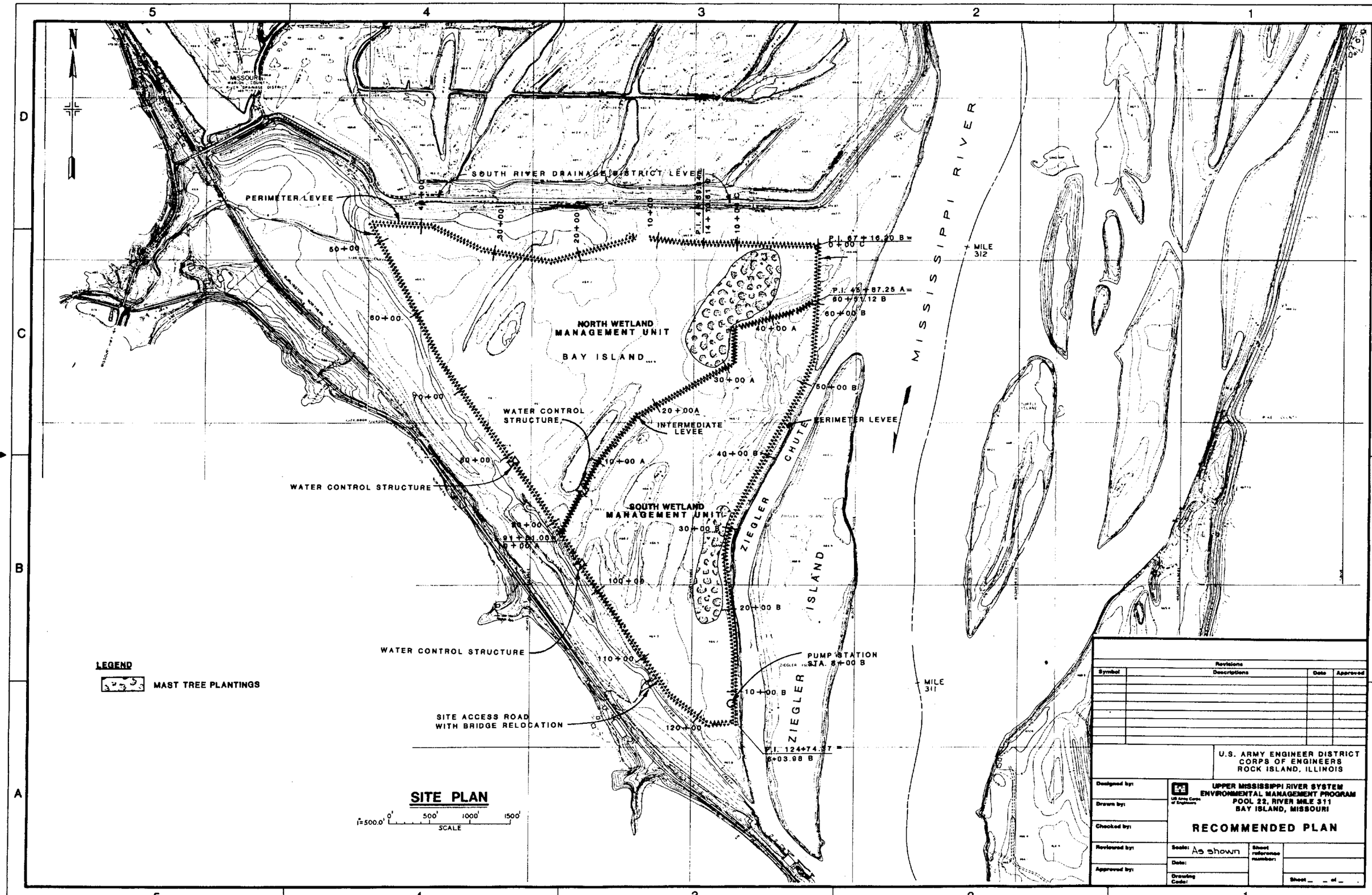
PLATE 2



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RECOMMENDED PLAN

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Sheet _ of _

PLATE 3

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ALTERNATIVE PUMP LOCATION

SOUTH RIVER DRAINAGE DISTRICT LEVEE

PERIMETER LEVEE

NORTH WETLAND MANAGEMENT UNIT

BAY ISLAND

WATER CONTROL STRUCTURE

INTERMEDIATE LEVEE

WATER WELL SOURCE

CLEAR CREEK DREDGING

WATER CONTROL STRUCTURE

ALTERNATIVE PUMP LOCATION

SOUTH WETLAND MANAGEMENT UNIT

WATER CONTROL STRUCTURE

SITE ACCESS ROAD

ZIEGLER CHUTE

ZIEGLER ISLAND

SEDIMENT DEFLECTION LEVEE

PUMP STATION

MILE 312

MILE 311

Mississippi River

LEGEND

INTERIOR DREDGING

MAST TREE PLANTINGS

SITE PLAN

0' 500' 1000' 1500'

SCALE

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ALTERNATIVE PLANS

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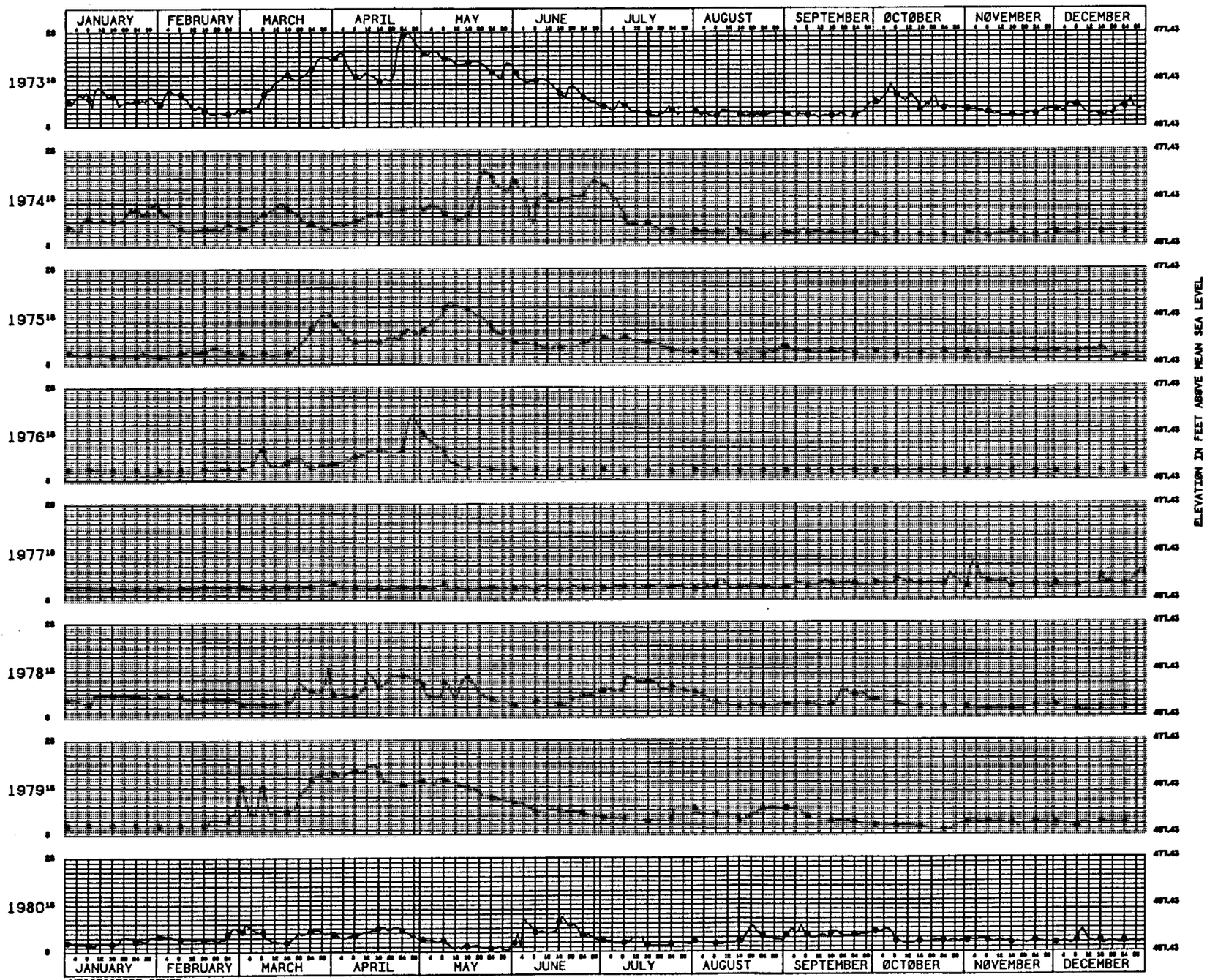
PLATE 4



MISSISSIPPI RIVER

NØTE-

HYDRØGRAPH -
HANNIBAL, MISSØURI

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HYDRAULIC DATA I

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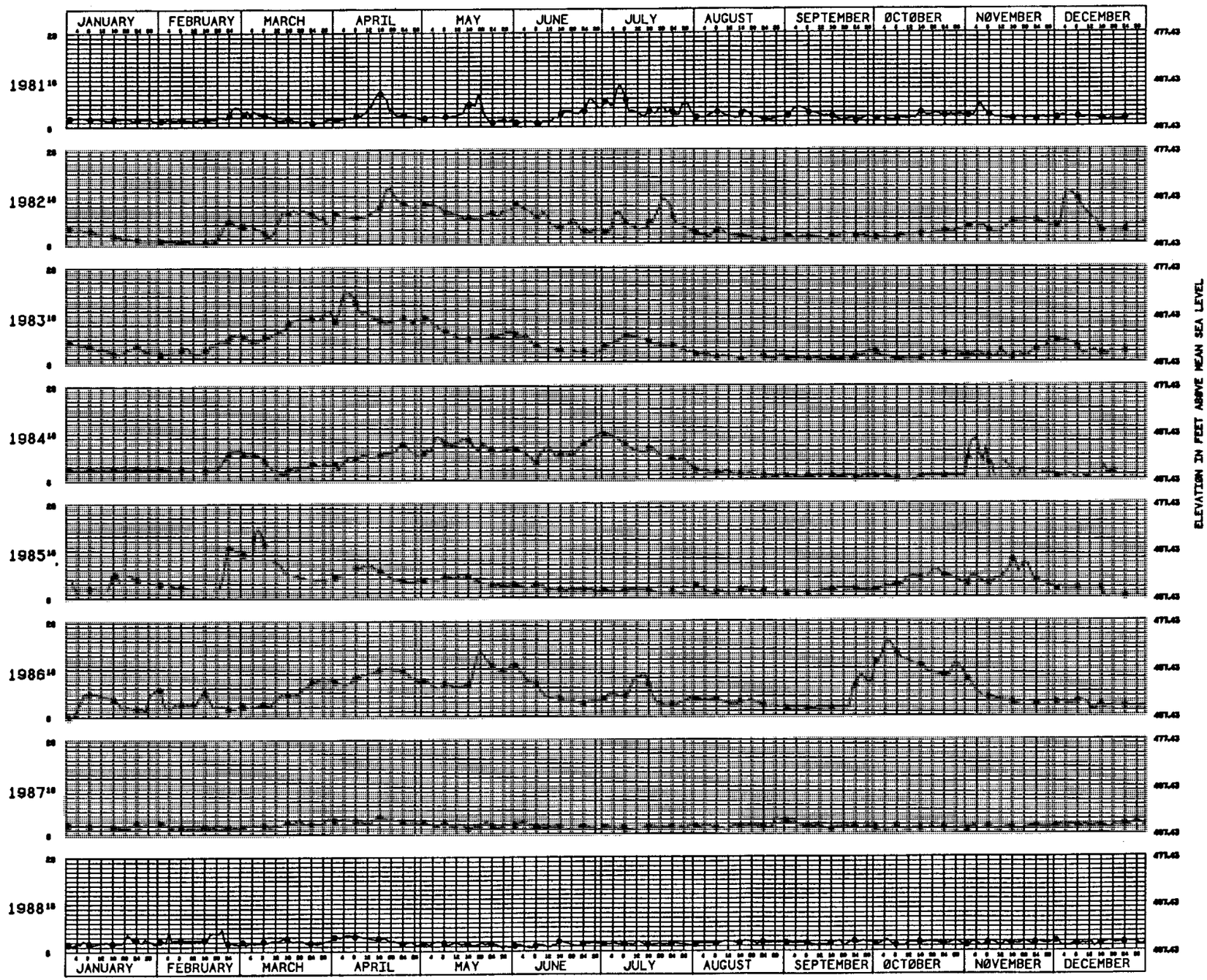
PLATE 5



MISSISSIPPI RIVER

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HYDRAULIC DATA II

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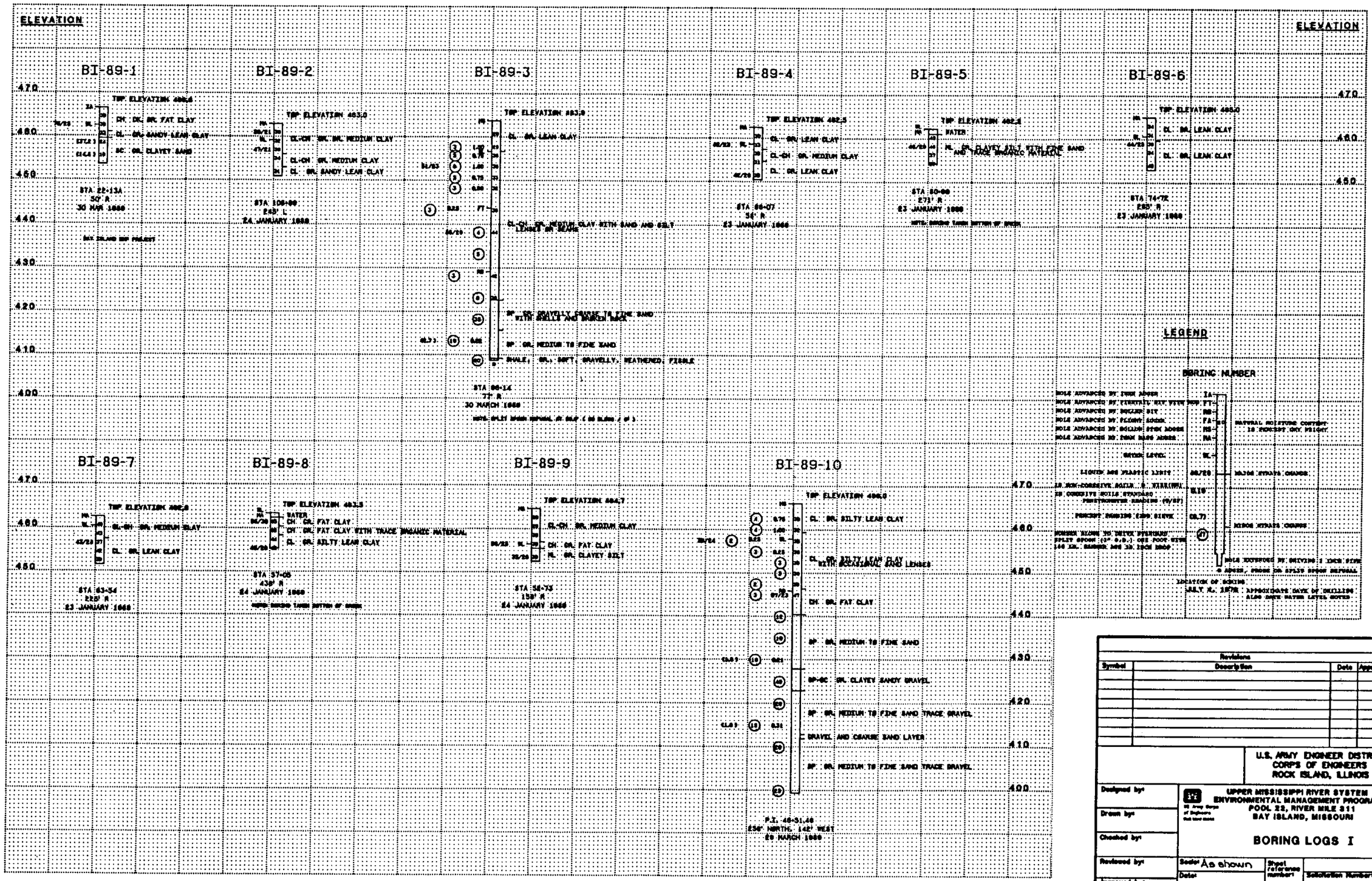
PLATE 6



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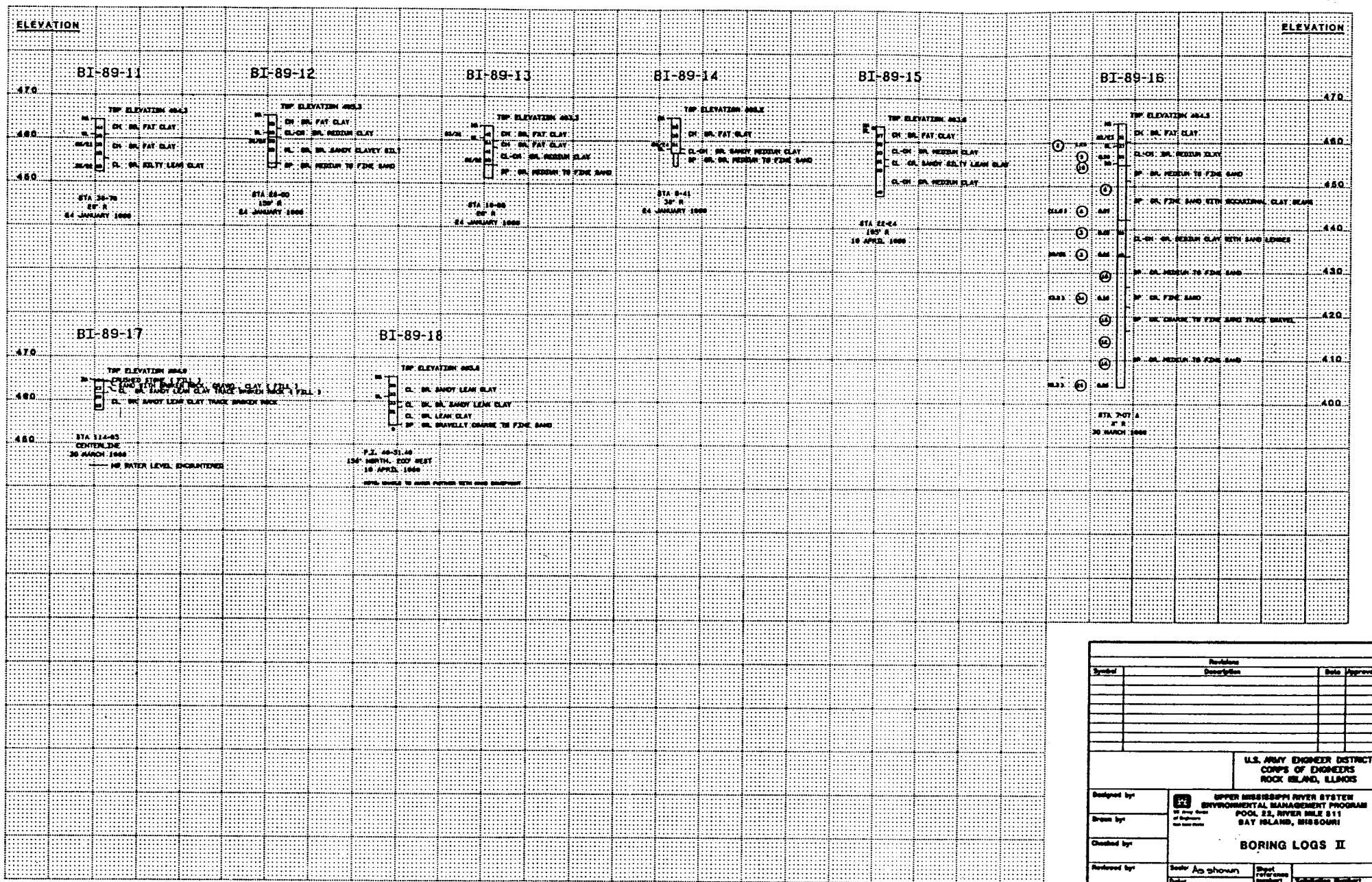
Approved by:

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

BORING LOGS I

Scale: As shown
Date:
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet of

PLATE 7



Revisions			
Symbol	Description	Date	Approved

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

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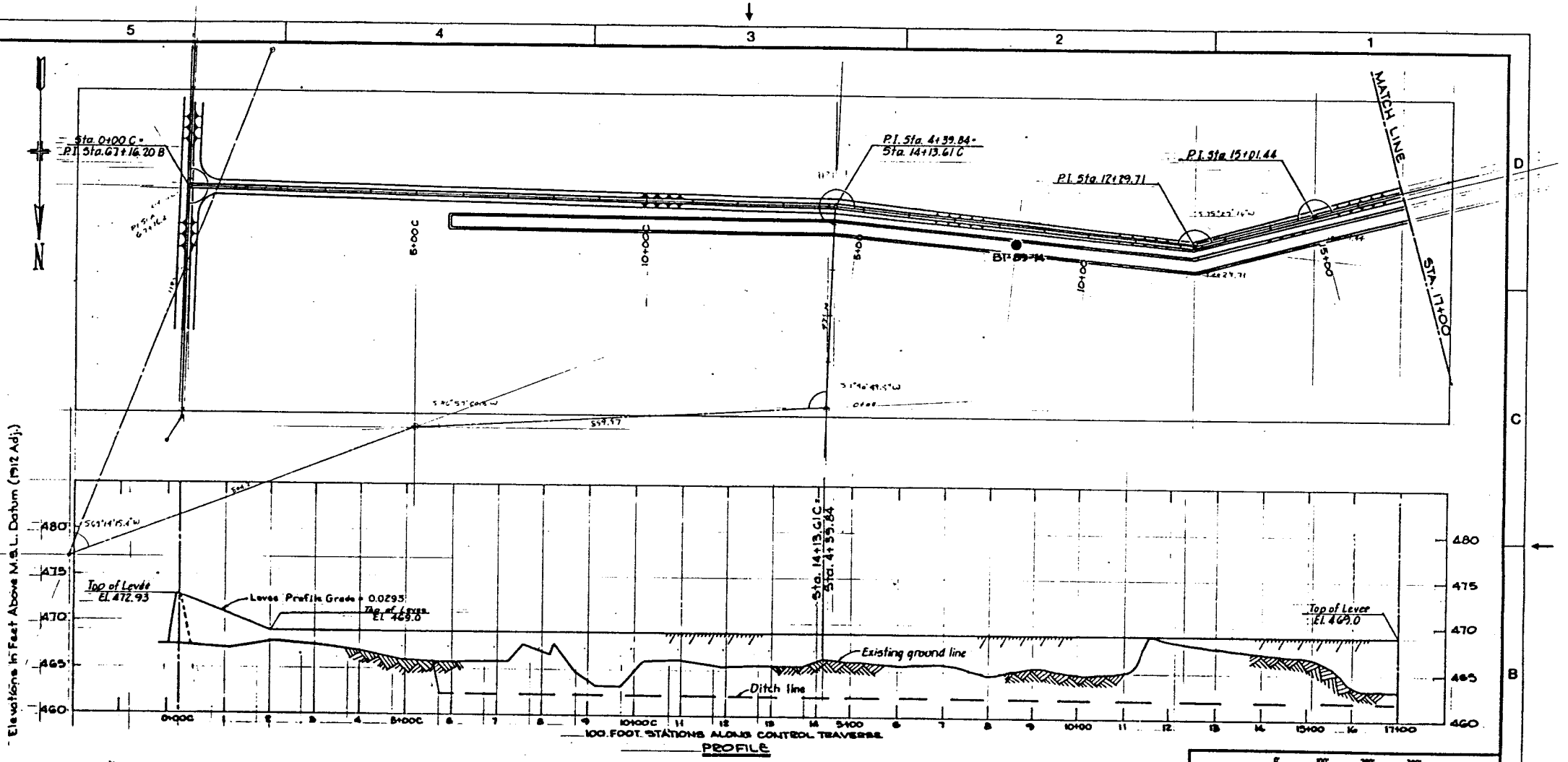
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 511
BAY ISLAND, MISSOURI

BORING LOGS II

Scale: As shown
Date:
Drawing Number:
Sheet reference number:
Sheet of

PLATE 8



Symbol	Description	Date	Approved

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ROCK ISLAND, ILLINOIS

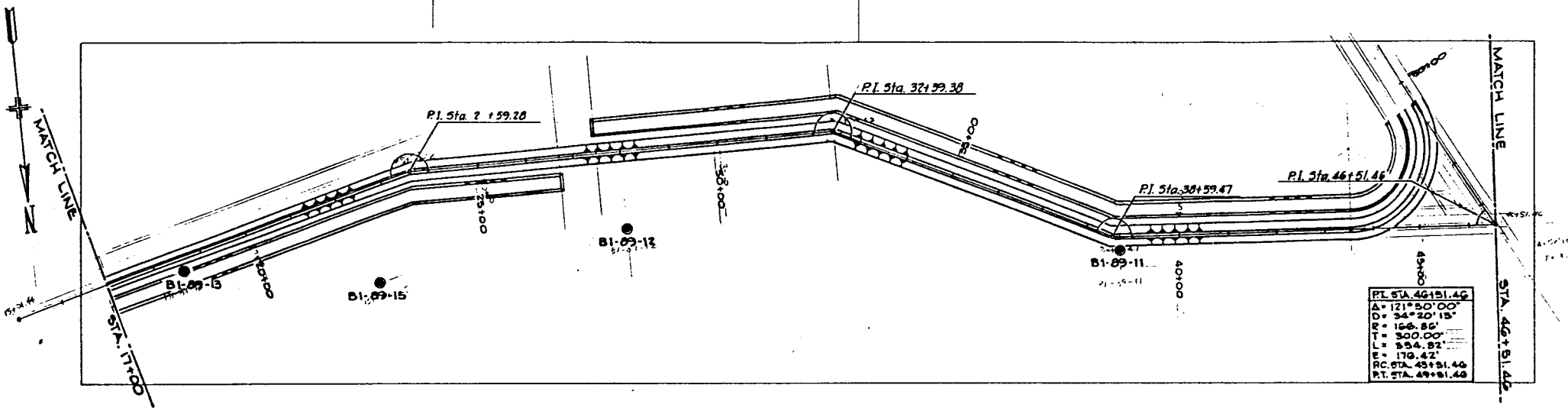
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 511
BAY ISLAND, MISSOURI

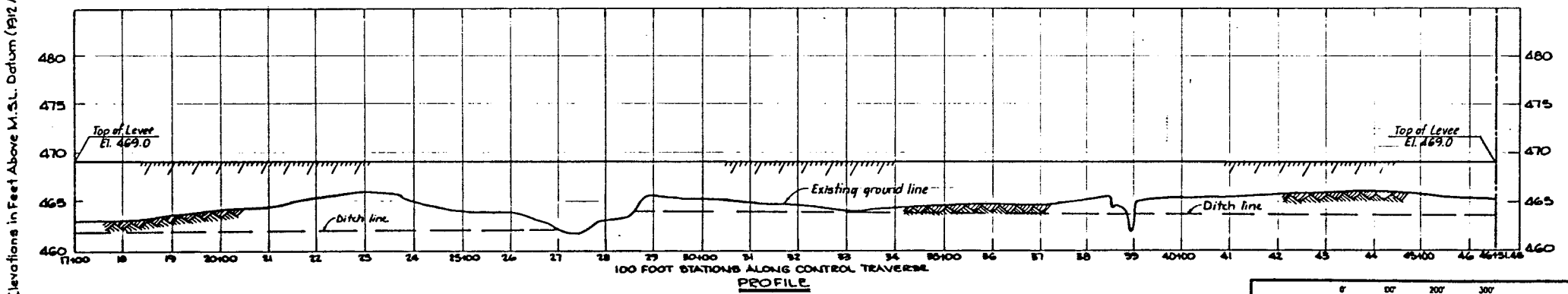
LEVEE PLAN & PROFILE
STA. 0+00 C TO STA. 17+00

Scale: 1"=100'

Drawing Code:

PLATE 9





PROFILE

Reference:

0' 100' 200' 300'

Symbol	Description	Date	Approved

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

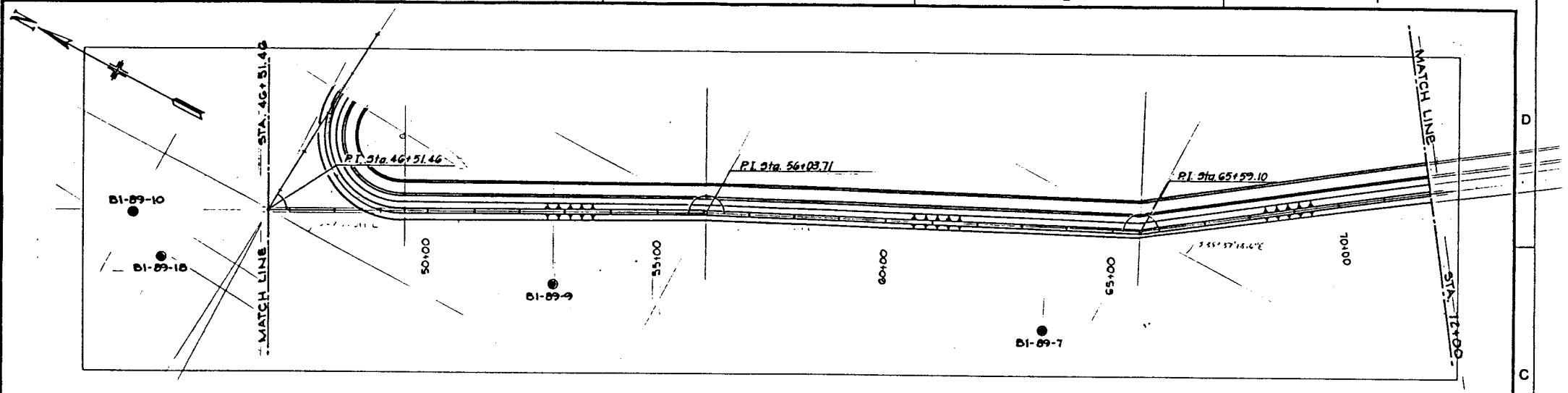
LEVEE PLAN & PROFILE
STA. 174+00 TO STA. 461+51.46

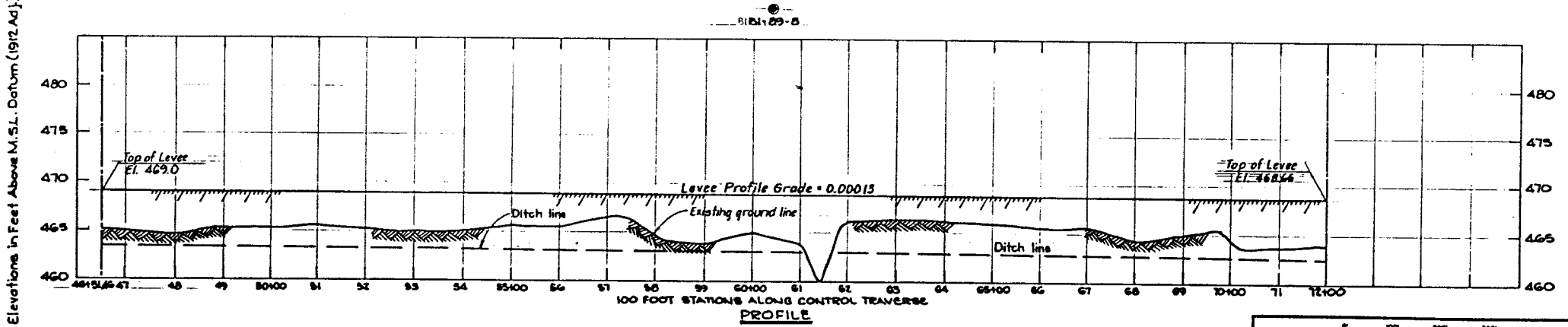
Scales: 1" = 100'

Drawing Code:

Sheet _ of _

PLATE 10





Elevations in Feet Above M.S.L. Datum (1912 Adj.)

PROFILE

Reference:

Symbol	Revisions Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
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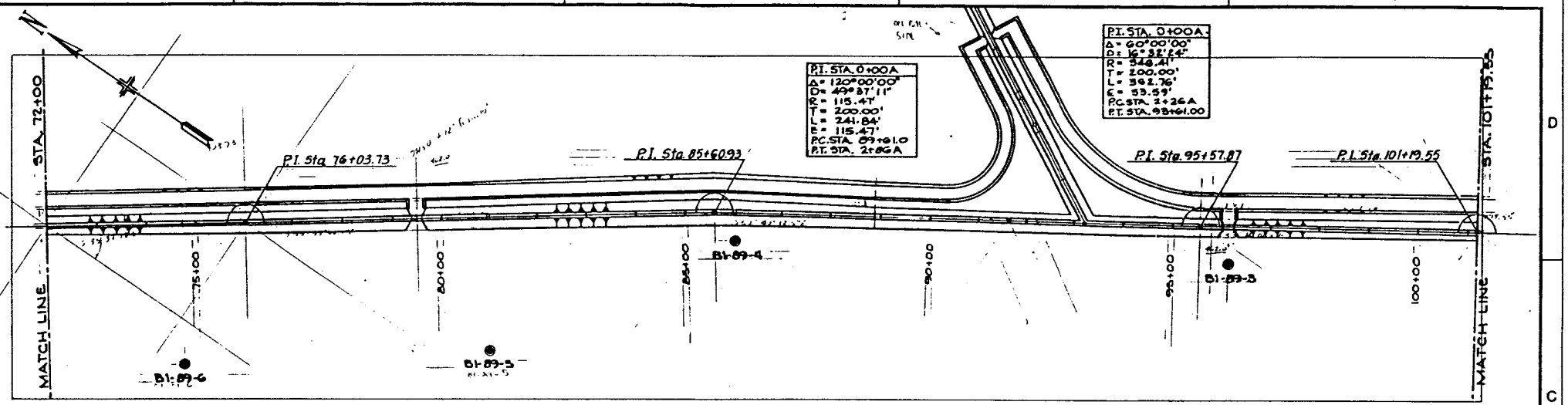
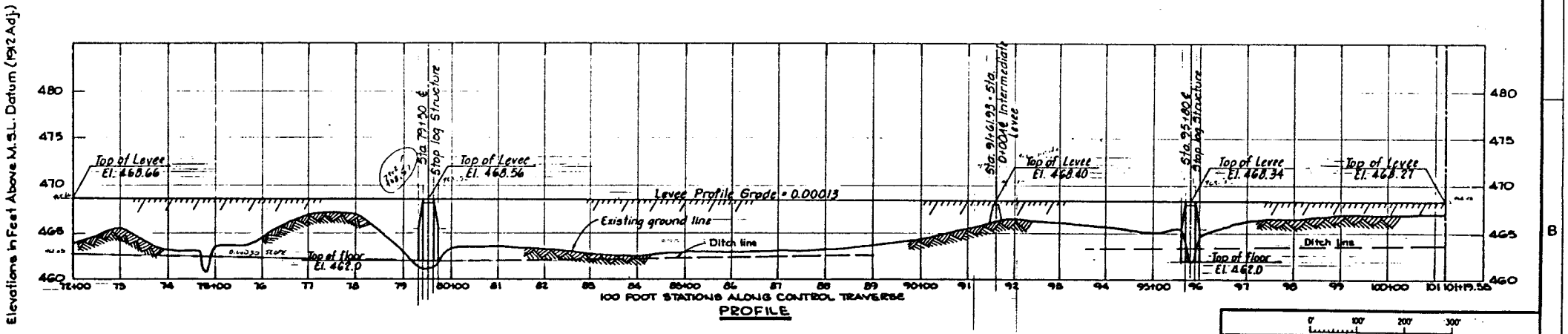
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 46+51.46 TO STA. 72+00

Scale 1" = 100'
Date
Drawing Code
Sheet reference numbers
Sheet __ of __

PLATE 11





Reference:

0' 100' 200' 300'

Symbol	Description	Date	Approved

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

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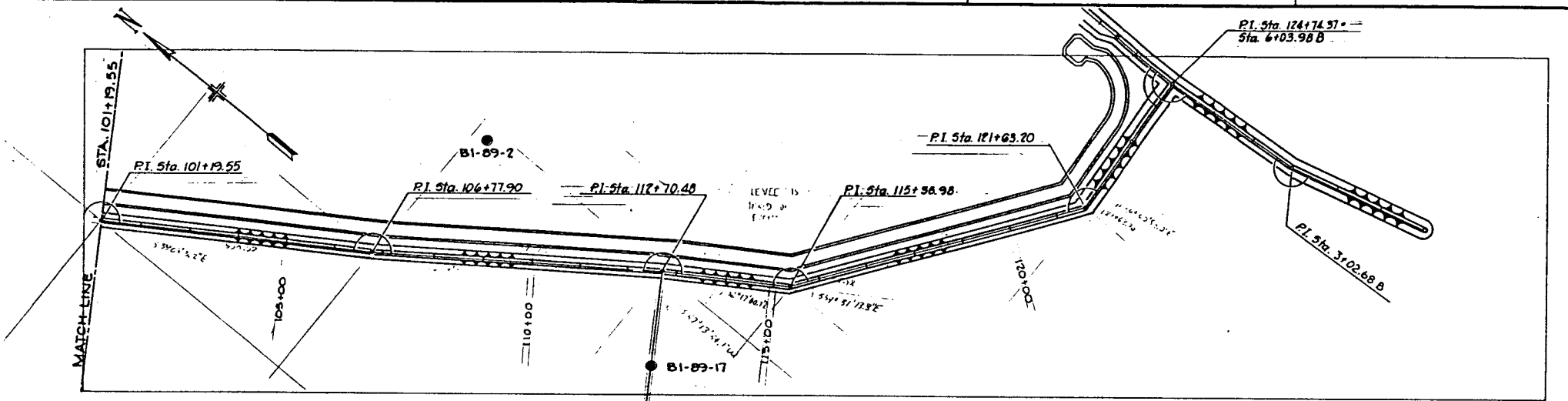
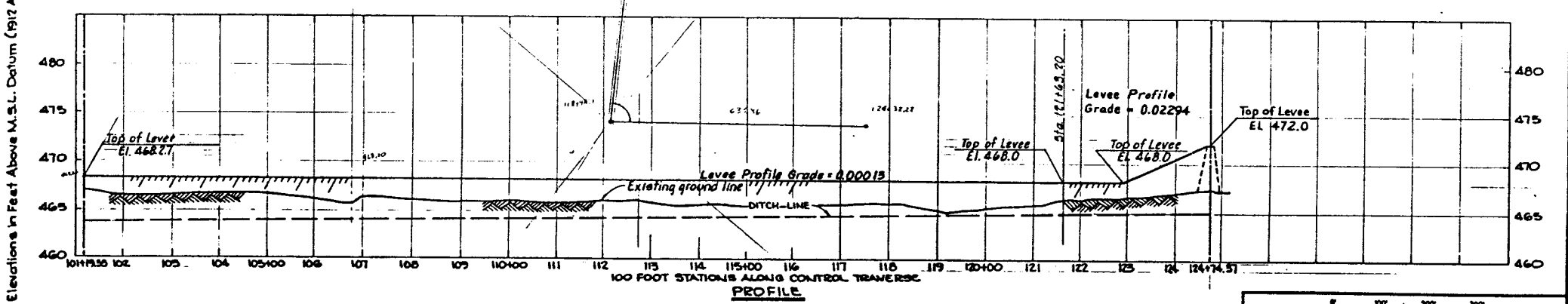
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 811
BAT ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 72+00 TO STA. 101+19.55

Scale 1"=100'
Date
Drawing Code
Sheet reference numbers
Sheet _ of _

PLATE 12





Reference:

0' 100' 200' 300'

Revisions			
Symbol	Description	Date	Approved

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

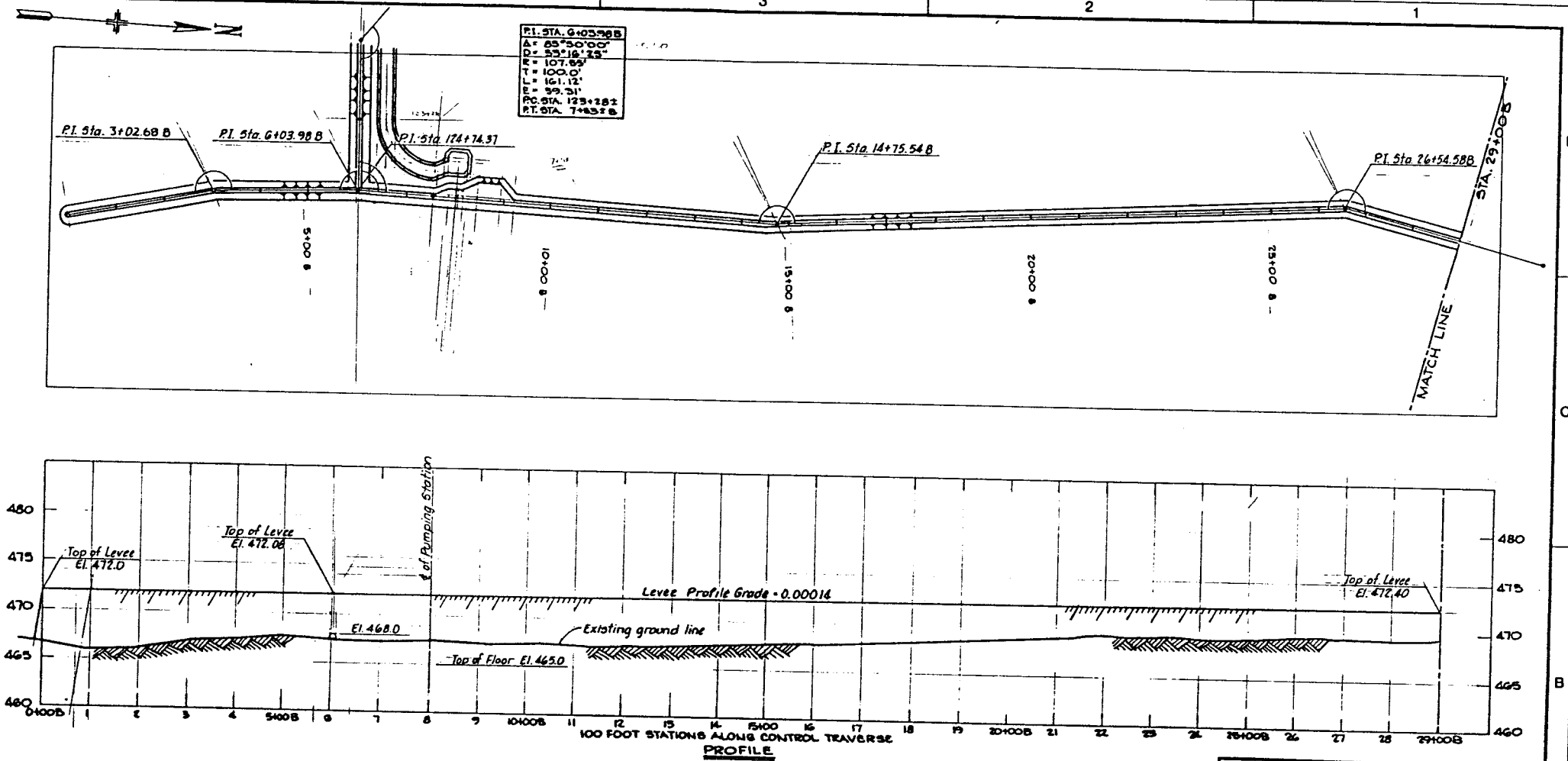
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
SAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 101+19.55 TO STA. 124+74.57

Design by
Drawn by
Checked by
Traced by
Approved by

Scale 1"=100'
Date
Drawing Code
Sheet reference number
Sheet _ of _

PLATE 13



Reference:

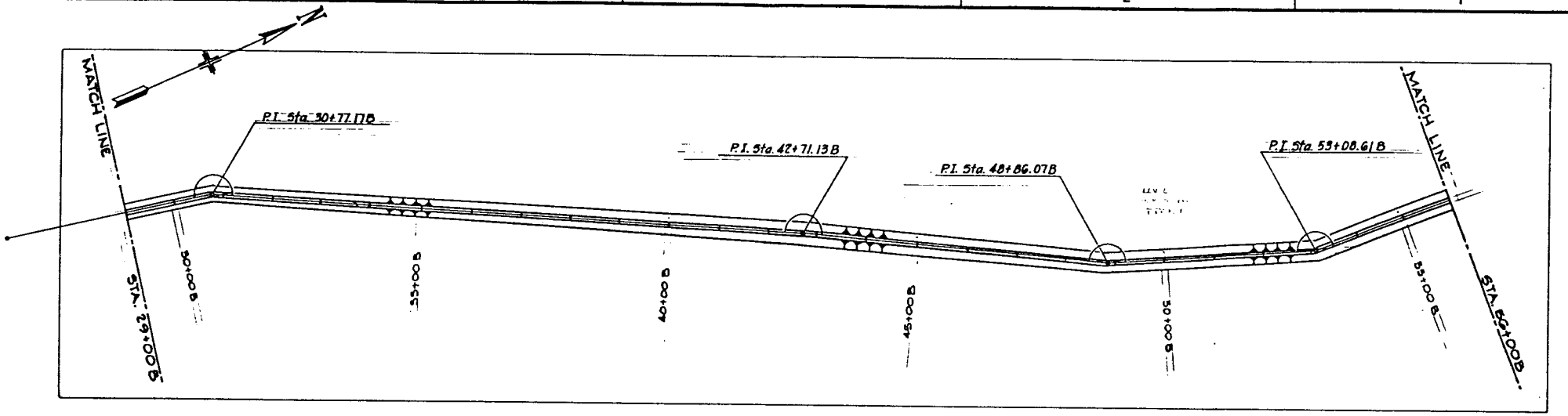
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

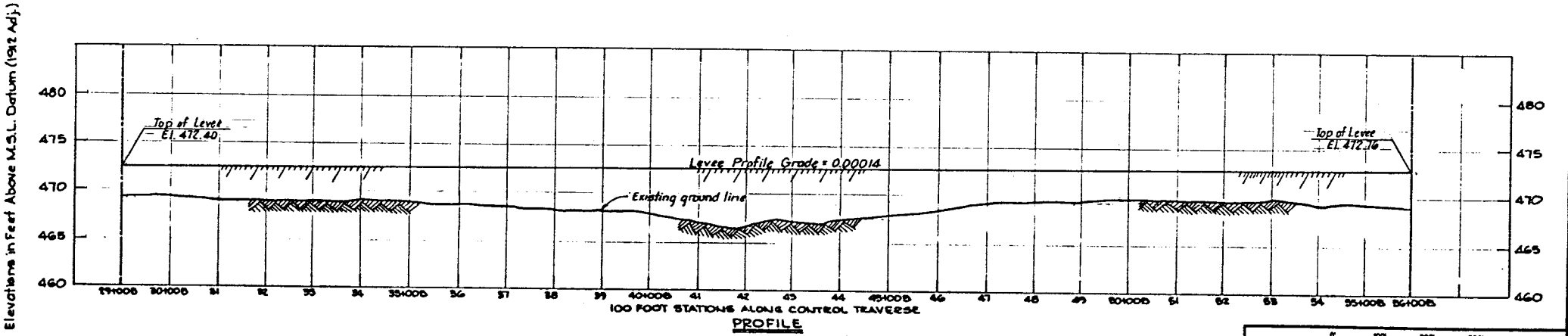
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
SAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 0+00 B TO STA. 29+00 B

Scale 1" = 100'

PLATE 14





PROFILE

Reference:

0' 100' 200' 300'

Symbol	Revisions Descriptions	Date	Approved

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 29+00B TO STA. 56+00B

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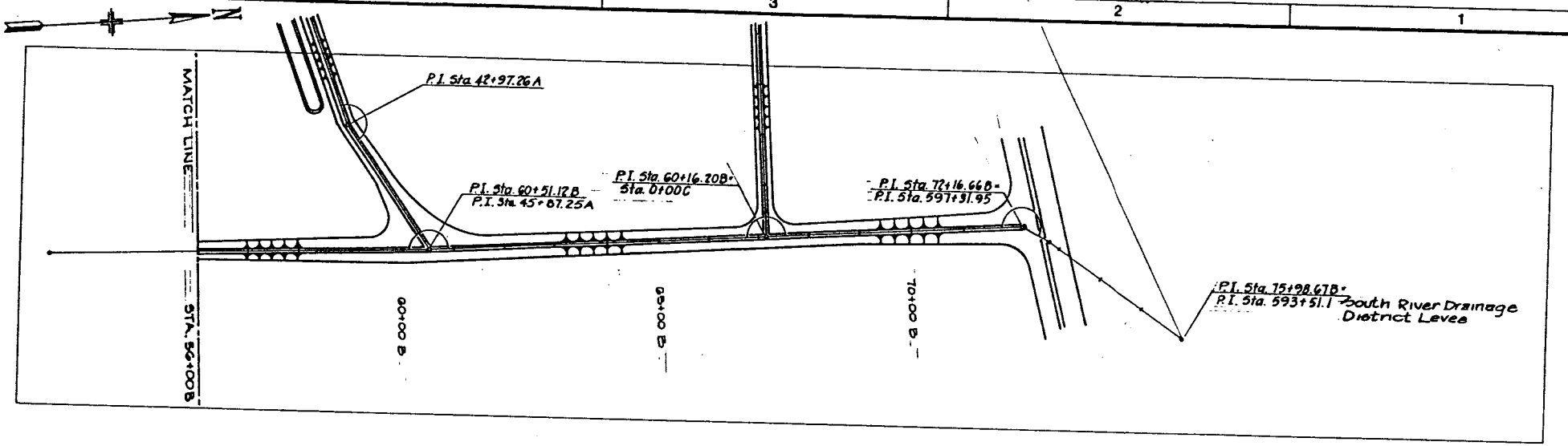
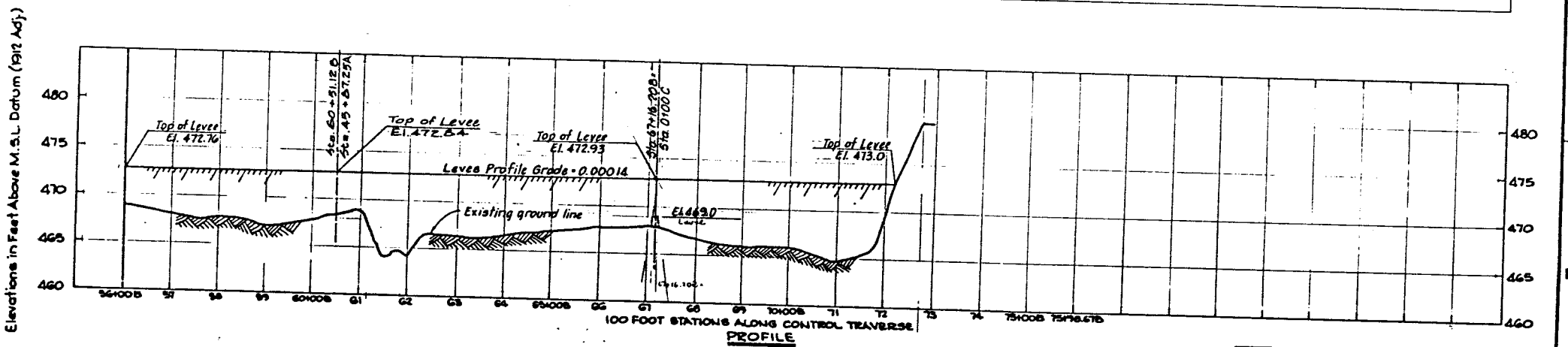
Reviewed by	
Approved by	
Scale	1"=100'
Date	
Drawing Code	
Sheet reference numbers	
Sheet _ of _	

PLATE 15





PROFILE

Reference:

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U.S. ARMY ENGINEER DISTRICT
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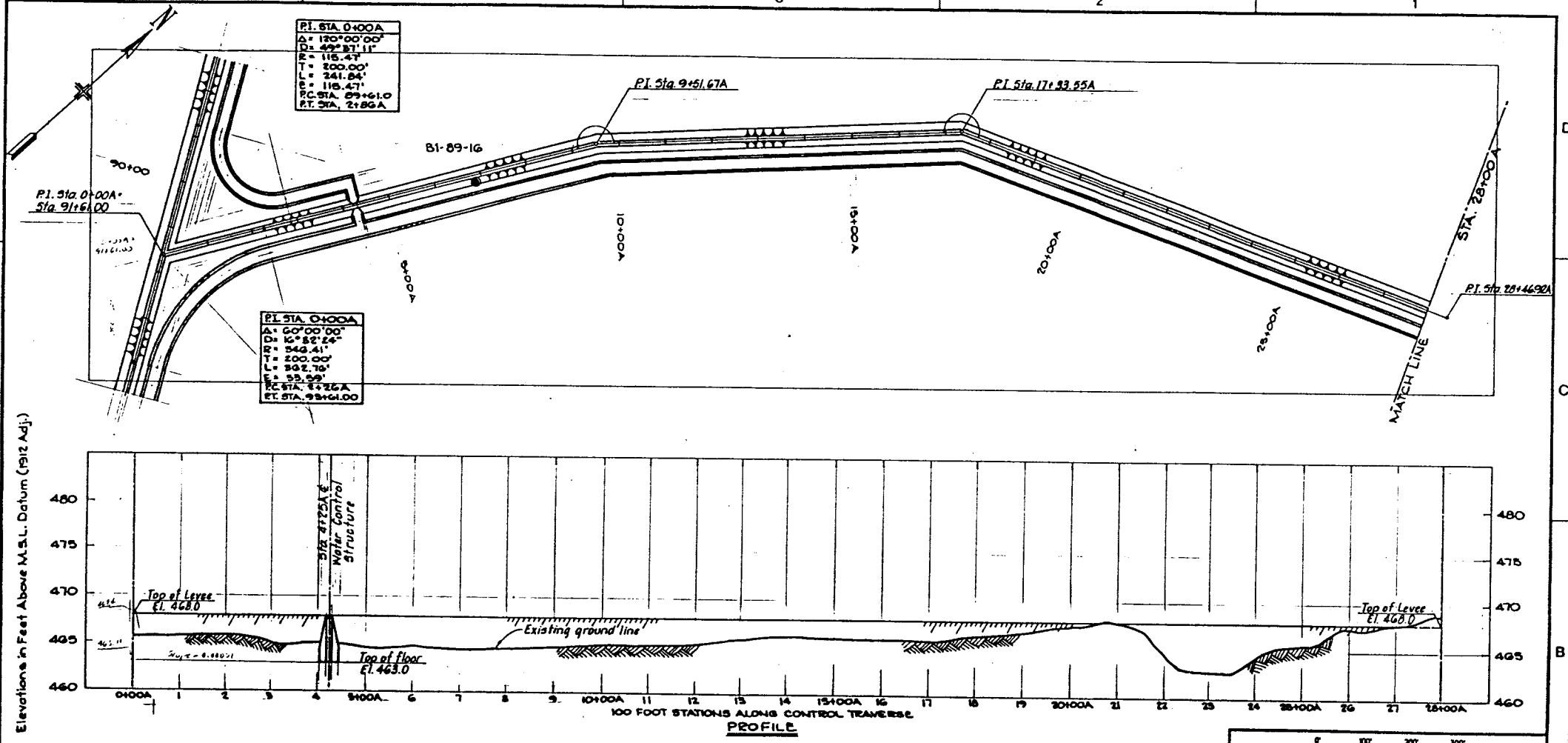
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 56+00 B TO STA. 72+16.96 B

Scales: 1" = 100'
Dates:
Drawing Code:
Sheet reference numbers:
Sheet __ of __

PLATE 16



Reference:

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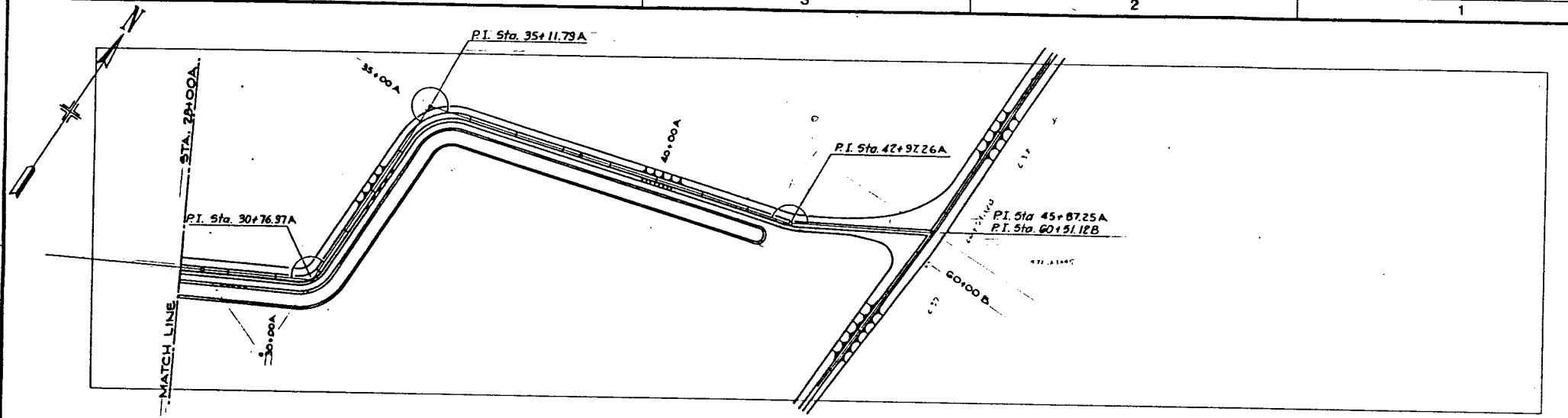
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

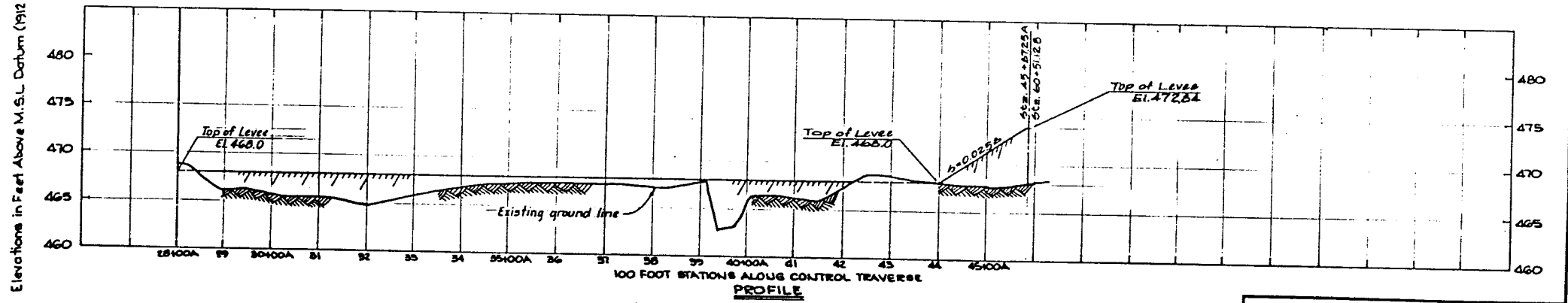
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 511
BAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 0+00A TO STA. 28+00A

Scale 1"=100'

PLATE 17





PROFILE

Reference:

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
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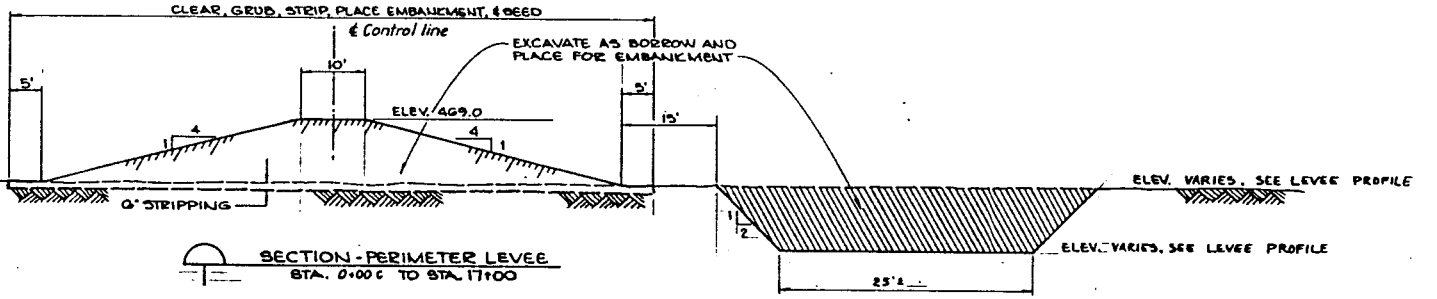
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 511
SAY ISLAND, MISSOURI

LEVEE PLAN & PROFILE
STA. 28+00A TO STA. 45+87.25A

Scale: 1"=100'
Sheet reference number:
Date:
Drawing Code:
Sheet _ of _

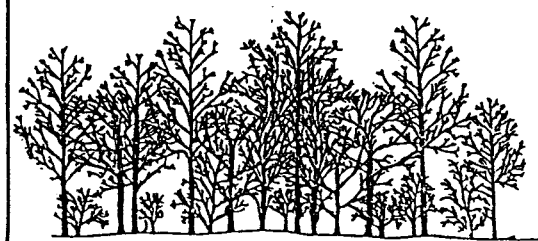
PLATE 18

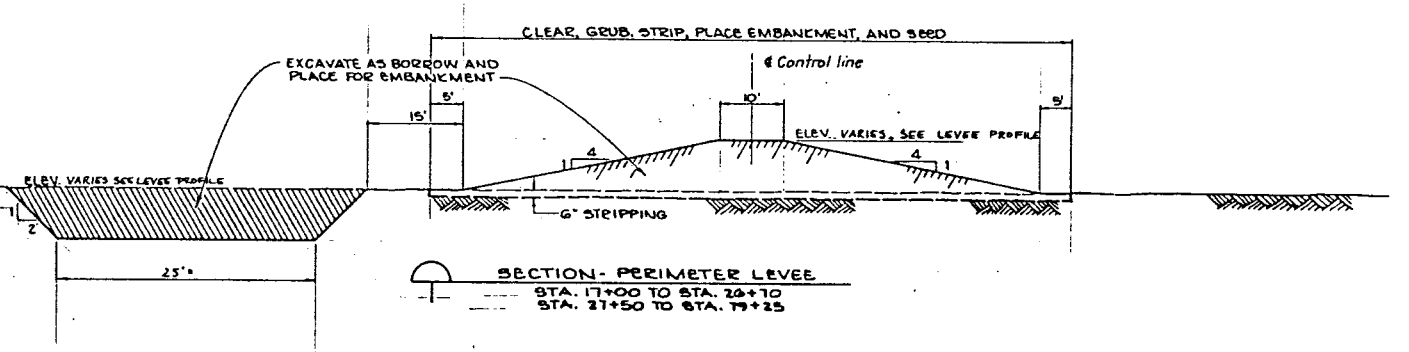
WETLAND MANAGEMENT UNIT



SECTION - PERIMETER LEVEE
STA. 0+00 C TO STA. 17+00

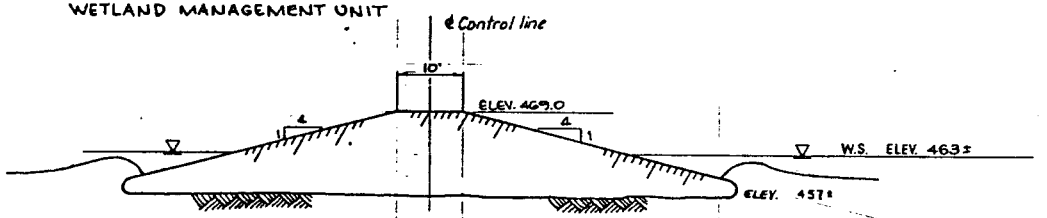
WETLAND MANAGEMENT UNIT





SECTION - PERIMETER LEVEE
STA. 17+00 TO STA. 24+70
STA. 27+50 TO STA. 79+25

WETLAND MANAGEMENT UNIT



SECTION - PERIMETER LEVEE
STA. 24+70 TO STA. 27+50

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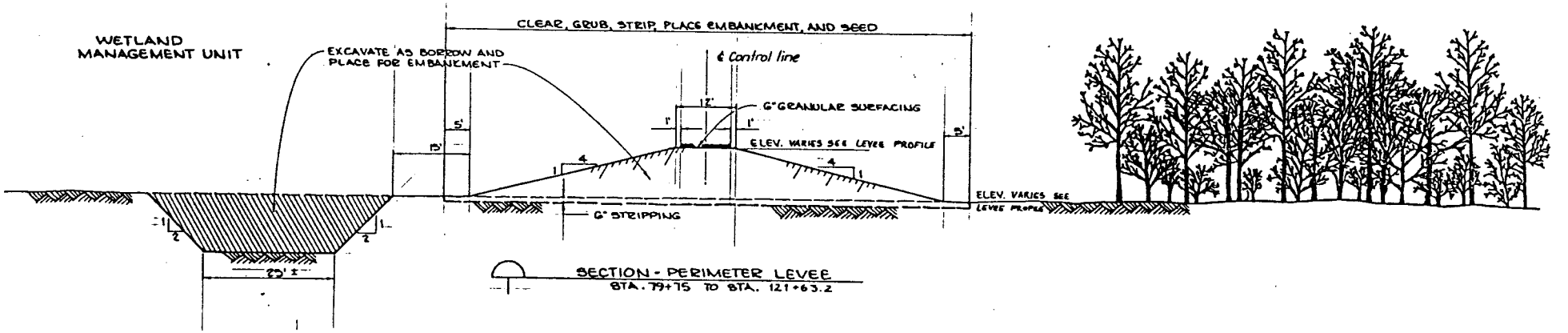
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

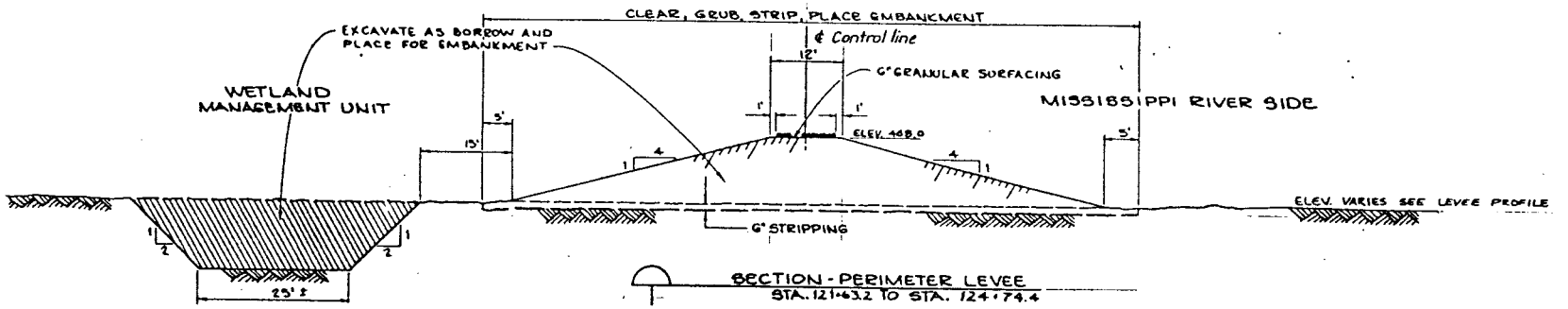
TYPICAL SECTIONS I

Scales: No Scale
Dates:
Drawing Control:
Sheet reference numbers:
Sheet __ of __

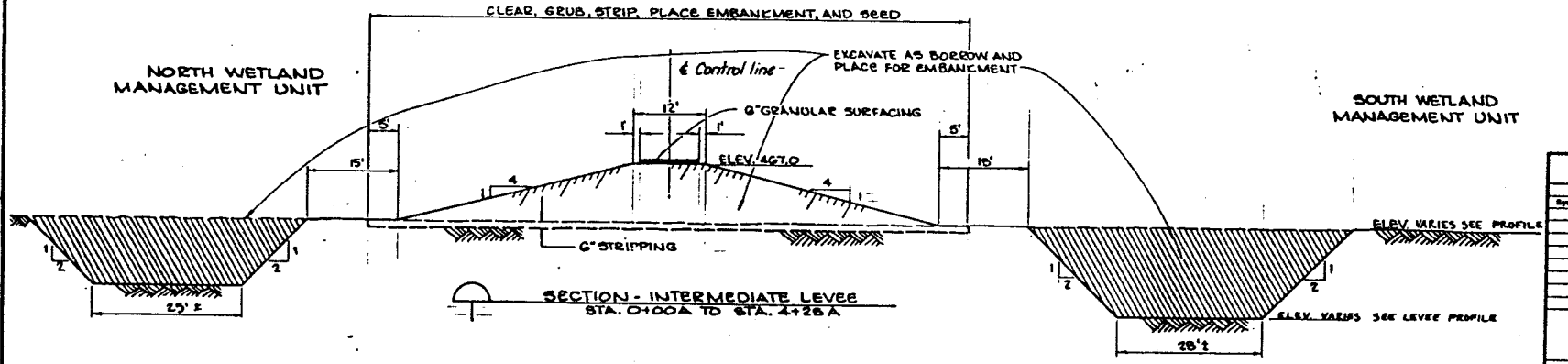
PLATE 19



SECTION - PERIMETER LEVEE
STA. 79+75 TO STA. 121+63.2



SECTION - PERIMETER LEVEE
STA. 121+63.2 TO STA. 124+74.4



SECTION - INTERMEDIATE LEVEE
STA. 0+00A TO STA. 4+28A

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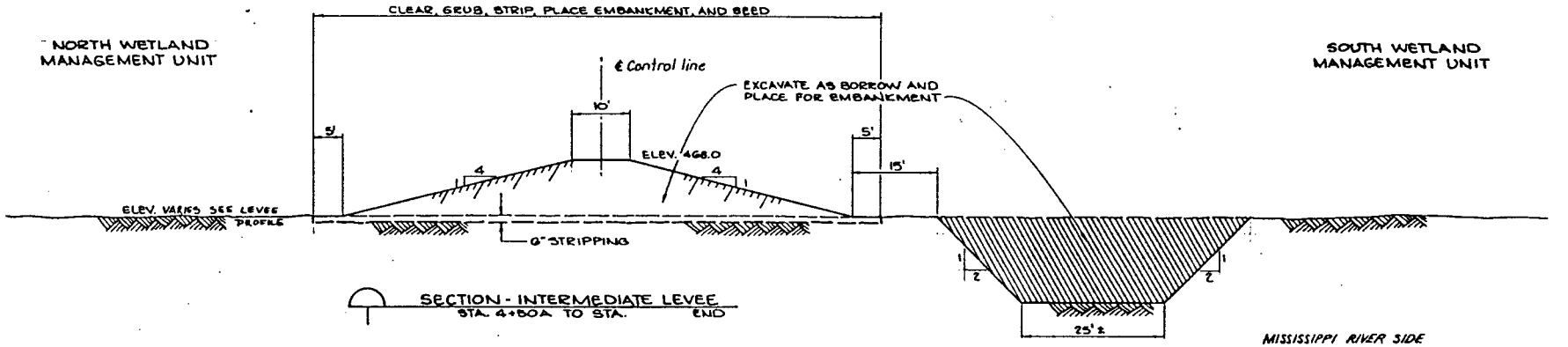
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

TYPICAL SECTIONS II

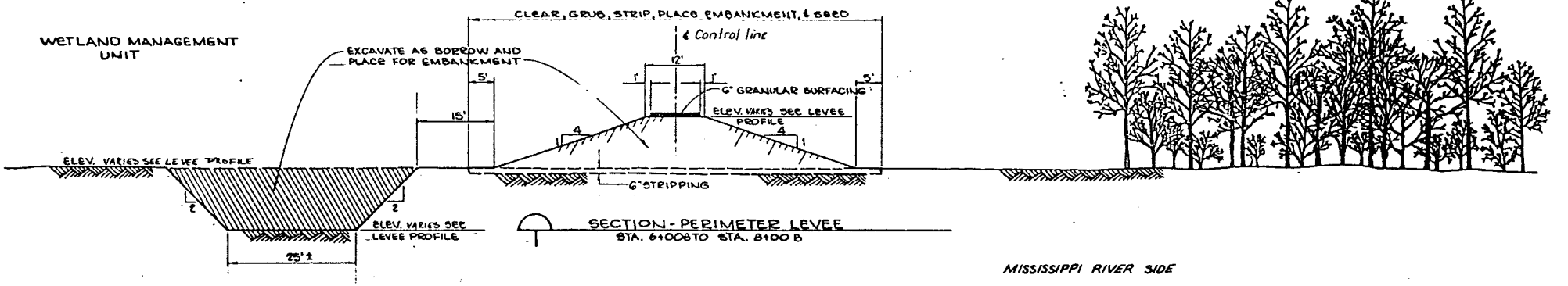
Scale: No Scale
Date:
Drawing Code:
Sheet reference numbers:
Sheet __ of __

PLATE 20



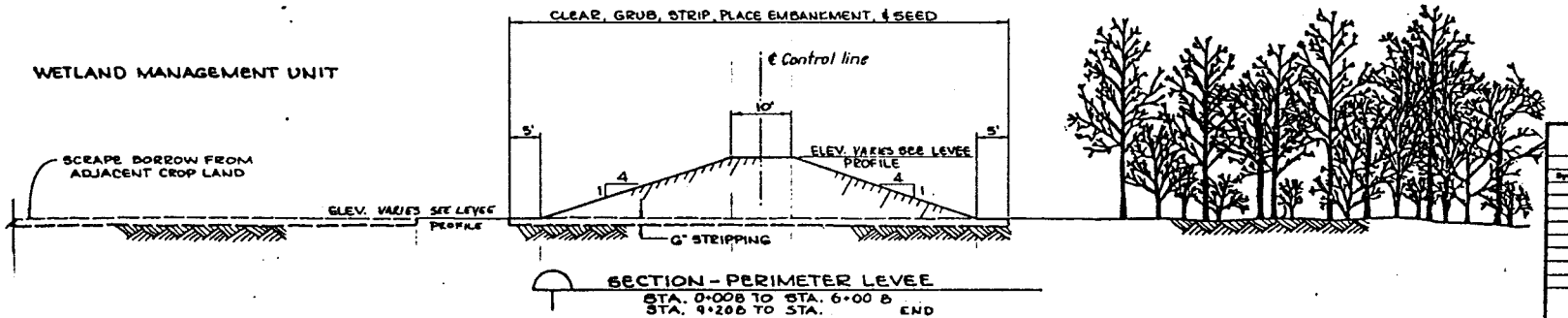
SECTION - INTERMEDIATE LEVEE
STA. 4+50A TO STA. END

MISSISSIPPI RIVER SIDE



SECTION - PERIMETER LEVEE
STA. 6+00B TO STA. 8+00 B

MISSISSIPPI RIVER SIDE



SECTION - PERIMETER LEVEE
STA. 0+00B TO STA. 6+00 B
STA. 9+20B TO STA. END

Symbol	Revisions Descriptions	Date	Approved

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

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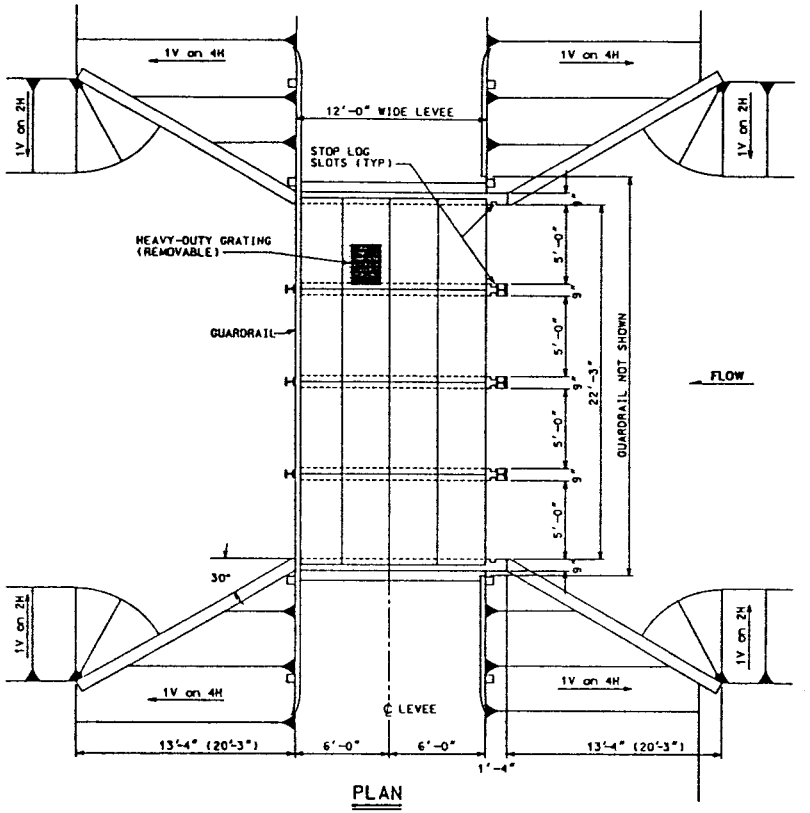
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

TYPICAL SECTIONS III

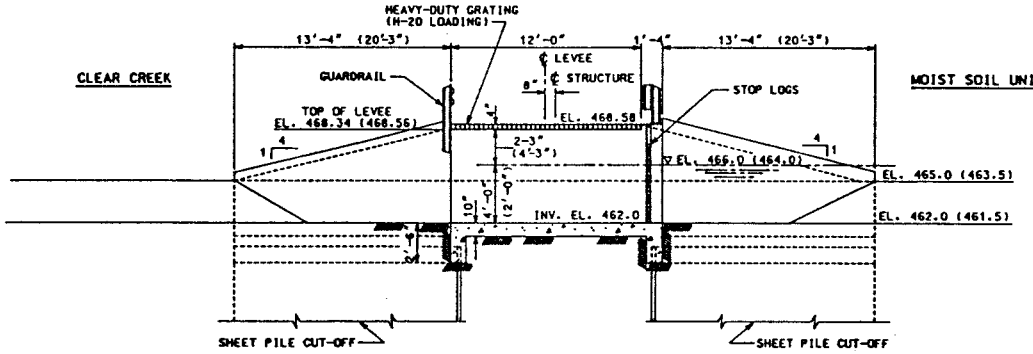
Scale: No Scale
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _

PLATE 21



PLAN

SCALE: 1/8" = 1'-0"



LONGITUDINAL SECTION

SCALE: 1/8" = 1'-0"

NOTES:

1. THE BASIC LAYOUT SHOWN IS FOR BOTH THE SOUTH UNIT AND NORTH UNIT WATER CONTROL STRUCTURES.
2. WHEN ELEVATIONS AND DIMENSIONS ARE GIVEN THUS 13'-4" (20'-3"), THOSE OUTSIDE THE ( ) ARE FOR THE SOUTH UNIT WATER CONTROL STRUCTURE AND THOSE INSIDE THE ( ) ARE FOR THE NORTH UNIT WATER CONTROL STRUCTURE.

Revisions			
Symbol	Description	Date	Approved

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

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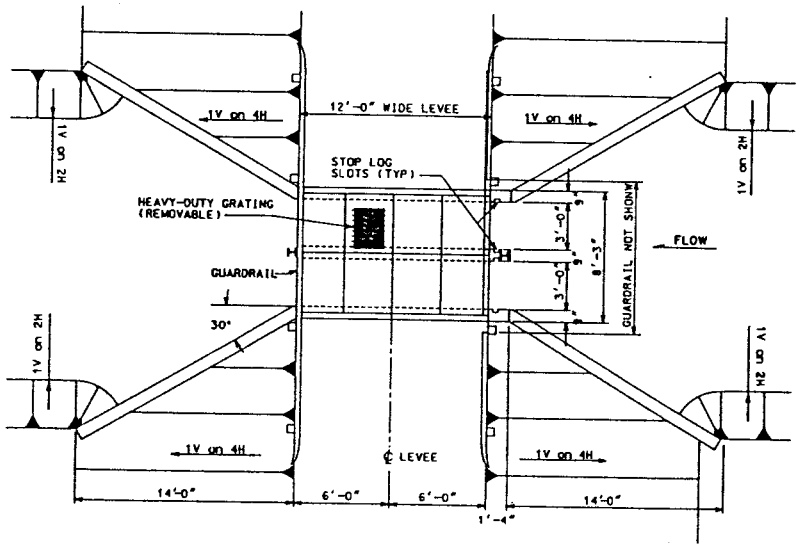
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

PERIMETER LEVEE WATER CONTROL STRUCTURES

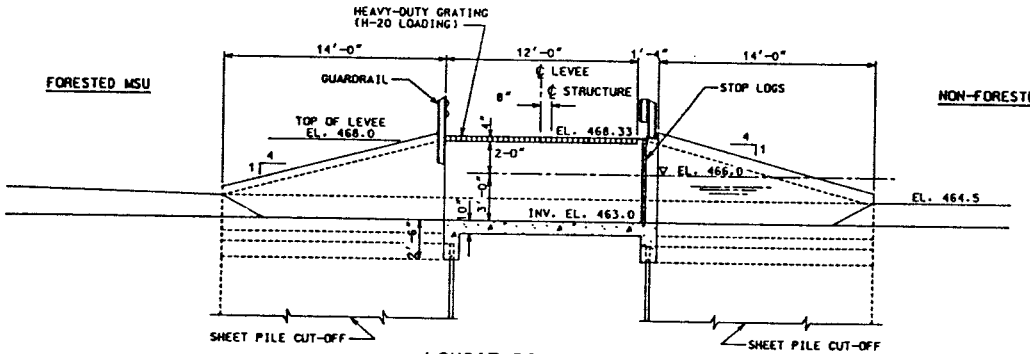
Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet of

PLATE 22



PLAN

SCALE: 1/4" = 1'-0"



LONGITUDINAL SECTION

SCALE: 1/4" = 1'-0"

Revisions			
Symbol	Description	Date	Approved

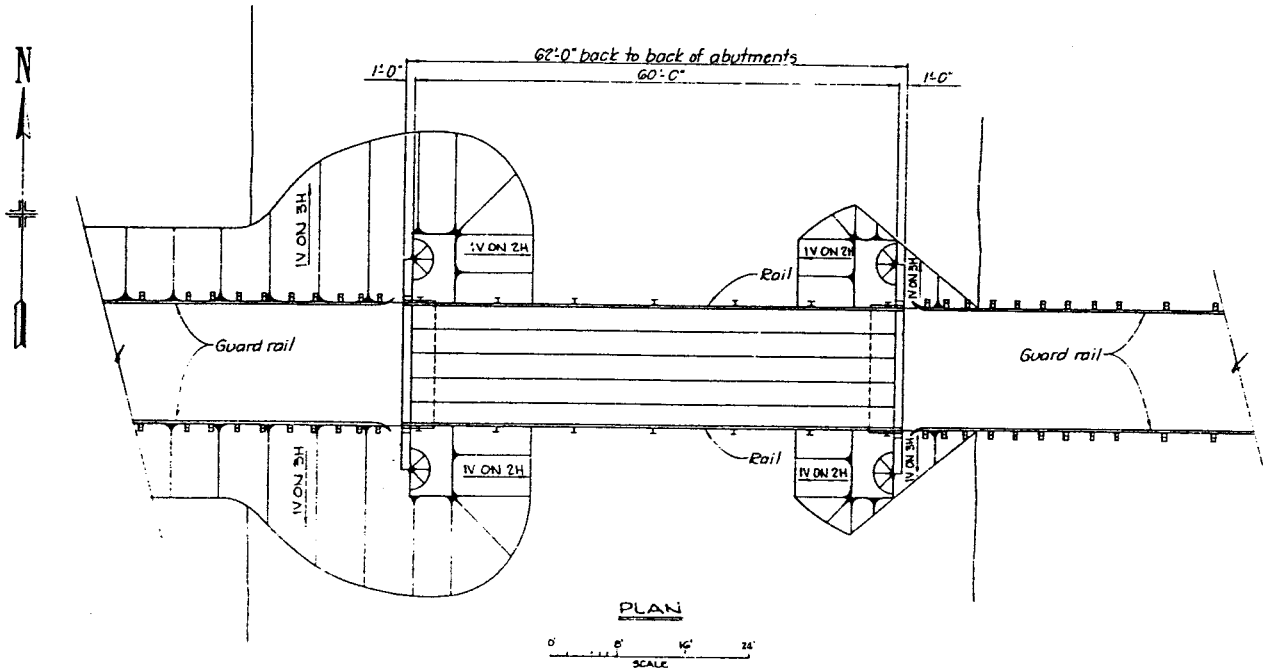
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

INTERMEDIATE LEVEE
WATER CONTROL STRUCTURE

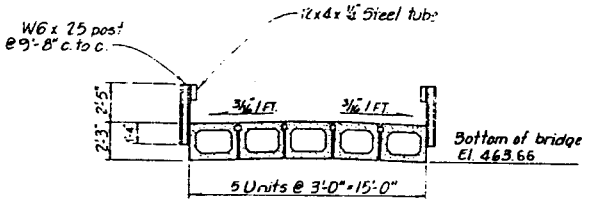
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet of

PLATE 23



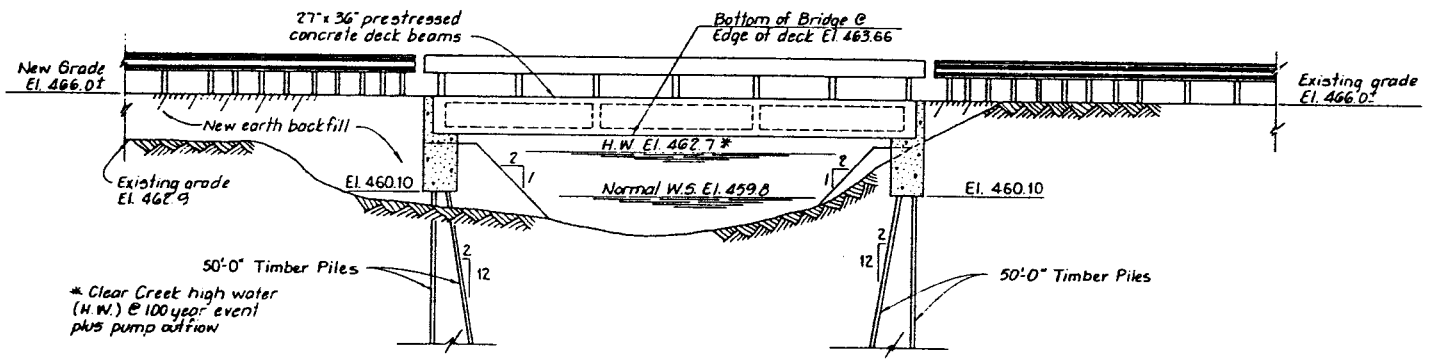
PLAN

SCALE 0 8' 16' 24'



SECTION

SCALE 0 4' 8' 12'



PROFILE

HORIZONTAL SCALE 0 8' 16' 24'

VERTICAL SCALE 0 4' 8' 12'

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ROCK ISLAND, ILLINOIS

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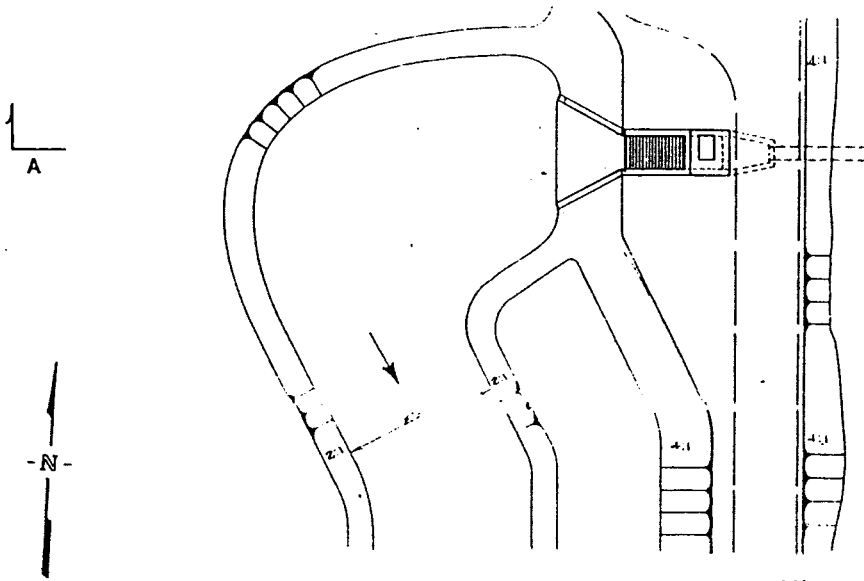
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

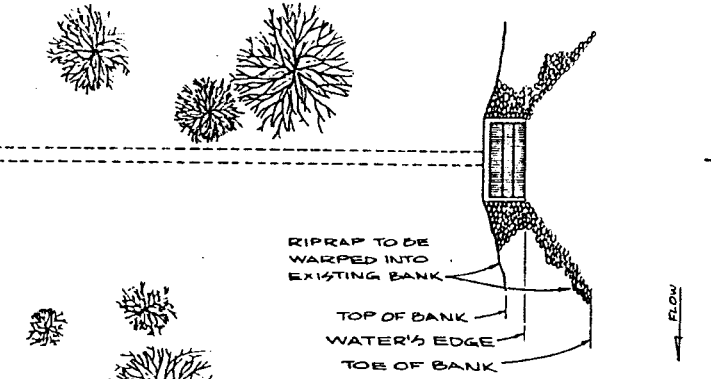
ACCESS BRIDGE

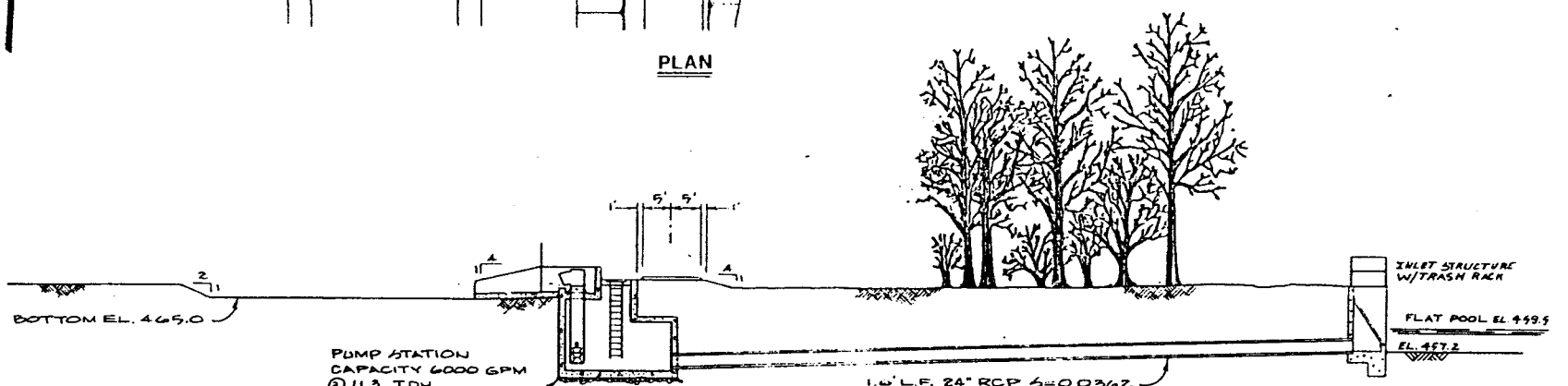
Scale: As Shown
Date:
Drawing Code:
Sheet reference number:
Sheet _ of _

PLATE 24

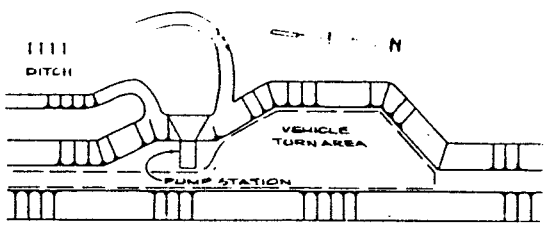


PLAN





SECTION A-A



SCHEMATIC LAYOUT

NO SCALE

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PUMP STATION SITE PLAN

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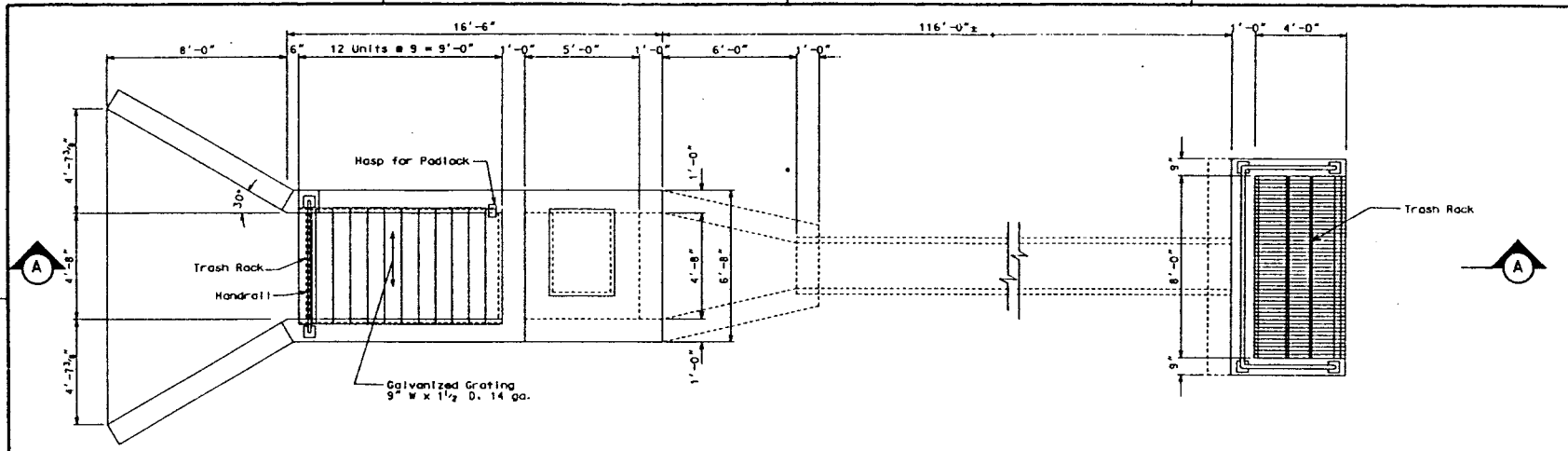
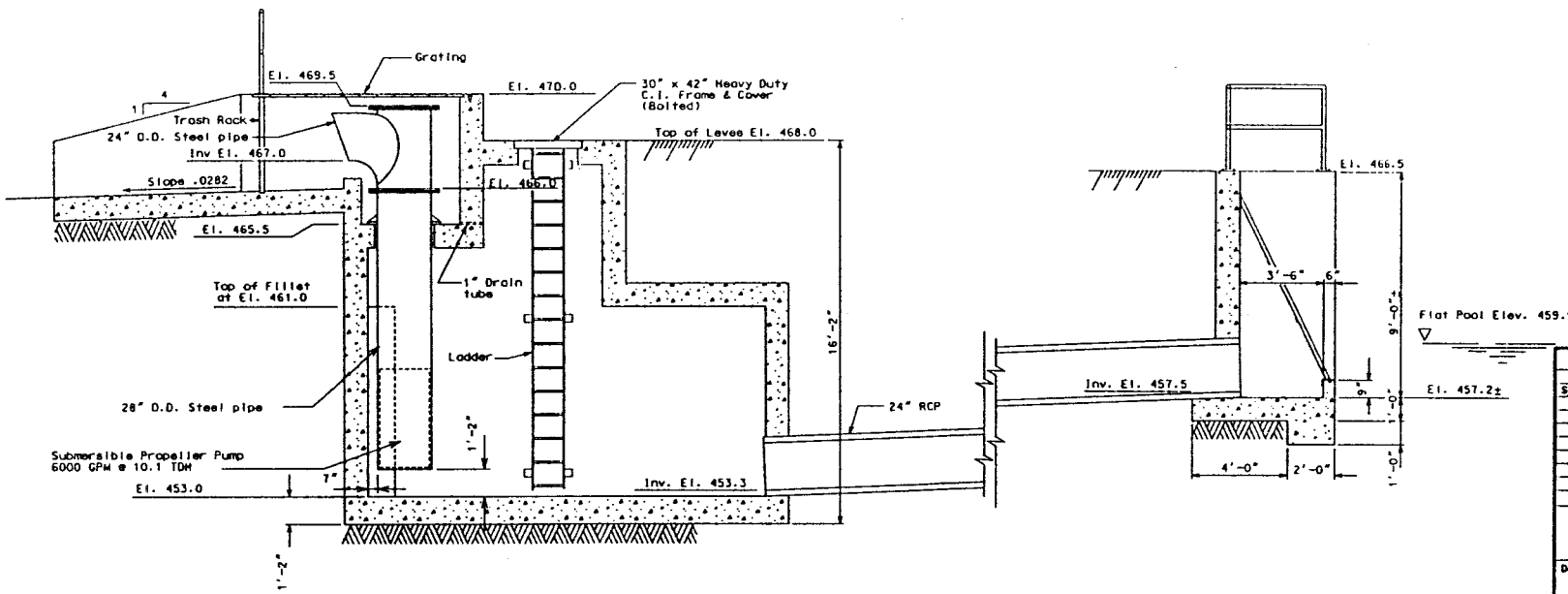
Checked by:
Reviewed by:
Approved by:
Scale: NO SCALE
Date:
Drawing Code:
Sheet reference Number:
Sheet _ of _

PLATE 25



PLAN



SECTION A-A

SCALE: 1" = 1'-0"

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Approved by:
Joel E. Brown
Chief, Office of Engineering

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
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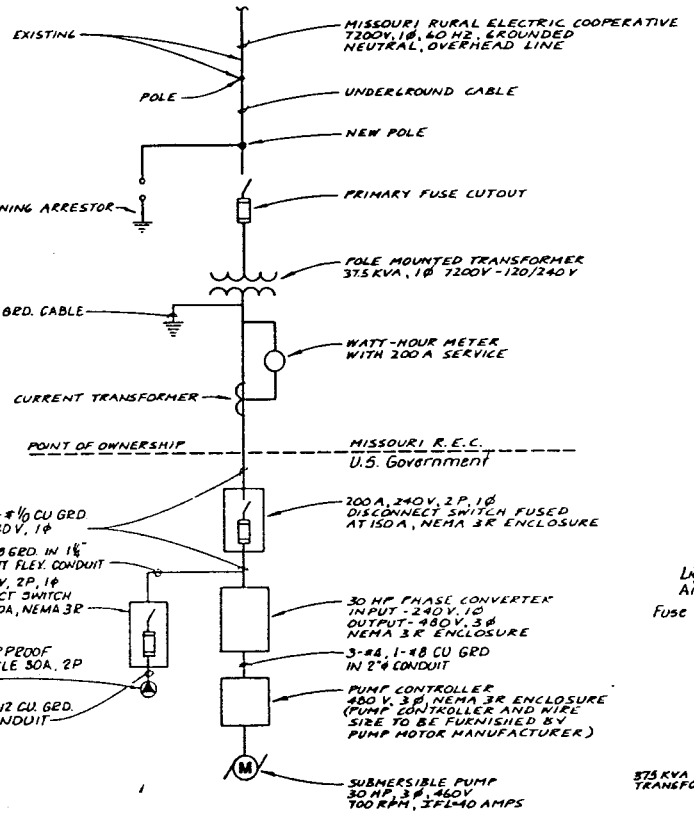
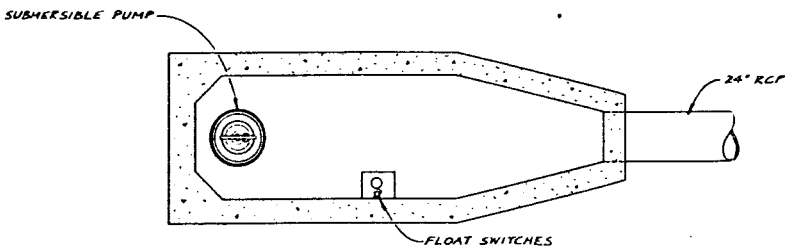
PUMP STATION DETAILS

Scale: 3/8"=1'-0"
Date:
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet of

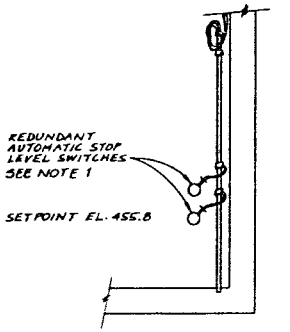
PLATE 26



ONE-LINE DIAGRAM OF PUMP STATION POWER SERVICE

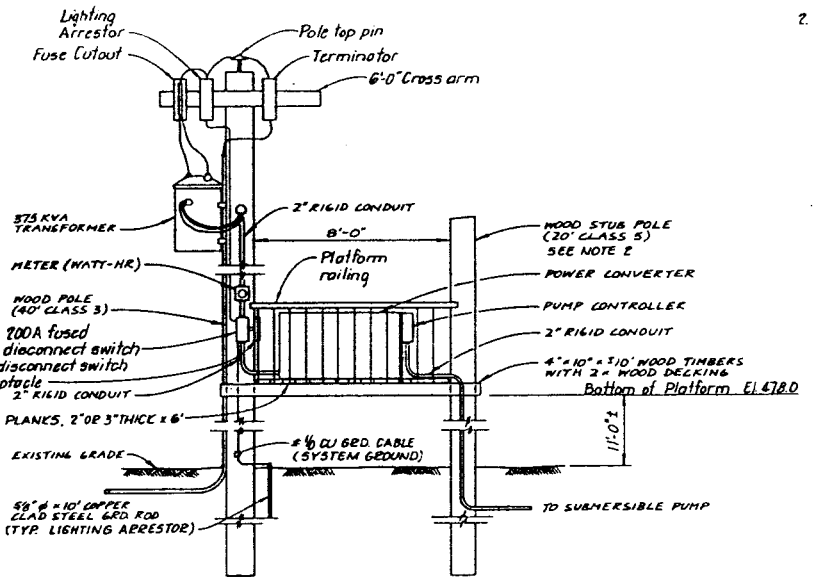


ELECTRICAL EQUIPMENT PLAN



FLOAT SWITCHES

Notes
1. Upon sump low level trip, pump will require manual reset to restart
2. Stub pole will be provided with a limited access ladder with a hinged cover.



ELECTRICAL SERVICE

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POOL 22, RIVER MILE 311
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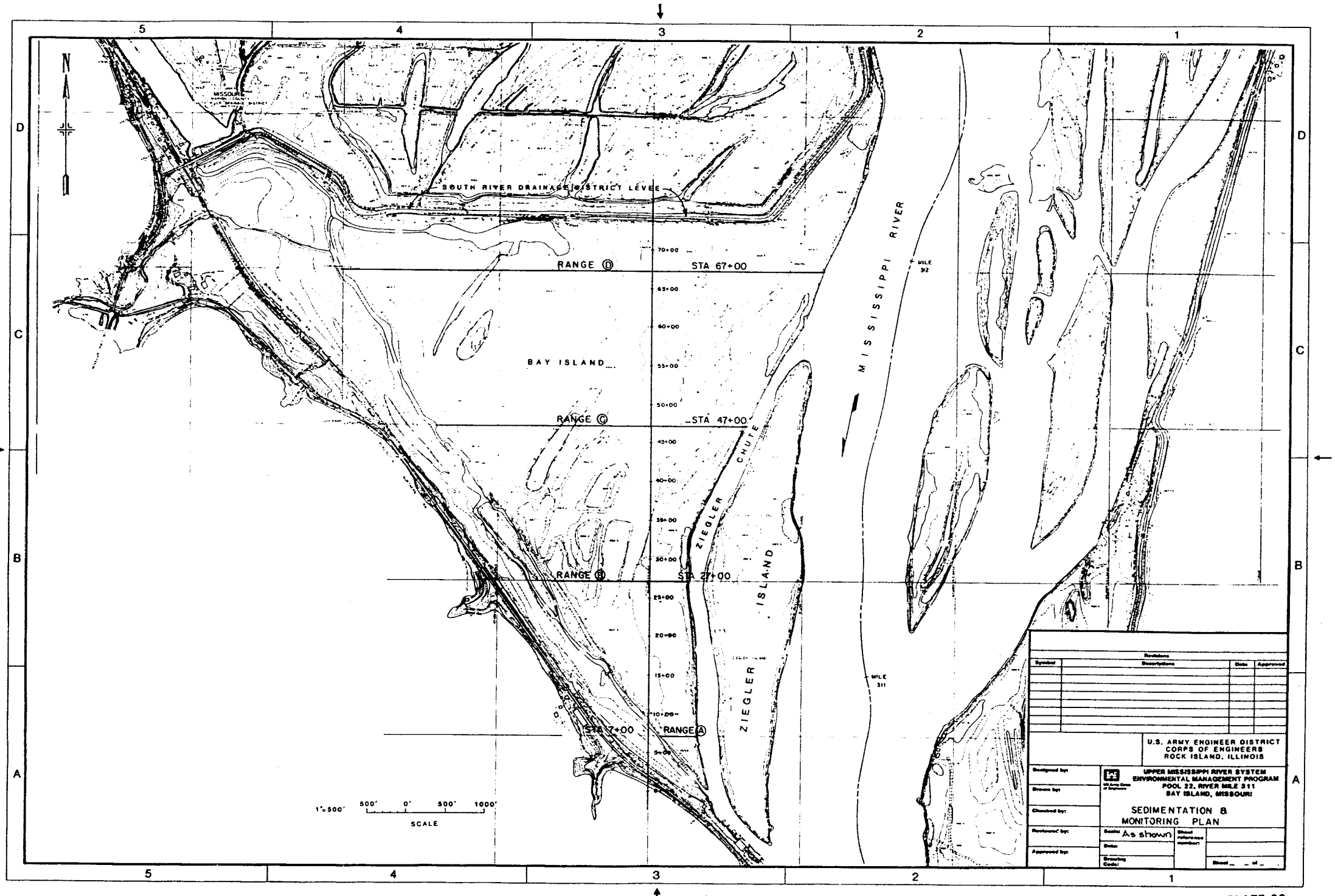
ELECTRICAL

Scale: No Scale
Date:
Drawing Code:
Sheet reference number:
Sheet __ of __

PLATE 27


N
SOUTH RIVER DRAINAGE DISTRICT LEVEE
RANGE D
STA 67+00
BAY ISLAND
RANGE C
STA 47+00
RANGE B
STA 27+00
RANGE A
STA 7+00
ZIEGLER CHUTE
ZIEGLER ISLAND
MISSISSIPPI RIVER
MILE 312
MILE 311
1"=500'
500' 0' 500' 1000'
SCALE
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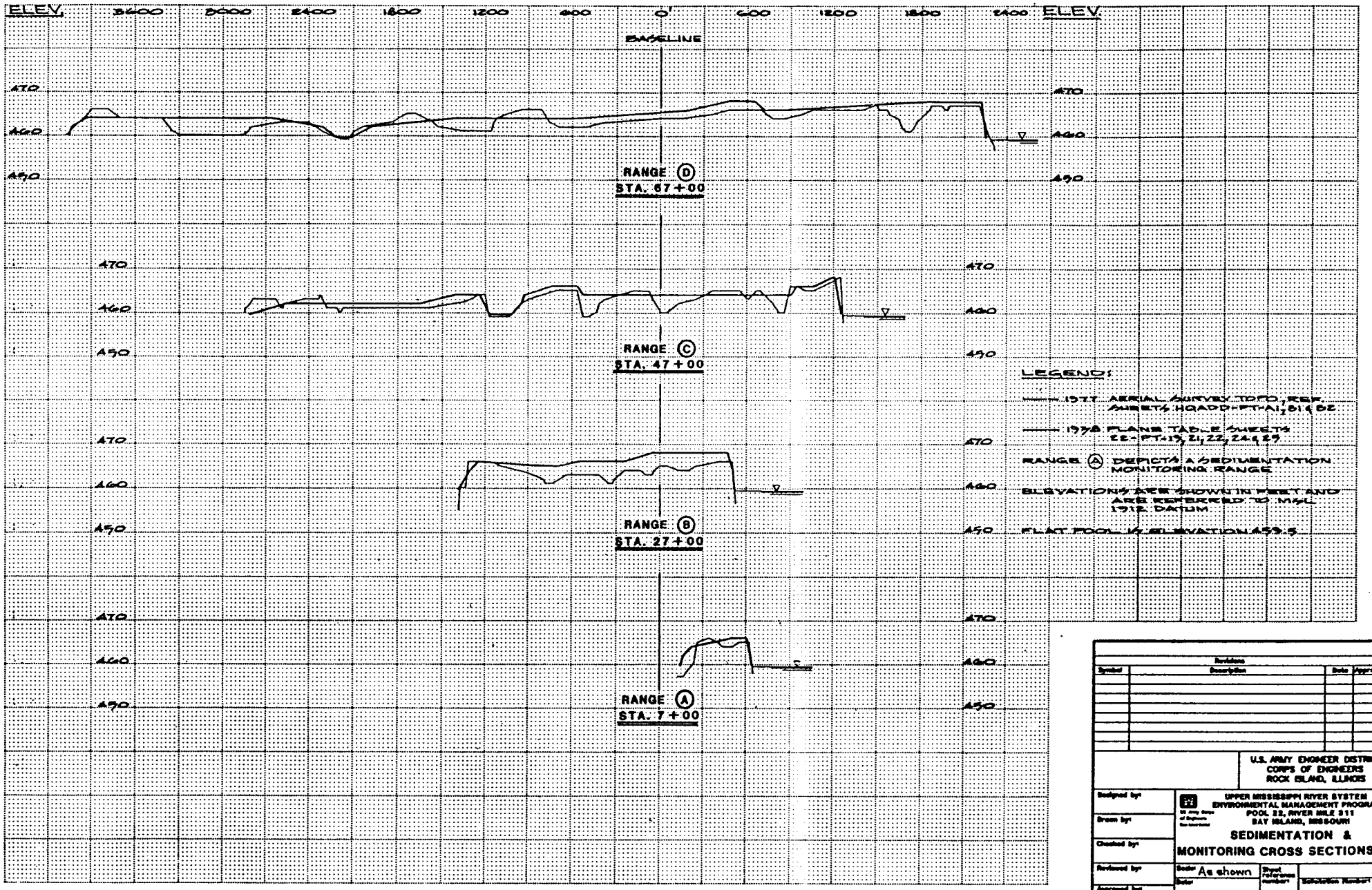
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI
SEDIMENTATION & MONITORING PLAN
As shown

PLATE 28



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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILE 311
BAY ISLAND, MISSOURI

SEDIMENTATION & MONITORING CROSS SECTIONS

Scale: As shown
Date:
Drawing File:
Sheet References:
Submission Number:
Sheet of

PLATE 29