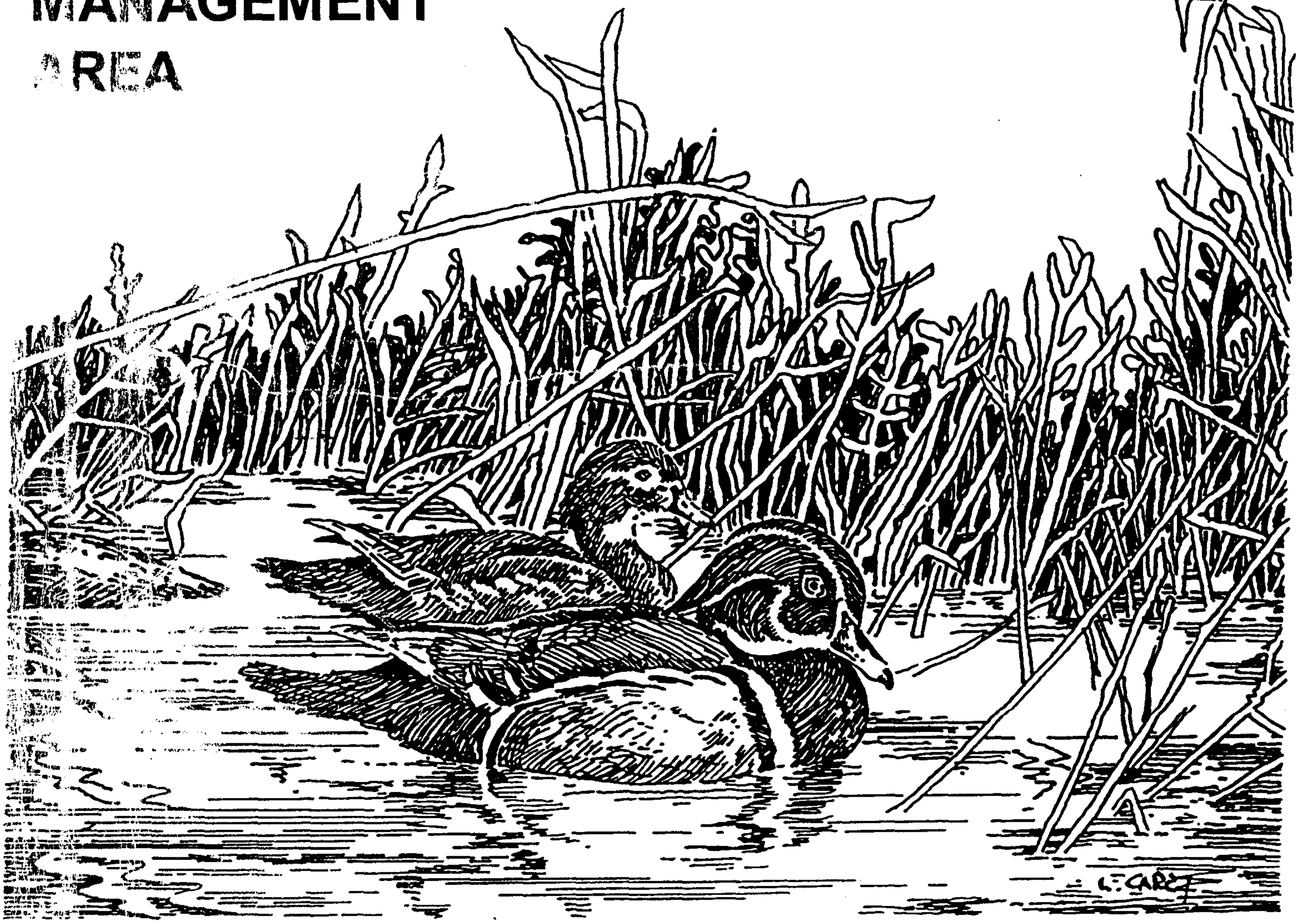
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (R-10F)
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

PRINCETON WILDLIFE MANAGEMENT AREA



FEBRUARY 1995

US Army Corps
of Engineers
Rock Island District

POOL 14
MISSISSIPPI RIVER
MILES 504.0 - 506.5
SCOTT COUNTY, IOWA

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

REPLY TO
ATTENTION OF

CENCR-PD-W

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
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POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

FEBRUARY 1995

ACKNOWLEDGMENT

Primary study team personnel who are familiar with the technical aspects of the study are listed below:

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US Army Corps of Engineers
Rock Island District

WE'RE PROUD TO SIGN OUR WORK

EXECUTIVE SUMMARY

The 1,129-acre Princeton Wildlife Management Area (WMA) lies adjacent to the Mississippi River between River Miles (RM) 504.0 and 506.5, just upstream of Princeton, Iowa. This wetland complex is delimited on the north and east by an existing perimeter levee. Its western and southern limits are essentially defined by a railroad grade and access roadway, respectively. Seven hundred eleven acres of the Princeton WMA are federally owned, with the remaining 418 acres having been acquired by the State.

The Princeton WMA has historically been managed for migratory birds and other wetland dwelling species. However, water level control limitations and levee overtopping and breaching events have negatively impacted efforts to optimize the operation of this area and meet management goals and objectives. Opportunities exist to increase the reliability, total quantity, and overall quality of preferred habitats at this location.

The goal of the proposed project is to enhance wetland habitat. The following objectives have been identified to meet this goal: (1) increase potential for reliable food production and resting/loafing habitat for migratory birds and (2) increase overall vegetation diversity and availability of preferred wildlife food resources.

Six alternatives were considered to achieve the project goal and objective: (A) No Federal Action; (B) Levee Restoration; (C) Levee Restoration with Mast Tree Planting; (D) 1-Cell Wetland Management Unit (WMU) Enhancement; (E) 1-Cell WMU Enhancement with Mast Tree Planting; (F) 2-Cell WMU Enhancement; and (G) 2-Cell WMU Enhancement with Mast Tree Planting.

Evaluation of these project alternatives was accomplished through application of a habitat quantification methodology and annualization of outputs and costs. Existing conditions and future with- and without-project scenarios were first developed and assessed utilizing the Wildlife Habitat Appraisal Guide (WHAG). The WHAG numeric values were subsequently used in conjunction with project cost data and functional life expectancy to compare the proposed project alternatives. Through this analysis, it was determined that project Alternative G (see Figure ES-1) would provide the greatest total outputs per unit cost over time.

The recommended plan (Alternative G) includes: restoring 16,400 feet of existing perimeter levee to a 15-year level of protection; constructing 5,350 feet of cross dike and 2,400 feet of overflow roadway; relocating the existing pump station; installing one stoplog and one gatewell structure; and planting approximately 25 acres with mast-producing trees.

Restoration of the perimeter levee, construction of the cross dike, overflow roadway, stoplog and gatewell structures and relocation of the existing pump station are all actions required to optimize water level management at the Princeton WMA and, subsequently, the reliability of those food resources and resting and loafing habitats required by migratory birds and other marsh-dwelling species. Implementation of these project features will result in the conversion of the Princeton WMA from a single unit to a 2-celled configuration with independent management capabilities. Also, additional shallow water habitat will be created as a result of the borrow material excavation required to accomplish the levee restoration.

The mast tree planting component of the project will offset habitat losses being incurred as a result of the cross dike construction and provide additional project outputs (food resources, cover opportunities and nesting sites) benefiting various migratory bird species and other wildlife.

Implementation of the recommended plan will provide increased management flexibility and the capability to optimize the quality and quantity of preferred habitat at this location. The project outputs meet site management goals and objectives and support the overall goals and objectives of the UMRS-EMP, the North American Waterfowl Management Plan, and the Partners for Flight program.

Project operation and maintenance, at an estimated average annual cost of $26,600, will be accomplished by the Iowa Department of Natural Resources (IADNR), the non-Federal project sponsor.

The U.S. Army Corps of Engineers will be responsible for the Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the final Definite Project Report and that is needed as a result of specific storm or flood events. Rehabilitation of the project is considered to be reconstructive work which cannot be accurately estimated at this time.

Section 906 (e) of the 1986 Water Resources Development Act (WRDA) specifies that first cost funding for enhancement features "located on lands managed as a national wildlife refuge" will be 100 percent Federal. The majority of the project features will be located on federally owned lands managed as part of the Upper Mississippi River National Fish and Wildlife Refuge by the IADNR through cooperative agreement with the U.S. Fish and Wildlife Service (USFWS).

In accordance with WRDA 1986, a 25 percent non-Federal cost-sharing of the general design and construction costs assessable to those project features or portions thereof located on lands not "managed as a national wildlife refuge" will be required. A Project Cooperation Agreement (PCA) will be executed consistent with this requirement.

Per Section 107 (b) of the 1992 WRDA, all project operation and maintenance costs shall be the responsibility of the IADNR.

The District Engineer has reviewed the project outputs and determined that the implementation of the selected plan is justified and in the Federal interest. Therefore, approval of the construction of the Princeton Wildlife Management Area is recommended by the Rock Island District Engineer at an estimated Federal expense of $2,389,195. Total Federal cost, including general design, is $2,855,790. The total non-Federal cost share is estimated at $20,841.

UMRS
EMP

PRINCETON WILDLIFE MANAGEMENT AREA

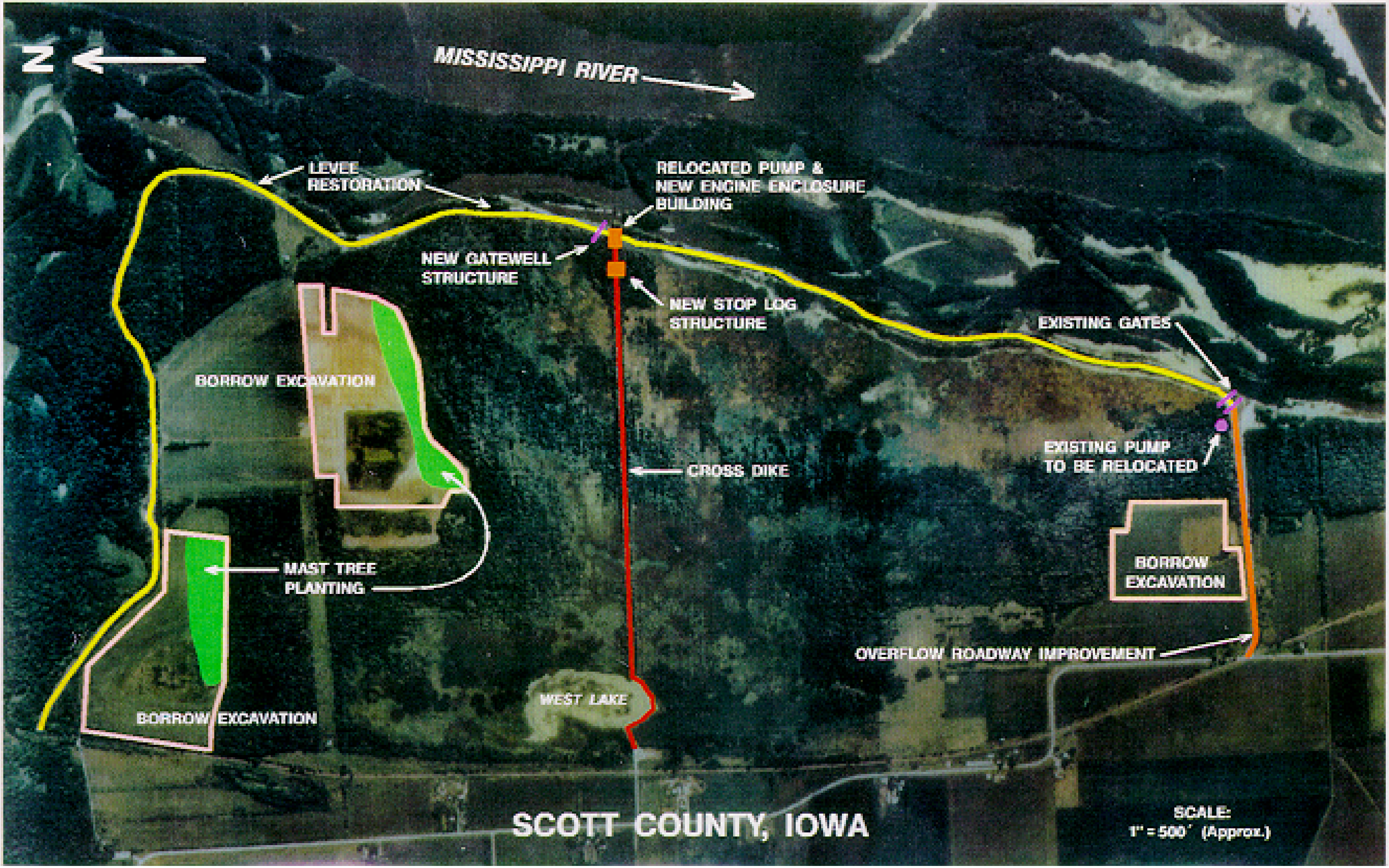

FIGURE ES-1

UPPER MISSISSIPPI RIVER SYSTEM
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SCOTT COUNTY, IOWA

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

List of Tables

TABLE OF CONTENTS (Cont'd)

List of Figures

List of Plates

TABLE OF CONTENTS (Cont'd)

List of Appendices

UPPER MISSISSIPPI RIVER SYSTEM
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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 Princeton Wildlife Management Area (WMA). 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. The primary resource problem in the study area is the inability to control water at desirable levels due to a deteriorating levee and inadequate water level management capability. Water level control is necessary to maximize and maintain quality wetland habitat for migratory birds.

The opportunity exists in the study area to improve water level control and thus enhance overall wetland habitat quality and quantity.

c. Scope of Study. Princeton WMA is a leveed wetland management area located on the Iowa side of the Mississippi River approximately 10 miles upstream of Lock and Dam 14, between River Miles (RM) 504.0 and 506.5. It is located in Scott County, approximately 1 mile north of Princeton, Iowa. About 418 acres of the area is State-owned, with the remaining 711 acres being Federal lands. Plate 1 provides vicinity and general location maps for the Princeton WMA. A site-specific plan is shown on plate 3a.

The scope of this study focuses on proposed project features that will improve wetland habitat and enhance overall resource values. The project was planned for the benefit of resident and migratory birds and other wildlife and is consistent with agency management goals.

Field surveys, aerial photography, terrain modeling, and habitat quantification procedures were completed to support the planning and assessment of proposed project alternatives. Hydrographic soundings were performed in developing sedimentation estimates and estimating excavation quantities. Soil borings were taken to determine sediment types and excavation difficulty.

Wildlife observations within the study area have been made by the Iowa Department of Natural Resources. These observations, along with future studies and monitoring, will assist in evaluating project performance.

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 the Princeton WMA 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, and Sections 7 and 8 describe the selected plan in accordance with the National Environmental Policy Act. Section 9 provides general design and construction considerations. Section 10 assesses the environmental effects from the proposed plan. Section 11 summarizes project accomplishments and outputs. Sections 12, 13, and 14 describe estimated operation and maintenance considerations, performance monitoring, and detailed cost estimates for both initial construction and annual operation and maintenance. Sections 15, 16, 17, and 18 provide a summary of implementation requirements and coordination. Sections 19 and 20 present the conclusions and recommendations. A Joint Finding of No Significant Impact follows the main report.

Drawings (plates) have been furnished to provide sufficient detail to allow review of the existing features and the proposed plan. Plate 1 shows the project location and the Pool 14 environs. Plates 2 and 3 show the recommended plan and the potential enhancement features. Plate 3a shows the existing Princeton WMA site conditions. Plates 4 through 7 provide 27 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 8 and 9 provide soil boring logs which were used to evaluate foundation effects and excavation/fill methods. Plates 10 through 15 show plan and profile views of the proposed project embankments. Typical levee sections are presented on plates 16 and 17. The pump station site plan, section views, and details are shown on plates 18 through 21. Plate 22 shows plan and section views of the stoplog structure. Plate 23 shows the gatewell structure plan and elevation view. The project monitoring plan is shown on plate 24.

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 hereby declared to be the

intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. Congress further recognizes that this 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 PROCESSING

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 Upper Mississippi River System - Environmental Management Program (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 Addenda.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addenda 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 River Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan and General Plan identify examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the following conclusions:

(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 side channels 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 opening/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 measures which address human-induced impacts could result in significant long-term protection and restoration of UMRS habitat. Proposed projects which include such measures will be examined in terms of policy and technical feasibility and will be recommended on a case-by-case basis only after consideration of system-wide effects.

(3) **Subsequent Annual Addenda**. Subsequent annual addenda, of which the Sixth Annual Addendum (dated May 1991) is the most recent, provide a vehicle for reporting program progress, communicating policy guidance, and ensuring thorough coordination among the participating State and Federal agencies.

b. Habitat Project Selection and Prioritization Process. All Mississippi River habitat projects currently being pursued by the Rock Island District under the UMRS-EMP were originally identified in the Fish and Wildlife Interagency Committee (FWIC) report entitled, *Goals for Management of Fish and Wildlife Resources and Habitat Rehabilitation and Enhancement for Pools 11-22* (portions of which are provided in Appendix A). The FWIC is comprised of biologists and other environmental specialists from the State and Federal agencies responsible for natural resources management in this area.

Selected projects from this report have subsequently been submitted for FWIC ranking. The FWIC ranking process results in the prioritization of habitat projects according to their potential biological outputs. High category projects represent those projects having received the highest numerical values based upon weighted criteria (see Appendix A). To date, only high-ranked projects (with the exception of Bay Island, Missouri, and Lake Odessa, Iowa) have been scheduled for baseline monitoring, general design, or construction in the Rock Island District's Habitat Rehabilitation and Enhancement Project (HREP) Program.

Recognizing the value of the FWIC's established coordination mechanisms and biological expertise, the District has accepted and continues to utilize the FWIC project ranking system as the primary basis for project selection and prioritization. Figure 2-1 provides a comprehensive summary of the current FWIC rankings for all District habitat projects being implemented or considered for future implementation.

The FWIC rankings are forwarded to the District and the River Resources Coordinating Team (RRCT), an interagency policy group responsible for broad coordination of river activities. The RRCT reviews the FWIC rankings consistent with agency policy perspectives. The RRCT-approved rankings are then submitted to the District. The District develops a recommended program based upon these project rankings and District resources. This program is subsequently submitted to the EMP program manager at North Central Division for funding and general program coordination.

FIGURE 2-1

FWIC Rankings for CENCR HREPs

Projects completed/underway			*FWIC Priority List 5/*		*Projects ranked; not prioritized*		
Project Name	**Points**	**Rank**	**Project Name**	**Points**	**Project Name**	**Points**	**Rank**
Monkey Chute, MO		(not ranked)	Peosta, IA	27	Molo Slough, IA 2/	27	High
Andalusia Refuge, I L		(not ranked)	Smith's Creek, IA 2/	24	Elk River, IA	23	Medium
Brown's Lake, IA		(not ranked)	Pleasant Creek, IA 2/	26	Turkey River Bottoms, IA	20	Low
Bertom/McCartney, WI		(not ranked)	Gregory Landing, MO	22	Chautauqua Lake, IL (Phase II)	24	High
Big Timber, IA		(not ranked)	Huron Island, IA	26/27	Mud Lake, IA	22	Medium
Potter's Marsh, IL	27	High	Blackhawk Bottoms, IA	27	Quincy Bay, IL	20	Low
Peoria Lake, IL	25	High	Pool 12 Overwintering, IL	26	Turkey/Otter Islands, IA	20/21	Low
Bay Island, MO	23	Medium	Eagle Fill, IL 6/	18	Sny Side Channel, IL 6/	21	Low
Chautauqua Lake, IL	24	High	Sanganois or Emiquon, IL	26,27	Bunker Chute, IA 6/	20	Low
Spring Lake, IL 1/	24/27	High			Middle Sabula, IA 6/	19	Low
Lake Odessa, IA	23	Medium			Pin Island, IA 6/	20	Low
Cottonwood Island, MO	26	High			Keithsburg Refuge, IL	22	Low
Gardner Division, IL	25	High			Miller's Lake, IL	26	High
Banner Marsh, IL	29	High			Credit Island, IA	25	High
Rice Lake, IL	27	High			Beaver Island, IA	26	High
Princeton Refuge, IA	27	High					
Pool 11 Islands, WI	25	High					
Ranked projects completed via other programs							
Green Island, IA	23	Medium					

1/ Ranked as two phases subsequently rescoped to a single project.

2/ Baseline monitoring underway.

3/ Locational factors resulted in project being ranked high.

4/ High ranking reflects FWS prioritization considerations.

5/ Per 17/18 May 93 FWIC meeting. Within list order does not reflect priority. With-in list project initiation will be funding and resources dependent.

6/ Small project to be accomplished under proposed delegated authority (approval pending).

Projects have consequently been screened by State, USFWS, and Corps representatives who have considered resource needs and deficiencies pool-by-pool and identified the most suitable locations for addressing these needs. The Rock Island District assists the State and Federal partners, as projects are being conceptualized, by means of an in-house, multi-disciplinary task force. This group meets on-site with State and Federal personnel to thoroughly examine what site-specific rehabilitation and/or enhancements would be both environmentally sound and engineeringly feasible.

c. **Specific Site Selection**. The Princeton WMA was recommended and supported as providing significant wetland benefits with opportunities for habitat enhancement if the proposed project features were implemented.

Originally leveed off in the 1920's, active management of Princeton began in the late 1950's with efforts to manipulate water levels for purposes of influencing vegetative growth. The goal of these efforts was to improve habitat, in terms of food and cover resources, primarily for migratory waterfowl. These efforts were often compromised by overtopping of the levee and generally inadequate water level management capabilities.

Though it remains a high quality wildlife area, enhanced capability to manage the area for waterfowl as well as nongame wildlife will only be achieved by restoring the levee and improving water control. The primary features proposed for this project address these needs.

The following points were major considerations, along with the FWIC ranking, in selecting this project for the HREP program:

1. The Princeton WMA is the only habitat project currently being implemented in Pool 14.

2. The Princeton WMA is located near an area of historically high wildlife use, the bottomlands surrounding the confluence of the Wapsipinicon and Mississippi Rivers.

3. The area experiences a high degree of recreational use as well as the inherent value of its designated refuge portion. These quiet, undisturbed non-channel waters are especially important as feeding areas for herons and egrets.

4. The opportunity exists to capitalize on present habitat interspersion—a mixture of aquatic, marshland, agricultural, grassland, and timber.

3. ASSESSMENT OF EXISTING RESOURCES

a. Resource History and Description of Existing Features. The U.S. Government purchased the Princeton Wildlife Area (PWA) from the Carroll Levee District when the Corps of Engineers navigation pools were established in the 1930's as part of the 9-Foot Channel Navigation Project. The Corps has primary administrative responsibility for 711 acres. This Corps-administered land was outgranted to the USFWS who, in turn, licensed it to the Iowa Conservation Commission in 1956. The Commission, which later became the Iowa Department of Natural Resources (IADNR), subsequently purchased an additional 418 acres within and around the licensed land.

Prior to 1957, active management consisted solely of occasional timber sales by the Corps. Until the late 1980's, share-cropping agreements were negotiated by the State, and up to 246 acres of land within the PWA in any given year was planted to row crops or winter wheat. Traditionally, 10 percent of the row crop (typically corn) was left standing for winter food plots. In recent years, farming has been conducted on a cash rent basis, and timber management has been limited in scope.

The levee surrounding Princeton, originally constructed in the 1920's and 1930's, was upgraded in 1982, with joint IADNR and private funding. A small capacity pump and outlet structure, originally installed in 1957, allowed some manipulation of water levels, but management was often compromised by limited pumping capability and levee overtopping during high water events. The levee improvements, plus the installation of a higher capacity mobile pump (16,000 gpm) in 1983, helped to overcome some of these difficulties. Siltation has generally not been a problem.

b. Land Use and Current Area Management Objectives. A 348-acre refuge was created in the south end of the area in 1979, and, after a brief decline, peak waterfowl concentrations increased dramatically over pre-refuge numbers (Table 3-1). The refuge was relocated to the north end in 1989, allowing more traditional boat-blind hunting in the south. Water level management is designed to maintain suitable conditions for migratory birds, upland birds, and furbearer populations, thus allowing continued public use of the area for hunting, trapping, and wildlife observation.

For the purpose of habitat analysis, the project area has been classified into the habitat types shown in Table 3-1.

TABLE 3-1

Existing Habitat Classification
Habitat Type (in Acres)

Non-Forested Wetland	Forested Wetland	Grassland	Cropland
27 (Deep Water) 377 (Shallow Water)	393	68	179

Additional acreage outside of the levee and/or railroad grade on the north and west sides of the area is not included here. These parcels are included in the Princeton jurisdiction, but will not be affected directly by the proposed project features. Indirectly, they will influence and benefit wildlife which use the immediate project area.

These adjacent areas include 25 acres of native grassland, approximately 40 acres of forested floodplain along the Wapsipinicon River, and approximately 20 acres of pasture/cropland.

Short- and long-range IADNR management goals of the Princeton WMA are to:

1. Improve water level control and thus enhance wetland management unit (WMU) capability.

2. Create additional marshland habitat.

3. Enhance wetland habitat for migratory birds, furbearers, and endangered species.

4. Improve overall habitat diversity.

5. Emphasize continued use of the area for a wide range of recreational activities.

The emphasis at Princeton on wetland and waterfowl management reflects not only the immediate goals of local resource managers, but also those of FWIC for habitat enhancement on Pools 11-22 of the Upper Mississippi River and the North American Waterfowl Management Plan (NAWMP). This plan aims to increase waterfowl populations and their habitats, particularly those which are at critically low levels. It has been estimated that 20 percent of all ducks in North America utilize the Upper Mississippi River System for feeding and resting during migration (Upper Mississippi River Basin Commission 1981). This statistic points to the need for optimum management of refuge areas such as Princeton. In fact, a recent study indicates that refuge areas may be necessary to prevent disturbance of waterfowl during spring and fall migrations (Havera *et al.*, 1992), particularly in areas where waterfowl numbers have declined.

c. **Wetland and Waterfowl Resources**. The Princeton WMA contains approximately 27 acres of deep, open water and 377 acres of shallow wetland habitat (Table 3-1). These wetland habitats occur primarily in the west-central, central, and southeastern portions of the area. The combined acreage approximates the total amount of marshland obtained when control structure stoplogs are adjusted to an elevation of 574.0. At this elevation, water depths are predominantly less than 1 foot.

Though aquatic vegetation composition is, of course, dynamic, the dominant species tend to consist of (in order of dominance) bulrush (*Scirpus* spp.), duck potato (*Sagittaria* spp.), duckweed (*Lemna* spp.), smartweed (*Polygonum* spp.), and cattail (*Typha* spp.). Rice cut-grass (*Leersia oryzoides*) and reed canary grass (*Phalaris arundinacea*) are also common in drier areas. Willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), and false indigo (*Amorpha fruticosa*) dominate the shrub component. Bottomland hardwoods consist of river birch (*Betula nigra*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), with scattered black oak (*Quercus velutina*), young pin oak (*Q. palustris*), and bitternut hickory (*Carya glabra*). This land cover classification is based upon interpretation of 1975 aerial photography (see Figures 3-1 and 3-2) and 1990 aerial photography (see Figure 3-3). Figure 3-4 provides 1989 pool-wide land cover classification data.

The Princeton WMA has historically been managed to provide waterfowl resting and feeding habitat, through water level manipulation. The area is normally drawn down to navigation pool levels (572.0 or below) during the summer to expose mudflats and stimulate emergent plant growth. The area is then reflooded (generally to 575.5) in the fall to accommodate migrating birds.

This management program is expected to continue with few modifications. Resident furbearer populations, particularly muskrats (*Ondatra zibethica*) also benefit from the water level regime. The ability to reach and maintain slightly higher water levels, as planned for in this project, would allow added management flexibility, a closer approximation to optimum (50:50) open water/emergent plant ratios, and better winter survival of muskrats.

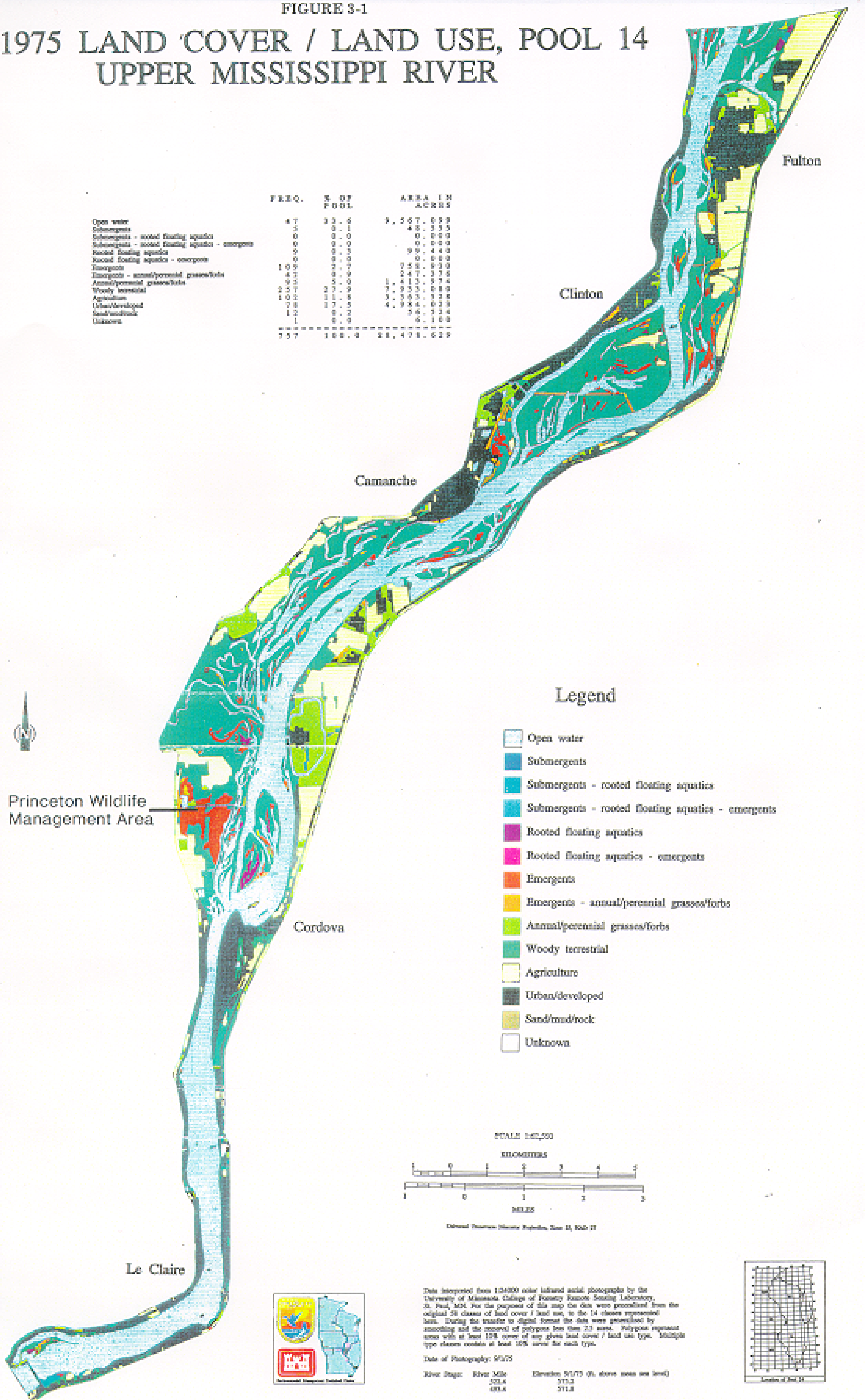
Waterfowl use data (Source: IADNR) from 1960 and 1974-1991 revealed the following average concentrations:

	Spring	**Fall**	**Peak Fall Concentration**	**Harvest**
Duck Day Use	103,000	61,068	11,700	2,450
Goose Day Use	31,718	2,725	632	43

Yearly figures for the above categories appear to indicate a decline in waterfowl concentrations beginning in the late 1980's and continuing up through the most recent year's data (Table 3-2). Causative factors are difficult to isolate from such

FIGURE 3-1

1975 LAND COVER / LAND USE, POOL 14 UPPER MISSISSIPPI RIVER



	FREQ.	% OF POOL	AREA IN ACRES
Open water	47	33.6	9,567.099
Submergents	5	0.1	48.333
Submergents - rooted floating aquatics	0	0.0	0.000
Submergents - rooted floating aquatics - emergents	0	0.0	0.000
Rooted floating aquatics	9	0.3	99.440
Rooted floating aquatics - emergents	0	0.0	0.000
Emergents	109	2.7	758.830
Emergents - annual/perennial grasses/forbs	43	0.9	247.378
Annual/perennial grasses/forbs	93	5.0	1,413.974
Woody terrestrial	257	27.9	7,933.080
Agriculture	102	11.8	3,363.328
Urban/developed	78	17.3	4,934.023
Sand/mud/rock	12	0.2	36.328
Unknown	1	0.0	6.100
	757	100.0	28,478.629

Data interpreted from 1:24000 color infrared aerial photographs by the University of Minnesota College of Forestry Remote Sensing Laboratory, St. Paul, MN. For the purposes of this map the data were generalized from the original 38 classes of land cover / land use, to the 14 classes represented here. During the transfer to digital format the data were generalized by smoothing and the removal of polygons less than 2.5 acres. Polygons represent areas with at least 10% cover of any given land cover / land use type. Multiple type classes contain at least 10% cover for each type.

Date of Photography: 9/1/75

River Stage: River Mile 523.4, 493.4 — Elevation 9/1/75 (ft. above mean sea level) 573.2, 571.8

FIGURE 3-2

1975 Land Use/Land Cover, Pool 14
Mississippi River, Miles 503-507

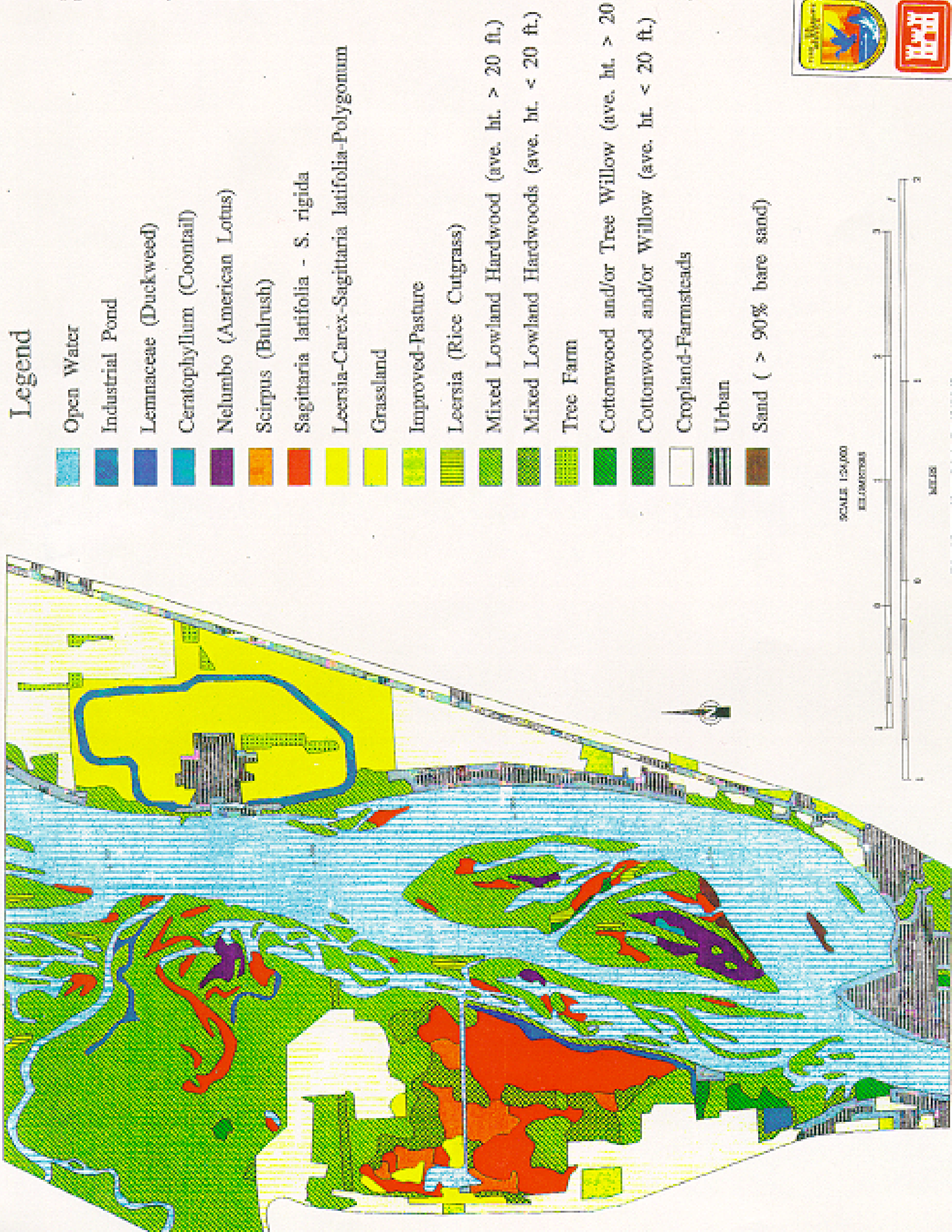
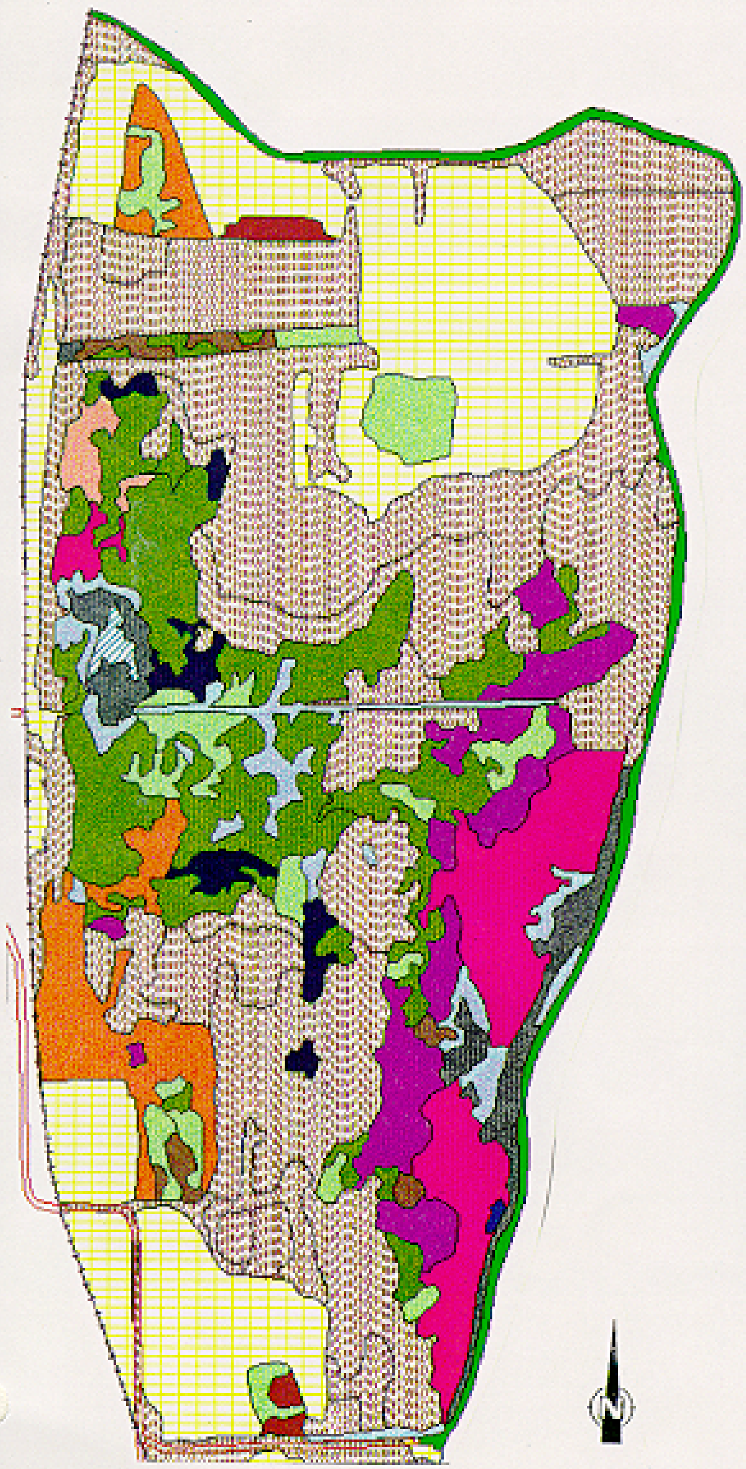


FIGURE 3-3

Princeton, Iowa, EMP Vegetation Map



Vegetation Type	Sq. Meters	Acres
Cephalanthus	104821.57	25.90
Cultivated/Man-made	966597.14	238.85
Forested Wetland	1955428.45	483.19
Grassland	104821.45	25.90
Leersia	24304.71	6.01
Mixed Forbs	22651.32	5.60
Myriophyllum/Ceratophyllum	104643.04	25.86
Open Water	43775.02	13.29
Open Water/Lemna	125569.09	31.03
Phalaris	191183.61	47.24
Polygonum	59584.80	14.72
Sagittaria/Lemna	252585.49	62.41
Sagittaria/Polygonum	197065.32	48.69
Salix/Amorpha	179415.12	44.33
Scirpus	493847.06	122.03
Typha	34010.90	8.40

Compiled from September
1990 aerial photography

FIGURE 3-4

Pool 14, Upper Mississippi River System
1989 Land Cover/Land Use

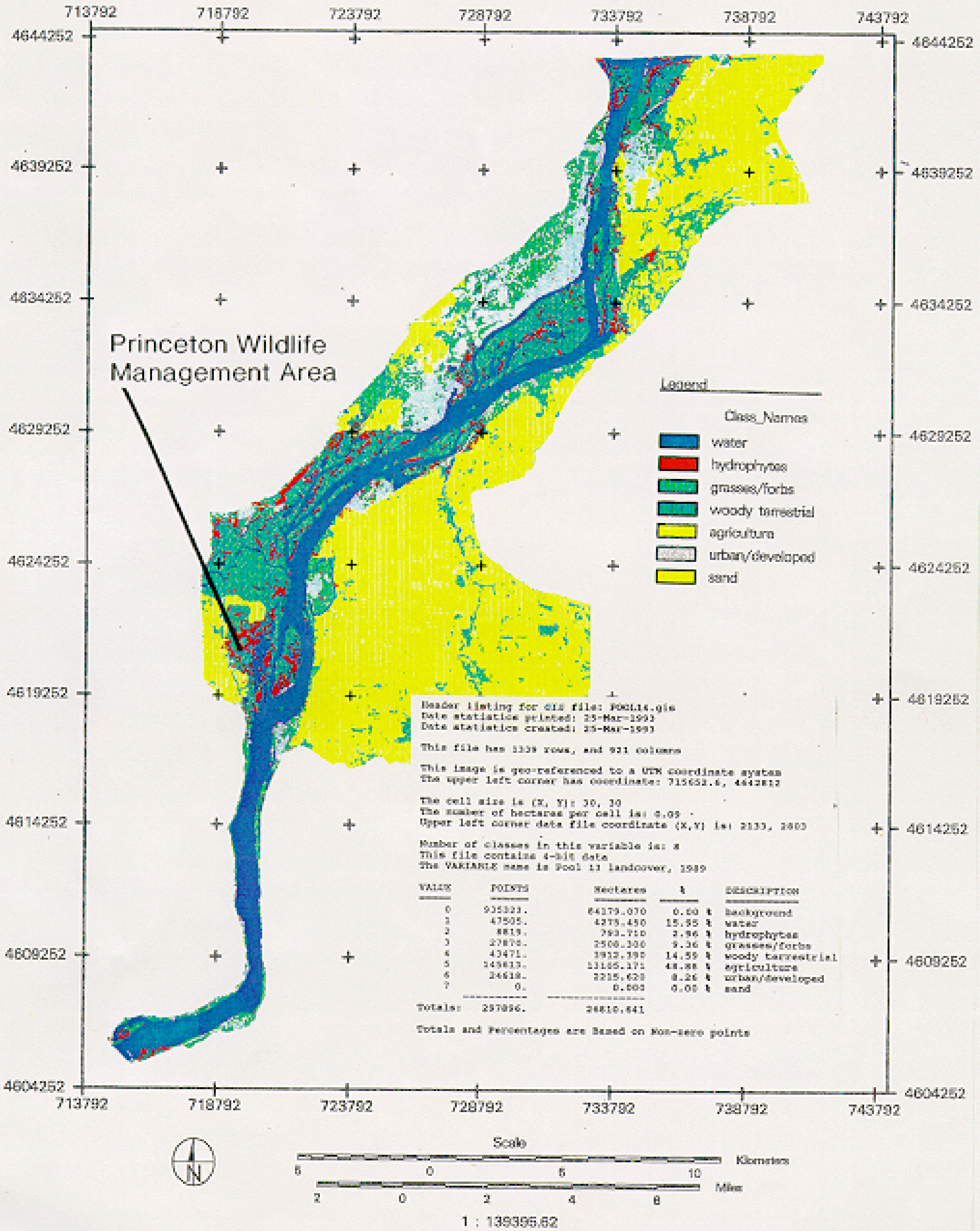


TABLE 3-2

Waterfowl Use Data, Princeton WMA

	SPRING		FALL		PEAK FALL CONCENTRATION		HARVEST	
	DUCK DAY USE	GOOSE DAY USE	DUCK DAY USE	GOOSE DAY USE	DUCK DAY USE	GOOSE DAY USE	DUCK DAY USE	GOOSE DAY USE
1993	50,000	1,500	8,000	250	500	50	500	25
1992	50,000	1,500	18,000	1,000	4,000	150	1,000	25
1991	50,000	1,500	20,000	1,000	4,000	150	1,000	25
1990	50,000	1,500	20,000	1,000	5,000	150	1,000	25
1989	60,000	2,000	35,000	1,400	5,000	250	1,000	25
1988	100,000	2,000	75,000	1,400	15,000	250	3,000	25
1987	150,000	2,000	100,000	1,400	1,500	250	4,000	50
1986	200,000	3,000	150,000	1,500	20,000	250	5,000	100
1985	75,000	4,500	250,000	1,200	18,000	150	4,000	40
1984	75,000	2,500	250,000	1,200	15,000	100	4,000	40
1983	75,000	2,500	40,000	1,500	20,000	6,000	150	40
1981	70,000	40,000	2,000	1,500	12,000	200	4,000	40
1980	70,000	40,000	2,000	1,500	8,000	100	3,800	60
1979	70,000	75,000	3,000	2,000	20,000	100	3,500	50
1977	68,000	91,000	4,200	2,800	3,700	420	1,242	42
1976	90,000	92,000	5,800	3,200	3,400	530	925	43
1974	120,000	73,000	2,100	1,000	3,100	210	810	27
1960	325,000	85,000	18,000	20,000	20,000	1,000	1,750	50
MEAN	103,000	32,344	61,069	2,725	4,213	632	2,869	43

data. The observation of the IADNR area biologist is that emergent marsh vegetation patterns have remained stable over the past 20 years. Sedge and emergent growth has actually increased somewhat at the edge of the main pool since water level management was improved in the early 1980's. Some minor perturbations, primarily to buttonbush, resulted from the 1993 flood. (See letter dated July 15, 1994, in Appendix B.). Peak fall concentrations increased five-fold in 1979 and remained relatively high in the following years. This change reflects the more protected conditions created upon establishment of the refuge in 1979. Species harvest frequencies from 1979, 1980, and 1982 reveal that mallards (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), blue-winged teal (*Anas discors*), and to a lesser extent green-winged teal (*A. crecca*) dominated the harvest. The first three species are generally most abundant during migration.

Grassland habitat in the western portion of the area supports hunting for ring-neck pheasant (*Phasianus colchicus*), and some rabbit and squirrel hunting occurs on the area as well. As of 1986, it was estimated that 20 to 30 trappers used the marsh each year to trap muskrat, mink (*Mustela vison*), and beaver (*Castor canadensis*).

d. Terrestrial Resources. Though primarily a wetland environment, the Princeton WMA also includes a diverse upland community. This is reflected primarily in data collected from the area during breeding bird surveys and research efforts. Specific information is lacking on mammalian populations, but it is reasonable to assume that small mammal numbers are substantial. The size of the area would preclude other than casual use by larger species such as white-tailed deer (*Odocoileus virginianus*). Nonetheless, hunting for deer and upland game birds does occur on the area.

Summaries of species lists, as well as Iowa Breeding Bird Atlas data from April 1991, revealed that up to 101 species have been observed at Princeton, with 46 confirmed and 42 probable as breeding. These numbers represent a wide range of species, including songbirds, raptors, shorebirds, and waterfowl. Two bird species of particular interest, the prothonotary warbler (*Prothonotaria citrea*) and the red-shouldered hawk (*Buteo lineatus*), were the subjects of recent research studies which included Princeton as a study site.

The nesting ecology of prothonotary warblers (*Prothonotaria citrea*) was studied by Brush (1991), and Princeton was considered to be high quality habitat due to the presence of open water nesting sites, a critical factor to warbler nesting success. Prothonotaries will be discussed later in relation to WHAG analysis. Stravers (1991) believed that areas such as Princeton, relatively undisturbed and containing large-sized floodplain timber, could be important areas for the State endangered red-shouldered hawk (*Buteo lineatus*). Red-shouldered hawk nesting activity has been confirmed in adjacent areas.

e. Aquatic Resources. Data on aquatic resources is limited and is confined primarily to personal observations of the IADNR biologist in charge of Princeton. No fisheries management or research data exists for the area. Historic management and use has focused on waterfowl hunting and some upland hunting and trapping. The unreliable nature of water levels has prevented a stable, high-quality fishery from developing. Fish kills occur almost yearly due to low oxygen conditions resulting primarily from shallow water.

Despite these limitations, some recreational fishing does take place, and a rudimentary boat landing allows access near the west end of the existing cross channel. Species composition and movements tend to be variable and unpredictable, depending on availability of access via intake tubes. Species known to have occurred include bullheads (*Ameiurus nebulosus*), bowfin (*Amia calva*), young bluegill (*Lepomis macrochirus*), and the occasional northern pike (*Esox lucius*). Fishermen use the south parking lot to both launch boats and bankfish in the adjacent Grant and Cordova sloughs.

f. Water Quality. Low seasonal dissolved oxygen levels occur due to shallow water and the effects of ice in winter and to some extent decaying vegetation in the summer. No other water quality problems have been identified. Due to this project's emphasis on wetland and, to a lesser degree, upland habitat improvement, water quality is not a leading concern.

g. Endangered Species. The federally endangered bald eagle (*Haliaeetus leucocephalus*) occurs in the vicinity of Princeton during the winter. The nearest lock and dam, Lock and Dam 14 at RM 493, recorded 205 adult and 36 juvenile eagles during the winter of 1990/91.

In a letter dated February 5, 1992, the IADNR indicated that no State threatened or endangered species have recently been identified on the project area. Records in past years have indicated the presence of the State endangered red-shouldered hawk and the massasauga rattlesnake (*Sistrurus catenatus*) in the vicinity of Princeton. The State threatened river otter (*Lutra canadensis*) also has been known to occur at the site. The IADNR has suggested that levee restoration and cross dike construction will create preferred habitat for the endangered rattlesnake species.

h. Historic Properties. An archaeological and geomorphological Phase I evaluation of the proposed project area discovered three previously unrecorded archeological sites. In addition, two previously recorded sites were revisited. The geomorphological investigation demonstrated that most of the surfaces in the project area are composed of late Woodfordian to early Holocene age deposits and that the potential for deeply buried archeological deposits was low. The sites are summarized as follows:

13 ST 106 is a very light mid- to late-nineteenth century historic scatter.
13 ST 107 is a recent historic scatter.
13 ST 105 is an isolated chert flake.
13 ST 88 is a light prehistoric lithic scatter.
13 ST 89 is a dense scatter of mid- to late-nineteenth century kitchen refuse and building materials.

All sites are located at elevations above the proposed inundation level of 577 feet NGVD (1912 Adjustment). All sites also are located outside of proposed construction and borrow areas. Details of the results of these investigations are contained in a report entitled *Phase I Archeological and Geomorphological Investigations: Princeton Refuge Rehabilitation and Enhancement Project,* prepared by American Resources Group, Ltd., under Contract DACW25-89-D-0018 with the Rock Island District.

i. Sedimentation. A study was conducted to evaluate sedimentation in the Princeton WMA. The scope of this study consisted of determining net sediment deposition from 1939 (pre-lock and dam) through 1989 (the most recent topographic data available). Based on a comparison of the 1939 and the 1989 land surface elevations, net sediment deposition in the Princeton WMA is negligible. During the Flood of 1993, the Princeton WMA experienced minimal localized sedimentation.

4. PROJECT OBJECTIVES

a. Objectives and Potential Enhancement Features. The project goal, objectives, and potential enhancement features are summarized in Table 4-1. In the development of the potential enhancement features, consideration was given to satisfying project objectives, while maximizing utilization of resource opportunities. A potential enhancement feature is intended to satisfy at least one objective, either singularly or in combination with other enhancement features.

Enhancement features are to be components of an overall plan which will satisfy the project goal and objectives. The enhancement features are described and assessed in Sections 5 and 6.

TABLE 4-1

Project Goals, Objectives, and Potential Enhancement Features

Goal	**Objective**	**Potential Enhancement Feature**
Enhance Wetland Habitat	Increase potential for reliable food production and resting/loafing habitat for migratory birds	* Levee restoration * Water control improvements
	Increase overall vegetation diversity and availability of preferred wildlife food resources	* Mast tree plantings

In the 1993/94 Annual Management Report/Plan for Princeton, the IADNR lists the following as project objectives and goals:

1. Waterfowl production and harvest.

2. Furbearer production and harvest.

3. Production and enhancement of raptor, heron, egret, and endangered species habitat.

4. Related recreational activities including: hunting, trapping, nature study, photography, primitive camping, fishing and hiking.

The Upper Mississippi River National Wildlife and Fish Refuge EIS/Master Plan, in its Mission, Goals, and Objectives statement, includes the following goals and objectives which appear relevant to the Princeton EMP-HREP:

Goal II - Migratory Birds

Provide the life requirements of waterfowl and other migratory birds occurring naturally along the Upper Mississippi River for the enjoyment of this and future generations.

Objectives:

* Restore species that are in critical condition (such as canvasbacks) and achieve national population or distribution objectives.

* Maintain or improve habitat of migrating waterfowl using the Upper Mississippi River.

* Promote use by the maximum number of species of migratory birds at optimum population levels to provide a recreation resource.

* Increase production of historically nesting waterfowl.

* Contribute to achievement of national population and distribution objectives identified in the North American Waterfowl Management Plan and flyway management plans.

Goal IV - Other Wildlife

Provide the life requirements of resident wildlife species for the enjoyment of this and future generations.

Objectives:

* Maintain or increase species diversity and abundance.

* Maintain furbearer populations at levels compatible with fisheries and waterfowl management and other management objectives to provide a resource for recreation.

Goal VII - Interpretation and Recreation

Gain active support for the preservation of the vulnerable floodplain ecosystem; to provide interpretation and education opportunities; to provide a wide range of opportunities for compatible wildlife/wildlands-oriented recreation; to allow other compatible traditional recreation uses.

* Provide outdoor recreation opportunities oriented toward wildlife, fish and wildlands (e.g., fishing, hunting, trapping, wildlife observation).

The stated goals and objectives of both the State and Federal management agencies are closely intertwined and provide a consistent backdrop for the goals and objectives of this project.

b. Criteria for Potential Enhancement Features. Table 4-2 presents general and specific criteria developed to assess potential enhancement features.

TABLE 4-2

Potential Enhancement Features Development Criteria

Item	Purpose of Criteria
A. General Criteria	
Locate and construct features consistent with EMP directives.	Comply with program authorities.
Construct features consistent with Federal, State, and local laws.	Comply with environmental laws.
Develop features that can be monitored.	Provide baseline for project effects (e.g., sedimentation, stability, water quality).
Design features to facilitate operation and maintenance.	Minimize operation and maintenance costs.
Locate and construct features consistent with best planning and engineering practice.	Provide basis for project evaluation and alternative selection.
Construct features which meet one or more project objectives.	Meet project goals and objectives.
B. Levee Restoration	
Provide reliable levee system consistent with management goals.	Provide flood protection to meet seasonal/annual reliability goals.
Locate borrow excavation in areas to enhance wetland development.	Improve existing habitat suitability for migratory birds.
C. Water Control	
Construct features that provide operational flexibility.	Provide site management capability to meet seasonal/annual goals.
D. Mast Tree Planting	
Locate plantings on existing high ground.	Maximize tree survival rate.

c. **Proposed Management Plan.** As mentioned in Section 3c, annual drawdowns have been included in the management of the Princeton WMA. These efforts often met with mixed results due to inadequate pumping flexibility. This technique is well accepted for wetland management and has been considered necessary for rejuvenating older, unproductive impoundments (Kadlec 1962). Stabilizing water levels, particularly at high levels, can be detrimental, and periodic drying and reflooding is beneficial for establishment of desired aquatic vegetation (Weller 1978, 1981:70).

The need for seasonal instability should not be equated with erratic water level changes at any time of the year (Weller 1981:70). This points to the benefit of securing better control capability over water levels at Princeton, a major goal of this project. Wildlife productivity will likely increase as wetlands experience a regular flooding cycle (Mitsch and Gosselink 1986:430).

The following plan is proposed for the Princeton area. Drawdowns will be partial in nature.

TABLE 4-3

Proposed Annual Management Plan for Princeton WMA

Month	Management Action	Purpose
May-July	Dewater area by pump station or gravity.	Expose and maintain mudflats to allow revegetation.
August-November	Gradually increase water levels to correspond with growth of marsh plant community.	Provide access to food plants for migratory waterfowl.
December-April	Maintain water levels to maximum extent possible (576.0 in south unit), primarily by use of pumping capability.	Control excessive plant growth if necessary and provide stable, deeper water to prevent complete ice-up (a critical concern for resident furbearers).

5. POTENTIAL FEATURES OF ALTERNATIVES

The purpose of this section is to describe and assess a preliminary number of potential enhancement features. Once these features are evaluated in this section, Section 6 will formulate alternatives based on combinations of features.

Potential enhancement features were determined based on their ultimate contribution to the project goal and objectives, engineering considerations, and local restrictions or constraints. These development criteria are summarized in Table 4-2. Enhancement features which were not feasible or did not meet the criteria of Table 4-2 were not subject to further evaluation. Once the initial screening was completed, the remaining potential enhancement features were optimized to fully or partially satisfy the project objective(s). The optimized potential enhancement features were combined to make up alternatives which meet the project goal and objectives.

a. Levee Restoration. The levee surrounding the Princeton WMA is crucial in preventing interior sedimentation and providing protection against loss of water control due to flooding. The levee was rebuilt by the IADNR to an approximate 15-year flood height as part of the 1982 levee improvements. However, steep side slopes and a narrow top width have resulted in several localized levee failures since that time. During these failure events, loss of water level control capabilities and localized sedimentation took place. Restoration of a reliable levee system is paramount to protect against flooding and its deleterious effects on WMU operations at the Princeton WMA.

Levee restoration consists of restoring the perimeter levee to the 15-year level of protection. Adequate side slopes and top width will be provided to ensure stability and maintainability of the levee system.

Consideration was given to raising the height of the levee system. In the past 28 years, from 1965 to 1993, both the 15-year elevation and the 25-year flood elevation at RM 505.0 have each been exceeded only twice. One of these overtopping events occurred in April, before site dewatering takes place. Consequently, the additional cost of raising the levee to a 25-year level of protection does not appear justifiable. The decision not to raise the levee is further supported in that other past flood protection problems experienced at the site have been due to levee stability failure rather than overtopping events.

Several options were considered for borrow material for the levee restoration. Borrow material is available from adjacent ditch excavation or interior land borrow sites.

Ditch excavation was not further pursued due to the sandy nature of the borrow material. Also, deepening of the land side ditches would have adverse underseepage impacts on the levee.

Interior land borrow excavation areas were selected as shown on plate 2. The utilization of these sites offers additional habitat benefit by converting existing cropland to non-forested wetland. These sites will be developed as large, shallow borrow excavations which will not only maximize habitat benefits but also will yield the most suitable impervious borrow material.

b. Water Level Control. To optimize water level control management capabilities, three options were considered: (1) maintenance of the existing single wildlife management unit; (2) construction of an interior dike and water control structures to create two cells; and (3) similar construction to create three cells. Levee configurations and water surface elevations used for analysis were based on optimizing the area of impounded water with 1 to 2 feet of depth. The existing 16,000 gpm pump is in good condition. A new pump is not necessary for this project, but consideration was given to relocating the existing pump.

(1) 1-Cell WMU (Wetland Management Unit). For the 1-cell configuration, the optimum water surface elevation is 576. As shown on Table 5-1, 348 acres of water with 1 to 2 feet of depth will be created, and 213 acres of water deeper than 2 feet also will be created. Based on existing site topography and past site management experience, impoundment to elevation 576 causes adverse surface and ground water impacts on the adjacent privately owned agricultural fields (plate 3a). To prevent these impacts, construction of a levee and a seepage cutoff pipeline with a lift station would be required, as shown on plate 3.

TABLE 5-1

Water Depths vs. Height:
1-Cell Configuration

Water Surface Elevation	Acres < 1' Deep	Acres 1'-2' Deep	Acres > 2' Deep	Total Acres Flooded
574	203.1	9.9	0.0	213.0
575	348.0	203.1	9.9	561.0
*576	238.0	348.0	213.0	799.0
577	130.0	238.0	561.0	929.0

* Optimum water surface elevation.

(2) 2-Cell WMU. Under current single-cell operation, the entire Princeton WMA is subject to uniform management. Due to natural land contours, water depths in the northern portion of the area are shallower, making woody invasion more prevalent, particularly during dry periods. As a result, this area tends to be more vegetated than the south portion of the area, which retains more open water and herbaceous vegetation.

To create greater management capabilities within the northern and southern areas of Princeton WMA, a 2-cell WMU configuration could be created by construction of a cross dike immediately north of the existing lateral ditch which crosses the area. This would create two separate operating cells: a north cell and a south cell, as shown on plate 3. The existing pump would be relocated to the east end of the cross dike and a gatewell structure would be constructed in the north cell. The pump would discharge directly into a new concrete stoplog structure. As shown on Table 5-2, the optimum water surface elevations for a 2-cell configuration are 576 in the north unit and 575 in the south unit. This creates a total of 348.1 acres of water with 1 to 2 feet of depth and 45.9 acres of water deeper than 2 feet.

Because water is impounded at a higher elevation (576) in the north cell only, which is approximately a half mile away from the nearest privately owned agricultural field, no adverse ground water impacts will be encountered with this configuration.

TABLE 5-2

Water Depths vs. Height:
2-Cell Configuration

Water Surface Elevation	Acres < 1' Deep	Acres 1'-2' Deep	Acres > 2' Deep	Total Acres Flooded
		South Unit		
574	167.1	9.9	0.0	177.0
*575	167.0	167.1	9.9	344.0
576	98.0	167.0	177.0	442.0
577	33.0	98.0	344.0	475.0
		North Unit		
574	36.0	0.0	0.0	36.0
575	181.0	36.0	0.0	217.0
*576	140.0	181.0	36.0	357.0
577	97.0	140.0	217.0	454.0

* Optimum water surface elevation

Table 5-3 compares the optimized 1- and 2-cell WMU configurations. As shown, the two configurations provide the same acreage of water 1 to 2 feet deep; however, the 1-cell configuration also creates an additional 167 acres of water deeper than 2 feet. This deeper water requires an additional 5.5 days of pumping to fill the WMA to optimum water depth conditions. This additional pumping time requirement represents a 32 percent increase in annual pump operation costs (approximately $1,000 per year).

TABLE 5-3

WMU Configuration Comparison

Configuration	Acres 1'-2' Deep	Acres > 2' Deep	Time to Fill Optimum Level(s) (Days)	Comments
1 Cell	348.0	213.0	22.5	Relatively inflexible water level manipulation capabilities over entire site.
2 Cell	348.1	45.9	17	Allows independent operation of cells. Flexible water level manipulation capabilities. Decreased pumping requirement.

Overall, the 2-cell configuration allows substantial flexibility in WMU operation. Because the two cells are designed to be operated independently, the cells can be flooded and drained at different times to optimize the targeted vegetation growth for each cell.

The potential advantages of this scheme appear consistent with recommendations made by Kelley, *et al.* (1993). These authors point out that levees and water control structures, if misplaced, can flood large portions of developed wetlands to depths that preclude foraging by some water birds. Proper placement can benefit not only waterfowl, but many other water birds which may use only shallowly flooded habitats (<25 cm). The authors conclude by recommending, in part, to construct levees on contours, provide independent water delivery and discharge for each planned impoundment, and maximize the flooded area to shallow depths (<25 cm).

(3) 3-Cell WMU. A third wetland management cell could be created by constructing an interior dike in the northwest corner of the north unit. The third cell would require a separate water source and an additional stoplog structure. This option was not pursued further due to increased operation and management requirements, potential flooding impacts on the adjacent railroad embankment, and potentially negative impacts to wildlife resulting from fragmentation of the area. Existing major habitat types would not be altered by a 1- or 2-cell option, whereas a 3-cell would require construction in an existing undisturbed habitat type.

c. Mast Tree Planting. Planting of mast-producing trees or shrubs is a well-documented technique for improving the food resources component of wildlife habitat. Mast can be classified as hard (acorns, nuts) or soft (berries). Historical aggregations of mast-bearing trees along the Mississippi River bottomlands have been greatly reduced. Reestablishing this resource is recognized as an important element of habitat enhancement efforts.

Earlier Corps of Engineers management plans for the Upper Mississippi (COE, 1981) included a management goal of increasing mast tree abundance. The Wapsipinicon basin and Beaver Island near Princeton have historically contained significant mast tree associations. This project represents an important opportunity to restore a portion of this resource.

Approximately 25 acres total have been identified at the Princeton WMA as potential mast tree planting sites. These sites possess slightly higher elevations than the surrounding topography. An elevation difference of as little as 1 foot can be significant in the survival of these trees. Their prevalence on ridgetops in extant stands is evidence of this sensitivity. To benefit a wide range of species, both hardwood (oaks and hickories) and softwood species (cedar) will be planted. Buttonbush also will be considered for planting in closer proximity to open water areas.

6. ALTERNATIVES

a. Alternative A - No Action.

b. Alternative B - Levee Restoration. This alternative consists solely of restoring the existing Princeton WMA levee with selective borrow as described in Section 5. Water control capabilities would remain unchanged.

c. Alternative C - Levee Restoration/Mast Tree Planting. This alternative consists of levee restoration augmented with mast tree planting as described in Section 5.

d. Alternative D - 1-Cell WMU. This alternative consists of constructing all features as identified in Section 5 to facilitate optimum water surface elevations utilizing a 1-cell WMU configuration. Construction features include levee restoration and seepage cutoff system.

e. Alternative E - 1-Cell WMU/Mast Tree Planting. This alternative consists of augmentation of the 1-Cell WMA with mast tree planting.

f. Alternative F - 2-Cell WMU. This alternative consists of construction of all elements as identified in Section 5 to facilitate optimum water surface elevations utilizing a 2-cell WMU configuration. Features include levee restoration, cross dike construction and pump station relocation, and water control structure construction. No seepage cutoff is required.

g. Alternative G - 2-Cell WMU/Mast Tree Planting. This alternative consists of augmentation of the 2-Cell WMU with mast tree planting.

7. EVALUATION OF ALTERNATIVES

a. Habitat Evaluation. A numerical habitat appraisal methodology was used to optimize potential enhancement features as well as to evaluate project alternatives.

The Missouri Department of Conservation and the Soil Conservation Service have developed a numerical habitat appraisal system, based on USFWS Habitat Evaluation Procedures (HEP). The system is used to evaluate existing habitat conditions and the effects of planned habitat management features. The system is termed the Wildlife Habitat Appraisal Guide (WHAG).

The WHAG is a field evaluation procedure designed to estimate habitat quality and account for changes due to land management practices. Checklist-type appraisal guides (see Appendix F) are used for both upland and wetland habitats, and computer programs are used to analyze field data in terms of habitat suitability for various evaluation species. The WHAG is based on the assumption that habitat can be numerically described by Habitat Suitability Indices (HSIs) calculated from species-habitat models (Urich *et al.*, 1984).

Habitat Units (HUs) also can be calculated from WHAG. They are a measure of habitat quality and quantity. Annualization of HUs can then be used to determine changes brought about by project features/alternatives over time. Many features, such as tree planting, will not begin to show benefits until well into the project life. The particular dynamics of the ecosystem under study then determine the target years chosen for analysis.

Habitat quality can be improved by: (1) increasing acreage for particular habitat types which may be limited or lacking; (2) altering a limiting factor, such as unpredictable water levels; (3) altering management strategies such as planting different types of cover species; and (4) a combination of the preceding.

For the Princeton HREP, the project goal is to enhance wetland habitat. The appraisal guides for wetland habitats were chosen, and the mallard and green-backed heron were used as the target species, emphasizing Princeton's role as both an important refuge for migrating birds and a source of quality habitat for various marsh-dwelling species. Several other species also were considered in the analysis process. It is accepted that some species, particularly nongame species, will benefit from certain areas of habitat which are not well reflected in the WHAG analysis. An example at Princeton would be the grass-covered levees which may contribute to the habitat needs of species such as songbirds, small mammals, or herpetiles. These species generally have small home ranges and require narrow land use patterns, conditions opposite of those rated by the WHAG models. The WHAG study team consisted of staff from the IADNR, the USFWS, and the Corps of Engineers.

The WHAG analysis always includes a without-project alternative. For Princeton, six additional alternatives were considered, reflecting the features discussed in Section

5: levee improvements only, 1- and 2-cell operational schemes, and mast tree planting. Analysis of the two operational approaches excluded the corresponding deepwater acreages. Appendices B and F contain detailed results of the WHAG analysis. The following is a summary discussion.

The analysis of the potential features indicates that the 2-cell option provides the greatest HU gain while minimizing the amount of undesirable deeper water. Compared to baseline conditions (without project), 8 of the 12 evaluation species realized gains in Average Annual Habitat Units (AAHUs). These gains ranged from 1% (wood duck) to 188% (coot) for both the 1- and 2-cell management options (Table 7-1, Figure 7-1). Most increases were between 25% and 60%.

The distinguishing factor in favor of the 2-cell option is that it minimizes the amount of deep water (>2') while maximizing the preferred shallow water (1' to 2') habitat. The negative effects of deeper water are clearly shown in Table 9, Appendix B, as 10 of the 12 evaluation species decrease an average 29% (range 4-74) when the water acreage greater than 2 feet is factored into the WHAG analysis. This effect is nearly identical when the same exercise is performed on the 2-cell option (Table 1, Appendix B, page B-24). See also Figure 7-1. Further details of the WHAG analysis may be found in appendices B and F.

Gains in AAHUs were realized by six of the evaluation species with the addition of mast tree planting (Figure 7-1; Table 11, Appendix B). It should be noted that three of these species are those which showed losses under Alternative F (beaver, parula and prothonotary warblers). In total, these proposed plantings should fit well with the overall project goal of enhancing wetland habitat, and they are included in the recommendations of the initial and supplementary Coordination Act Reports (CAR).

TABLE 7-1

Total AAHUs by Species and Alternative
(Mallard and Green-Backed Heron are Target Species)

	A	B	C	D	E	F	G
	Without Project	Levee Only	Levee Only Mast Tree	1-Cell Less Deepwater	1-Cell + Mast Tree	2-Cell Less Deepwater	2-Cell + Mast Tree
MALLARD	518	509	520	511	522	643	691
CANADA GOOSE	142	140	133	137	130	196	205
LEAST BITTERN	283	312	312	190	316	316	351
LESSER YELLOWLEGS	95	105	105	25	42	42	47
MUSKRAT	107	119	119	95	158	158	176
KING RAIL	170	188	188	146	146	243	270
GREEN-BACKED HERON	402	423	434	295	306	407	449
WOOD DUCK	151	150	153	153	156	152	155
BEAVER	206	204	211	127	134	125	131
AMERICAN COOT	108	119	119	168	168	280	312
PARULA WARBLER	192	190	214	150	174	149	173
PROTHON. WARBLER	232	230	238	148	156	147	155

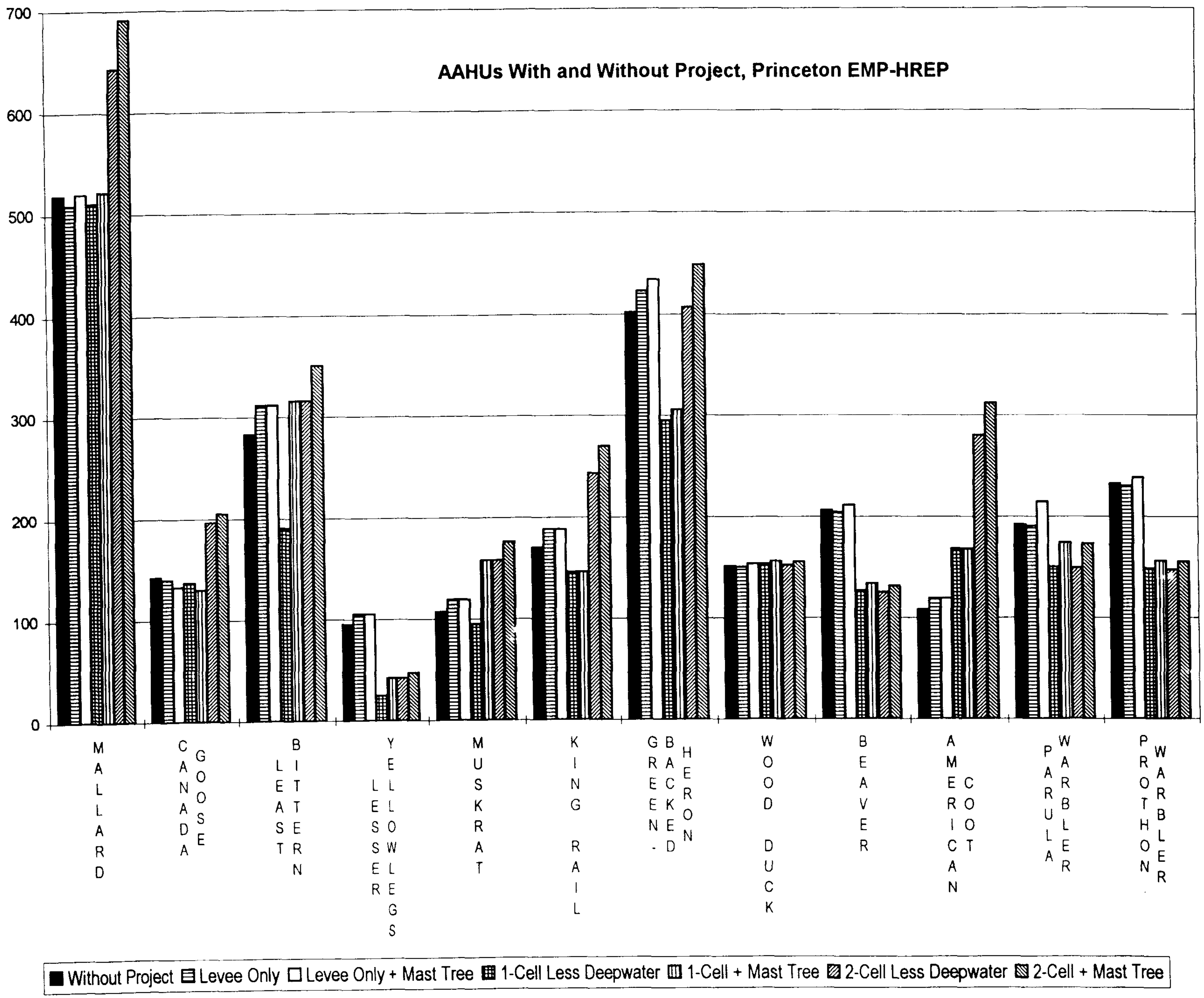

AAHUs With and Without Project, Princeton EMP-HREP
700
600
500
400
300
200
100
0
MALLARD
CANADA GOOSE
LEAST BITTERN
LESSER YELLOWLEGS
MUSKRAT
KING RAIL
GREEN-BACKED HERON
WOOD DUCK
BEAVER
AMERICAN COOT
PARULA WARBLER
PROTHON. WARBLER
Without Project
Levee Only
Levee Only + Mast Tree
1-Cell Less Deepwater
1-Cell + Mast Tree
2-Cell Less Deepwater
2-Cell + Mast Tree

FIGURE 7-1

Examining the WHAG results in terms of AAHU gains for the target species (mallard and green-backed heron) and applying these to the various features/combinations (Alternatives) results in three alternatives indicating disbenefits These are the no action (Alternative A), 1-cell enhanced (Alternative D), and 1-cell enhanced plus tree planting (Alternative E) alternatives. These alternatives were thus eliminated from further consideration.

Of the remaining evaluation species, four showed no change in AAHU values between the 1- and 2-cell alternatives (wood duck, beaver, parula and prothonotary warblers). The balance of species exhibited significant gains in AAHUs. As noted in the supplementary CAR, these increases are for the alternatives which reflect the qualitative value derived from deducting deepwater acreage from the analysis.

b. Cost Analysis. Based on the above habitat evaluation, Alternatives B, C, F, and G meet project goals and objectives and result in gains in AAHUs for target species. An incremental cost analysis was performed to determine the most cost-effective alternative and is presented in this section.

The remaining alternatives and their costs are listed in ascending order of their outputs (AAHUs) in Table 7-2. No Action is presented in the table for comparison purposes.

TABLE 7-2

Cost Effectiveness Analysis

Alternative	Total AAHUs	Total Annual Cost [1]
A - No Action	920	0
B - Restore Levee	932	197499
C - Restore Levee + Plant Trees	954	208773
F - 2 Cell WMU	1050	223970
G - 2 Cell WMU + Plant Trees	1072	235245

[1] Annualized cost includes initial construction cost and annual O&M costs based on a 50-year project life, 8.25 percent interest rate.

As shown in the table, the costs increase with increasing AAHUs. This indicates that there are no economically inefficient solutions which can be immediately eliminated.

To further evaluate the remaining alternatives, an incremental analysis was performed and is presented in Table 7-3 and Figure 7-2.

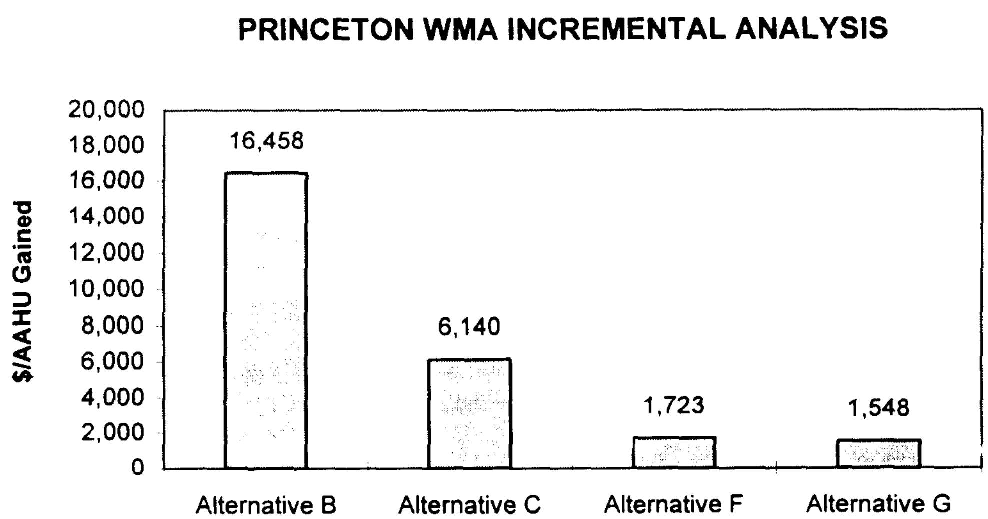
TABLE 7-3

Incremental Analysis

Alternative	AAHUs Gained	Annual Cost	$/AAHU Gained [1]
B - Restore Levee	12	197499	16458
C - Restore Levee + Plant Trees	34	208773	6140
F - 2 Cell	130	223970	1723
G - 2 Cell + Plant Trees	152	235245	1548

[1] Due to the inherent problems of assigning a dollar value to an environmental output, the values derived should be used as a basis for comparison for this project only.

FIGURE 7-2



The analysis shows that the average cost per AAHU gained decreases with increasing levels of environmental outputs, i.e., AAHUs gained. Therefore, additional incremental analysis is not required and the alternative with the highest output, Alternative G - 2-Cell WMU with Mast Tree Planting, is the selected alternative.

8. SELECTED PLAN WITH DETAILED DESCRIPTION

a. General Description. Alternative G was selected as the recommended project to be constructed. The recommended project features include WMU improvement and mast tree planting.

b. 2-Cell WMU Improvement. This feature includes levee construction and water control improvements which provide for reliable and flexible 2-cell WMU operations.

(1) Levee Restoration. The existing perimeter levee will be restored to a 15-year level of protection as shown on the plan and profile drawings on plates 10 through 13. To minimize damage potential, the perimeter levee profile parallel to the Mississippi River is sloped upstream to allow gradual overtopping during flood events greater than 15 years. The levee top width will be 12 feet in reaches having an access road and 10 feet in reaches without an access road, as shown on plate 16. The levee top will be offset away from the river side to avoid fill on the riverside slopes. Levee sideslopes will be shaped to 4:1 horizontal to vertical. Vegetative bank stabilization will be planted on selected reaches of the levee which have been historically vulnerable to scouring.

To provide for controlled overtopping of the perimeter levee system, a 2,300-foot-long overflow roadway emergency spillway will be constructed at elevation 580.3. The top width will be 24 feet and sideslopes will be 4:1 minimum. The overflow roadway will allow rapid filling of the WMU interior prior to perimeter levee overtopping in order to minimize the head differential between the exterior and interior water surfaces at the time of overtopping. An overtopping analysis is contained in Appendix H.

(2) Cross Dike. The proposed cross dike creating a 2-cell WMU configuration will be constructed to elevation 578. This will provide a minimum freeboard of 2 feet during the highest ponding scenario. The cross dike will be constructed with a 10-foot top width and 4:1 sideslopes. Borrow for the cross dike embankment will be from the designated interior borrow sites as well as from an adjacent ditch cut, as shown on plate 14.

(3) WMU Operating Scenario. As described in Section 4, the basic operating plan for the Princeton WMA is to keep water out of the WMUs in the spring and summer and to gradually flood the units in the fall. To manage for specific vegetation needs, it is best to be able to control water levels independently within the two WMUs. To accomplish independent filling of the units, the pump will directly discharge into a stoplog structure along the cross dike. Flow direction can be controlled by placement or removal of the stoplogs. To facilitate independent drainage of the units, a new gatewell structure will be constructed in the north unit to gravity drain that cell. The existing gate structures at the downstream end of the project area will be used to gravity drain the south unit.

(4) Gatewell Structure. A 36-inch gatewell structure will be constructed within the perimeter levee immediately upstream of the proposed cross dike, as shown on plate 23. The primary purpose of the gatewell is to facilitate independent drainage of the north WMU. The gatewell structure also will be used to enhance WMU filling operations. During late summer and fall high water events, the gate will be opened to "capture" Mississippi River water and to help decrease pumping requirements. Finally, the gatewell structure will serve as an additional opening for water to enter and fill the management area prior to Mississippi River overtopping events.

The gatewell will be cast-in-place concrete and will have a 36-inch heavy duty flat back sluice gate. Piping will be 36-inch precast reinforced concrete pipe with precast flared end sections. The gatewell intake structure will be reinforced with riprap.

(5) Pump Relocation. To facilitate the pumping requirements for the 2-cell WMU, the existing pump will be relocated, as shown on plate 18. A permanent concrete building will be constructed to house the diesel engine and supplies, as shown on plate 20. The building will provide a weather-tight, vandal-resistant enclosure. The pump itself will be placed in a new concrete intake structure founded on steel sheet piling, as shown on plate 19. The intake structure will be provided with a steel trash rack to protect the pump from debris, etc. Pump discharge piping will be 24-inch steel pipe and will discharge directly into the concrete stoplog structure.

(6) Stoplog Structure. A concrete stoplog structure will be constructed along the cross dike, as shown on plate 22. The structure will have one 5-foot-wide stoplog bay, with stoplog slots on both sides. The stoplogs can be used to control the direction of pumped water flow, i.e., allow filling of a single WMU, as well as to control the ponding elevation within each cell. The structure will have a steel grate to allow vehicle passage overhead.

c. Mast Tree Planting. Two sites have been selected for planting, both in the northern portion of the area (see plate 2). The entire 12 acres of the northernmost site will be utilized, while 13 acres of the southerly site will be planted. These 13 acres will be chosen based upon field reconnaissance and suitable microsite characteristics. Species selected include pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), bur oak (*Quercus macrocarpa*), pecan (*Carya illinoensis*), shellbark hickory (*Carya lacinosa*), and eastern red cedar (*Juniperus virginiana*). The possibility exists of also planting buttonbush (*Cephalanthus occidentalis*) in wet areas to further benefit waterfowl.

Planting stock will be 1/2-inch caliper for hardwoods, and 2 to 3 feet in height for eastern red cedar. Balled and burlapped stock will be used wherever possible and will be obtained from sources in the same physiographic range as the project area. The latter consideration is particularly important for bur oak, which exhibits significant genetic variability; seedlings should be obtained only from bottomland sources. Trees will be staked for the first year and mulched to a depth of 4 inches in a 3-foot diameter circle at the base of each tree. Herbicide treatments and mowing will be utilized in the first year following planting to minimize unwanted competing vegetation.

Planting will begin in the spring no earlier than March 15th and will be completed no later than May 5th. If planted in the fall, starting and ending dates will be October 1st and November 15th, respectively. Spacing will be 20' x 20' (108 trees per acre). Species will be intermixed at each site to avoid solid blocks of individual species. Planting rates per acre are as follows:

Species	**Area 1**	**Area 2**
Pin Oak	35	25
Swamp White Oak	30	30
Bur Oak	15	20
Pecan	18	15
Shellbark Hickory	10	10
Eastern Red Cedar	00	8
TOTAL:	108/acre	108/acre

NOTE: Eastern red cedar planted in area 2 shall be placed according to soil requirements.

9. DESIGN AND CONSTRUCTION CONSIDERATIONS

a. Existing Site Elevations. The entire Princeton WMA project area is located within the floodplain of the Mississippi River. Due to the pervious substrata materials at the site, ground water elevations are highly influenced by river levels as well as rainfall. Flat pool elevation is 572.0. The land surface elevation in the designated borrow areas ranges from 575 to 577. It is anticipated that shallow borrow and subsequent embankment construction can be accomplished using traditional earth-moving equipment during flat pool conditions. Dewatering likely will be required for foundation work associated with the gatewell, stoplog, and pump intake structures.

b. Borrow Sites/Construction Materials.

(1) Borrow Sites. Borrow material for the perimeter levee, the overflow roadway, and portions of the cross dike will come from the designated borrow areas as shown on plate 2. Borrow material for the west segment of the cross dike will be obtained from adjacent ditch borrow, as shown on plate 17.

(2) Construction Materials. Only common construction materials are required for this project. Crushed stone, riprap, and ready mix materials are available locally and can be trucked to the site. Construction areas are easily accessible, and construction materials can be transported on site by conventional equipment.

c. Storm Water Pollution/Erosion Control. The potential for storm water pollution during construction is minimal for this project. Storm water runoff from the disturbed areas on the landside of the perimeter levee as well as the runoff from all construction activity within the confines of the perimeter levee system will be contained within the Princeton WMA. Temporary stabilization measures will be employed on disturbed areas of the riverside perimeter levee slopes until final seeding and stabilization occurs. Stabilization practices may include mulching, temporary seeding, and/or the erection of silt fencing. Overall, the long-term storm water runoff characteristics of the site are not expected to change; all disturbed areas will be reseeded with similar vegetation types as before project conditions.

d. Construction Sequence. The probable construction sequence is summarized in Tables 9-1 and 9-2; however, no sequence will be contractually required.

e. Permits. A public notice, as required by Section 404 of the Clean Water Act, will be made prior to submission of this report for final approval. A Section 401 water quality certificate from the State of Iowa and a Section 404(b)(1) Evaluation will be included in the final submission of this report. Because all land disturbances associated with this project are addressed in the 404(b)(1) Evaluation, a National Pollutant Discharge Elimination System (NPDES or Section 402) permit for storm water discharges will not be required.

f. Existing Structures. An existing 345,000 volt transmission line crosses the northern portion of the north WMU. Final design of the project will incorporate all measures necessary to ensure electrical safety and to preserve integrity of the transmission structure foundations.

g. Historic Properties. A construction avoidance zone will be marked out around Site 13 ST 89. No construction materials or equipment shall be allowed in this area. No other construction activities shall be allowed to impact this area.

TABLE 9-1

Perimeter Levee and Overflow Roadway
Probable Construction Sequence

Construction Work Item	Instructions	Purpose
Clear & grub specified vegetation from perimeter levee	Place debris in piles adjacent to toe of new embankment	Provide slope erosion protection
Strip/excavate & place embankment/allow consolidation	Repeat embankment placement and consolidation cycles as necessary	Multiple passes required for material standup and to achieve final grades
Shape uncompacted levee and roadway	--	--
Place road stone and riprap where specified	--	--
Implement temporary soil stabilization practices on riverside slopes of perimeter levee	Only required if time between final levee shaping and initial seeding exceeds 21 days	To minimize storm water pollution potential
Seed levee and roadway	--	--
Gatewell structure and pump relocation	No sequence required	--

TABLE 9-2

Cross Dike
Probable Construction Sequence

Construction Work Item	Instructions	Purpose
Clear & grub vegetation along cross dike alignment	--	--
Strip/excavate & place embankment/allow consolidation	Repeat embankment placement and consolidation cycles as necessary	Multiple passes required for material standup and to achieve final grades
Shape uncompacted levee	--	--
Seed levee	--	--
Stoplog structure	No sequence required	--

10. ENVIRONMENTAL EFFECTS

a. Summary of Effects. The primary objectives of the Princeton HREP are to improve water level control capabilities and to create additional marshland habitat. Improved water level control will be achieved through levee upgrading, creation of a cross dike, and relocation of the existing pump plant. These features will provide greater flexibility in water level and vegetation management, thus providing a more desirable mix of open water, emergent vegetation, and 'greentree reservoir' conditions.

Borrow sites for levee improvements will provide reliable small marshlands for waterfowl, which are particularly important as brood habitat. Design of these excavations will include gently sloping banks to allow formation of mudflats. These flats will create additional nesting and feeding sites for shorebirds.

Approximately 4 acres of immature bottomland forest will be lost through construction of the cross dike. These acres will be compensated for by mast tree plantings in the northwestern portion of the area. A maximum of 25 acres could be planted, and a variety of species will be utilized to account for variable responses to inundation, as well as existing microsite characteristics.

b. Economic and Social Impacts.

(1) Community and Regional Growth. No short-term or long-term impacts to the growth of the community or region would be realized as a result of the project. The project would directly improve recreation opportunities at the Princeton Wildlife Management Area, increasing the attractiveness of the area for hunting, trapping, bird watching, and photography.

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

(3) Community Cohesion. While the proposed environmental enhancement project might indirectly increase the number of recreationists visiting the Princeton Wildlife Management Area, this increase is not expected to adversely impact area residents or property owners. Due to the nature of the project and its limited area of influence, no significant impacts to community cohesion would be noticed.

(4) Property Values and Tax Revenues. The potential value of property within the project area 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 project site draws numerous recreationists to the area annually. The project would positively impact public facilities by enhancing aquatic habitat on Federal lands managed by the Department of Natural Resources. The proposed environmental enhancement project would provide enhanced recreational opportunities within the Princeton Wildlife

Management Area. By maintaining the site and enhancing its quality as a fish and wildlife habitat area, recreationists partaking in activities will have more enjoyable recreation experiences.

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

(7) Business and Industrial Activity. Changes in business and industrial activities during project construction would not be noticed. Long-term impacts to business and industrial development would be related to tourism and recreational activities. The project would require no business relocations.

(8) 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 Scott County.

(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 levels during project construction. This increase in noise levels would disturb wildlife and recreationists in the refuge area. The project is located in an area with limited residential or other development, and no significant, long-term noise impacts could result.

(11) Aesthetics. The project would have negligible impacts on the aesthetic value of the area.

c. Natural Resources Impacts. Effects of the project on natural resources, particularly terrestrial and wetland resources, were evaluated using WHAG methodology (Urich *et al.*, 1984). The WHAG was used during project planning to evaluate various features and alternatives in terms of increased benefits to wildlife resources. Optimization of Habitat Units (HUs) in relation to project costs for target species is considered the goal of feature selection.

(1) Aquatic Resources. Additional discussion of aquatic and water quality impacts is contained in Appendix C - Clean Water Act, Section 404 (b)(1) Evaluation. The goal and objectives of the Princeton HREP do not include specific features for improvement of aquatic and fisheries habitat. Thus, WHAG methodology was not applied to this element.

Aquatic resources could be expected to benefit from the increased reliability expected in water level control. Although the primary benefits will be in the form of improved vegetative composition, particularly waterfowl food plants, planned annual drawdowns to encourage establishment of such plants will negatively impact already sparse fish populations. Muskrat populations should not be negatively affected, and, in fact, will likely benefit from somewhat deeper and more stable water levels. Even during periods of summer drawdown, some standing water will remain, and deeper water during the winter months will provide further insurance against complete ice-up, a more critical concern for muskrat populations.

(2) **Wetland and Terrestrial Resources.** Results indicate that mallards and geese will benefit under all alternatives compared to without-project conditions. Combined benefits are highest by a slight margin under Alternative G (2-Cell WMU/Mast Tree Planting). The creation of shallow marsh areas benefits muskrats and rails (these two species are often associated in marsh ecosystems). This is reflected in increased HSIs for these species (see Table 8, page B-15, Appendix B). A projected increase in cattail/sedge habitat in the south unit shows slight benefits for bitterns.

Herons would most likely benefit from marshland creation. This seems to be reflected in "mid-term" outputs which tend to decrease with time. Wood ducks particularly benefit from the additional feature of mast tree planting under Alternative C.

Lesser yellowlegs and beavers would be adversely affected by the proposed project features. Yellowlegs favor very shallow water, exposed substrates, and little vegetative cover, conditions which are not favored in the water level control regime and overall management emphasis planned for Princeton. Similarly, beavers may be negatively affected by the emphasis on mature forest cover and relatively stable water levels.

Coots showed a nearly 200 percent increase in AAHUs, as they benefit from increased submergent and emergent vegetation as well as shallow water habitat. The warbler species show slight habitat gains late in the project life in response to maturation of the mast trees planted. The anticipated reliability in water levels should favor prothonotaries; however, this reliability factor may not be picked up by the WHAG model.

Obviously, a project of this scope cannot be expected to benefit all evaluation species. The target species (mallard and green-backed heron) showed definite benefits from project implementation, and, overall, the range of evaluation species seems to reflect the positive changes expected from increased habitat diversity.

(3) **Endangered Species.** The federally endangered bald eagle (*Haliaeetus leucocephalus*) occurs in the vicinity of Princeton during the winter. The USFWS, in their Coordination Act Report (Appendix B), states that the proposed project will not affect bald eagles or their habitats.

In a letter dated February 5, 1992, the Iowa Department of Natural Resources indicated that no State threatened or endangered species have recently been identified on the project area. The agency states that the proposed project would not present a problem to such species, and that, in fact, bald eagles and river otters may possibly benefit from project implementation.

d. Historic Properties. Archeological Sites 13 ST 88, 13 ST 105, 13 ST 106, and 13 ST 107 were determined to be not eligible for listing on the National Register of Historic Places. Historic archeological site 13 ST 89 is potentially eligible for listing on the National Register of Historic Places. The site is located in the northeast corner of the project area and will not be impacted by any proposed construction activities. A buffer zone will be delimited around the site and marked to assure no inadvertent impacts to the area during construction. Since 13 ST 89 will be avoided and there are no other potentially significant historic properties in the project area, the project will have no effect on significant historic properties. By letter dated April 27, 1992, the Iowa State Historic Preservation Office concurred with this finding. The proposed project can proceed in full compliance with the National Historic Preservation Act (as amended).

e. Mineral Resources. No impacts are expected to occur to mineral resources as a result of this project.

f. Adverse Impacts Which Cannot be Avoided. The most significant unavoidable adverse impact is the clearing of vegetation for construction of the cross dike. Approximately 4 acres of mostly pole-sized timber, consisting primarily of river birch with scattered silver maple, will be removed. Clearing is necessary to allow adequate deposition of material, grading, and finishing of the dike.

An additional unavoidable impact is the excavation at the base of the levee, particularly on the refuge side. Excavation will be shallow and comprise 5 to 10 feet of linear width and 6 inches of depth. This area will be filled with new material in the course of levee reconstruction.

Construction of the cross dike is considered a critical element to achieve the objectives of improved water-level management. Operation of Princeton as a two-unit system will not only allow greater flexibility but increase habitat quality by creating greater vegetative diversity. In terms of overall resource benefits, construction of the cross dike will create more management options than would be possible with the existing system. In addition, 25 acres of quality, mast-producing trees is to be planted, thus allowing for additional benefits well into the future.

Two of the evaluation species, the lesser yellowlegs and beaver, would be adversely impacted by the proposed project. This impact is considered a tradeoff for the benefits realized to the other evaluation species. The overlapping and sometimes conflicting needs of a range of species cannot all be met by a single habitat improvement project such as this.

g. Short-Term Versus Long-Term Productivity. Though sedimentation has not been a serious problem, short-term productivity at Princeton will continue to be limited by the effects of uncontrollable flooding from the Mississippi River, as well as limited capacity to manage water to desired levels. Unpredictable water levels disallow the establishment of suitable migratory bird food plants (submerged and floating species such as pondweed, duckweed, and smartweed), and emergent plants which provide food and cover for a variety of marshland species.

Long-term productivity will be enhanced as optimum ratios of open water/vegetation can be maintained and the establishment of desirable vegetative species can be promoted. Overall habitat diversity will be increased, and both game and nongame wildlife species will benefit. In turn, both consumptive and nonconsumptive users will realize heightened opportunities for recreational use of the Princeton area.

h. Irreversible or Irretrievable Resource Commitments. Materials and human resources used in proposed construction or upgrading are the sole irreversible commitments envisioned.

i. Compliance With Environmental Quality Statutes. Compliance with applicable statutes is summarized in Table 10-1.

TABLE 10-1

Compliance of the Preferred Plan with WRC-Designated Environmental Statutes

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. 165h-7, et seq.	Full compliance
Clean Water Act (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.	Full compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Estuary Protection, 16 U.S.C. 1221, et seq.	Not applicable
Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq.	Full compliance
Land and Water Conservation Fund Act, 16 U.S.C. 4601, et seq.	Full compliance
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Full compliance
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full compliance
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Not applicable

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.

11. SUMMARY OF PROJECT ACCOMPLISHMENTS

The proposed project consists of upgrading the perimeter levee, relocating and improving the existing pumping plant, constructing a cross dike, and planting mast trees.

Upgrading of the perimeter levee will allow more reliable control over water levels within the area, both by limiting overtopping events and, more importantly, preventing further stability failure by scouring.

Improvement of the pumping plant and construction of the cross dike will allow increased pumping efficiency and operation of the area as two independent units. This will allow for maintenance of optimum water levels given the existing topography and seasonal habitat requirements of migratory birds.

Mast tree plantings will provide food resources for multiple migratory and resident species and increased overall habitat diversity.

Implementation of these project enhancement features is projected to result in HU gains for 8 of the 12 WHAG evaluation species. These increases, on an annualized basis, range from <1% to almost 200%. The target species, mallard and green-backed heron, could realize increases of 33% and 11%, respectively.

12. OPERATIONS, MAINTENANCE, AND REHABILITATION CONSIDERATIONS

a. Project Data Summary. Table 12-1 presents a summary of project data.

TABLE 12-1

Princeton WMA Project Data Summary

Feature	Measurement	Unit of Measure
Perimeter Levee		
Length	16,400	Feet
Crown Width	10 or 12	Feet
Side Slopes	4:1	H:V
Level of Protection	15	Year Event
Elevation	581.3-582.3	Feet NGVD 1912
Embankment Volume	100,000	CY
Cross Dike		
Length	5,350	Feet
Crown Width	10	Feet
Side Slopes	4:1	H:V
Level of Protection	<5	Year Event
Elevation	578	Feet NGVD 1912
Embankment Volume	18,500	CY
Overflow Roadway		
Length	2,400	Feet
Crown Width	24	Feet
Side Slopes	4:1	H:V
Level of Protection	10	Year Event
Elevation	580.3	Feet NGVD 1912
Embankment Volume	5,000	CY
Pump Station Relocation		
Intake Structure Sill Elevation	568	Feet NGVD 1912
Trash Rack	1	Each
Discharge Pipe		
Diameter	24	Inches
Length	235	Feet
Riprap	600	Tons
Discharge Flowline El.	576	Feet NGVD 1912

TABLE 12-1 (Cont'd)

Feature	Measurement	Unit of Measure
Stoplog Structure		
Weir Length	5	Feet
Concrete Sill Elevation	574	Feet NGVD 1912
Riprap	300	Tons
Gatewell Structure		
Slide Gate	1	Each 3 Ft x 3 Ft
RCP Discharge Pipe		
Diameter	36	Inches
Length	64	Feet
Landside Invert El.	573.25	Feet NGVD 1912
Riverside Invert El.	572.25	Feet NGVD 1912
Gatewell Floor El.	573.0	Feet NGVD 1912
Riprap		Tons

b. Operation. Table 12-2 summarizes the general operating requirements to manage WMU water levels.

Estimated annual operation costs are presented in Table 14-2.

c. Maintenance. The proposed features have been designed to ensure low annual maintenance requirements, with the estimated annual maintenance costs presented in Table 14-2. These quantities and costs may change during final design.

TABLE 12-2

WMU Water Level Management
Operating Requirements

Desired Function	Operating Scenario	Operating Time	Remarks
Emergency Fill of WMU (both cells)	When river elevation reaches el. 576.4 with stage higher than 580.3 predicted, open gatewell in north WMU and existing gates in south WMU. Remove all logs from stoplog structure.	8 days to equalize levels between WMU interior and river.	Prevents overtopping damage to perimeter levee.
Fill WMU			
Using Gatewell	When river stage exceeds el. 576, open gatewell structure and south gates until desired WMU elevation is achieved.	7 days	Allows filling of unit without pumping costs
Using Pump	1) Close all perimeter levee gates; 2) set stoplogs to fill north cell, south cell, or both; 3) use pump to fill desired cells	12 days	--
Dewatering WMU			
North Cell Only	Open gatewell	25 days	
South Cell Only	Open existing gates in south cell	4 days	
Both Units	1) Remove stoplogs 2) Open all perimeter levee gates	4 days	

Note: More complete operation times and rating curves are contained in Appendix H.

13. PROJECT PERFORMANCE ASSESSMENT

This section summarizes the monitoring and data collection aspects of the project. The primary project objectives have been summarized elsewhere in this document, and the performance assessment is designed to gauge progress toward meeting these objectives.

Table 13-1 presents overall types, purposes, and responsibilities of monitoring and data collection.

Table 13-2 presents actual monitoring and data parameters grouped by project phase, as well as data collection intervals.

Table 13-3 presents the post-construction evaluation plan, which displays the specific parameters and the levels of enhancement which the project hopes to achieve.

TABLE 13-1

Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluate planning assumptions.	USFWS	USFWS (EMTC)	LTRM	--
	Pre-Project Monitoring	Identify and define problems at HREP site. Establish need of proposed project features.	Sponsor	Sponsor	Sponsor	--
	Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field station or sponsor thru Cooperative Agreements or Corps.	HREP	See Table 13-2.
Design	Data Collection for Design	Include quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	See Table 13-2.
Construction	Construction Monitoring	Assess construction impacts; assure permit conditions are met.	Corps	Corps	HREP	See State Section 401 Stipulations.
Post-Construction	Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative) and sponsor (field observations).	Field station or sponsor thru Cooperative Agreement, sponsor thru O&M, or Corps.	HREP	See Table 13-3.
	Biological Response Monitoring	Evaluate predictions and assumptions of habitat unit analysis beyond the scope of performance evaluation.	Corps	Corps	HREP	This is an overall EMP program element, carried out at select project sites. Princeton is not included among these.

TABLE 13-2

Resource Monitoring and Data Collection Summary

	ENGINEERING DATA			NATURAL RESOURCE DATA				
Type Measurement	Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase	Sampling Agency	Remarks
POINT MEASUREMENTS								
Select Point Locations								
Soil Borings	1	1					Corps	
TRANSECT MEASUREMENTS								
Transects								
Vegetation						5Y	USFWS	
Levee System		1	5Y				Corps	
Cross section at even 500-foot intervals & profile cross dike & perimeter levee								
AREA MEASUREMENTS								
Mapping								
Vegetation Monitoring					1		Corps	
Aerial Photograph (1:1250)				1		5Y	USFWS	
Land Topographic (1' contour)		1					Corps	

Legend

Y = Yearly
1,2,3 --- = number of times data is collected within designated project phase

TABLE 13-3

Post-Construction Evaluation Plan

Goal	Objective	Enhancement Feature	Unit	Enhancement Potential: Year 0 Without Alternative	Year X With Alternative[1]	Year 50 Target With Alternative	Feature Measurement Reference Table 13-2	Annual Field Observations by Site Manager
Enhance Wetland Habitat	-Provide reliable food source for migratory birds	Levee restoration	Lineal feet of eroded levee	16,400	--	0	Levee system transects/profiles	Describe any erosional/ seepage effects
		Water control improvements	Acres of aquatic vegetation	213	--	300 [2]	Vegetation transects	Estimate effective acreage and wildlife use
	-Increase overall vegetation diversity and availability of preferred wildlife foods	Mast tree planting	Acres of mast trees	Approx. 7-10	--	40	Vegetation transects	Estimate area of established/ regenerated vegetation

1 This column is completed for the year the enhancement feature is monitored.
2 Includes areas of cropland → non-forested wetland conversion.

14. COST ESTIMATES

A detailed estimate of project design and construction costs is presented in Table 14-1. A detailed estimate of operation, maintenance, and rehabilitation costs is presented in Table 14-2. Table 14-3 presents the estimated annual monitoring costs as described in Section 13. Quantities may vary during final design.

TABLE 14-1

PRINCETON REFUGE
REHABILITATION AND ENHANCEMENT EMP
PROJECT COST SUMMARY
DIVISION OF COST
OCTOBER 1994

ACCOUNT	FEATURE	CURRENT WORKING ESTIMATE (CWE)		2/ FULLY FUNDED ESTIMATE (FFE)	
		FEDERAL	1/ COST SHARED	FEDERAL	COST SHARED
06.	FISH AND WILDLIFE FACILITIES	$ 1,924,204	$ 57,428	$ 2,134,327	$63,699
30.	PLANNING, ENGINEERING AND DESIGN	$ 626,308	$ 18,692	$ 694,701	$20,733
31.	CONSTRUCTION MANAGEMENT	$ 242,755	$ 7,245	$ 269,264	$8,036
	SUBTOTAL	$ 2,793,267	$ 83,365	$ 3,098,291	$92,469

SUMMARY OF COST APPORTIONMENT

	CWE	FFE
1. TOTAL COST SUMMARY		
TOTAL PROJECT COSTS	$ 2,876,632	$ 3,190,760
FEDERAL SUBTOTAL	$ 2,793,267	$ 3,098,291
TOTAL PROJECT COSTS SUBJECT TO COST SHARING	$ 83,365	$ 92,469
2. NON-FEDERAL COSTS		
REQUIRED NON-FEDERAL CASH CONTRIBUTION	$ 20,841	$ 23,117
NON-FEDERAL LANDS & DAMAGES	$ -	$ -
TOTAL NON-FEDERAL COST	$ 20,841	$ 23,117
3. FEDERAL COST		
TOTAL FEDERAL COSTS	$ 2,855,790	$ 3,167,643
GENERAL DESIGN, DEFINITE PROJECT REPORT	(466,595)	(470,000)
REMAINING FEDERAL COSTS	$ 2,389,195	$ 2,697,643

NOTES:

1/ PROJECT FEATURES LOCATED ON STATE LANDS ARE SUBJECT TO 75% FEDERAL AND 25% NON-FEDERAL COST SHARE.

2/ CONSTRUCTION SCHEDULED FOR AUG 95 - JUN 97. FULLY FUNDED ESTIMATE (FFE) IS BASED ON MIDPOINT OF CONSTRUCTION OF JUL 96, RESULTING IN INFLATION FACTORS OF 1.1627 FOR SALARIES AND 1.1092 FOR ALL OTHER COSTS PER CECW-B MEMO, 25 JAN 93, SUBJECT: FACTORS FOR UPDATING STUDY/PROJECT COST ESTIMATES FOR THE FY 1995 BUDGET SUBMISSION.

TABLE 14-1 (Cont'd)

PRINCETON REFUGE
REHABILITATION AND ENHANCEMENT EMP
PROJECT COST ESTIMATE
OCTOBER 1994

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
06	**FISH AND WILDLIFE FACILITIES (ON FEDERAL LANDS)**							
06.-.-.-	**PERIMETER LEVEE IMPROVEMENT**							
06.0.1.B	STRIPPING	18240	CY	$ 1.50	$ 27,360	$ 4,104	15.0%	1
06.0.1.B	CLEARING & GRUBBING	9.8	ACR	$ 2,700.00	$ 26,460	$ 5,292	20.0%	1,6
06.0.1.B	EMBANKMENT FILL	110170	CY	$ 1.75	$ 192,798	$ 58,225	30.2%	1,6
06.0.C.B	CRUSHED STONE	3000	TON	$ 20.00	$ 60,000	$ 12,000	20.0%	2,3,5
06.0.1.B	SEEDING	26.2	ACR	$ 2,000.00	$ 52,400	$ 13,100	25.0%	3,6
06.0.1.B	RIPRAP	2000	TON	$ 37.00	$ 74,000	$ 14,800	20.0%	2,3,5
06.0.5.B	GATEWELL STRUCTURE	1	LS	$ 70,000.00	$ 70,000	$ 21,000	30.0%	1,4,6
06.0.1.B	EMBANKMENT PROTECTION	1500	LF	$ 20.00	$ 30,000	$ 9,000	30.0%	
	TOTAL				$ 533,018	$ 137,521		
06.-.-.-	**OVERFLOW ROADWAY IMPROVEMENT**							
06.0.1.B	STRIPPING	1650	CY	$ 1.50	$ 2,475	$ 371	15.0%	1
06.0.1.B	EMBANKMENT FILL	3900	CY	$ 1.25	$ 4,875	$ 1,463	30.0%	1,6
06.0.C.B	CRUSHED STONE	717	TON	$ 20.00	$ 14,340	$ 2,868	20.0%	2,3,5
06.0.1.B	SEEDING	0.5	ACR	$ 2,000.00	$ 1,000	$ 250	25.0%	3,6
	TOTAL				$ 22,690	$ 4,952		
06.-.-.-	**BORROW AREA EXCAVATION**							
06.0.1.B	STRIPPING	30930	CY	$ 1.50	$ 46,395	$ 6,959	15.0%	1
06.0.1.B	EXCAVATION	132570	CY	$ 4.00	$ 530,280	$ 132,570	25.0%	1,2,6
	TOTAL				$ 576,675	$ 139,529		
06.-.-.-	**CROSS DIKE CONSTRUCTION**							
06.0.1.B	STRIPPING	1575	CY	$ 1.50	$ 2,363	$ 354	15.0%	1
06.0.1.B	EMBANKMENT FILL	18500	CY	$ 1.25	$ 23,125	$ 6,938	30.0%	1,6
06.0.1.B	SEEDING	2.1	ACR	$ 2,000.00	$ 4,200	$ 1,050	25.0%	3,6
06.0.5.B	STOPLOG/INTAKE STRUCTURES	1	LS	$ 181,000.00	$ 181,000	$ 45,250	25.0%	1,4,6
06.0.5.B	RIPRAP	900	TON	$ 37.00	$ 33,300	$ 6,660	20.0%	2,3,5
06.0.5.B	BEDDING	20	TON	$ 20.00	$ 400	$ 80	20.0%	
	TOTAL				$ 244,388	$ 60,332		
06.0.2.N	**PUMP ENGINE BUILDING**	1	LS	$ 52,000.00	$ 52,000	$ 15,600	30.0%	1,4,6
06.-.-.-	**MAST TREE PLANTING**	1	LS	$ 90,000.00	$ 90,000	$ 22,500	25.0%	6
06.-.-.-	**MOB AND DEMOB**	1	LS	$ 20,000.00	$ 20,000	$ 5,000	25.0%	2,5
	SUBTOTAL, FISH AND WILDLIFE FACILITIES				$ 1,538,770	$ 385,434		
06	**TOTAL, FISH AND WILDLIFE FACILITIES (ON FEDERAL LANDS)**				$ 1,924,204			

TABLE 14-1 (Cont'd)

PRINCETON REFUGE
REHABILITATION AND ENHANCEMENT EMP
PROJECT COST ESTIMATE
OCTOBER 1994

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
06.	**FISH AND WILDLIFE FACILITIES (ON STATE LANDS)**							
06.-.-.-	**PERIMETER LEVEE IMPROVEMENT**							
06.0.1.B	STRIPPING	3020	CY	$ 1.50	$ 4,530	$ 680	15.0%	1
06.0.1.B	CLEARING & GRUBBING	2.2	ACR	$ 2,700.00	$ 5,940	$ 1,188	20.0%	1,6
06.0.1.B	EMBANKMENT FILL (ADJACENT)	4830	CY	$ 1.75	$ 8,453	$ 2,629	31.1%	1,6
06.0.1.B	SEEDING	3.8	ACR	$ 2,000.00	$ 7,600	$ 1,900	25.0%	3,6
	TOTAL				$ 26,523	$ 6,396		
06.-.-.-	**OVERFLOW ROADWAY IMPROVEMENT**							
06.0.1.B	STRIPPING	830	CY	$ 1.50	$ 1,245	$ 187	15.0%	1
06.0.1.B	EMBANKMENT FILL (ADJACENT)	1100	CY	$ 1.25	$ 1,375	$ 413	30.0%	1,6
06.0.C.B	CRUSHED STONE	835	TON	$ 20.00	$ 16,700	$ 3,340	20.0%	2,3,5
06.0.1.B	SEEDING	0.5	ACR	$ 2,000.00	$ 1,000	$ 250	25.0%	3,6
	TOTAL				$ 20,320	$ 4,189		
	SUBTOTAL, FISH AND WILDLIFE FACILITIES				$ 46,843	$ 10,585		
06.	**TOTAL, FISH AND WILDLIFE FACILITIES (ON STATE LANDS)**				$ 57,428			
06.	**TOTAL, FISH AND WILDLIFE FACILITIES (ON FED AND STATE LANDS)**				$ 1,585,613	$ 396,019		
06.	**TOTAL, FISH AND WILDLIFE FACILITIES (TOTAL COST)**				$ 1,981,632			
						FEDERAL	COST SHARED	
30.	**PLANNING, ENGINEERING AND DESIGN**							
	DEFINITE PROJECT REPORT				$ 470,000	$ 456,379	$ 13,621	
	PLANS AND SPECIFICATION				$ 145,000	$ 140,798	$ 4,202	
	ENGINEERING DURING CONSTRUCTION				$ 30,000	$ 29,131	$ 869	
				TOTAL	$ 645,000	$ 626,308	$ 18,692	
31.	**CONSTRUCTION MANAGEMENT**							
	CONSTRACT ADMINISTRATION				$ 90,000	$ 87,392	$ 2,608	
	REVIEW OF SHOP DRAWINGS				$ 10,000	$ 9,710	$ 290	
	INSPECTION AND QUALITY ASSURANCE				$ 150,000	$ 145,653	$ 4,347	
				TOTAL	$ 250,000	$ 242,755	$ 7,245	

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 14-2

Estimated Annual Operation and Maintenance Costs
(June 1993 Price Level)

	Qty	Unit	Unit Price ($)	Total Cost ($)
Operation				
Pump Fuel	1	Sum	2,550	2,550
Pump Station Operation	20	Hr	25	500
Gate Operation	16	Hr	25	400
Stoplog Operation	16	Hr	25	400
Subtotal Operation:				3,850
Maintenance				
Levee Inspection	40	Hr	25	1,000
Levee Mowing (once/yr)	40	Ac	45	1,800
Pump Replacement (@ yr 25)	1	Sum	5,500	5,500
Pump Maintenance	40	Hr	30	1,200
Crushed Stone	50	Ton	22	1,100
Stoplog Replacement	4	Ea	10	40
Riprap	140	Ton	32	4,480
Levee Erosion Control	20	Hr	100	2,000
Planting Maintenance	30	Ac	40	1,200
Subtotal Maintenance:				18,320
Rehabilitation [1]				
			Subtotal:	22,170
Contingencies (20%)				4,430
			TOTAL:	26,600

[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 a result of major storms or flood events.

TABLE 14-3

Estimated Post-Construction Annual Monitoring Costs ($) (June 1993 Price Level)

Item	Annual Cost ($)
Engineering Data [1]	3,000
Natural Resource Data [1]	2,000
Subtotal	5,000
Contingencies (20%)	1,000
Subtotal	6,000
Planning, Engineering, Design [2]	1,500
Total	7,500

[1] Reference Tables 13-2 and 13-3.
[2] Includes cost of annual evaluation report.

15. REAL ESTATE REQUIREMENTS

a. General. The majority of the project features are located on federally owned General Plan land under Corps of Engineers administration. Management of these lands was subsequently transferred to the USFWS for fish and wildlife purposes under a Cooperative Agreement between the Department of Interior, USFWS, and the Department of the Army, dated February 14, 1963. Under a successive Cooperative Agreement between the USFWS and the IADNR dated October 11, 1963, the IADNR assumed responsibility for managing all Federal lands within the project area for fish and wildlife purposes. Management of these project features after construction will be the responsibility of the IADNR.

The remainder of the project features are located on lands owned and managed by the IADNR. Management of these project features after construction also will be the responsibility of the IADNR.

b. Cooperation Agreements/Cost-Sharing.

(1) Federal Lands. Funding for the initial construction of the project features located on Federal lands will be 100 percent Federal. Since the project lands are all managed as part of the Upper Mississippi River 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-
>
> (3) 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 D. Estimated operati n and maintenance costs are presented in Table 14-2.

(2) State Lands. Initial cost-sharing is required for project features located on State lands because these lands are not managed as a National Wildlife Refuge as prescribed by Section 906(e) of the Water Resources Development Act of 1986. A draft project cooperation agreement for these features is included in Appendix E. The agreement principally states that the first cost of these proposed construction features will be cost-shared 75 percent Federal/25 percent State in accordance with the Water Resources Development Act of 1986.

c. Land Interests. No land acquisition will be necessary as the project is located entirely on lands owned by either the Government or the State of Iowa. Rights-of-entry will need to be provided by both the USFWS and the State of Iowa to the Government for access to lands needed for construction under their respective jurisdictions. Certification as to the availability of real estate will need to be accomplished by Real Estate Division prior to the advertisement of the construction contract.

16. SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 16-1 presents the schedule of project completion steps.

TABLE 16-1

Project Implementation Schedule

Requirement	Scheduled Date
Submission of Draft DPR to Corps of Engineers, North Central Division, for Review	Aug 93
Distribution of DPR for Public and Agency Review	Oct 94
Submission of Final and Public Reviewed DPR to North Central Division	Feb 95
Receive Plans and Specifications Funds	Feb 95
Construction Approval by Commander, North Central Division	Feb 95
Submit Final Plans and Specifications to North Central Division for Review and Approval	Mar 95
Obtain Approval of Plans and Specifications	May 95
Execute Cooperation Agreements	May 95
Advertise Contract	Jul 95
Award Contract	Jan 96
Complete Construction	Dec 97

17. 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 Iowa, and other affected agencies. The Rock Island District will submit the subject definite project report; program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration.

b. **U.S. Fish and Wildlife Service.** The USFWS is the Federal sponsor of the project and will determine that all project features are compatible with refuge purposes. The recommendations provided via the Draft Coordination Act Report are the result of extensive interagency coordination efforts throughout the planning process. These recommendations will be fully incorporated in the final design and implementation of this project.

c. **Iowa Department of Natural Resources**. Operation and maintenance of the project, as described in Table 14-2, is the responsibility of the IADNR in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580. These functions will be further specified in the Project Operation and Maintenance Manual to be provided by the U.S. Army Corps of Engineers prior to final acceptance of the project by the sponsor. The IADNR is the non-Federal sponsor of the project.

18. COORDINATION, PUBLIC VIEWS, AND COMMENTS

a. Coordination Meetings. Ongoing coordination between the Corps of Engineers, USFWS, and IADNR was demonstrated by the following meetings:

(1) December 5, 1988. Corps of Engineers in-house meeting; general project discussion.

(2) December 6, 1988. On-site meeting with Corps of Engineers, USFWS, and IADNR to scope proposed project.

(3) July 19, 1990. Plan formulation meeting at Corps of Engineers, Rock Island District between Corps, USFWS and IADNR.

(4) December 12, 1991. General design meeting at IADNR Green Island Field Station between Corps, USFWS and IADNR.

(5) December 14, 1994. Project coordination meeting at Corps of Engineers, Rock Island District between Corps, USFWS, and IADNR.

b. Coordination by Letters and Telephone Conversations. Letter and telephone correspondence was received from the following agencies:

State Historical Society of Iowa
Iowa Department of Natural Resources
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

The IADNR, in a February 5, 1992, letter, concluded that no significant environmental concerns are associated with the project as planned and expressed support for its implementation.

In a letter dated March 4, 1992, the U.S. Environmental Protection Agency commented that the project document should address potential impacts of off-site flooding. This issue has been addressed in the Section 404(b)(1) Evaluation (Appendix C). No other comments were offered.

By letter dated April 27, 1992, the State Historical Society of Iowa stated that planned protection measures for a potential National Register Site were adequate, and that the proposed project would have no effect on significant historic properties.

The IADNR, in a June 1, 1992, letter, agreed to the project cost sharing and operation and maintenance requirements.

The U.S. Fish and Wildlife Service submitted a Coordination Act Report dated May 3, 1993. The report concluded that the proposed project will have benefits beyond the immediate area, extending to national and international plans to protect and enhance habitat for migratory birds. The report also noted the importance of a sound levee and its role in effective water level management. It was recommended that the 2-cell configuration be utilized to maintain optimum water depths.

In a letter dated July 15, 1994, the IADNR Area Biologist provided additional information in response to Corps of Engineers, North Central Division, project comments, again voicing support for overall project implementation.

Supplementary WHAG analyses and supporting information were provided via a letter from the U.S. Fish and Wildlife Service, dated July 22, 1994. This letter reiterated the initial recommendations and added the recommendation for mast tree planting as a project feature.

In a letter dated November 10, 1994, the USFWS expressed their support for the project.

The Iowa-Illinois Gas and Electric Company, in a letter dated November 29, 1994, expressed their concern for electrical safety and preserving integrity of transmission structure foundations.

19. CONCLUSIONS

The wetland habitat value of the Princeton WMA is not being fully realized due to water level management limitations. In addition, annual perimeter levee maintenance has been limited by breaching, and areas adjacent to breach sites have been negatively impacted by sedimentation. Overall, usage of this area by migratory birds has been declining.

The recommended project features (levee restoration, water level control, and mast tree planting) are designed to meet the project's specific goal and objective of enhancing wetland habitat at this location by increasing the potential for reliable food production and resting/loafing habitat for migratory birds.

Assessment of the future with-project scenario shows definite increases in total habitat units and HSIs over the 50-year project life for the target species, as well as a majority of other wetland dwelling species considered. These increases represent quantification of the projected outputs: improved habitat quality and increased preferred habitat quantity.

This project is consistent with and fully supports the overall goal and objectives of the UMRS-EMP, the North American Waterfowl Management Plan, and the Partners for Flight program.

20. RECOMMENDATIONS

I have weighed the outputs to be obtained from the full implementation of this habitat rehabilitation and enhancement project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. In my judgment, this project, as proposed, justifies expenditure of Federal funds. I recommend that the Secretary of the Army for Civil Works approve the proposed project to include: restoration of 16,400 feet of perimeter levee; construction of 5,350 feet of cross dike with 2,400 feet of overflow roadway; relocation of the existing pump station; construction of stoplog and gatewell structures; and mast tree plantings.

The current estimated construction cost of this project is $2,406,632. Total estimated project cost, including general design, is $2,876,632.

Those portions of this project to be constructed upon State-owned lands and an equivalent percentage of the project general design cost will be cost shared (75% Federal/25% non-Federal) with the non-Federal project sponsor, the Iowa Department of Natural Resources.

At this time, I further recommend that funds in the amount of $145,000 be allocated for the preparation of project plans and specifications.

Charles S. Cox
Colonel, U.S. Army
District Engineer

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 the Princeton Wildlife Management Area 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 may be reevaluated if warranted by further developments.

Alternatives considered include:

a. No Federal Action

b. Wetland Management Unit Improvement

c. Wetland Management Unit Improvement/Mast Tree Planting

Alternative C is the preferred alternative.

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 Princeton area for migratory birds and resident wildlife.

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 significant economic impacts to the project area are envisioned.

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

1 Feb 95
Date

Charles S. Cox
Charles S. Cox
Colonel, U.S. Army
District Engineer

PROJECT IDENTIFICATION AND SELECTION

APPENDIX A

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX A
PROJECT IDENTIFICATION AND SELECTION

TABLE OF CONTENTS

Subject **Page**

DRAFT 3-2-87

GOALS FOR MANAGEMENT OF FISH AND WILDLIFE RESOURCES AND HABITAT REHABILITATION AND ENHANCEMENT FOR POOLS 11-22

The Upper Mississippi River Management Act of 1986 was enacted "to ensure the coordinated development and enhancement of the Upper Mississippi River System." The Act declared that it is 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." The Act specifically recommends several programs. They are a) habitat rehabilitation and enhancement, b) long-term resource monitoring, c) computerized inventory and analysis system, d) recreation projects and economic analysis, and e) navigation traffic monitoring. A second lock at Lock and Dam 26 (Replacement) is also authorized. This report will address the habitat rehabilitation and enhancement program (HREP) for pools 11 through 22 (Guttenberg, Iowa, to Saverton, Missouri).

BACKGROUND

As stated in the Master Plan, "the Habitat Rehabilitation and Enhancement Program would consist of numerous enhancement efforts aimed at the imple-mentation of techniques to preserve, protect, and restore habitat that is deteriorating due to natural and man-induced activities. The enhancement effort would extend for a ten-year period in order to adequately evaluate and understand the effectiveness of techniques and measures being applied to protect, enhance, or rehabilitate habitat." The Upper Mississippi River Basin Association (UMRBA) has recommended that the following eligibility criteria be used to develop and select habitat rehabilitation and enhancement projects:

* Projects must meet the defined program objectives of:

  a) protecting, restoring, or improving fish and wildlife habitat that has deteriorated, is threatened, or will be threatened as a result of human-induced or natural impacts;

  b) assuring that adverse impacts on the fish and wildlife resource of the river system are avoided, minimized, rectified, or eliminated over time, or compensated for;

c) address structural and nonstructural measures for environmental enhancement through long-term resource monitoring efforts and available documents;

d) address first solutions related to navigation impacts including navigation traffic and operation and maintenance of the navigation system;

e) address second other human-induced impacts not related to navigation, and;

f) address last naturally occurring impacts.

* Projects must be located along the main channel, side channel, backwaters, or mouth of tributaries within the UMRS.

* Projects must not involve rehabilitation of facilities for which maintenance is or could be provided under existing federal or state programs unless additional habitat benefits can be demonstrated.

* Projects which include the following characteristics should be encouraged:

    a) minimal operation and maintenance costs,

    b) minimal land acquisition,

    c) auxiliary benefits to navigation or water quality

The above will be used by the states and the U.S. Fish and Wildlife Service in selecting projects to be submitted to the Corps of Engineers. However, the Corps is selecting projects first according to need and efficacy of the proposed project, and secondly, according to what we might be able to learn from it. They have also stated that reality demands consideration of factors such as geographic dispersion and readiness to proceed. Further, the Corps of Engineers' General Plan for the Environmental Management Program states that applicable techniques are 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, and acquisition of wildlife lands. The Corps does not specifically endorse as HREP projects pool level management, altering the navigation channel, tow operation restrictions, change in dredging practices, floating breakwaters, or improved fleeting design because they fall outside their conventional activities. However, the Corps has recently acknowledged that these innovative measures might result in 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.

The act authorizes appropriations of $124.6 million. The Corps of Engineers has requested that the five state conservation agencies of the UMRS and the U.S. Fish and Wildlife Service submit potential habitat rehabilitation and enhancement projects for funding. However, this piecemeal-like submission process ignores a major objective of Congress to manage the UMRS as an ecosystem. It is in this regard the Fish and Wildlife Interagency Committee has become involved.

ROLE OF FWIC

As recommended by GREAT II, the Fish and Wildlife Interagency Committee (FWIC) is to provide coordination regarding fish and wildlife matters associated with physical river modifications and river management studies and investigations. In light of this charge, the FWIC decided that their role in the HREP is to integrate ecosystem management into the project selection process. Their first task was to define fish and wildlife management objectives for Pools 11 through 22 and identify potential management objectives in these pools. This information was then used to identify potential construction alternatives for each objective. The remainder of this report summarizes the work at four regional task force meetings held in October and November 1986.

GOALS AND OBJECTIVES FOR POOLS 11-22

The FWIC will strive to preserve the Upper Mississippi River floodplain for the enjoyment and use of this and future generations. Emphasis will be placed on the protection and conservation of fish, wildlife and their habitats. [The FWIC recognizes that sedimentation is the River's greatest problem and that watershed protection and land treatment would provide the greatest benefits in protection and management of the River's fish and wildlife resources. However, the FWIC views this as a responsibility of the U.S. Department of Agriculture and not a function of the EMP.]

Goal I - Environmental Quality - To preserve and enhance the environmental quality, wild character and natural beauty of the River's floodplain ecosystem.

Goal II - Migratory Birds - To provide the life requisites of waterfowl and other migratory birds.

Goal III - Fisheries and Aquatic Resources - To provide the life requirements of fish and other aquatic plant and animal life occurring naturally along or in the Upper Mississippi River.

Goal IV - Other Wildlife - To provide the life requirements of resident wildlife species.

Goal V - Endangered Species - To conserve, restore and enhance federal and state protected species and the habitats upon which they depend.

Table 1 lists the objective for each goal, example species for management, and potential habitat projects that may contribute toward achievement of the objective.

Pool Application

After management goals and objectives were discussed, the task forces identified existing management activities and additional objectives that could be achieved in the backwater complexes of each pool. Possible construction alternatives were also identified. Tables 2-13 summarize the results of this discussion.

Summary of Habitat Management Needs in Pools 11-22

Tables 14, 15, and 16 summarize the work of the task forces. Table 14 lists the areas evaluated, potential management objectives, and relative importance of management of an area to the management of the pool. Table 15 summarizes the management alternatives identified and the management objectives they may address. Finally, Table 16 lists highly important areas for management in the Rock Island District.

Recommendations

1. The information contained in this report be used in HREP project development so ecosystem management is integrated in the program.

2. Alternatives be developed to consider reclamation of marginal lands, reducing the impacts of navigation, improving benthos habitat, and protecting threatened or endangered species.

3. Engineering research should be focused on identifying additional alternatives to achieve stated objectives.

Table 1. FWIC for fish and wildlife management objectives for Pools 11-22.

Objectives	Example Management Species	Implementation Alternatives	Relative Importance in Management of Pools (H-High, M-Medium, L-Low) 11	12-15	16-19	20-22
Environmental Quality						
1. To reduce the adverse impacts of sedimentation and turbidity that enters the river ecosystem.	All	dredging, levees, upland sediment control, dikes, flow regulation, shoreline protection, measures to minimize tow impacts.	H	H	H	H
2. To eliminate or reduce the adverse impacts of water quality degradation.	All	flow regulation, wetland development, dredging.	H	H	H	H
3. To protect and reclaim fish and wildlife habitat from encroachments.	All	acquisition of floodplain lands, reclaim marginal agricultural lands, reclaim expired cabin lease land.	H-M	H-M	H	L-M
4. To reduce the adverse impacts of navigation and channel maintenance to the river ecosystem.	All	island creation, levees, dikes, mussel bed creation, breakwaters, shoreline protection, revegetation, improved fleeting design, water level stabilization and/or control, side channel closures, flow diversion structures, main channel realignment, speed limits.	H	H	H	H
5. To preserve, create, and/or manage representative ecotypes.	See Goals II, III, IV, & V	species specific management	H	H	H	H
Goal II - Migratory Birds						
6. To support species that are in critical conditions and to achieve population and distribution objectives.	canvasback, tundra swan, see Goal V	wetland development (emersed and submersed vegetation)	H	H	H	H
7. To maintain or improve the habitat of migratory birds using the river.	All migratory birds	wetland development and management, island creation, artificial roost structures. 11/	H	H	H	H
8. To maintain or increase the current population and distribution of colonial nesting birds.	cormorant, herons, egret see Goal V.	forestry management, sand nesting habitat development, wetland development and management, artificial roost sites. 11/	M-H	H	H	H
9. To increase production of historically nesting birds.	wood ducks, raptors, see Goal V.	erosion control, nesting cavity structures, artificial structures 11/ wetland development, forestry management, land acquisition, island creation.	H	H	H	L-M

Table 1, continued.

Objectives	Example Management Species	Implementation Alternatives	Relative Importance ir Management of Po... (H-High, M-Medium, L-Low) 11	12-15	16-19	20-22
Goal III - Fisheries and Aquatic Resources						
10. To maintain and enhance the habitat of fish on the river.	All fish	selective dredging, substrate enhancement, wetland development and management, flow regulation, low speed limits.	H	H	H	H
11. To maintain and enhance the habitat of mussels and other invertebrates on the river.	All mussels	substrate enhancement, fleeting design.	H	H	H	H
12. To maintain and enhance the habitat of other aquatic life on the river.	aquatic plants	island creation, breakwaters, wetland development.	H	H	M	M
13. To increase critical fish wintering, spawning, and nursery habitat.	catfish, paddlefish, walleye, largemouth bass, buffalo sp.	selective dredging, flow enhancement, habitat structures, wetland development	H	H	L	H
Goal IV - Other Wildlife						
14. To maintain and enhance the habitat of furbearers on the river.	muskrats, beavers, otters, raccoons. 12/	forestry management, wetland development and management, water level control, stocking	H	H	H	M
15. To maintain and enhance the habitat of other resident wildlife.	reptiles, amphibians, white-tailed deer, turkey	forestry management, mast production	L	L	L	L
Goal V - Endangered Species						
16. To protect and enhance the river habitat and to maintain or increase its use by native species historically found in the area.	See Appendix A	artificial structures 11/ mussel substrate enhancement, species specific management	H	H	H	H
17. To carry out the recommendation of Federal endangered or threatened species recovery plans applicable to the river.	See Appendix A	enhance eagle roost sites (i.e., bank stabilization, plant tree buffers, maintain forest opening for access), enhance eagle feeding areas (i.e., improve prey habitat, increase number of perches), enhance nesting habitat (buffers, artificial structures), increase distribution of endangered mussels (i.e., translocation, substrate enhancement	H	H	H	H

11/ Creation of natural structures through forestry management practices is preferred.

12/ Raccoon management not preferred where nuisance problems exist.

Table 16. Areas in Pools 11-22 with high relative importance for habitat management.

Pool	Area	# of Potential Management Objectives	Potential Project Submitted	Management Objectives Addressed by Proposed Project
11	Middle Pool 11	7	X	
	Lower Pool 11	6	X	
12	Nine Mile/Frentress/Tippy	6	X	
	Main Channel Border	2		
	Lower 12	5		
13	Pleasant Creek	11	X	
	Green Island	7	X	
	Brown's Lake/Pin Oak	6	X	
	Miller's Lake/Savanna Bay	8	X	
	Spring Lake	10	X	
	Thomson/Potter's Marsh	7	X	
	Elk River	11	X	
14	Middle Pool 14	6		
16	Milan Bottoms	12		
	Andalusia Island	16		
	Andalusia Refuge	12	X	
17	Louisa Division	16	X	
	Lake Odessa	16	X	
18	Boston Bay	16		
	Keithsburg Unit	16		
	Oquawka Refuge	16		
19	Land Acquisition			
20	Dam 19	1		
	Lower 20	6		
21	Gardner Division	8	X	
	Quincy Bay	3		
	Cottonwood Island	3	X	
	Monkey Chute	3	X	
22	Texas Chute/Goose Island	1		
	Beebe/Armstrong/Turtle/Whitney	5		
	Bay Island	5	X	

Table 5. Existing and potential management in Pool 14.

Area	Mile	Existing Management	Potential Management Objectives	Possible Habitat Rehabilitation or Enhancement Project	Trade-Offs	Data Needs
Upper Pool 14	513-522.5		1. Reduce sedimentation, 2. Improve water quality, 10. Enhance fish habitat	a. selective dredging in back-backwaters of Beaver Island, Sunfish Slough complex, and North Fulton complex. b. habitat structures in Joyce Island area.		sediment quality
Middle Pool 14	503-513	closed area, moist soil unit, fish rearing area, forestry management	1. Reduce sedimentation, 2. Improve water quality, 7. Improve bird habitat, 10. Enhance fish habitat, 13. Increase critical fish habitat	a. selective dredging in Princeton Wildlife Area, Rock Creek complex, and Meredosia Slough complex b. improve low level dikes in Princeton Wildlife Area c. alternatives to reduce sedimentation from Rock Creek d. notch wing dams at RM 512.5 and 513 e. dredge accreted sediments at wing dams		sediment quality monitor Steamboat Slough area
Lower Pool 14	493-503					

Table 14. Summary of existing and proposed management objectives for Pools 11-22.

				Goal I - Environmental Quality					Goal II - Migratory Birds				Goal III-Fisheries & Aquatic Resources				Goal IV - Other Wildlife		Goal V - Endangered Species	
Pool	River Mile	Area	Relative Importance	1 Reduce Sedimentation and Turbidity	2 Improve Water Quality	3 Reclaim Fish & Wildlife Habitat	4 Reduce Impacts of Navigation	5 Preserve Representative Ecotypes	6 Supports Population or Distribution Objectives	7 Improve Bird Habitat	8 Increase Population & Distribution of Colonial Nesters	9 Increase Bird Nesting	10 Improve Fish Habitat	11 Improve Benthos Habitat	12 Enhance Other Aquatic Habitat	13 Increase Critical Habitat	15 Increase Species Diversity & Abundance of Resident Wildlife	14 Maintain Furbearer Populations	16 Protect & Enhance Native Species Habitat	17 Carryout Recovery Plans
11	614-615	St. Paul District	M	P	P				E	P			P							
	603.5-614	Upper Pool 11	M-L	P	P	P			E				P							
	592-603.5	Middle Pool 11	H	P	P	P	P	P	E	P			P	P						
	587-592	Lower Pool 11	H	P	P	P	P			P		P	P							
12	582-582.8	Dam/Tailwater	L										P							
	580.5-582	Ham Island/Peosta	M		P	P				P								P		
	569-580.5	Nine Mile/Trentress/Tippy	H	P	P			P				E	P				E			
	556.7-569	Lower Pool 12	H	P	P			P		P			P							
	All	Main Channel Border	H												P	P				
13	551-556.7	Upper 13/Crooked Slough	?																	
	548.5-551	Pleasant Creek	H	P	P				E	P		P	P		P	P	E	P	P	
	548.5	Maquoketa R.	M	P	P															
	546-548.5	Green Island	M	P	P				E	E			P		P	P		P		
	542-546	Borwn's Lake/Pin Oak	M	P	P					P			P		P	P				
	539-542	Miller's Lake/Savanna Bay	M	P	P					P		E	P		P	P	E			
	536-540	Keller's Island	M	P	P								P		P			P		
	534-536	Sabula Lakes	L							P	P		P							
	531-536	Spring Lake	M	P	P	P			E	E	P	E	P		P	P	E	P	P	
	526-532	Elk River	H	P	P	P			E	E		P	P			P	P	P	P	
	524-526	Thomson/Potter's Marsh	H	P	P					P			P		P		E	P		
	522.5-524	Lower 13	L	P	P							P			P					
14	513-522.5	Upper 14	M	P	P								P							
		Middle 14	H	P	P				E	P			P			P				
		Lower 14	L																	
15	483-493	Pool 15	L					P									P			
16	478-483	Upper 16	M	P	P								P		P		P			
	477-478	Milan Bottoms	H	P	P	P		P	P	P	P	P	P			P	E	P		
	476-477	Enchanted Island	L	P	P								P		P					
	463-476	Andalusia Slough	M	P	P								P	P	P		P			
	463-476	Andalusia Island	H	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	

A-9

Table 15. Summary of management objectives that could be met with example implementation alternatives in Pools 11-22.

Alternative Management	Goal I - Environmental Quality						Goal II - Migratory Birds					Goal III - Fisheries & Aquatic Resources				Goal IV - Other Wildlife		Goal V - Endangered Species		
	1	2	3	4		5	6	7	8		9	10	11	12	13	14	15	16	17	
	Reduce Sedimentation and Turbidity	Improve Water Quality	Reclaim Fish & Wildlife Habitat	Reduce Impacts of Navigation		Preserve Representative Ecotypes	Supports Population or Distribution Objectives	Improve Bird Habitat	Increase Population & Distribution of Colonial Nesters		Increase Bird Nesting	Improve Fish Habitat	Improve Benthos Habitat	Enhance Other Aquatic Habitat	Increase Critical Habitat	Increase Species Diversity & Abundance of Resident Wildlife	Maintain Furbearer Populations	Protect & Enhance Species Habitat	Carryout Recovery Plans	# of Objectives Addressed
1. Dredging	x	x	x					x	x			x			x					7
2. Levees	x	x	x	x				x	x		x			x			x	x		10
3. Upland sediment control	x	x						x	x			x		x			x			2
4. Dikes	x	x	x	x				x	x					x			x			5
5. Flow regulation	x	x		x				x				x								4
6. Shoreline protection	x	x		x							x	x	x	x						5
7. Tow mitigation	x			x				x				x								3
8. Wetland development		x	x			x	x	x	x		x	x		x	x		x			11
9. Land Acquisition		x	x								x									2
10. Reclaim marginal agricultural land or cabin sites	x	x	x					x			x									1
11. Island creation	x	x	x	x				x	x		x	x		x		x				9
12. Mussel bed creation				x									x	x	x			x	x	5
13. Breakwaters	x	x	x	x				x												2
14. Revegetation		x	x	x				x								x				2
15. Fleeting design	x	x	x	x				x					x							2
16. Channel alignment	x	x	x	x				x												1
17. Nesting structures								x	x		x							x		4
18. Roost structures								x											x	2
19. Forestry management			x			x		x	x		x					x	x	x	x	7
20. Sand nesting development								x	x		x					x				4
21. Substrate enhancement												x	x	x	x			x	x	5
22. Mast production																x				1
23. Spawning structures												x			x					

A-10

EMP Habitat Project Ranking Procedures
(Revised)

Program Objectives
(YES or NO) Projects must meet the defined program objectives identified by the UMRBA:

1. Protecting, restoring, or improving fish and wildlife habitat that has deteriorated, is threatened, or will be threatened as a result of human-induced or natural impacts;

2. Assuring that adverse impacts on the fish and wildlife resource of the river system are avoided, minimized, rectified, or eliminated over time, or compensated for;

3. Address structural and nonstructural measures for environmental enhancement through long-term resource monitoring efforts and available documents;

4. Address first solutions related to navigation impacts including navigation traffic and operation and maintenance of the navigation system;

5. Address second other human-induced impacts not related to navigation, and;

6. Address last naturally occurring impacts.

* Projects must be located along the main channel, side channel, backwaters, or mouth of tributaries within the UMRS.

* Projects must provide public benefits and be sponsored by a federal, state, or local governmental agency.

* Projects must not involve rehabilitation of facilities for which maintenance is or could be provided under existing federal or state programs unless additional habitat benefits can be demonstrated.

* Projects which include the following characteristics should be encouraged:

  a) minimal operation and maintenance costs,

  b) minimal land acquisition,

  c) auxiliary benefits to navigation or water quality

Goals and Objectives for Pools 11-22
(YES or NO) Projects must meet one or more of the Goals and Objectives identified by the FWIC:

Goal I - Environmental Quality - To preserve and enhance the environmental quality, wild character, and natural beauty of the river's floodplain ecosystem.

Goal II - Migratory Birds - To provide the life requisites of waterfowl and other migratory birds.

Goal III - Fisheries and Aquatic Resources - To provide the life requirements of fish and other aquatic plant and animal life occurring naturally along or in the Upper Mississippi River.

Goal IV - Other Wildlife - To provide the life requirements of resident wildlife species.

Goal V - Endangered Species - To conserve, restore, and enhance federal and state protected species and the habitats upon which they depend.

Table A-1 lists the objective for each goal, example species for management, and potential habitat projects that may contribute toward achievement of the objective.

Resource Problems

Projects will be assessed as to whether they do or do not address the following resource problems. For ranking purposes, projects which do address the problems will be given the points noted in the parentheses and those which do not will receive no points for that problem.

(5) **Reduce or rectify backwater sedimentation**: Backwater is interpreted to be an existing impoundment within the floodplain of the Mississippi River System. Reducing or rectifying sedimentation involves a degree of blockage of incoming sediments or deepening of the basin to set back the sedimentation rate. It includes sedimentation from all sources and causes.

(4) **Improve water quality**: Water quality improvement generally includes improving water depth or flow to result in overall higher dissolved oxygen levels and/or decreased turbidity.

(3) **Increase in important habitat**: This problem focuses on the lack of important habitat to targeted fauna such as waterfowl nesting/feeding areas, fish spawning/wintering areas. It includes increasing the productivity of existing habitat, increasing the longevity of existing habitat and/or creating habitat where previously it was limited.

(2) **Improved habitat protection**: This refers to regulatory measures which are taken to protect lands as, for example, creating a "closed area" boundary on a refuge.

(1) **Increase in public land base**: Land ownership actually changes hands under this category, going from private to public.

Ranking Factors

Projects will be assessed as to whether they address the following ranking factors ranging from a high of 3 points down to -3 points for adverse impacts.

(0-3) **Fishery benefits**: Rating 3 - Direct fishery benefits as a major project purpose including rehabilitation of a backwater through increasing flow or depth and/or placement of fish habitat improvement structures (e.g., Miller's Lake).

Rating 2 - Significant improvements to water quality, enabling spawning or prolonging nursery or overwintering benefits (e.g., Potter's Marsh).

Rating 1 - Some improvements to fish habitats by placing riprap or fish structures, for example (e.g., Elk River).

Rating 0 - No fishery benefits, no improvement of water quality (e.g., Princeton Refuge, a levee improvement project which will not reduce flood frequency or increase the interior depth through dredging for borrow).

(0-3) **Wildlife benefits**: Rating 3 - Direct wildlife benefits as a major project purpose including creation of wildlife habitat or intensive management (e.g., Turkey Bottoms, Pleasant Creek).

Rating 2 - Significant improvements to wildlife habitat including increasing the food base or prolonging the life of an area (e.g., Bay Island).

Rating 1 - Some wildlife benefits as in increased water clarity and therefore an increase in aquatic vegetation as waterfowl food source (e.g., Peosta/Molo).

Rating 0 - No wildlife benefits (no examples).

(0-3) **Habitat diversity**: Rating 3 - Major increase in habitat diversity as in flooding a farm field to create a wetland (e.g., Turkey Bottoms or island creation, Pool 11).

Rating 2 - Significant increase in habitat diversity as in dredging out potholes in shallow waters or possibly creating islands (e.g., Lower Spring Lake).

Rating 1 - Some increase in habitat diversity as in planting mast producers or putting up wood duck boxes (e.g., Gardner Division)

Rating 0 - No increase in habitat diversity (no examples).

(0-3) **Innovative/ experimental**: Rating 3 - A very innovative idea (e.g., island creation, Pool 11 or Peoria Lake).

Rating 2 - Some innovative ideas involved in the development of the project (e.g., Upper Spring Lake or Potter's Marsh).

Rating 1 - Some small attempt at a new idea (Lower Spring Lake).

Rating 0 - Tried and true (no examples)

0-3 **Longevity**: Rating 3 - One of the project purposes is to increase the life of the habitat (e.g., all the levee protection projects).

Rating 2 - Project is not completely protected but habitats will result in a longer life span than without project (e.g., island creation, Pool 11).

Rating 1 - Not expected to last too long beyond natural conditions (e.g., Huron Island).

Rating 0 - Not worth the trouble (no examples).

(0-3) **Maintenance**: Rating 3 - Very little maintenance required (e.g., island creation, Pool 11 or Huron Island).

Rating 2 - Some maintenance required (e.g., Turkey Bottoms).

Rating 1 - Regular maintenance required (no examples).

Rating 0 - Heavy maintenance requirements (no examples).

(0-3) **Socioeconomic**: Rating 3 - High socioeconomic benefits provided, likely near populous areas, permits public access (e.g., Bay Island).

Rating 2 - Significant benefits provided, most likely in the form of increased production of fish and or waterfowl (Turkey River Bottoms).

Rating 1 - Few socioeconomic benefits provided (e.g., Pleasant Creek).

Rating 0 - No socioeconomic benefits (no examples).

[0-(-3)]**Adverse impacts**: Rating 0 - No significant adverse impacts (e.g., Turkey River Bottoms or Bay Island).

Rating -1 - Some adverse impacts, may be due to difficulty in dredged material disposal or encroachment into wetlands from levee building (e.g., island creation, Pool 11).

Rating -2 - Adverse impacts expected, may result from changing hydraulics which may actually increase sedimentation rate (no examples).

Rating -3 - Severe adverse impacts resulting from project construction (no examples).

The ranking points will be added to those of the resource problems for an overall score. The scores are then broken into "High," "Medium," and "Low" categories and forwarded to the River Resources Coordinating Team for their approval.

Table 1, continued.

Objectives	Example Management Species	Implementation Alternatives	Relative Importance in Management of Pools (H-High, M-Medium, L-Low) 11	12-15	16-19	20-22
Goal III - Fisheries and Aquatic Resources						
10. To maintain and enhance the habitat of fish on the river.	All fish	selective dredging, substrate enhancement, wetland development and management, flow regulation, low speed limits.	H	H	H	H
11. To maintain and enhance the habitat of mussels and other invertebrates on the river.	All mussels	substrate enhancement, fleeting design.	H	H	H	H
12. To maintain and enhance the habitat of other aquatic life on the river.	aquatic plants	island creation, breakwaters, wetland development.	H	H	M	M
13. To increase critical fish wintering, spawning, and nursery habitat.	catfish, paddlefish, walleye, largemouth bass, buffalo sp.	selective dredging, flow enhancement, habitat structures, wetland development	H	H	L	H
Goal IV - Other Wildlife						
14. To maintain and enhance the habitat of furbearers on the river.	muskrats, beavers, otters, raccoons. 12/	forestry management, wetland development and management, water level control, stocking	H	H	H	M
15. To maintain and enhance the habitat of other resident wildlife.	reptiles, amphibians, white-tailed deer, turkey	forestry management, mast production	L	L	L	L
Goal V - Endangered Species						
16. To protect and enhance the river habitat and to maintain or increase its use by native species historically found in the area.	See Appendix A	artificial structures 11/ mussel substrate enhancement, species specific management	H	H	H	H
17. To carry out the recommendation of Federal endangered or threatened species recovery plans applicable to the river.	See Appendix A	enhance eagle roost sites (i.e., bank stabilization, plant tree buffers, maintain forest opening for access), enhance eagle feeding areas (i.e., improve prey habitat, increase number of perches), enhance nesting habitat (buffers, artificial structures), increase distribution of endangered mussels (i.e., translocation, substrate enhancement	H	H	H	H

11/ Creation of natural structures through forestry management practices is preferred.

12/ Raccoon management not preferred where nuisance problems exist.

Table 1. FWIC for fish and wildlife management objectives for Pools 11-22.

Objectives	Example Management Species	Implementation Alternatives	Relative Importance in Management of Pools (H-High, M-Medium, L-Low) 11	12-15	16-19	20-22
Environmental Quality						
1. To reduce the adverse impacts of sedimentation and turbidity that enters the river ecosystem.	All	dredging, levees, upland sediment control, dikes, flow regulation, shoreline protection, measures to minimize tow impacts.	H	H	H	H
2. To eliminate or reduce the adverse impacts of water quality degradation.	All	flow regulation, wetland development, dredging.	H	H	H	H
3. To protect and reclaim fish and wildlife habitat from encroachments.	All	acquisition of floodplain lands, reclaim marginal agricultural lands, reclaim expired cabin lease land.	H-M	H-M	H	L-M
4. To reduce the adverse impacts of navigation and channel maintenance to the river ecosystem.	All	island creation, levees, dikes, mussel bed creation, breakwaters, shoreline protection, revegetation, improved fleeting design, water level stabilization and/or control, side channel closures, flow diversion structures, main channel realignment, speed limits.	H	H	H	H
5. To preserve, create, and/or manage representative ecotypes.	See Goals II, III, IV, & V	species specific management	H	H	H	H
Goal II - Migratory Birds						
6. To support species that are in critical conditions and to achieve population and distribution objectives.	canvasback, tundra swan, see Goal V	wetland development (emersed and submersed vegetation)	H	H	H	H
7. To maintain or improve the habitat of migratory birds using the river.	All migratory birds	wetland development and management, island creation, artificial roost structures. 11/	H	H	H	H
8. To maintain or increase the current population and distribution of colonial nesting birds.	cormorant, herons, egret see Goal V.	forestry management, sand nesting habitat development, wetland development and management, artificial roost sites. 11/	M-H	H	H	H
9. To increase production of historically nesting birds.	wood ducks, raptors, see Goal V.	erosion control, nesting cavity structures, artificial structures 11/ wetland development, forestry management, land acquisition, island creation.	H	H	H	L-M

FWIC Ranking for EMP-HREPs 1/

Ranking Year: 1987

Design Year: 1989

			RESOURCE PROBLEMS						RANKING FACTORS													
	TOTAL ACRES AFFECTED	ESTIMATED COST ($M)	SEDIMENTATION	WATER QUALITY	IMPORTANT HABITAT	HABITAT PROTECTION	PUBLIC LAND BASE		FISH BENEFITS	WILDLIFE BENEFITS	HABITAT DIVERSITY	INNOVATIVE	LONGEVITY	MAINTENANCE	SOCIOECONOMIC/RECREATION	ADVERSE IMPACTS		TOTAL SCORE	RELATIVE BENEFIT	RELATIVE SCORE	RANK	OBJECTIVES ADDRESSED
MAXIMUM VALUE			5	4	3	2	1		3	3	3	3	3	3	3	0						
Credit Island	?	2.0	5	4	3	-	-		3	1	2	1	1	3	3	-1		20			L	
Middle Sabula	300	0.5	-	4	3	-	-		3	1	2	1	3	1	1	0		19			L	
Huron Island	2000	5.0	-	4	3	-	-		3	2	2	1	1	3	2	-1		20			L	
Green Island	3600	1.3	-	4	3	-	-		2	3	3	1	3	1	3	0		23			M	
Princeton	1190	2.3	5	4	3	-	-		0	3	3	2	3	1	3	0		27			H	
Mud Lake	80	3.4	5	4	3	-	-		3	1	1	1	2	1	2	-2		22			L	

1/ This is a partial list. All projects currently being monitored, designed, or constructed by the Rock Island District, with the exception of certain projects developed early on in the program, have been evaluated and ranked using this procedure (see Report, Section 2, page 4).

APPENDIX

B

CORRESPONDENCE

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX B
CORRESPONDENCE

Letter From **Page**

STATE OF IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

February 5, 1992

District Engineer
U.S. Army Engineer Dist., Rock Island
ATTENTION: Planning Division - Dudley Hanson
Clock Tower Building, Box 2004
Rock Island, IL 61204-2004

Dear Mr. Hanson:

This letter is written in reply to your correspondence dated 1-10-92 requesting comments from the Iowa DNR relative to the proposed Princeton EMP project in Scott County, Iowa.

The department is very supportive of the proposed plans for the Princeton EMP project. Our field staff has worked closely with the Corps of Engineers and U.S. Fish and Wildlife Service representatives in planning this important natural resource development and management project. We are very comfortable with the project plans that have been proposed to date and look forward to reviewing and commenting on the Definite Project Report when it is completed.

My staff is not aware of any environmental problems that would be associated with completion of this project. On the contrary, we believe that the project would be very beneficial to the vast majority of wildlife species that utilize this wildlife management area. We do not envision any problem being encountered that would negatively affect a state or federally listed threatened or endangered species. Bald eagle and river otter usage of the area may actually be enhanced as a result of the improved and expanded wetland conditions that will be provided on the area.

Daryl Howell (DNR Parks, Recreation and Preserves Division) advises that there was a red-shouldered hawk nest reported in the Wapsipinicon River floodplain to the north of the proposed project site some years ago. Also, a dead massasauga rattlesnake was reportedly found along Highway 67 near the project site. We are unaware of any recent reports relative to these two species.

Construction work could be timed to avoid activity during the nesting and fledging period if it was considered necessary to do so, thus reducing the possibility of hawk nesting interference. The expanded and improved wetland conditions and the expanded levee widths are considered to be favorable habitat factors for massasauga rattlesnakes that could be in the project vicinity.

In conclusion, I do not believe that there are significant environmental concerns associated with this EMP project. If other natural resource agency representatives have additional information available in this regard or have

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contradictory views concerning the environmental aspects of the project, we would be more than willing to discuss the subjects in greater depth.

Thank you for the opportunity to provide our views on this natural resource development and management project. We look forward to cooperating with your agency in this endeavor.

Sincerely,

LARRY J. WILSON, DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

(DC036.sp)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

March 4, 1992

Colonel John R. Brown, USA
District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Environmental Analysis Branch
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This is in response to your request for our comments on the proposed Princeton Wildlife Area Habitat Rehabilitation and Enhancement Project.

Our only comment is to note that the environmental documentation for the project should assess the impact of any offsite flooding induced by the project.

Thank you for the opportunity to comment.

Sincerely,

Michael J. Bronoski

for Walter E. Foster
Acting Chief, Environmental Review and Coordination Section

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

April 27, 1992

In reply refer to:
R&C#: 920482111

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

RE: COE - SCOTT COUNTY - PRINCETON WILDLIFE REFUGE - PHASE I ARCHAEOLOGICAL & GEOMORPHOLOGICAL INVESTIGATION

Dear Mr.Hanson:

We have reviewed the information submitted regarding the above-referenced project. We concur with the COE's opinion that 13ST88, 13ST105, 13ST106, and 13ST107 are not eligible for the National Register of Historic Places. We also agree that 13ST 89 is potentially eligible for The National Register of Historic Places. The COE plans to establish a buffer around site 13ST89 to ensure construction avoidance. Since site 13ST89 is to be avoided and there are no other potentially significant properties in the project area, we concur with the COE that the project will have no effect on significant historic properties. We recommend that the project proceed as planned.

Should you have any questions or if the office can be of further assistance to you, please contact the Review and Compliance program at 515-281-8743.

Sincerely,

Kathy Gourley

Kathy Gourley
Archeologist, Review and Compliance Program
Historic Preservation Bureau

/st

cc: James H. Blanchar, P.E.

☐ 402 Iowa Avenue
Iowa City, Iowa 52240
(319) 335-3916

☐ Capitol Complex
Des Moines, Iowa 50319
(515) 281-5111

☐ Montauk
Box 372
Clermont, Iowa 52135
(319) 423-7173

STATE OF IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

LARRY J. WILSON, DIRECTOR

June 1, 1992

Colonel John R. Brown
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

Dear Colonel Brown:

The Iowa Department of Natural Resources hereby agrees to the following cost-share conditions for the Princeton Refuge Habitat Rehabilitation and Enhancement Project under the Environmental Management Program (EMP):

1. Construction:

a. The State of Iowa is responsible for 25 percent of all construction costs assigned to project features located on non-Federal lands within the project area. In this case, the non-Federal lands are owned by the State of Iowa.

b. The Federal Government, through the U.S. Army Corps of Engineers, is responsible for the remaining 75 percent of construction costs assigned to project features located on non-Federal lands within the project area.

c. The Federal Government, through the U.S. Army Corps of Engineers, is responsible for 100 percent of all constuction costs assigned to project features located on Federal lands within the project area that are "managed as a national wildlife refuge" in the context of Section 906(e) of the Water Resources Development Act of 1986. In this case, Federal lands are General Plan lands managed by the Iowa Department of Natural Resources through a cooperative agreement with the U.S. Fish and Wildlife Service.

2. Operation, Maintenance, and Repair:

a. The State of Iowa is responsible for 100 percent of operations, maintenance, and repair of project features located on non-Federal lands.

b. The State of Iowa will cooperate with the U.S. Fish and Wildlife Service to assure that non-Federal operation, maintenance, and repair responsibilities associated with the project features on Federal land are in conformance with Section 906(e) of the Water Resources Development Act of 1986 and existing agreements between the Service and the Director, Iowa Department of Natural Resources.

Sincerely,

LARRY J. WILSON
DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967 / FAX 515-281-8895

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Rock Island Field Office (ES)
4469 - 48th Avenue Court
Rock Island, Illinois 61201

309/793-5800

IN REPLY REFER TO

May 3, 1993

Colonel Albert J. Kraus
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Kraus:

This letter constitutes our revised Fish and Wildlife Coordination Act (FWCA) report for the Princeton Wildlife Refuge Habitat Rehabilitation and Enhancement Project (HREP) in Pool 14, Upper Mississippi River, Scott County, Iowa, superseding our February 1, 1993, letter. It has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 et seq.); the Endangered Species Act of 1973, as amended; and in accordance with the Fish and Wildlife Service's Mitigation Policy.

The Princeton Wildlife Refuge HREP is a component of the Upper Mississippi River System Environmental Management Program (EMP) authorized in Section 1103 of the Water Resources Development Act of 1986. The goal of the EMP is to implement "...numerous enhancement efforts...to preserve, protect and restore habitat that is deteriorating due to natural and man-induced activities."

The project area includes lands owned in fee title by the Iowa Department of Natural Resources as well as lands under license from the U. S. Army Corps of Engineers that are managed under a General Plan and Cooperative Agreement with the Iowa Department of Natural Resources.

DESCRIPTION OF THE PROJECT AREA

The study area is located adjacent to the right descending bank of the Mississippi River between river miles 504 and 506.4 at the confluence of the Wapsipinicon River. The approximately 1190 acres of habitat includes forested and nonforested wetlands and croplands important to migratory birds and fish. A 3.5-mile perimeter levee built by the Carroll County Levee District in the 1920's and 30's (pre-lock and dam construction) protects the

Princeton area from water-level fluctuations and silt loads of the Mississippi River. However, the levee today is degraded and in need of repairs. The Iowa Conservation Commission assumed management of the Princeton area in 1957. After installation of two 36" diameter stem gate culverts and a small (1500 GPM) pumping station, the Iowa Conservation Commission began efforts to draw water levels down during summer months to re-vegetate mudflats, and reflood the area during the fall to provide better marsh conditions for migrating waterfowl.

A 348 acre refuge was established on the south end of the State marshland in 1979 providing a resting and feeding zone free from hunting pressure during the fall migration. A high capacity (17,000 GPM) hydraulic water pump replaced the smaller pump in 1983 and the refuge was subsequently relocated to the north end of the marsh in 1989.

The Princeton area marsh complex is an important waterfowl hunting and furbearer trapping area managed by the Iowa Department of Natural Resources (IDNR), formerly the Iowa Conservation Commission. The adjacent Grant and Steamboat Sloughs on the Mississippi River are known for their sportfishery and ice-fishing values. Bluegill, largemouth bass, and crappie are the most common species sought by fisherman. Nonconsumptive recreational uses including bird watching and nature photography are also popular in the project area.

PROJECT OBJECTIVES

The goal of the Princeton HREP is to rehabilitate, enhance, and protect forested and nonforested wetland habitat for migratory birds and furbearers. This objective will be accomplished by a combination of construction features and management practices that will increase nesting and brood habitat as well as feeding and loafing areas for waterfowl and nongame species alike. Water level manipulations and selective plantings will provide food, cover, and travel corridors for resident furbearer populations. In addition the integrity of the marsh complex will be maintained by upgrading the existing levee system to a 10-year level of flood protection.

METHODOLOGY

Habitat analysis of existing study area conditions, future conditions without the project and impacts of the several proposed alternatives and increments was accomplished using the Wildlife Habitat Appraisal Guide (WHAG) procedures developed by the Missouri Department of Conservation and the USDA Soil Conservation Service. This analysis employed a multi-agency team approach with representatives from the Corps of Engineers, the Iowa Department of Natural Resources, as well as the Service.

The WHAG analysis is a numerical system for evaluating the quality and quantity of particular habitats for species selected by the WHAG team members. The qualitative component of the analysis is known as the habitat suitability index (HSI) and is rated on a 0.1 to 1.0 scale. The suitability of a given habitat type for a set of evaluation species is determined by the qualitative characteristics of the habitat type. The WHAG procedures include the use of limiting factors which is a habitat requirement for an individual species during a critical time of year. Absence of that habitat characteristic makes the habitat unsuitable and results in the lowest HSI value of 0.1. The quantitative component of the WHAG analysis is the measure of acres of habitat that are available for the selected target species. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula (HSI x Acres = HU's).

Existing habitat conditions were evaluated on-site by the team, whereas future conditions with and without the project were estimated using the expertise of team members. The team considered both game and nongame species aspects of the project as well as impacts/benefits to the resident furbearer population by selecting the mallard, green-backed heron, and the muskrat as target species to represent those groups respectively. Several planning iterations were required as the project evolved and engineering data was refined.

For project planning and impact analysis, project life was established as 50 years. To facilitate comparison, target years were established at 0 (existing conditions) 1, 15 and 50 years. Habitat suitability indices (HSI) and average annual habitat units (AAHU's) for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

THREATENED AND ENDANGERED SPECIES

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

Therefore, we are furnishing you the following list of species which may be present in the concerned area:

Classification	Common Name	Scientific Name	Habitat
Endangered	Bald eagle	Haliaeetus leucocephalis	Winters along major rivers and reservoirs
Endangered	Iowa pleistocene snail	Discus macclintocki	North-facing algific talus slopes

Since the proposed project will not affect these species or their habitats this precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended. Should this project be modified or new information indicate endangered species may be affected, consultation should be initiated.

EXISTING FISH AND WILDLIFE RESOURCES

For the purpose of evaluation, the study area was categorized according to the following habitat types: nonforested wetland, forested wetland, cropland, and grassland. Table 1 is a presentation of the acreage calculations of habitat types at present.

Table 1. Princeton Marsh HREP existing habitat types and acreage.

Habitat type	Acres
Non-forested wetland	404
Forested wetland	393
Cropland	179
Grassland	68
Total	1044

The results of the WHAG analysis for existing conditions indicate a broad range of values for the evaluation species, reflective of the variety of habitat requirements for those species (Table 2).

Table 2. Princeton Marsh HREP existing terrestrial habitat suitability and corresponding Habitat Unit values.

SPECIES	HSI	HU
Mallard	0.51	493
Canada goose	0.22	142
Least bittern	0.72	291
Lesser yellowlegs	0.24	95
Muskrat	0.27	109
King rail	0.44	179
Green-backed heron	0.52	417
Wood duck	0.37	147
Beaver	0.58	227
American coot	0.27	108
Parula warbler	0.40	157

The habitat values calculated by the WHAG matrix are consistent with past field data collected at the Princeton site. The mixture of habitats within the Princeton marsh provide life requisites for many resident and nonresident wildlife species.

FUTURE WITHOUT PROJECT

The No Federal Action alternative (Alternative A) is the future without the project condition where the Princeton marsh complex will continue to function as a forested and non-forested floodplain wetland, with minor successional changes occurring over time. The area will continue to be actively managed with the existing pump facility but there would be no new construction or rehabilitation of the area under this alternative. The successional changes will result in qualitative improvements, such as the maturing of bottomland tree species, but the relative acreage of the habitat types will remain constant (Table 3).

Table 3. Princeton Marsh HREP habitat types and acreage without the proposed project.

Habitat/TY	TY0	TY1	TY15	TY50
Non-forested wetland	404	404	404	404
Forested wetland	393	393	393	393
Cropland	179	179	179	179
Grassland	68	68	68	68
Total	1044	1044	1044	1044

The current strategy of water level management will allow continued control of woody plant invasion thus maintaining the quality and quantity of nonforest wetland habitat. Maturing of the existing forested wetland will provide additional habitat value for several of the evaluation species, specifically parula and prothonotary warblers. However, the most critical component of the continued success of the marsh complex, the protective levee system, will be subjected to further degradation over time, jeopardizing management of the entire complex. Juxtaposition of the marsh at the confluence of the Wapsipinicon River with the Mississippi River, further increases the risk for levee deterioration especially under flood conditions. A major levee repair occurred in 1982 when the IDNR spent approximately $100,000 to upgrade the perimeter levee. However, the recent cycle of flooding on the Wapsipinicon River has deteriorated the level of protection especially at the confluence with the Mississippi River.

FUTURE WITH PROJECT

Enhancement options at the project site included increasing the quality of existing habitat types, increasing the acreage of a particular habitat type(s), or a combination of both. Several alternatives were evaluated using the WHAG methodology to determine the best management of the habitat types in Princeton area. To meet the overall goal of enhancing habitat for migratory birds, continued active management of the area was evaluated. This included evaluating the existing condition of levee protection, the current water control and pumping facilities as well as improved pumping capacity and relocation of the pump to flood additional acreage in the fall after desired vegetation has matured. Relocation of the pump would allow greater control of the areas to be flooded. Use of water level control was also considered as a management tool for controlling woody invasion.

Proposed Array of Options Considered:

- Levee upgrade using selective borrow areas.

This option involves the necessary upgrade of the levee system with selective excavation in the agricultural fields as a source of levee material. Forty-three acres of additional nonforested wetland habitat will be created through this alternative if ponding levels are maintained at 575 feet National Geodetic Vertical Datum (NGVD)(see Table 4). The levee would have a 10-year level of protection with an additional foot of freeboard.

Table 4. Princeton Marsh HREP habitat types and acreage with levee upgrade and selective excavation.

Habitat	W/O	With
Non-forested wetland	404	447
Forested wetland	393	393
Cropland	179	136
Grassland	68	68
Total	1044	1044

- 1-cell management with levee upgrade and increased water level control.

This option involves continued management of the Princeton marsh complex as a single unit. Increased water control translates into the capacity to pond water a foot deeper over the complex, up to elevation 576 feet NGVD. The 43 acres of excavated nonforested wetland would be increased to 57 acres with increased water control. In addition, the overall acreage of nonforested wetland is increased to 461 acres at elevation 576 feet NGVD.

However, under the 1-cell management plan over 213 acres of nonforested wetland is greater than 2 feet deep at 576 feet NGVD (see Table 5). This limits the value of the habitat for dabbling ducks, one of the target species selected for habitat enhancement. Ponding water to elevation 576 feet NGVD in the southern portion of the area could also potentially have a negative affect on an adjacent landowners's property unless a seepage ditch is constructed along the field boundary.

Table 5. Princeton Marsh HREP habitat types and acreage under 1-cell management.

Habitat	W/O	With
Non-forested wetland	404	461*
Forested wetland	393	393
Cropland	179	122
Grassland	68	68
Total	1044	1044

*213 acres are greater than 2 feet deep.

- 2-celled management with levee upgrade and increased water control.

A 2-celled management unit was evaluated to allow increased flexibility of management operations as well as maximize water level control. A crossdike would be constructed adjacent to the existing lateral ditch to divide the area into north and south management units. The pump facilities would be relocated to the crossdike to allow a greater degree of control over water levels in the two cells. As a result, water levels in the two cells could be managed independently (576 feet NGVD in the north and 575 feet NGVD in the south) without impacting an adjacent landowner's property.

While the overall acreage of nonforest wetland is the same as the one cell alternative, only 46 acres of the total are more than 2 feet deep with this alternative (see Table 6). Consequently, the habitat is much more manageable and of greater value for dabbling ducks. Construction of the crossdike will require clearing and conversion of 4 acres of forested wetland habitat adjacent to the lateral ditch. Once the dike is completed the slopes will be seeded to grasses (approximately 3 acres) and managed as grassland habitat.

Table 6. Princeton Marsh HREP habitat types and acreage under 2-celled management with increase water level control.

Habitat	W/O	With
Non-forested wetland	404	461
Forested wetland	393	389
Cropland	179	122
Grassland	68	72
Total	1044	1044

DISCUSSION

Evaluation of Alternatives

The value of this area is reflected in the qualitative assessment of the WHAG analysis. Evaluation of the project generated moderate HSI values for all of the target species. This indicates the wide range of habitat types suitable for many different species (remembering that the target species represent a group of species). It is difficult to generate large differences in HSI or HU values when evaluating existing refuge areas that have been managed for fish and wildlife resources. However, this does not mean that there is no room for improvements as will be discussed below.

Tables 7 and 8 present a qualitative comparison of the Princeton HREP with and without construction of the project. Table 7 shows that without construction of the project, the HSI values for the evaluation species change very little over the projected life of the project. Management of successional influences will maintain the Princeton area qualitatively assuming, however, that the levee remains intact.

Table 7. Mean Habitat Suitability Index values for the Without Project alternative evaluated at Princeton.

SPECIES	Existing	TY 1	TY 15	TY 50
Mallard	0.51	0.51	0.53	0.54
Canada goose	0.22	0.22	0.22	0.22
Least bittern	0.72	0.72	0.71	0.68
Lesser yellowlegs	0.24	0.24	0.24	0.24
Muskrat	0.27	0.27	0.27	0.27
King rail	0.44	0.44	0.42	0.41
Green-backed heron	0.52	0.53	0.50	0.50
Wood duck	0.37	0.37	0.38	0.39
Beaver	0.58	0.58	0.52	0.51
American coot	0.27	0.27	0.27	0.27
Parula warbler	0.40	0.43	0.50	0.50
Prothonotary warbler	0.43	0.56	0.60	0.60

Construction of a 2-celled complex (Alternative B) with increased water level management capabilities will result in qualitative improvements to the Princeton refuge as well as a larger surface acreage of water to manage. Table 8 shows that HSI values for 8 of the 12 evaluation species increased under the with-project scenario. In addition, the negative impacts to the 4 species will be offset through a mast tree planting alternative discussed later.

Table 8. Mean Habitat Suitability Index values for the With Project 2-celled management with levee improvements evaluated at Princeton.

SPECIES	Existing	TY 1	TY 15	TY 50
Mallard	0.51	0.69	0.70	0.71
Canada goose	0.22	0.32	0.32	0.32
Least bittern	0.72	0.74	0.78	0.75
Lesser yellowlegs	0.24	0.10	0.10	0.10
Muskrat	0.27	0.37	0.39	0.39
King rail	0.44	0.60	0.59	0.59
Green-backed heron	0.52	0.53	0.52	0.51
Wood duck	0.37	0.34	0.38	0.42
Beaver	0.58	0.36	0.32	0.30
American coot	0.27	0.39	0.73	0.73
Parula warbler	0.40	0.27	0.40	0.41
Prothonotary warbler	0.43	0.32	0.38	0.40

Habitat unit values for each of the proposed alternatives were calculated from the HSI and acreage numbers. These numbers were annualized over the 50-year project life to arrive at the AAHU figures used for comparing alternatives (Table 9). The success of any of the proposed alternatives is dependent on maintaining the integrity of the levee system to protect the existing wetland community. Severe erosion along the riverward toe has jeopardized this integrity to a point where none of the above alternatives appear feasible without first upgrading the levee system. Therefore, the No Action or Without Project alternative will not meet the project objective of ensuring the quality of the marshland habitat in future years.

Creation of additional nonforested wetland habitat through excavation for borrow material does appear to be a cost effective method for upgrading the existing levee. Therefore this alternative should be included as part of any 'With Project' plan for this site. The WHAG results indicate that implementation of Alternative B (2-celled management complex) will generate the greatest benefits for the majority of the evaluation species. The species which show a decrease in AAHU's is reflective of certain types of habitat manipulations which benefit selected species at the expense of others. The decrease in AAHU's appears to be more the result of less acreage of a particular habitat type, rather than degradation of the quality of that habitat type.

Table 9. Average Annual Habitat Units for the alternatives evaluated at Princeton.

SPECIES	Without	ALT 1	ALT 1*	ALT 2
Mallard	518	683	511	680
Canada goose	142	211	137	212
Least bittern	283	351	190	351
Lesser yellowlegs	95	47	25	47
Muskrat	107	176	95	176
King rail	170	270	146	270
Green-backed heron	402	440	295	438
Wood duck	151	153	153	152
Beaver	206	127	127	125
American coot	108	312	168	312
Parula warbler	192	150	150	149
Prothonotary warbler	232	148	148	147

Alternative 1. 1-cell complex.
Alternative 1*. 1-cell complex minus acreage greater than 2 feet deep.
Alternative 2. 2-celled complex.

Table 10. Princeton marsh HREP habitat types and acreage under 2-celled management with additional mast tree plantings.

Habitat	W/O	With
Non-forested wetland	404	461
Forested wetland	393	414
Cropland	179	97
Grassland	68	72
Total	1044	1044

To offset the impacts of clearing trees for the construction of the crossdike and improvements to the main perimeter levee and to further enhance the site for wildlife, a mast tree planting plan (Alternative C) has been developed to replant mast trees in three locations for a total of 25 acres. Species selected include oaks, hickories and red cedar which are locally adapted and will increase the diversity of the refuge for both game and nongame species alike.

Table 11. Incremental comparison of AAHU's for natural succession vs. mast tree planting at Princeton.

SPECIES	Natural Success	Mast Trees
Mallard	680	691
Canada goose	212	205
Least bittern	351	351
Lesser yellowlegs	47	47
Muskrat	176	176
King rail	270	270
Green-backed heron	438	449
Wood duck	152	155
Beaver	125	132
American coot	312	312
Parula warbler	149	173
Prothonotary warbler	147	155

CONCLUSIONS AND RECOMMENDATIONS

The Princeton HREP offers a unique opportunity to protect and enhance a bottomland community flanked by two major river systems. In addition, the proposed HREP will indirectly benefit the goals of the North American Waterfowl Management Plan (an international, inter-agency plan to increase waterfowl populations) and the goals of the Partners for Flight program to protect and increase the habitats for neotropical migrants.

First and foremost the future value of the project is dependent on the integrity of the levee system to keep floodwaters and sedimentation out of the area. Therefore the levee upgrade is a necessary part of any proposed alternative. Secondly, water level control offers the best tool for management of this area for fish and wildlife resources. Water level manipulations play a key role in determining which species will benefit the most. Stable, permanent water will benefit the species which are more indicative of a true hemi-marsh habitat; like bitterns and coots. Seasonal drawdowns and refloodings will generate moist soil plants and expose mudflat habitats that benefit dabbling ducks and shorebirds respectively.

Not only is the capacity to pump water important, but equally important is the ability to manage optimum water levels which create the most acreage of water 1 to 2 feet deep during critical times of the migration season. The 2-celled configuration seems to offer the best option while the 1-cell configuration creates much deeper water, translating into a higher pumping cost and a greater possibility of damaging trees with excessive flooding.

Therefore we recommend:

1. The perimeter levee improvements be made to protect Princeton Refuge lands.

2. The two-celled management configuration with upgraded pumping facilities be constructed.

3. The 25 acres of mast tree plantings be implemented.

We appreciate the opportunity to provide these comments and look forward to continued coordination. If you have any questions, please contact Mr. Joe Slater of my staff at (309) 793-5800.

Sincerely,

Wayne A. Fischer
for Richard C. Nelson
Field Supervisor

cc: USEPA (DiLaura)
IADNR (Sheets, Howell, Ehresman)

JS:jp

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

7-15-94

Rich Fristik- Environmental Section
USACE- Rock Island

Rich,

I received your letter regarding NCD comments on the Princeton HREP project. I will respond to the sections you had highlighted;

Main Report

#5- Emergent marsh vegetation patterns have remained stable over the past 20 years. The 1993 flood has brought about a temporary die back on approximately 20% of the buttonbush surrounding the main pool in the South segment. Cattail, Hardstem bulrush, Lily and Arrowweed stands appear to have sustained the flood. Pond Lilies are less dense in 94 compared to 92. There has been a gradual conversion from young sapling and pole stage silver maple timber to sedge and emergent growth at the edge of the main pool since water level mgmt was improved in 1981. Initital levee grading and break repair was undertaken resulting in improved water level control for the first time since the 1950s. Forest land remains stable on the Western and Northwest segments of the area.

#11- Ground water impacts: Original HREP planning targeted an overall increase in water elevation to 576.0 during the fall. This would have created moist soil on the East edge of a 14 acre inholding in the Southwest segment of the area. Creating 2 cells will allow optimum fall levels to reach 574.5 on the South segment thereby avoiding ground water encroachment on this adjacent inholding. 576.0 levels on the North segment will not infringe on any adjacent land at any time of year. The surrounding private land is much higher.

#16- 2 Cells vs one cell: The tw ocell concept will create additional edge effect for resident wildlife production and migrant wildlife loafing and feeding conditions. It will create additional food sources that will be available for a wider variety of wildlife species for a longer time frame each year. The 2 cell approach will in addition, create buffer food sources, insuring some measure of food in a given cell, should flood or drought conditions destroy food crops in the other cell. The single cell approach creates the added risk of all foods being destroyed or unavailable under uncontrolled water elevations. Habitat fragmentation will be minimal due to the existing major change in habitat on the proposed cross levee alignment.

#16 Continued: The main pool existing in the South segment will remain intact. The only primary change will be conversion of row crop land to wet sedge meadow and emergent marsh in the North segment. All conversions under the 2 cell approach are considered to be beneficial.

#19-Levee Improvements vs control elements: Levee improvements alone, go part way in improving wetland values at the site. They will allow water elevations of 574.5 to be reached on the South segment of the marsh only. No added wetland will be created. They will also help protect the area from frequent spring flooding and subsequent uprooting of marsh vegetation. Creation of the cross dike and adding the potential of water level control on both segments of the marsh goes several steps further towards enhancement of the area. The double cell design will allow occasional gravity flow water mgmt thereby improving the cost efficiency of regulating the marsh. It will also insure more stable food sources in either cell in the event that the other is washed out due to levee failure. Secondly, it will increase the habitat diversity created by doubling the edge effect around both cells verses a single cell.

I hope these comments help understand our concept of the Princeton HREP project design. Please call if you have further questions.

cc AR
RR
file

Sincerely,

Bob Sheets

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office (ES)
4469 - 48th Avenue Court
Rock Island, Illinois 61201

IN REPLY REFER TO

COM: 309/793-5800
FAX: 309/793-5804

July 22, 1994

Colonel Albert J. Kraus
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Kraus:

This letter constitutes supplementary information to our May 3, 1993, Fish and Wildlife Coordination Act (FWCA) report for the Princeton Wildlife Refuge Habitat Rehabilitation and Enhancement Project (HREP) in Pool 14, Upper Mississippi River, Scott County, Iowa. It has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 et seq.); the Endangered Species Act of 1973, as amended; and in accordance with the Fish and Wildlife Service's Mitigation Policy.

Per recent discussions with the Corps' project manager and project biologist concerning the output of the initial Wildlife Habitat Appraisal Guide (WHAG) analysis, the habitat analysis of the Princeton HREP has been modified to reflect acreage changes of usable habitat for specific target species. Our earlier report indicated that the acreage of nonforested wetland over 2-feet deep was not desirable for dabbling duck species, but the acres were included in the analysis. The revised analysis has deducted those acres of nonforested wetland over 2 feet deep from the total acres of available habitat in each of the alternatives studied, while recognizing that those acres do have intrinsic value for wildlife species in general. Because we are focusing on target species for specific project goals and objectives, we felt that the best way to reflect the changes in relative values was to deduct the less desirable wetland acreage where appropriate. The results of the modified WHAG are presented below with the conclusion that the recommendations to construct a 2-celled management unit with additional mast tree plantings remaining valid.

Recap of Proposed Array of Options Considered:

- Levee upgrade using selective borrow areas.

This option involves the necessary upgrade of the levee system with selective excavation in the agricultural fields as a source of levee material. Forty-three acres of additional nonforested wetland habitat will be created through this alternative if ponding levels are maintained at 575 feet National Geodetic Vertical Datum (NGVD). The levee would have a 10-year level of protection with one foot of freeboard.

- 1-celled management with levee upgrade and increased water level control.

This option involves continued management of the Princeton marsh complex as a single unit. Increased water control translates into the capacity to pond water a foot deeper over the complex, up to elevation 576 feet NGVD. The 43 acres of excavated nonforested wetland would be increased to 57 acres with increased water control. In addition, the overall acreage of nonforested wetland is increased to 461 acres at elevation 576 feet NGVD. However, under the 1-celled management plan over 213 acres of nonforested wetland is greater than 2 feet deep at 576 feet NGVD. This limits the value of the habitat for dabbling ducks, one of the target species selected for habitat enhancement. Ponding water to elevation 576 feet NGVD in the southern portion of the area could also potentially have a negative affect on an adjacent landowners's property unless a seepage ditch is constructed along the field boundary.

- 2-celled management with levee upgrade and increased water control.

A 2-celled management unit was evaluated to allow increased flexibility of management operations as well as maximize water level control. A crossdike would be constructed adjacent to the existing lateral ditch to divide the are a into north and south management units. The pump facilities would be relocated to the crossdike to allow a greater degree of control over water levels in the two cells. As a result, water levels in the two cells could be managed independently (576 feet NGVD in the north and 575 feet NGVD in the south) without impacting an adjacent landowner's property.

While the overall acreage of nonforest wetland is the same as the 1-celled alternative, only 46 acres of the total are more than 2 feet deep with this alternative. Consequently, the habitat is much more manageable and of greater value for dabbling ducks. Construction of the crossdike will require clearing and conversion of 4 acres of forested wetland habitat adjacent to the lateral ditch. Once the dike is completed the slopes will be seeded to grasses (approximately 3 acres) and managed as grassland habitat.

Re-evaluation of Alternatives

The "Without project" analysis did not require changing acreage values and therefore the output is the same as in the first report (Table 1). It is important to remember that this alternative assumes that levee will remain intact providing protection to the refuge. The Flood of '93 demonstrated the magnitude of the power of the river under extreme flood conditions. If the levee were to be breached at some point in the future, the values reflected in the "Without project" column would no longer be valid. Therefore, it is important that the integrity of the levee is ensured before any additional alternatives are considered.

The analysis of the levee upgrade with selective borrow alternative (Table 1. Levee) resulted in slight improvements to most target species, but a lower AAHU value for the mallard target species even with the increase in nonforested wetland acreage created from the borrow area. This is due to the net decrease in the cropland acres which are weighted high for mallard target species in the WHAG model. The bittern, yellowlegs, muskrat, rail, heron, and coot target species will benefit from the increased acres of marsh and fringe habitats realized by the conversion of cropland to wetland via excavation for borrow.

The 1- and 2-celled management alternatives were analyzed with 2 model runs each to distinguish between the benefits gained by a relative increase in acreage (as with the 1-celled plan) and an increase in acreage that was of particular qualitative value for the mallard target species. Therefore, the ALT 1 and ALT 2 values presented in Table 1 represent the increase in value attributed to increasing just the acreage of marsh habitats, while ALT 1* and ALT 2* represent the relative qualitative values derived by deducting the acreage that is over 2-feet deep from both of the alternatives (213 acres and 46 acres, respectively). A lack of significant differences in habitat values between ALT 1 and ALT 2 is due to increasing the acreage values of nonforested wetland the same for both alternatives. However, when the 213 acres of water in ALT 1 that is over 2 feet deep, versus the 46 acres over 2-feet deep in ALT 2 is factored into the analysis the results do become significant for dabbling duck species. An additional 135 AAHU's above the ALT 1* alternative were generated for the mallard target species. In addition, ponding water to depths greater than 2 feet deep, as is required with ALT 1, will create water depths in the south end of the project that will impact forested wetland habitats with some tree mortality likely.

With respect to the other target species affected by the project, the Princeton refuge area has a diversity of habitat types that benefit many wildlife species. The adverse affects to the beaver and warbler target species will be offset by the mast tree plantings included to compensate for the clearing of trees along the crossdike.

Table 1. Average Annual Habitat Units for the alternatives evaluated at Princeton.

SPECIES	Without	Levee	ALT 1	ALT 1*	ALT 2	ALT 2*
Mallard	518	509	683	508	680	643
Canada goose	142	140	211	138	212	196
Least bittern	283	312	351	190	351	316
Lesser yellowlegs	95	105	47	25	47	42
Muskrat	107	119	176	95	176	158
King rail	170	188	270	146	270	243
Green-backed heron	402	423	440	294	438	407
Wood duck	151	150	153	152	152	152
Beaver	206	204	127	125	125	125
American coot	108	119	312	168	312	280
Parula warbler	192	190	150	149	149	149
Prothonotary warbler	232	230	147	147	147	147

Alternative 1. 1-cell complex.
Alternative 1*. 1-cell complex minus acreage greater than 2 feet deep.
Alternative 2. 2-celled complex.
Alternative 2*. 2-celled complex minus acreage greater than 2 feet deep.

CONCLUSIONS AND RECOMMENDATIONS

The Princeton HREP offers a unique opportunity to protect and enhance a bottomland community flanked by two major river systems. In addition, the proposed HREP will indirectly benefit the goals of the North American Waterfowl Management Plan (an international, inter-agency plan to increase waterfowl populations) and the goals of the Partners for Flight program to protect and increase the habitats for neotropical migrants.

First and foremost, the future value of the project is dependent on the integrity of the levee system to keep floodwaters and sedimentation out of the area. Therefore the levee upgrade is a necessary part of any proposed alternative. Secondly, water level control offers the best tool for management of this area for fish and wildlife resources. Water level manipulations play a key role in determining which species will benefit the most. Stable, permanent water will benefit the species which are more indicative of a true hemi-marsh habitat; like bitterns and coots. Seasonal drawdowns and refloodings will generate moist soil plants and expose mudflat habitats that benefit dabbling ducks and shorebirds respectively.

Not only is the capacity to pump water important, but equally important is the ability to manage optimum water levels which create the most acreage of water 1 to 2 feet deep during critical times of the migration season. The 2-celled configuration seems to offer the best option while the 1-cell configuration creates much deeper water, translating into a higher pumping cost and a greater possibility of damaging trees with excessive flooding.

Therefore we continue to recommend:

1. The perimeter levee improvements be made to protect Princeton Refuge lands.

2. The two-celled management configuration with upgraded pumping facilities be constructed.

3. The 25 acres of mast tree plantings be implemented.

We appreciate the opportunity to provide these additional comments and look forward to continued coordination. If you have any questions, please contact Mr. Joe Slater of my staff at (309) 793-5800.

Sincerely,

Wayne H. Fischer
for Richard C. Nelson
Field Supervisor

cc: USEPA (DiLaura)
IADNR (Sheets, Howell)

JS:sjg

United States Department of the Interior

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

IN REPLY REFER TO:
FWS/ARW-SS

NOV 10 1994

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

Dear Colonel Cox:

The U.S. Fish and Wildlife Service (Service) has reviewed the "Definite Project Report (R-10PR) with Integrated Environmental Assessment" dated October 1994 for the Princeton Wildlife Management Area Project.

The project has been coordinated with the Service and we approve and support the project as planned and described in the definite project report. The Service agrees with the preferred alternative described in the environmental assessment, that of restoring the existing levee, constructing a cross-dike, relocating the pumping facility, constructing a stoplog structure, and planting 25 acres of mast trees. The Refuge Manager will be submitting a compatibility determination as required by the National Wildlife Refuge Administration Act.

Operation and maintenance requirements of the project will be accomplished by the Iowa Department of Natural Resources in accordance with Section 906(e) of the Water Resources Development Act of 1986. Note, however, that the draft memorandum of agreement for this project should reference Upper Mississippi River National Fish and Wildlife Refuge, not just National Wildlife Refuge (pages D-1 and D-3).

We look forward to our continued cooperative efforts in developing habitat rehabilitation and enhancement projects under the Environmental Management Program.

Sincerely,

Sam Marler

Sam Marler
Regional Director

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

DAVENPORT, IOWA

November 29, 1994

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

Subject: Comments on the Draft Definite Project Report (R-10PR) with Integrated Environmental Assessment for the Princeton Wildlife Management Area

Dear Colonel Cox:

I'm commenting on the above report for Pool 14 of the Mississippi River Miles 504.0 to 506.5 in Scott County, Iowa. In response to your October 27, 1994 letter, I've skimmed your report without finding any references to our 345,000 Volt transmission line or right-of-way. I've also routed your report to others in our Company responsible for transmission line construction and vegetation management.

Our 345,000 Volt transmission line crosses the Mississippi River west from Quad Cities Generating Station and over the Princeton Wildlife Management Area. The two areas where you are proposing to plant oak trees appear to be far enough away from the transmission line right-of-way.

However, the northern edge of the eastern excavation site is adjacent to our right-of-way. Electrical safety dictates that any excavation equipment booms remain at least twenty (20) feet from the conductors at all times. We would also be concerned if your excavations encroach on the right-of-way enough, or if the project subsequently flooded the right-of-way deep or often enough, to threaten any transmission structure foundations or vertical line clearances.

Please call me or Jim Puentes (309/793-3710) if other questions develop, or if you need additional information.

Respectfully,

Steve Johnson

Steve Johnson
Environmental Services Division
319/326-7386

STEVEN M. JOHNSON

smj
Enclosure
cc: J. Puentes
J. L. Roseman

POST OFFICE BOX 4350, 206 EAST SECOND STREET, DAVENPORT, IOWA 52808

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Denver Federal Center, Building 56, Room 100..
P.O. Box 25007 (D-108)
Denver, Colorado 80225-0007

December 14, 1994

ER 94/863

Colonel Charles S. Cox
Rock Island District Engineer
U.S. Army Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Cox:

The Department of the Interior (DOI) has reviewed the Upper Mississippi River System Environmental Management Program, Definite Project Report (R-10PR) with Integrated Environmental Assessment, Princeton Wildlife Management Area Pool 14 (RM 504.0 through 506.5), Scott County, Iowa. The subject document for the proposed project adequately addresses the environmental concerns of the DOI.

We appreciate the opportunity to review the document and provide comments.

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

February 2, 1995

Charles S. Cox
Colonel, U.S. Army
Corps of Engineers
P.O. Box 2004
Rock Island, IL 61204-2004

Subject: Request for Section 401 Water Quality Certification
Proposed restoration of 16,400 feet of existing perimeter levee, construction of 5350 feet of cross dike and 2400 feet of overflow roadway, relocation of an existing pump station, installation of one stoplog and one gatewell structure, and planting of approximately 25 acres of mast-producing trees in the Princeton Wildlife Management Area for the purpose of wetland habitat enhancement. The proposed project is located in Sections 23, 24, 25, 26, 35, and 36, T80N, R5E, Scott County, Iowa.
WRS Log No. 94-N-163-12-04-G and Public Notice No. CENCR-296500

Water Use Designation: Wetlands adjacent to the Mississippi River are protected as general use surface waters of the state at all places at all times for livestock and wildlife watering, aquatic life, non-contact recreation, crop irrigation, and industrial, domestic, agricultural, and other incidental water withdrawal uses.

Dear Colonel Cox:

This department has received and reviewed your request for State Certification pursuant to Section 401 of the Clean Water Act. State Section 401 Certification is required by the Army Corps of Engineers before a Section 404 permit can be issued. Section 401 Certification is this department's concurrence that this project is consistent with Iowa's Water Quality Standards.

This letter certifies, subject to the following conditions, that this department has determined that there is reasonable assurance the proposed activity will be conducted in a manner that will not violate water quality standards of the state of Iowa.

Conditions:

1. Construction activities shall employ controls to reduce the erosiveness of land adjacent to surface waters; this includes revegetation of the disturbed areas and maintenance of the erosion controls.

2. Fill material for the restoration of the perimeter levee and construction of the cross dike shall be limited to clean earthen fill free of toxics in toxic amounts.

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967 / FAX 515-281-8895

3. Compensation for the loss of approximately four acres shall occur through the planting of approximately 25 acres of mast producing trees in the north cell. Species selected for planting, including pin oak, swamp white oak, bur oak, pecan, shellbark hickory, and eastern red cedar, shall be planted at a density of 108 species per acres; buttonbush shall also be planted in wet areas.

While not a condition of this certification, you are reminded that the applicants are responsible for obtaining an NPDES Storm Water Permit from the Department prior to initiating construction if the construction activity associated with the proposed project will result in the disturbance of five or more acres, total land area.

Sincerely,

Janet A. Gastineau
Water Resources Section

cc: Rick Fristik/Barb Kimler, Department of the Army Corps of Engineers, Rock Island District
Dave Claman, DNR, Local
BOB Sheets, DNR, Maquoketa Wildlife Unit

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

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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

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

TABLE OF CONTENTS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

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

SECTION 1 - PROJECT DESCRIPTION

LOCATION

The proposed project is located on the Iowa side of the Mississippi River (River Miles 504.0-506.4) in Scott County, Iowa. Princeton Wildlife Area was purchased from the Carroll Levee District by the Corps of Engineers upon creation of the navigation pools in the mid-1930s. Although originally licensed to the U.S. Fish and Wildlife Service, the area has been managed by the Iowa Department of Natural Resources (originally the Iowa Conservation Commission) since 1956. The area comprises 1,129 acres. See plates 1 and 2 of the Definite Project Report (DPR).

GENERAL DESCRIPTION

By definition and Federal regulatory jurisdiction, the site is classified as wetland or as "waters of the United States" and is therefore subject to evaluation and regulation under Section 404 of the Clean Water Act.

The Princeton Wildlife Area HREP is a project to increase water level control capability, enhance levee integrity, and create additional marshland habitat in an existing floodplain marsh. These improvements will benefit both game and nongame wildlife as well as enhance overall habitat diversity.

Water level control will be improved by creation of a cross dike and relocation of pumping equipment to create a two-unit system. Approximately 18,000 cubic yards of borrow material will be added to an existing low-level dike to achieve a 10-foot top width with 4:1 side slopes.

Water control structures and a pump house will be constructed where the cross dike intersects with the perimeter levee. A gatewell structure (see plate 23 of the DPR) will allow totally independent operation of the north unit. The intake pipe of the pumping plant will connect directly to the water control structures on each side of the cross dike.

Perimeter levee enhancement will be achieved by placement of borrow material from 2 to 3 sites within the interior of the area, as well as adjacent excavation. The interior excavations will be configured to create additional shallow marshland habitat, totaling approximately 43 acres. If excavated to depths of 573 MSL in the south and 574 MSL in the north, water table elevations should allow reliable levels of water in the marshlands. Borrow material will be placed to achieve a uniform dimension of a 4:1 slope and a 10-foot top width, providing a 15-year level of protection. Approximately 100,000 cubic yards of material will be required for perimeter levee improvements.

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.

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 planning efforts by the State of Iowa, the U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers.

GENERAL DESCRIPTION OF DREDGED AND FILL MATERIAL

Project construction materials (borrow) are considered to be fill for the purpose of this evaluation and to consist primarily of alluvial soils with generally large particle sizes.

Because these construction materials originate from upland sites and will be placed on upland sites, contaminant and detailed sediment analyses were not conducted. Material will be placed and shaped according to the elevations and profiles shown on plates 16 and 17 of the DPR.

DESCRIPTION OF PROPOSED DISCHARGE SITE

Interior and/or borrow material from the north sites will be placed on the north side of the dike, which is actually split by a shallow boat channel.

Approximately 4 acres of bottomland trees will be cleared to accommodate placement and necessary shaping of material. The forested area impacted consists primarily of river birch. Ground cover is primarily composed of typical wet-site species such as sedges (*Carex* spp.), false indigo (*Amorpha canascens*), wild grape (*Vitis* spp.) and willow (*Salix* spp.).

Enhancement of the perimeter levee will entail placement of material on cleared, grass-covered sites. No clearing of trees will be required. Placement sites will be reseeded to grass as needed.

DESCRIPTION OF PLACEMENT METHOD

Material will be excavated by mechanical means, using a dragline or clamshell bucket, and then transported to the appropriate locations. Plate 18 of the DPR shows the detail of the water control structure and pump station to be constructed at the intersection of the perimeter levee and cross dike. The north structure will consist of a 36-inch pre-cast concrete culvert with gatewell, while the pumping plant will be upgraded with a concrete intake structure and trash rack. The intake will connect via a 36-foot metal pipe to a double stoplog structure in the cross dike (see plate 18 of the DPR).

The pump station will require a concrete pad, as well as construction of inlet and discharge pipes. The Iowa Department of Natural Resources has drawn up plans for a concrete structure to enclose the pump, and this structure will become part of the project design. Vegetative plantings will be placed in selected locations along the river side of the levee to protect the pump facilities or reinforce areas particularly susceptible to erosion.

SECTION 2 - FACTUAL DETERMINATIONS

PHYSICAL SUBSTRATE DETERMINATIONS

Information obtained from the Scott County office of the Soil Conservation Service indicates that project excavation and construction will take place on soils of the Ambraw, Shaffton, and/or Dickinson series, as well as unclassified marsh (aquoll) soils. These series are characterized by poor to good drainage, clay loam to sandy loam surface layers, and increasingly sandy substrata. All are alluvial in origin, with some wind-deposited sediments present.

The sandy nature of the soils in the north/northeast would not indicate a problem with presence or release of contaminants during excavation. Soils in the southern portion of the area tend to be more silty in nature, of the Richwood and Rawley series. These soils are more suited to cultivation.

For the most part, aquatic substrates will be affected incidentally to adjacent upland construction activities. Aquatic substrates will be directly affected by ditch cuts at the base of the perimeter levee and at the west end of the cross dike to facilitate connection to the perimeter levee at this point. These excavations will consist of approximately 5,500 cubic yards of material and cover approximately 56,700 square feet.

WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS

WATER

Aquatic integrity of the project site would be affected during high water events and normal pumping operations. The site is subject to flooding from the Mississippi and Wapsipinicon Rivers. During normal periods, water is most likely to pool in the southeastern and central portions of the area.

The proposed project is not intended to enhance aquatic habitat per se, and concentrates primarily on terrestrial habitat improvement.

CURRENT PATTERNS AND CIRCULATION

Princeton is essentially a closed system, so water movement is virtually nonexistent other than during flood events. Proposed changes in pumping regime may affect currents in the adjacent Grant Slough, but not to any significant degree. During flood events, water tends to back in through the southwestern portion of the area. Enhancement of the levee in this area will likely divert floodwaters further southwest, and there should not be any threat posed to private lands or public facilities.

NORMAL WATER LEVEL FLUCTUATIONS

As stated above, the closed nature of the Princeton system precludes any significant water level fluctuations other than planned changes for management purposes. Fluctuations in the adjacent Mississippi River system, both daily and seasonal, depend on discharge changes, lock and dam operations, and seasonal weather patterns. These changes should not affect the project site, and conversely, project implementation is not expected to affect normal river stages or flood heights.

SALINITY GRADIENTS

This consideration is not applicable.

ACTIONS TAKEN TO MINIMIZE IMPACTS

The use of borrow material of upland origin and the stabilization of levee improvement areas by revegetation are both intended to minimize impacts to the aquatic system.

SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

Due to the normal isolation of the project area from flowing water, suspended particulates and elevated turbidity will likely be limited to the vicinity of levee construction and construction of the pumping facilities. These effects will be limited in both scope and duration.

CONTAMINANT DETERMINATIONS

Specific contaminant analyses were not conducted, as fill material will be used in upland applications. Any contaminants introduced into the Princeton or adjacent river systems are not expected to differ from those ordinarily found in these systems.

Possible introduction of equipment or construction-related contaminants will be controlled by adherence to runoff monitoring plans during construction activity. No toxic materials will be introduced to the area as a result of construction activities. Appropriate measures, such as hay bales or silt fences, will be implemented to control stormwater discharge. Should any such discharges occur, they would be contained on site.

These measures are designed to constitute compliance with point source discharge (S. 402) requirements of the Clean Water Act. A complete stormwater pollution prevention plan is found in Section 9c. of the main report.

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 the Project Area or Placement Sites.
   (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 in this project.
F. Threatened and Endangered Species (refer to Section 230.30)
G. Other Wildlife (refer to Section 230.32)

The nature and location of the project does not project any effects on A through E above, as enhancement of wetland habitat values is to be emphasized.

Elements E(1) through (4) are found in the project area. Projects goals and features have been coordinated to match the management objectives of the Iowa Department of Natural Resources, and these elements are expected to be enhanced by implementation of the project.

Direct impacts of construction involve conversion of approximately 43 acres of cropland to shallow marsh, and conversion of approximately 4 acres of immature bottomland forest to grassed levee. Though project design allows for free movement of impounded water to the adjacent Mississippi River system, it is expected that a slightly larger acreage of trees on the west side of the area will be subject to seasonal flooding. This is a desirable condition from a habitat standpoint, but could result in some tree mortality in the long term.

Project planning considered to the full extent the minimization of wetland loss, and it is intended that wetland values and extent will be improved as a result of project implementation.

Correspondence from the U.S. Fish and Wildlife Service and the Iowa Department of Natural Resources (see appendix B) indicates that no impacts are envisioned to threatened or endangered species. Other wildlife, both avian and mammalian, is generally expected to benefit from this project due to increased overall habitat diversity.

PROPOSED PLACEMENT SITE DETERMINATIONS

This project does not involve dredging, but rather placement of material on existing levees for means of enhancement or reconstruction. All construction materials will be obtained on site, and direct impacts to wetland substrates will be minimal.

DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

Aquatic habitat values were not emphasized in this project, but this did not preclude their consideration during project design. Princeton has not had a high quality fishery in the past, and periodic movement of fish between the area and the Mississippi River System should not be compromised by this project. Thus, cumulative effects to the aquatic system should not be significant.

DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

Sedimentation has not been a problem at this site in the past, and sediment deposition is not expected to change significantly as a result of project implementation.

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. Alternatives which were considered for the proposed action were as follows:

a. Alternative A - No Federal Action

b. Individual project features were evaluated independently of each other. The individual features were levee restoration, wetland management unit (WMU) improvement, and mast tree planting. Alternatives B through G consisted of various combinations of these features.

Alternative G (2-Cell WMU/Mast Tree Planting) was selected as the most practicable alternative since it provided the greatest benefits in the public interest at the least cost.

3. Certification under Section 401 of the Clean Water Act will be obtained from the Iowa Department of Natural Resources and will be included in the final version of this report. The project will thus be in compliance with the water quality requirements of the State of Iowa.

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 the U.S. Fish and Wildlife Service, Ecological Services Office.

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 will be chemically and physically stable. No contamination of the river is anticipated.

9. 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.

1 Feb 95
Date

Charles S. Cox
Charles S. Cox
Colonel, U.S. Army
District Engineer

DRAFT MEMORANDUM OF AGREEMENT AND LETTERS OF INTENT

APPENDIX D

DRAFT
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
PRINCETON WILDLIFE MANAGEMENT AREA

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, repairing, and rehabilitating the Princeton Wildlife Management Area (PWMA), Iowa, separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

a. The Federally owned project lands of the Princeton Wildlife Management Area are managed under a cooperative agreement between the Department of the Interior, USFWS, and the U.S. Army Corps of Engineers, dated 14 February 1963. Management of these project lands has been assumed by the Iowa Department of Natural Resources under a successive cooperative agreement between the USFWS and the Iowa Department of Natural Resources dated 11 October 1963.

b. 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. Approximately 65 percent of the project area is managed for the USFWS by the Iowa Department of Natural Resources (IDNR) as part of The Upper Mississippi River National Fish and Wildlife Refuge. Under conditions of Section 906(e) of the

Water Resources Development Act of 1986, Public Law 99-662, 100 percent of the construction costs of those fish and wildlife features located on those lands managed as a National Wildlife Refuge are the responsibility of the DOA and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, all costs of operation and maintenance for the Princeton Wildlife Management Area, Iowa are 100 percent the responsibility of Iowa Department of Natural Resources.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of converting the PWMA to a 2-celled managed marsh by restoring 16,400 feet of perimeter levee, to include 2,400 feet of overflow roadway; constructing a cross dike and 1 stoplog and 1 gatewell structure; and relocating an existing pump station. In addition, approximately 25 acres within the project area will be planted with mast-producing tree species.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction. Rehabilitation of the existing perimeter levee; construction of a cross dike, and one gatewell and one stoplog structure; relocation of the existing pump station; and planting 25 acres of mast-producing trees.

2. Major Rehabilitation. The Federal share of 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, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, DOA will construct on the Federally owned lands of the Princeton Wildlife Management Area, Iowa, the Fish and Wildlife Enhancement Project as described in the Upper Mississippi River System Environmental Management Program Definite

Project Report (R-10D) with Integrated Environmental Assessment Princeton Wildlife Management Area dated August 1993, 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 order 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. The 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 property reflect total costs. The 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. FWS Responsibilities. Upon completion of construction as determined by the District Engineer, Rock Island, the USFWS shall accept the Project as part of the Upper Mississippi River National Fish and Wildlife Refuge of the Princeton, Wildlife Management Area, Iowa.

c. Non-Federal Responsibilities. In accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, 100 percent of all costs associated with the operation, maintenance, and repair of the Princeton Wildlife Management Area, Iowa will be borne by the Iowa Department of Natural Resources.

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.

FWS: 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

VII. EFFECTIVE DATE OF MOA

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

THE DEPARTMENT OF THE ARMY

BY: ______________________
CHARLES S. COX
Colonel, U.S. Army
District Engineer

DATE: ______________________

THE U.S. FISH AND WILDLIFE SERVICE

BY: ______________________
SAM MARLER
Regional Director
U.S. Fish and Wildlife Service

DATE: ______________________

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

June 1, 1992

Colonel John R. Brown
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

Dear Colonel Brown:

The Iowa Department of Natural Resources hereby agrees to the following cost-share conditions for the Princeton Refuge Habitat Rehabilitation and Enhancement Project under the Environmental Management Program (EMP):

1. Construction:

a. The State of Iowa is responsible for 25 percent of all construction costs assigned to project features located on non-Federal lands within the project area. In this case, the non-Federal lands are owned by the State of Iowa.

b. The Federal Government, through the U.S. Army Corps of Engineers, is responsible for the remaining 75 percent of construction costs assigned to project features located on non-Federal lands within the project area.

c. The Federal Government, through the U.S. Army Corps of Engineers, is responsible for 100 percent of all constuction costs assigned to project features located on Federal lands within the project area that are "managed as a national wildlife refuge" in the context of Section 906(e) of the Water Resources Development Act of 1986. In this case, Federal lands are General Plan lands managed by the Iowa Department of Natural Resources through a cooperative agreement with the U.S. Fish and Wildlife Service.

2. Operation, Maintenance, and Repair:

a. The State of Iowa is responsible for 100 percent of operations, maintenance, and repair of project features located on non-Federal lands.

b. The State of Iowa will cooperate with the U.S. Fish and Wildlife Service to assure that non-Federal operation, maintenance, and repair responsibilities associated with the project features on Federal land are in conformance with Section 906(e) of the Water Resources Development Act of 1986 and existing agreements between the Service and the Director, Iowa Department of Natural Resources.

Sincerely,

J Wilson

LARRY J. WILSON
DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

DRAFT PROJECT COOPERATION AGREEMENT

APPENDIX E

DRAFT
PROJECT COOPERATION AGREEMENT BETWEEN THE DEPARTMENT OF THE ARMY AND THE STATE OF IOWA FOR CONSTRUCTION OF THE PRINCETON WILDLIFE MANAGEMENT AREA REHABILITATION AND ENHANCEMENT PROJECT AT SCOTT COUNTY, IOWA

THIS AGREEMENT is entered into this ___ day of ___________, 199__, by and between **THE DEPARTMENT OF THE ARMY** (hereinafter the "Government"), represented by the Assistant Secretary of the Army (Civil Works), and **THE STATE OF IOWA** (hereinafter the "State"), represented by the Director, Iowa Department of Natural Resources.

WITNESSETH, THAT:

WHEREAS, construction of the Habitat Rehabilitation and Enhancement Project, at Princeton Wildlife Management Area, in Clinton County, Iowa (hereinafter referred to as the "Authorized Project" and defined in Article I.a.(1) of this Agreement), was approved under the terms of the Upper Mississippi River System Environmental Management Program, as authorized by Section 1103(e) of the Water Resources Development Act of 1986, Public Law 99-662, as amended; and

WHEREAS, the Government and the State desire to enter into a Project Cooperation Agreement for construction of a portion of the Authorized Project (defined in Article I.a.(2) and hereinafter referred to as the "Project") as the Project is to be constructed on lands owned by the State of Iowa which pursuant to Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, requires a cost-sharing agreement; and

WHEREAS, Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, as amended, specifies the cost-sharing requirements applicable to the Project; and

WHEREAS, Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, specifies that the cost of operation and maintenance is the responsibility of the agency that manages the land for fish and wildlife purposes, the state will provide 100 percent of the cost of operation and maintenance of the Project;

WHEREAS, Section 221 of the Flood Control Act of 1970, Public Law 91-611, as amended, provide that the Secretary of the Army shall not commence construction of any water resources project, or separable element thereof, until each non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

WHEREAS, the Government and the State have the full authority and capability to perform as hereinafter set forth and intend to cooperate in cost-sharing and financing of the construction of the Project in accordance with the terms of this Agreement.

NOW, THEREFORE, the Government and the Non-Federal Sponsor agree as follows:

ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

A(1). The term "Authorized Project" shall mean the improvement and development of an approximate 1050 acre wet land management area which includes approximately 16,400 lineal feet of earthen levee improvements; approximately 5000 lineal feet of new earthen levee; a stop log water control structure; a gated water intake structure; relocation of an existing hydraulic pump; and approximately 2,400 lineal feet of rock-armored overflow levee, as generally described in the Definite Project Report dated August ___, 1993 and approved by the Chief of Engineers on ____________________, 19___.

A(2). The term "Project" shall mean that portion of construction which will take place on lands owned by the State of Iowa, which shall include the improvement of approximately 3750 lineal feet of earthen levee and development of approximately 1250 lineal feet of rock-armored overflow levee.

B. The term "total project costs" shall mean all costs incurred by the State and the Government in accordance with the terms of this Agreement directly related to construction of the Project. Subject to the provisions of this Agreement, the term shall include, but is not necessarily limited to: continuing planning and engineering costs incurred after October 1, 1985; advanced engineering and design costs; preconstruction engineering and design costs; engineering and design costs during construction; the costs of investigations to identify the existence and extent of hazardous substances in accordance with Article XV.A. of this Agreement; costs of historic preservation activities in accordance with Article XVIII.A. of this Agreement; actual construction costs, including the costs of alteration, lowering, raising, or replacement and attendant removal of existing railroad bridges and approaches thereto; the value of utility and facility alterations or relocations provided for the project by the State; supervision and administration costs; costs of participation in the Project Coordination Team in accordance with Article V of this Agreement; costs of contract dispute settlements or awards; and costs of audit in accordance with Article X of this Agreement. The term does not include any costs for operation, maintenance, repair, replacement, or rehabilitation; the value of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas; any costs due to betterments; or any costs of dispute resolution under Article VII of this Agreement.

C. The term "financial obligation for construction" shall mean a financial obligation of the Government, other than an obligation pertaining to the provision of lands, easements, rights-of-way, relocations, and borrow and dredged or excavated material disposal areas, that results or would result in a cost that is or would be included in total project costs.

D. The term "non-Federal proportionate share" shall mean the ratio of the State's total cash contribution required in accordance with Articles II.D.1. and II.D.4. of this Agreement to total financial obligations for construction, as projected by the Government.

E. The term "period of construction" shall mean the time from the date the Government first notifies the State in writing, in accordance with Article VI.B. of this Agreement, of the scheduled date for issuance of the solicitation for the first construction contract to the date that the U.S. Army Engineer for the Rock Island District (hereinafter the "District Engineer") notifies the State in writing of the Government's determination that construction of the Project is complete.

F. The term "highway" shall mean any public highway, roadway, street, or way, including any bridge thereof.

G. The term "relocation" shall mean providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway or other public facility, or railroad (excluding existing railroad bridges and approaches thereto) when such action is authorized in accordance with applicable legal principles of just compensation or as otherwise provided in the authorizing legislation for the Project or any report referenced therein. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

H. The term "fiscal year" shall mean one fiscal year of the Government. The Government fiscal year begins on October 1 and ends on September 30.

I. The term "functional portion of the Project" shall mean a portion of the Project that is suitable for tender to the State to operate and maintain in advance of completion of the entire Project. For a portion of the Project to be suitable for tender, the District Engineer must notify the State in writing of the Government's determination that the portion of the Project is complete and can function independently and for a useful purpose, although the balance of the Project is not complete.

J. The term "betterment" shall mean a change in the design and construction of an element of the Project resulting from the application of standards that the Government determines exceed those that the Government would otherwise apply for accomplishing the design and construction of that element.

ARTICLE II - OBLIGATIONS OF THE GOVERNMENT AND THE STATE

A. The Government, subject to receiving funds appropriated by the Congress of the United States (hereinafter, the "Congress") and using those funds and funds provided by the State, shall expeditiously construct the Project (including alteration, lowering, raising, or replacement and attendant removal of existing railroad bridges and approaches thereto), applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

1. The Government shall afford the State the opportunity to review and comment on the solicitations for all contracts, including relevant plans and specifications, prior to the government's issuance of such solicitations. The Government shall not issue the solicitation for the first construction contract until the State has confirmed in writing its willingness to proceed with the Project. To the extent possible, the Government shall afford the State the opportunity to review and comment on all contract modifications, including change orders, prior to the issuance to the contractor of a Notice to Proceed. In any instance where providing the State with notification of a contract modification or change order is not possible prior to issuance of the Notice to Proceed, the Government shall provide such notification in writing at the earliest date possible. To the extent possible, the Government also shall afford the State the opportunity to review and comment on all contract claims prior to resolution thereof. The Government shall consider in good faith the comments of the State, but the contents of solicitations, award of contracts, execution of contract modifications, issuance of change orders, resolution or contract claims, and performance of all work on the Project (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Government.

2. Throughout the period of construction, the District Engineer shall furnish the State with a copy of the Government's

Written Notice of Acceptance of Completed Work for each contract for the Project.

B. The State may request the Government to accomplish betterments. Such requests shall be in writing and shall describe the betterments requested to be accomplished. If the Government in its sole discretion elects to accomplish the requested betterments or any portion thereof, it shall so notify the State in writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The State shall be solely responsible for all costs due to the requested betterments and shall pay all such costs in accordance with Article VI.C. of this Agreement.

C. When the District Engineer determines that the entire Project is complete or that a portion of the Project has become a functional portion of the Project, the District Engineer shall so notify the State in writing and furnish the State with an Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (hereinafter the "OMRR&R Manual") and with copies of all of the Government's Written Notices of Acceptance of Completed Work for all contracts for the Project or the functional portion of the Project that have not been provided previously. Upon such notification, the State shall operate, maintain, repair, replace, and rehabilitate the entire Project or the functional portion of the Project in accordance with Article VIII of this Agreement.

D. The State shall contribute 25 percent of total project costs in accordance with the provisions of this paragraph.

1. The State shall provide a cash contribution equal to 5 percent of total project costs in accordance with Article VI.B. of this Agreement.

2. In accordance with Article III of this Agreement, the State shall provide all lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the State must provide for the construction, operation, and maintenance of the Project.

3. In accordance with Article III of this Agreement, the State shall perform or ensure performance of all relocations that the Government determines to be necessary for the construction, operation, and maintenance of the Project.

4. If the Government projects that the value of the State's contributions under paragraphs D.1 and D.3. of this Article and Articles V, X, and XV.A. of this Agreement will be less than 25 percent of total project costs, the Non-Federal Sponsor shall provide an additional cash contribution, in accordance with Article VI.B. of this Agreement, in the amount necessary to make the Non-Federal Sponsor's total contribution equal to 25 percent of total project costs.

E. The State may request the Government to provide lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or perform relocations on behalf of the State. Such requests shall be in writing and shall describe the services requested to be performed. If in its sole discretion the Government elects to perform the requested services or any portion thereof, it shall so notify the State in writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such writing and this Agreement, this Agreement shall control. The State shall be solely responsible for all costs of the requested services and shall pay all such costs in accordance with Article VI.C. of this Agreement. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government, the State shall be responsible, as between the Government and the State, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

F. The Government shall perform a final accounting in accordance with Article VI.D. of this Agreement to determine the contributions provided by the State in accordance with paragraphs B., D., and E. of this Article and Articles V, X, and XV.A. of this Agreement and to determine whether the State has met its obligations under paragraphs B., D., and E. of this Article.

G. The State shall not use Federal funds to meet the State's share of total project costs under this Agreement unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

ARTICLE III - LANDS, RELOCATIONS, DISPOSAL AREAS, AND PUBLIC LAW 91-646 COMPLIANCE

A. The Government, after consultation with the State, shall determine the lands, easements, and rights-of-way required for the construction, operation, and maintenance of the Project, including those required for relocations, borrow materials, and dredged or excavated material disposal. The Government in a timely manner shall provide the State with general written descriptions, including maps as appropriate, of the lands, easements, and rights-of-way that the Government determines the State must provide, in detail sufficient to enable the State to fulfill its obligations under this paragraph, and shall provide the State with a written notice to proceed with acquisition of such lands, easements, and rights-of-way. Prior to the end of the period of construction, the State shall acquire all lands, easements, and rights-of-way set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each construction contract, the State shall provide the Government with authorization for entry to all lands, easements, and rights-of-way the Government determines the State must provide for that contract. For so long as the Project remains authorized, the State shall ensure that lands, easements, and rights-of-way that the Government determines to be required for the operation and maintenance of the Project and that were provided by the State are retained in public ownership for uses compatible with the authorized purposes of the Project.

B. The Government, after consultation with the State, shall determine the improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the Project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and de-watering pumps and pipes. The Government in a timely manner shall provide the State with general written descriptions of such improvements in detail sufficient to enable the State to fulfill its obligations under this paragraph, and shall provide the State with a written notice to proceed with construction of such improvements. Prior to the end of the period of construction, the State shall provide all improvements set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the State shall prepare plans and specifications for all improvements the Government determines to be required for the proper disposal of dredged or excavated material under that contract, submit such plans and specifications to the Government for approval, and provide such improvements in accordance with the approved plans and specifications.

C. The Government, after consultation with the State, shall determine the relocations necessary for the construction, operation, and maintenance of the Project, including those necessary to enable the removal of borrow materials and the proper disposal of dredged or excavated material. The Government in a timely manner shall provide the State with general written descriptions, including maps as appropriate, of such relocations in detail sufficient to enable the State to fulfill its obligations under this paragraph, and shall provide the State with a written notice to proceed with such relocations. Prior to the end of the period of construction, the State shall perform or ensure the performance of all relocations as set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the State shall prepare or ensure the preparation of plans and specifications for, and perform or ensure the performance of, all relocations the Government determines to be necessary for that contract.

D. The State in a timely manner shall provide the Government with such documents as are sufficient to enable the Government to determine the value of any contribution provided pursuant to paragraphs B. or C. of this Article. Upon receipt of such documents the Government, in accordance with Article IV of this Agreement and in a timely manner, shall determine the value of such contribution, include such value in total project costs, and afford credit for such value toward the States' share of total project costs.

E. The State shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 C.F.R. Part 24, in acquiring lands, easements, and rights-of-way required for the construction, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and shall inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - CREDIT FOR VALUE OF RELOCATIONS AND IMPROVEMENTS OF DISPOSAL AREAS

A. The State shall receive credit toward its share of total project costs for the value of the relocations and improvements for the proper disposal of dredged or excavated material that the State must perform or for which it must ensure performance pursuant to Article III of this Agreement. However, the State shall not receive credit for the value of any relocations, or improvements for the proper disposal of borrow and dredged or excavated material disposal areas that have been provided previously as an item of cooperation for another Federal project. The State also shall not receive credit for the value of relocations, or improvements for the proper disposal of borrow and dredged or excavated material disposal areas to the extent that such items are provided using Federal funds unless the Federal granting agency verifies in writing that such credit is expressly authorized by statute.

B. After consultation with the State, the Government shall determine the value of relocations in accordance with the provisions of this paragraph.

1. For a relocation other than a highway, the value shall be only that portion of relocation costs that the Government determines is necessary to provide a functionally equivalent facility, reduced by depreciation, as applicable and by the salvage value of any removed items.

2. For a relocation of a highway, the value shall be only that portion of relocation costs that would be necessary to accomplish the relocation in accordance with the design standard that the State of Iowa would apply under similar conditions of geography and traffic load, reduced by the salvage value of any removed items.

3. Relocation costs shall include, but not necessarily be limited to, actual costs of performing the relocation; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with performance of the relocation, but shall not include any costs due to betterments, as determined by the Government, nor any additional cost of using new material when suitable used material is available. Relocation costs shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

C. The value of the improvements made to lands, easements, and rights-of-way for the proper disposal of dredged or excavated material shall be the costs of the improvements, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such costs shall include, but not necessarily be limited to, actual costs of providing the improvements; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with providing the improvements, but shall not include any costs due to betterments, as determined by the Government.

ARTICLE V - PROJECT COORDINATION TEAM

A. To provide for consistent and effective communication, the State and the Government, not later than 30 days after the effective date of this Agreement, shall appoint named senior representatives to a Project Coordination Team. Thereafter, the Project Coordination Team shall meet regularly until the end of the period of construction. The Government's Project Manager and a counterpart named by the State shall co-chair the Project Coordination Team.

B. The Government's Project Manager and the State counterpart shall keep the Project Coordination Team informed of the progress of construction and of significant pending issues and actions, and shall seek the views of the Project Coordination Team on matters that the Project Coordination Team generally oversees.

C. Until the end of the period of construction, the Project Coordination Team shall generally oversee the Project, including issues related to design; plans and specifications; scheduling; real property and relocation requirements; real property acquisition; contract awards and modifications; contract costs; the Government's cost projections; final inspection of the entire Project or functional portions of the Project; preparation of the proposed OMRR&R Manual; anticipated requirements and needed capabilities for performance of operation, maintenance, repair, replacement, and rehabilitation of the Project; and other related matters. This oversight shall be consistent with a project management plan developed by the Government after consultation with the State.

D. The Project Coordination Team may make recommendations that it deems warranted to the District Engineer on matters that the Project Coordination Team generally oversees, including suggestions to avoid potential sources of dispute. The Government in good faith shall consider the recommendations of the Project Coordination Team. The Government, having the legal authority and responsibility for construction of the Project, has the discretion to accept, reject, or modify the Project Coordination Team's recommendations.

E. The costs of participation in the Project Coordination Team shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE VI - METHOD OF PAYMENT

A. The Government shall maintain current records of contributions provided by the parties and current projections of total project costs and costs due to betterments. At least quarterly, the Government shall provide the State with a report setting forth all contributions provided to date and the current projections of total project costs, of total costs due to betterments, of the components of total project costs, of each party's share of total project costs, of the State's total cash contributions required in accordance with Articles II.B., II.D., and II.E. of this Agreement, and of the non-Federal proportionate share. On the effective date of this Agreement, total project costs are projected to be $92,500, and the State's cash contribution required under Article II.D. of this Agreement is project to be $23,125. Such amounts are estimates subject to adjustment by the Government and are not to be construed as the total financial responsibilities of the Government and the State.

B. The State shall provide the cash contribution required under Articles II.D.1. and II.D.4. of this Agreement in accordance with the following provisions: Not less than 60 calendar days prior to the scheduled date for issuance of the solicitation for the first construction contract, the Government shall notify the State in writing of such scheduled date and the funds the Government determines to be required from the State to meet its projected cash contribution under Articles II.D.1. and II.D.4. of this Agreement. Not later than such scheduled date, the State shall provide the Government with the full amount of the required funds by delivering a check payable to "FAO, USAED, Rock Island" to the District Engineer. The Government shall draw from the funds provided by the State such sums as the Government deems necessary to cover: (a) the non-Federal proportionate share of financial obligations for construction incurred prior to the commencement of the period of construction; and (b) the non-Federal proportionate share of financial obligations for construction as they are incurred during the period of construction. In the event the Government determines that the State must provide additional funds to meet the State's cash contribution, the Government shall notify the State in writing of the additional funds required. Within 60 calendar days thereafter, the Non-Federal Sponsor shall provide the Government with a check for the full amount of the additional required funds.

C. In advance of the Government incurring any financial obligation associated with additional work under Article II.B. or II.E. of this Agreement, the State shall provide the Government with the full amount of the funds required to pay for such additional work by delivering a check payable to "FAO, USAED, Rock Island" to the District Engineer. The Government shall draw from the funds provided by the State such sums as the Government deems necessary to cover the Government's financial obligations for such additional work as they are incurred. In the event the Government determines that the State must provide additional funds to meet its cash contribution, the Government shall notify the State in writing of the additional funds required. Within 30 calendar days thereafter, the State shall provide the Government with a check for the full amount of the additional required funds.

D. Upon completion of the Project or termination of this Agreement, and upon resolution of all relevant claims and appeals, the Government shall conduct a final accounting and furnish the State with the results of the final accounting. The final accounting shall determine total project costs, each party's contribution provided thereto, and each party's required share thereof. The final accounting also shall determine costs due to betterments and the State's cash contribution provided pursuant to Article II.B. of this Agreement.

1. In the event the final accounting shows that the total contribution provided by the State is less than its required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the State shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet the State's required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement.

2. In the event the final accounting shows that the total contribution provided by the State exceeds its required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the Government shall, subject to the availability of funds, refund the excess to the State no later than 90 calendar days after the final accounting is complete. In the event existing funds are not available to refund the excess to the Non-Federal Sponsor,

the Government shall seek such appropriations as are necessary to make the refund.

ARTICLE VII - DISPUTE RESOLUTION

As a condition precedent to a party bringing any suit for breach of this Agreement, the party must first notify the other party in writing of the nature of the purported breach and seek in good faith to resolve the dispute through negotiation. If the parties cannot resolve the dispute through negotiation, they may agree to a mutually acceptable method of non-binding alternative dispute resolution with a qualified third party acceptable to both parties. The parties shall each pay 50 percent of any costs for the services provided by such a third party as such costs are incurred. The existence of a dispute shall not excuse the parties from performance pursuant to this Agreement.

ARTICLE VIII - OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

A. Upon notification in accordance with Article II.C. of this Agreement and for so long as the authorized Project remains authorized, the State shall operate, maintain, repair, replace, and rehabilitate the entire authorized Project or the functional portion of the authorized Project, at no cost to the Government, in a manner compatible with the authorized Project's authorized purposes and in accordance with applicable Federal and State laws as provided in Article XI of this Agreement and specific directions prescribed by the Government in the OMRR&R Manual and any subsequent amendments thereto.

B. The State hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the State owns or controls for access to the authorized Project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the authorized Project. If an inspection shows that the State for any reason is failing to perform its obligations under this Agreement, the Government shall send a written notice describing the non-performance to the State. If, after 30 calendar days from receipt of notice, the State continues to fail to perform, then the Government shall have the right to enter, at reasonable times and in a reasonable manner, upon property that the State owns or controls for access to the authorized Project for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the authorized Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Government shall operate to relieve the State of responsibility to meet the State's obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to ensure faithful performance pursuant to this Agreement.

ARTICLE IX - INDEMNIFICATION

The State shall hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE X - MAINTENANCE OF RECORDS AND AUDIT

A. Not later than 60 calendar days after the effective date of this Agreement, the Government and the State shall develop procedures for keeping books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement. These procedures shall incorporate, and apply as appropriate, the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 C.F.R. Section 33.20. The Government and the State shall maintain such books, records, documents, and other evidence in accordance with these procedures and for a minimum of three years after the period of construction and resolution of all relevant claims arising therefrom. To the extent permitted under applicable Federal laws and regulations, the Government and the State shall each allow the other to inspect such books, documents, records, and other evidence.

B. Pursuant to 32 C.F.R. Section 33.26, the State is responsible for complying with the Single Audit Act of 1984, 31 U.S.C. Sections 7501-7507, as implemented by Office of Management and Budget (OMB) Circular No. A-128 and Department of Defense Directive 7600.10. Upon request of the State and to the extent permitted under applicable Federal laws and regulations, the Government shall provide to the State and independent auditors any information necessary to enable an audit of the State's activities under this Agreement. The costs of any non-Federal audits performed in accordance with this paragraph shall be allocated in accordance with the provisions of OMB Circulars A-87 and A-128, and such costs as are allocated to the Project shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

C. In accordance with 31 U.S.C. Section 7503, the Government may conduct audits in addition to any audit that the State is required to conduct under the Single Audit Act. Any such Government audits shall be conducted in accordance with Government Auditing Standards and the cost principles in OMB Circular No. A-87 and other applicable cost principles and regulations. The costs of Government audits performed in accordance with this paragraph shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE XI - FEDERAL AND STATE LAWS

In the exercise of their respective rights and obligations under this Agreement, the State and the Government agree to comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulations 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

ARTICLE XII - RELATIONSHIP OF PARTIES

A. In the exercise of their respective rights and obligations under this Agreement, the Government and the State each act in an independent capacity, and neither is to be considered the officer, agent, or employee of the other.

B. In the exercise of its rights and obligations under this Agreement, neither party shall provide, without the consent of the other party, any contractor with a release that waivers or purports to waive any rights such other party may have to seek relief or redress against such contractor either pursuant to any cause of action that such other party may have or for violation of any law.

ARTICLE XIII - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, nor any resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XIV - TERMINATION OR SUSPENSION

A. If at any time the State fails to fulfill its obligations under Article II.B., II.D., II.E., VI, or XVIII.C. of this Agreement, the Assistant Secretary of the Army (Civil Works) shall terminate this Agreement or suspend future performance under this Agreement unless he determines that continuation of work on the Project is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project.

B. If the Government fails to receive annual appropriations in amounts sufficient to meet Project expenditures for the then-current or upcoming fiscal year, the Government shall so notify the State in writing, and 60 calendar days thereafter either party may elect without penalty to terminate this Agreement or to suspend future performance under this Agreement. In the event that either party elects to suspend future performance under this Agreement pursuant to this paragraph, such suspension shall remain in effect until such time as the Government receives sufficient appropriations or until either the Government or the State elects to terminate this Agreement.

C. In the event that either party elects to terminate this Agreement pursuant to this Article or Article XV of this Agreement, both parties shall conclude their activities relating to the Project and proceed to a final accounting in accordance with Article VI.D. of this Agreement.

D. Any termination of this Agreement or suspension of future performance under this Agreement in accordance with this Article or Article XV of this Agreement shall not relieve the parties of liability for any obligation previously incurred. Any delinquent payment shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13-week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

ARTICLE XV - HAZARDOUS SUBSTANCES

A. After execution of this Agreement and upon direction by the District Engineer, the State shall perform, or cause to be performed, any investigations for hazardous substances that the Government or the State determines to be necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (hereinafter "CERCLA"), 42 U.S.C. Sections 9601-9675, that may exist in, on, or under lands, easements, and rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the District Engineer provides the State with prior specific written direction, in which case the State shall perform such investigations in accordance with such written direction. All actual costs incurred by the State for such investigations for hazardous substances shall be included in total project costs and cost shared in accordance with the provisions of this Agreement, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

B. In the event it is discovered through any investigation for hazardous substances or other means that hazardous substances regulated under CERCLA exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project, the State and the Government shall provide prompt written notice to each other, and the State shall not proceed with the acquisition of the real property interests until both parties agree that the State should proceed.

C. The Government and the State shall determine whether to initiate construction of the Project, or, if already in construction, whether to continue with work on the Project, suspend future performance under this Agreement, or terminate this Agreement for the convenience of the Government, in any case where hazardous substances regulated under CERCLA are found to exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project. Should the Government and the State determine to initiate or continue with construction after considering any liability that may arise under CERCLA, the State shall be responsible, as between the Government and the State, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination. Such costs shall not be considered a part of total project costs. In the event the State fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge the State's responsibilities under this paragraph upon direction by the Government, the Government may, in its sole discretion, either terminate this Agreement for the convenience of the Government, suspend future performance under this Agreement, or continue work on the Project.

D. The State and the Government shall consult with each other in accordance with Article V of this Agreement in an effort to ensure that responsible parties bear any necessary clean up and response costs as defined in CERCLA. Any decision made pursuant to paragraph C. of this Article shall not relieve any third party from any liability that may arise under CERCLA.

E. As between the Government and the State, the State shall be considered the operator of the Project for purposes of CERCLA liability. To the maximum extent practicable, the State shall operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

ARTICLE XVI - NOTICES

a. Any notice, request, demand, or other communication required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and either delivered personally or by telegram or mailed by first-class, registered, or certified mail, as follows:

If to the State:

Director
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, Iowa 50319-0034

If to the Government:

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

B. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

C. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at the earlier of such time as it is actually received or seven calendar days after it is mailed.

ARTICLE XVII - CONFIDENTIALITY

To the extent permitted by the laws governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

ARTICLE XVIII - HISTORIC PRESERVATION

A. The costs of identification, survey and evaluation of historic properties shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

B. As specified in Section 7(a) of Public Law 93-291 (16 U.S.C. Section 469c(a)), the costs of mitigation and data recovery activities associated with historic preservation shall be borne entirely by the Government and shall not be included in total project costs, up to the statutory limit of one percent of the total amount authorized to be appropriated for the Project.

C. The Government shall not incur cost for mitigation and data recovery that exceed the statutory one percent limit specified in paragraph B. of this Article unless and until the Assistant Secretary of the Army (Civil Works) has waived that limit in accordance with Section 208(3) of Public Law 96-515 (16 U.S.C. Section 469c-2(3)). Any costs of mitigation and data recovery that exceed the one percent limit shall not be included in total project costs but shall be cost shared between the State and the Government consistent with the minimum non-Federal cost sharing requirements for the underlying habitat rehabilitation and enhancement project, as follows: 25 percent borne by the Non-Federal Sponsor, and 75 percent borne by the Government.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the Assistant Secretary of the Army (Civil Works).

THE DEPARTMENT OF THE ARMY	THE STATE OF IOWA, DEPARTMENT OF NATURAL RESOURCES
BY: ____________________ Charles S. Cox Colonel, U.S. Army District Engineer	BY: ____________________ Director Iowa Department of Natural Resources
DATE: ________________	DATE: ________________

CERTIFICATE OF AUTHORITY

I, ________________________________, do hereby certify that I am the Attorney General for the State of Iowa, that the State of Iowa is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the State of Iowa in connection with a Habitat Rehabilitation and Enhancement Project at, Princeton Wildlife Management area, in Scott County, Iowa, and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, as amended, and that the person who has executed this Agreement on behalf of the State of Iowa has acted within his statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this __________ day of _______________, 19____.

____
Attorney General for
the State of Iowa

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrant, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

STATE OF IOWA DEPARTMENT OF NATURAL RESOURCES

BY: ______________________
Director

DATE: ____________________

CERTIFICATION OF LEGAL REVIEW

The draft Project Cooperation Agreement for Construction of Princeton Wildlife management area Rehabilitation and Enhancement Project at Scott County, Iowa, has been fully reviewed by the Office of Chief Counsel, USAED, Rock Island.

THOMAS F. CRANE
District Counsel

HABITAT EVALUATION AND QUANTIFICATION

APPENDIX F

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX F
HABITAT EVALUATION AND QUANTIFICATION

TABLE OF CONTENTS

List of Figures

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

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SCOTT COUNTY, IOWA

APPENDIX F
HABITAT EVALUATION AND QUANTIFICATION

PURPOSE

The purpose of this appendix is to present an overview and the results of the process used for quantification of habitat outputs for this enhancement project. The method was applied by an inter-agency team composed of staff members from the U.S. Fish and Wildlife Service (USFWS), the Iowa Department of Natural Resources (IADNR), and the U.S. Army Corps of Engineers.

BACKGROUND

The need for quantification of HREP outputs as a project performance evaluation tool, a project ranking tool, and a project planning tool has been discussed by various agencies associated with the UMRS-EMP. This application involves quantification solely for the purpose of project planning.

The benefits to be derived from habitat rehabilitation and enhancement projects are not readily convertible to actual monetary units as is customarily required for traditional benefit-cost analyses. A method of quantification is needed to adequately evaluate project features for planning, design, and administrative purposes.

Measurable changes in habitat value can be described by suitability indices, habitat units, animal numbers, or animal use days.

The selected approach is referred to as a Habitat Unit (HU) accounting methodology. Several similar methodologies exist at this time, such as Habitat Evaluation Procedures (HEP), which was developed by the USFWS as an impact assessment tool; Habitat Evaluation System (HES), which was developed by the Corps of Engineers also as an impact assessment method; and Habitat Management Evaluation Method (HMEM), which was developed by the Bureau of Reclamation. Of the three methodologies referenced, HEP is likely to be the most familiar to all participants in the EMP. Based on the HEP, the Missouri Department of Conservation (MDOC) and the U.S. Soil Conservation Service (SCS) developed a regional habitat appraisal model called Wildlife Habitat Appraisal Guide (WHAG). The WHAG is a field evaluation procedure designed to estimate habitat quality and to account for changes due to land management practices.

METHODOLOGY

NOMENCLATURE

Habitat Suitability Index **(HSI)** = Index of habitat quality or suitability for particular species derived by a numeric ranking of life requisite characteristics at selected sample sites.

Habitat Unit **(HU)** = (Acreage of a particular habitat type) * (HSI value). HUs represent a numeric estimate of usable habitat for particular species within a defined area.

Average Annual Habitat Unit **(AAHU)** = AAHUs represent an average HU value based on annualization of HUs over a series of selected Target Years (TY). AAHUs account for changes in habitat values over the life of a project.

For this project, HUs were chosen as the unit of comparison for project features or alternative plans. HUs are derived by multiplying habitat acreages or volumes by habitat quality, determined by HSIs. HSIs result from numeric ranking of site characteristics at sample sites throughout a given project area.

Numeric ranking for terrestrial and wetland habitat values was accomplished using the existing Wildlife Habitat Appraisal Guide (WHAG) field data sheets for forested and non-forested wetlands and a computer program developed by the Missouri Department of Conservation and the U.S. Soil Conservation Service. A brief example of site characteristics is listed below.

WHAG Site Characteristics for Forested and Non-Forested Wetlands

Percent of the study area non-forested wetland
Percent of the study area lake or reservoir
Water level control
Substrate conditions
Average water depth
Emergent vegetation coverage
Vegetative species diversity
Size of the wetland
Percent of the area covered by food plants

Woodland size class and canopy coverage
Ratio of mudflats to permanent water
Hydrologic conditions
Number of cavity trees
Extent of forest openings
Understory density and diversity

Additional characteristics used in the grassland and cropland matrices are as follows:

WHAG Site Characteristics for Grassland and Cropland Wetlands

Cropfield management
Cropping practice
Crop rotation
Field size
Herbaceous vegetation height and composition
Distance to grassland
Proximity to major river or lake

Computer results are provided for estimated total HUs and calculated HSI values for the forested, non-forested, grassland, and cropland components of the project. After existing conditions were determined, the study team reviewed the habitat appraisal guides to determine where habitat quality can be improved. HUs were annualized for target years using the USFWS HEP 80 program in order to evaluate changes in project features over time.

Habitat quality ratings can be improved by: (1) increasing acreages 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.

Primary project goals for habitat enhancement include improving water level control to enhance management capability and create additional marshland habitat. Benefits will accrue to migratory birds, furbearers, and endangered species. These goals led the study team to select appraisal guides for wetland habitats, with the mallard and green-backed heron as target species (species of emphasis).

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.

ASSUMPTIONS

a. Target years of 0, 1, 15, and 50 are sufficient to annualize HUs and characterize habitat changes over the estimated project life.

b. Alternatives evaluated represent available options to modify habitat suitability for migratory birds and other marsh-dwelling species, and are represented by the habitat categories of forested wetland, non-forested wetland, cropland, and grassland.

c. The IADNR would continue to manage fall water levels to a maximum elevation of 575.5 feet, and that the private property adjacent to the IADNR land (which is needed to manage above elevation 575.5) would not be acquired in the foreseeable future. [Note: The 14 acres in question, adjacent to the southwest corner of the Princeton Wildlife Management Area (WMA), will be considered for acquisition if and when there are willing sellers.]

d. The existing levee's current level of integrity/projection would remain essentially the same over the 50-year project life.

e. There would be minimal changes in habitat over the project life, with the exception of a gradual decrease in bottomland forest for the next 10-15 years.

f. The mallard and green-backed heron are suitable species of emphasis, representing game and non-game migratory birds, and characterizing life requisite requirements for the purpose of incremental analysis of this project.

g. The muskrat, wood duck, Canada goose, least bittern, lesser yellowlegs, king rail, coot, beaver, prothonotary warbler and northern parula are suitable species for evaluation of overall wetland values, and changes in these values resulting from construction of the features proposed for this project.

h. Improved water level control will result in desired changes in vegetative composition and distribution, with the exception of possible pin oak mortality near existing agricultural fields in the northwest.

RESULTS

Alternatives evaluated for the Princeton WMA included Alternative A - No Federal Action; Alternative B - Levee Restoration; Alternative C - Levee Restoration/Mast Tree Planting; Alternative D - 1-Cell Wetland Management Unit (WMU) Enhancement; Alternative E - 1-Cell WMU/Mast Tree Planting; Alternative F - 2-Cell WMU; and Alternative G - 2-Cell WMU/Mast Tree Planting. Each alternative was composed of enhancement features which were evaluated independently. The WHAG analysis of these features is shown in Figures F-1 through F-7 and Tables F-1 and F-2.

The interagency WHAG team assessed the existing conditions of the project area using field evaluation sheets for each of the habitat types in the project area. The results are presented as HUs and AAHUs for the selected target years (TY) for each project alternative. The WHAG analysis evaluated a wetland species group, with two designated target species, to derive a representative picture of existing conditions at Princeton. Future conditions without construction of the project were predicted for TY1, TY15, and TY50 based on the existing conditions, successional changes over time, and any management practices that may be implemented with or without the proposed project.

The remainder of this section provides the numerical assessment, while the Discussion section provides the narrative interpretation of the analysis.

The WHAG wetland matrix was used to evaluate habitat quality for the existing conditions (without project) and for the three proposed management options. Without-project HSIs show a slight increase for mallards, wood ducks, and the warbler species through TY50; habitat for the remaining species remains static or declines (see Table 7 of the Coordination Act Report in Appendix B). With improved water level control, 9 of the 12 evaluation species show increases in HSIs (see Table 8 of the Coordination Act Report in Appendix B). Species which show decreases may be reflecting losses of timber which occur with higher water levels. Tables 9 and 11 of the Coordination Act Report in Appendix B, as well as Table 1 of the Supplementary Coordination Act Report also show increases in AAHUs as the features of improved water level control and mast tree planting are incorporated along with the levee upgrade.

Figures F-3 through F-7 depict habitat changes with the various water level management options (1-cell vs. 2-cell) and with the addition of mast tree planting. Numerically, the 1- and 2-cell options are similar in their effects (Figures F-3 and F-5), but, as discussed in the main report, the 1-cell scheme results in a large proportion of deep water as well as impacts on adjacent private lands. Figure F-4 reflects the large decrease in habitat value for all species when analysis is done with the theoretical loss of 213 acres of shallow water habitat.

Mast tree planting restores some of the benefits lost due to tree mortality over time, particularly for prothonotary warblers and green-backed herons (Figure F-7; Table 11, Coordination Act Report in Appendix B).

DISCUSSION

The results of the WHAG analysis appear to confirm that the Princeton WMA is a well-functioning wetland complex, but can be enhanced with the features proposed for this project. Results of the WHAG application were compared as increments to costs where applicable. This incremental analysis is discussed in Section 7 (Evaluation of Alternatives) of the main report.

The proposed project for the Princeton WMA involves three primary enhancement features: levee upgrading, improved water level control, and mast tree planting. As explained in the text of the main report, improvement of the existing levee is considered an essential starting point for implementation of these features. Thus, the incremental cost analysis evaluated levee restoration by itself and in combination with the two water control options and mast tree planting.

This project is designed to enhance habitat for wetland-dependent birds and to some extent furbearing mammals. Fisheries enhancement was not considered. Levee improvements by themselves resulted in habitat unit increases for half of the evaluation species and relatively smaller decreases for the others (see Figures F-1 and F-2). These changes are due primarily to corrresponding conversion of cropland to non-forested wetland at the borrow sites. The WHAG program weights certain habitat characteristics according to species, and these weightings can be reflected when habitat type areal changes occur. The simple fact that pumping plant already exists at the site is reflected in the relatively small HU gain when the improved water level control option is added. Additively, however, these two features display significant benefits for the project site and for a majority of the evaluation species. The analysis also showed that a 1-cell operation could not be justified on the basis of undesirable water depths and resultant disbenefits for the target species (Figure 7-1).

The addition of mast tree planting restores habitat benefits for some of the evaluation species, particularly in the out-years of the project. This addition comes at a relatively low cost and also provides additional diversity to the existing habitat mix.

In conclusion, the WHAG analysis indicates that a 2-cell water control option will best capitalize upon the improved levee. This combination will allow the IADNR manager optimal management flexibility conditioned on existing area topography. Mast tree planting adds to habitat quality and diversity.

ROCK ISLAND DISTRICT CORPS OF ENGINEERS
FISH AND WILDLIFE SERVICE ROCK ISLAND

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA

FUTURE WITHOUT PROJECT CONDITIONS

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCEWO	7	PRINCETON HREP
TARGET YR 15 = PRINCEWO	7	PRINCETON HREP
TARGET YR 50 = PRINCEWO	7	PRINCETON HREP

FILE PRINCEWO CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND   TODAY'S DATE 02-17-1992

THESE DATA SETS ARE FOR FUTURE WITHOUT PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	404	404	404
BOTTOMLAND HARDWOODS-W	393	393	393	393
CROPLAND-WETLAND	179	179	179	179
GRASSLAND-WETLAND	68	68	68	68
TOTAL	1044	1044	1044	1044

FIGURE F-1

ACRES OF AVAILABLE HABITAT

SPECIES	PRESENT ACRES	T YR 1 ACRES	T YR 1 % CHANGE	T YR 15 ACRES	T YR 15 % CHANGE	T YR 50 ACRES	T YR 50 % CHANGE
MALL	976.0	976.0	0.0%	976.0	0.0%	976.0	0.0%
GOOS	651.0	651.0	0.0%	651.0	0.0%	651.0	0.0%
BITT	404.0	404.0	0.0%	404.0	0.0%	404.0	0.0%
YLEG	404.0	404.0	0.0%	404.0	0.0%	404.0	0.0%
MUSK	404.0	404.0	0.0%	404.0	0.0%	404.0	0.0%
RAIL	404.0	404.0	0.0%	404.0	0.0%	404.0	0.0%
HERO	797.0	797.0	0.0%	797.0	0.0%	797.0	0.0%
DUCK	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
BEAV	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
COOT	404.0	404.0	0.0%	404.0	0.0%	404.0	0.0%
PARU	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
PROT	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%

(TARGET YEARS: T YR 1, T YR 15, T YR 50)

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

SPECIES	PRESENT INDEX	T YR 1 INDEX	T YR 1 % CHANGE	T YR 15 INDEX	T YR 15 % CHANGE	T YR 50 INDEX	T YR 50 % CHANGE
MALL	0.51	0.51	1.9%	0.53	5.3%	0.54	6.1%
GOOS	0.22	0.22	0.0%	0.22	0.0%	0.22	0.0%
BITT	0.72	0.72	0.0%	0.71	-1.3%	0.68	-6.0%
YLEG	0.24	0.24	0.0%	0.24	0.0%	0.24	0.0%
MUSK	0.27	0.27	0.0%	0.27	-1.3%	0.27	-1.3%
RAIL	0.44	0.44	0.0%	0.42	-4.3%	0.41	-7.5%
HERO	0.52	0.53	1.7%	0.50	-4.0%	0.50	-5.4%
DUCK	0.37	0.37	0.0%	0.38	2.2%	0.39	5.5%
BEAV	0.58	0.58	0.0%	0.52	-9.8%	0.51	-12.3%
COOT	0.27	0.27	0.0%	0.27	0.0%	0.27	0.0%
PARU	0.40	0.43	6.3%	0.50	25.0%	0.50	25.0%
PROT	0.43	0.56	29.9%	0.60	39.3%	0.60	39.3%

(TARGET YEARS: T YR 1, T YR 15, T YR 50)

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-1 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
MALL	492.9	502.3	1.9%	519.1	5.3%	522.9	6.1%
GOOS	141.9	141.9	0.0%	141.9	0.0%	141.9	0.0%
BITT	290.5	290.5	0.0%	286.6	-1.3%	273.2	-6.0%
YLEG	95.1	95.1	0.0%	95.1	0.0%	95.1	0.0%
MUSK	108.5	108.5	0.0%	107.1	-1.3%	107.1	-1.3%
RAIL	178.9	178.9	0.0%	171.2	-4.3%	165.4	-7.5%
HERO	417.4	424.5	1.7%	400.6	-4.0%	394.8	-5.4%
DUCK	146.7	146.7	0.0%	149.9	2.2%	154.7	5.5%
BEAV	227.1	227.1	0.0%	204.8	-9.8%	199.2	-12.3%
COOT	107.7	107.7	0.0%	107.7	0.0%	107.7	0.0%
PARU	157.2	167.0	6.2%	196.5	25.0%	196.5	25.0%
PROT	168.8	219.3	29.9%	235.2	39.3%	235.2	39.3%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-1 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	517.6
CANADA GOOSE	141.9
LEAST BITTERN	282.5
LESSER YELLOWLEGS	95.1
MUSKRAT	107.3
KING RAIL	170.4
GREEN-BACKED HERON	402.3
WOOD DUCK	151.0
BEAVER	206.4
AMERICAN COOT	107.7
NORTHERN PARULA	191.7
PROTHONOTARY WARBLER	232.2

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-1 (Cont'd)

U.S. FISH AND WILDLIFE SERVICE
ROCK ISLAND FIELD OFFICE, ILLINOIS

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA FUTURE WITH PROJECT

LEVEE IMPROVEMENT/SELECTED BORROW

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCEWO	7	PRINCETON HREP
TARGET YR 15 = PRINCEWO	7	PRINCETON HREP
TARGET YR 50 = PRINCEWO	7	PRINCETON HREP

FILE PRINCEWO CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND   TODAY'S DATE 07-19-1994

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	447	447	447
BOTTOMLAND HARDWOODS-W	389	389	389	389
CROPLAND-WETLAND	179	136	136	136
GRASSLAND-WETLAND	72	72	72	72
TOTAL	1044	1044	1044	1044

FIGURE F-2

ACRES OF AVAILABLE HABITAT

SPECIES	PRESENT ACRES	TARGET YEARS T YR 1 ACRES	T YR 1 % CHANGE	T YR 15 ACRES	T YR 15 % CHANGE	T YR 50 ACRES	T YR 50 % CHANGE
MALL	972.0	972.0	0.0%	972.0	0.0%	972.0	0.0%
GOOS	655.0	655.0	0.0%	655.0	0.0%	655.0	0.0%
BITT	404.0	447.0	10.6%	447.0	10.6%	447.0	10.6%
YLEG	404.0	447.0	10.6%	447.0	10.6%	447.0	10.6%
MUSK	404.0	447.0	10.6%	447.0	10.6%	447.0	10.6%
RAIL	404.0	447.0	10.6%	447.0	10.6%	447.0	10.6%
HERO	793.0	836.0	5.4%	836.0	5.4%	836.0	5.4%
DUCK	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
BEAV	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
COOT	404.0	447.0	10.6%	447.0	10.6%	447.0	10.6%
PARU	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
PROT	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

SPECIES	PRESENT INDEX	TARGET YEARS T YR 1 INDEX	T YR 1 % CHANGE	T YR 15 INDEX	T YR 15 % CHANGE	T YR 50 INDEX	T YR 50 % CHANGE
MALL	0.50	0.51	0.5%	0.52	3.9%	0.53	4.7%
GOOS	0.22	0.21	-2.3%	0.21	-2.3%	0.21	-2.3%
BITT	0.72	0.72	0.0%	0.71	-1.3%	0.68	-6.0%
YLEG	0.24	0.24	0.0%	0.24	0.0%	0.24	0.0%
MUSK	0.27	0.27	0.0%	0.27	-1.3%	0.27	-1.3%
RAIL	0.44	0.44	0.0%	0.42	-4.3%	0.41	-7.5%
HERO	0.52	0.53	1.6%	0.51	-3.6%	0.50	-5.2%
DUCK	0.37	0.37	0.0%	0.38	2.2%	0.39	5.5%
BEAV	0.58	0.58	0.0%	0.52	-9.8%	0.51	-12.3%
COOT	0.27	0.27	0.0%	0.27	0.0%	0.27	0.0%
PARU	0.40	0.43	6.3%	0.50	25.0%	0.50	25.0%
PROT	0.43	0.56	29.9%	0.60	39.3%	0.60	39.3%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-2 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
		TARGET YEARS					
MALL	490.7	493.2	0.5%	509.9	3.9%	513.6	4.7%
GOOS	142.9	139.6	-2.3%	139.6	-2.3%	139.6	-2.3%
BITT	290.5	321.4	10.6%	317.2	9.2%	302.3	4.0%
YLEG	95.1	105.2	10.6%	105.2	10.6%	105.2	10.6%
MUSK	108.5	120.1	10.6%	118.5	9.2%	118.5	9.2%
RAIL	178.9	198.0	10.6%	189.4	5.9%	183.1	2.3%
HERO	415.4	445.0	7.1%	422.2	1.7%	415.2	-0.0%
DUCK	145.2	145.2	0.0%	148.4	2.2%	153.1	5.5%
BEAV	224.8	224.8	0.0%	202.7	-9.8%	197.2	-12.3%
COOT	107.7	119.2	10.6%	119.2	10.6%	119.2	10.6%
PARU	155.6	165.3	6.2%	194.5	25.0%	194.5	25.0%
PROT	167.1	217.1	29.9%	232.8	39.3%	232.8	39.3%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-2 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	508.5
CANADA GOOSE	139.6
LEAST BITTERN	312.3
LESSER YELLOWLEGS	105.1
MUSKRAT	118.6
KING RAIL	188.4
GREEN-BACKED HERON	423.1
WOOD DUCK	149.5
BEAVER	204.3
AMERICAN COOT	119.1
NORTHERN PARULA	189.7
PROTHONOTARY WARBLER	229.8

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-2 (Cont'd)

ROCK ISLAND DISTRICT CORPS OF ENGINEERS
FISH AND WILDLIFE SERVICE ROCK ISLAND

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA FUTURE WITH PROJECT

1-CELL MANAGEMENT OPTION

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCNAT	7	PRINCETON HREP
TARGET YR 15 = PRINCNAT	7	PRINCETON HREP
TARGET YR 50 = PRINCNAT	7	PRINCETON HREP

FILE PRINCNAT CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND

TODAY'S DATE 02-17-1992

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	461	461	461
BOTTOMLAND HARDWOODS-W	393	393	393	393
CROPLAND-WETLAND	179	122	122	122
GRASSLAND-WETLAND	68	68	68	68
TOTAL	1044	1044	1044	1044

FIGURE F-3

ACRES OF AVAILABLE HABITAT

SPECIES	PRESENT ACRES	TARGET YEARS T YR 1 ACRES	T YR 1 % CHANGE	T YR 15 ACRES	T YR 15 % CHANGE	T YR 50 ACRES	T YR 50 % CHANGE
MALL	976.0	976.0	0.0%	976.0	0.0%	976.0	0.0%
GOOS	651.0	651.0	0.0%	651.0	0.0%	651.0	0.0%
BITT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
YLEG	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
MUSK	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
RAIL	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
HERO	797.0	854.0	7.2%	854.0	7.2%	854.0	7.2%
DUCK	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
BEAV	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
COOT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
PARU	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
PROT	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

SPECIES	PRESENT INDEX	TARGET YEARS T YR 1 INDEX	T YR 1 % CHANGE	T YR 15 INDEX	T YR 15 % CHANGE	T YR 50 INDEX	T YR 50 % CHANGE
MALL	0.51	0.68	35.6%	0.70	39.0%	0.71	40.2%
GOOS	0.22	0.32	46.9%	0.33	49.2%	0.33	49.2%
BITT	0.72	0.74	2.3%	0.78	8.3%	0.75	4.3%
YLEG	0.24	0.10	-57.5%	0.10	-57.5%	0.10	-57.5%
MUSK	0.27	0.37	38.1%	0.39	43.4%	0.39	43.4%
RAIL	0.44	0.60	35.5%	0.59	32.3%	0.59	32.3%
HERO	0.52	0.53	1.3%	0.52	-1.7%	0.51	-2.9%
DUCK	0.37	0.34	-8.8%	0.38	2.8%	0.42	12.7%
BEAV	0.58	0.36	-37.3%	0.32	-44.0%	0.30	-48.9%
COOT	0.27	0.39	47.7%	0.73	174.2%	0.73	174.2%
PARU	0.40	0.27	-33.3%	0.40	0.0%	0.41	1.4%
PROT	0.43	0.32	-24.8%	0.38	-12.6%	0.40	-6.4%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-3 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
		TARGET YEARS					
MALL	492.9	668.5	35.6%	684.9	39.0%	691.2	40.2%
GOOS	141.9	208.4	46.9%	211.7	49.2%	211.7	49.2%
BITT	290.5	339.2	16.8%	358.9	23.6%	345.8	19.0%
YLEG	95.1	0.0	-100.0%	0.0	-100.0%	0.0	-100.0%
MUSK	108.5	171.0	57.5%	177.6	63.7%	177.6	63.7%
RAIL	178.9	276.6	54.6%	270.0	50.9%	270.0	50.9%
HERO	417.4	453.1	8.5%	439.9	5.4%	434.2	4.0%
DUCK	146.7	133.7	-8.8%	150.8	2.8%	165.3	12.7%
BEAV	227.1	142.4	-37.3%	127.3	-44.0%	116.0	-48.9%
COOT	107.7	181.5	68.5%	337.1	212.9%	337.1	212.9%
PARU	157.2	104.8	-33.3%	157.2	0.0%	159.4	1.4%
PROT	168.8	126.9	-24.8%	147.5	-12.6%	158.0	-6.4%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-3 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	682.7
CANADA GOOSE	210.5
LEAST BITTERN	350.7
LESSER YELLOWLEGS	46.6
MUSKRAT	175.9
KING RAIL	270.1
GREEN-BACKED HERON	439.6
WOOD DUCK	153.3
BEAVER	126.6
AMERICAN COOT	311.5
NORTHERN PARULA	150.1
PROTHONOTARY WARBLER	148.3

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-3 (Cont'd)

ROCK ISLAND DISTRICT CORPS OF ENGINEERS
FISH AND WILDLIFE SERVICE ROCK ISLAND

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA FUTURE WITH PROJECT

1-CELL MANAGEMENT OPTION, LESS

213 ACRES DEEP WATER

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD
2	GOOS	CANADA GOOSE
3	BITT	LEAST BITTERN
4	YLEG	LESSER YELLOWLEGS
5	MUSK	MUSKRAT
6	RAIL	KING RAIL
7	HERO	GREEN-BACKED HERON
8	DUCK	WOOD DUCK
9	BEAV	BEAVER
10	COOT	AMERICAN COOT
11	PARU	NORTHERN PARULA
12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCNAT	7	PRINCETON HREP
TARGET YR 15 = PRINCNAT	7	PRINCETON HREP
TARGET YR 50 = PRINCNAT	7	PRINCETON HREP

FILE PRINCNAT CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND

TODAY'S DATE 02-17-1992

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	248	248	248
BOTTOMLAND HARDWOODS-W	393	393	393	393
CROPLAND-WETLAND	179	122	122	122
GRASSLAND-WETLAND	68	68	68	68
TOTAL	1044	831	831	831

FIGURE F-4

ACRES OF AVAILABLE HABITAT

		TARGET YEARS					
	PRESENT	T YR 1		T YR 15		T YR 50	
SPECIES	ACRES	ACRES	% CHANGE	ACRES	% CHANGE	ACRES	% CHANGE
MALL	976.0	763.0	-21.8%	763.0	-21.8%	763.0	-21.8%
GOOS	651.0	438.0	-32.7%	438.0	-32.7%	438.0	-32.7%
BITT	404.0	248.0	-38.6%	248.0	-38.6%	248.0	-38.6%
YLEG	404.0	248.0	-38.6%	248.0	-38.6%	248.0	-38.6%
MUSK	404.0	248.0	-38.6%	248.0	-38.6%	248.0	-38.6%
RAIL	404.0	248.0	-38.6%	248.0	-38.6%	248.0	-38.6%
HERO	797.0	641.0	-19.6%	641.0	-19.6%	641.0	-19.6%
DUCK	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
BEAV	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
COOT	404.0	248.0	-38.6%	248.0	-38.6%	248.0	-38.6%
PARU	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%
PROT	393.0	393.0	0.0%	393.0	0.0%	393.0	0.0%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

		TARGET YEARS					
	PRESENT	T YR 1		T YR 15		T YR 50	
SPECIES	INDEX	INDEX	% CHANGE	INDEX	% CHANGE	INDEX	% CHANGE
MALL	0.51	0.65	28.6%	0.67	32.6%	0.68	34.2%
GOOS	0.22	0.31	41.8%	0.31	43.7%	0.31	43.7%
BITT	0.72	0.74	2.3%	0.78	8.3%	0.75	4.3%
YLEG	0.24	0.10	-57.5%	0.10	-57.5%	0.10	-57.5%
MUSK	0.27	0.37	38.1%	0.39	43.4%	0.39	43.4%
RAIL	0.44	0.60	35.5%	0.59	32.3%	0.59	32.3%
HERO	0.52	0.48	-8.7%	0.46	-12.6%	0.45	-14.0%
DUCK	0.37	0.34	-8.8%	0.38	2.8%	0.42	12.7%
BEAV	0.58	0.36	-37.3%	0.32	-44.0%	0.30	-48.9%
COOT	0.27	0.39	47.7%	0.73	174.2%	0.73	174.2%
PARU	0.40	0.27	-33.3%	0.40	0.0%	0.41	1.4%
PROT	0.43	0.32	-24.8%	0.38	-12.6%	0.40	-6.4%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-4 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
		TARGET YEARS					
MALL	492.9	495.6	0.5%	510.8	3.6%	517.0	4.9%
GOOS	141.9	135.4	-4.6%	137.2	-3.3%	137.2	-3.3%
BITT	290.5	182.5	-37.2%	193.1	-33.5%	186.0	-36.0%
YLEG	95.1	0.0	-100.0%	0.0	-100.0%	0.0	-100.0%
MUSK	108.5	92.0	-15.2%	95.6	-12.0%	95.6	-12.0%
RAIL	178.9	148.8	-16.8%	145.3	-18.8%	145.3	-18.8%
HERO	417.4	306.5	-26.6%	293.3	-29.7%	288.8	-30.8%
DUCK	146.7	133.7	-8.8%	150.8	2.8%	165.3	12.7%
BEAV	227.1	142.4	-37.3%	127.3	-44.0%	116.0	-48.9%
COOT	107.7	97.7	-9.4%	181.4	68.3%	181.4	68.3%
PARU	157.2	104.8	-33.3%	157.2	0.0%	159.4	1.4%
PROT	168.9	126.9	-24.8%	147.5	-12.6%	158.0	-6.4%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-4 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	510.6
CANADA GOOSE	137.0
LEAST BITTERN	190.0
LESSER YELLOWLEGS	25.4
MUSKRAT	95.2
KING RAIL	146.2
GREEN-BACKED HERON	294.9
WOOD DUCK	153.3
BEAVER	126.6
AMERICAN COOT	168.1
NORTHERN PARULA	150.1
PROTHONOTARY WARBLER	148.3

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-4 (Cont'd)

ROCK ISLAND DISTRICT CORPS OF ENGINEERS
FISH AND WILDLIFE SERVICE ROCK ISLAND

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA FUTURE WITH PROJECT

2-CELL MANAGEMENT OPTION

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCNAT	7	PRINCETON HREP
TARGET YR 15 = PRINCNAT	7	PRINCETON HREP
TARGET YR 50 = PRINCNAT	7	PRINCETON HREP

FILE PRINCNAT CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND

TODAY'S DATE 02-17-1992

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT	TARGET YEARS		
	0	1	15	50
NONFOREST WETLAND	404	461	461	461
BOTTOMLAND HARDWOODS-W	389	389	389	389
CROPLAND-WETLAND	179	122	122	122
GRASSLAND-WETLAND	72	72	72	72
TOTAL	1044	1044	1044	1044

FIGURE F-5

ACRES OF AVAILABLE HABITAT

SPECIES	PRESENT ACRES	T YR 1 ACRES	T YR 1 % CHANGE	T YR 15 ACRES	T YR 15 % CHANGE	T YR 50 ACRES	T YR 50 % CHANGE
MALL	972.0	972.0	0.0%	972.0	0.0%	972.0	0.0%
GOOS	655.0	655.0	0.0%	655.0	0.0%	655.0	0.0%
BITT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
YLEG	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
MUSK	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
RAIL	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
HERO	793.0	850.0	7.2%	850.0	7.2%	850.0	7.2%
DUCK	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
BEAV	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
COOT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
PARU	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
PROT	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

SPECIES	PRESENT INDEX	T YR 1 INDEX	T YR 1 % CHANGE	T YR 15 INDEX	T YR 15 % CHANGE	T YR 50 INDEX	T YR 50 % CHANGE
MALL	0.50	0.69	35.8%	0.70	39.1%	0.71	40.4%
GOOS	0.22	0.32	46.6%	0.32	48.9%	0.32	48.9%
BITT	0.72	0.74	2.3%	0.78	8.3%	0.75	4.3%
YLEG	0.24	0.10	-57.5%	0.10	-57.5%	0.10	-57.5%
MUSK	0.27	0.37	38.1%	0.39	43.4%	0.39	43.4%
RAIL	0.44	0.60	35.5%	0.59	32.3%	0.59	32.3%
HERO	0.52	0.53	1.5%	0.52	-1.5%	0.51	-2.8%
DUCK	0.37	0.34	-8.8%	0.38	2.8%	0.42	12.7%
BEAV	0.58	0.36	-37.3%	0.32	-44.0%	0.30	-48.9%
COOT	0.27	0.39	47.7%	0.73	174.2%	0.73	174.2%
PARU	0.40	0.27	-33.3%	0.40	0.0%	0.41	1.4%
PROT	0.43	0.32	-24.8%	0.38	-12.6%	0.40	-6.4%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-5 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
MALL	490.7	666.2	35.8%	682.5	39.1%	688.7	40.4%
GOOS	142.9	209.5	46.6%	212.8	48.9%	212.8	48.9%
BITT	290.5	339.2	16.8%	358.9	23.6%	345.8	19.0%
YLEG	95.1	0.0	-100.0%	0.0	-100.0%	0.0	-100.0%
MUSK	108.5	171.0	57.5%	177.6	63.7%	177.6	63.7%
RAIL	178.9	276.6	54.6%	270.0	50.9%	270.0	50.9%
HERO	415.4	451.7	8.8%	438.6	5.6%	433.0	4.2%
DUCK	145.2	132.4	-8.8%	149.2	2.8%	163.6	12.7%
BEAV	224.8	141.0	-37.3%	126.0	-44.0%	114.8	-48.9%
COOT	107.7	181.5	68.5%	337.1	212.9%	337.1	212.9%
PARU	155.6	103.7	-33.3%	155.6	0.0%	157.8	1.4%
PROT	167.1	125.6	-24.8%	146.0	-12.6%	156.4	-6.4%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-5 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	680.3
CANADA GOOSE	211.6
LEAST BITTERN	350.7
LESSER YELLOWLEGS	46.6
MUSKRAT	175.9
KING RAIL	270.1
GREEN-BACKED HERON	438.4
WOOD DUCK	151.7
BEAVER	125.3
AMERICAN COOT	311.5
NORTHERN PARULA	148.6
PROTHONOTARY WARBLER	146.8

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-5 (Cont'd)

U.S. FISH AND WILDLIFE SERVICE
ROCK ISLAND FIELD OFFICE, ILLINOIS

WILDLIFE HABITAT APPRAISAL GUIDE

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

PRINCETON WMA FUTURE WITH PROJECT
2-CELL MANAGEMENT OPTION
LESS 46 ACRES
DEEP WATER

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINCNAT	7	PRINCETON HREP
TARGET YR 15 = PRINCNAT	7	PRINCETON HREP
TARGET YR 50 = PRINCNAT	7	PRINCETON HREP

FILE PRINCNAT CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND TODAY'S DATE 07-12-1994

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	415	415	415
BOTTOMLAND HARDWOODS-W	389	389	389	389
CROPLAND-WETLAND	179	122	122	122
GRASSLAND-WETLAND	72	72	72	72
TOTAL	1044	998	998	998

FIGURE F-6

ACRES OF AVAILABLE HABITAT

SPECIES	PRESENT ACRES	TARGET YEARS T YR 1 ACRES	% CHANGE	T YR 15 ACRES	% CHANGE	T YR 0 ACRES	% CnANGI
MALL	972.0	926.0	-4.7%	926.0	-4.7%	926.0	-4.7%
GOOS	655.0	609.0	-7.0%	609.0	-7.0%	609.0	-7.0%
BITT	404.0	415.0	2.7%	415.0	2.7%	415.0	2.7%
YLEG	404.0	415.0	2.7%	415.0	2.7%	415.0	2.7%
MUSK	404.0	415.0	2.7%	415.0	2.7%	415.0	2.7%
RAIL	404.0	415.0	2.7%	415.0	2.7%	415.0	2.7%
HERO	793.0	804.0	1.4%	804.0	1.4%	804.0	1.4%
DUCK	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
BEAV	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
COOT	404.0	415.0	2.7%	415.0	2.7%	415.0	2.7%
PARU	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%
PROT	389.0	389.0	0.0%	389.0	0.0%	389.0	0.0%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SF
(NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

SPECIES	PRESENT INDEX	TARGET YEARS T YR 1 INDEX	% CHANGE	T YR 15 INDEX	% CHANGE	T YR 50 INDEX	% CHANGE
MALL	0.50	0.68	34.5%	0.70	38.0%	0.70	39.3%
GOOS	0.22	0.32	45.8%	0.32	48.0%	0.32	48.0%
BITT	0.72	0.74	2.3%	0.78	8.3%	0.75	4.3%
YLEG	0.24	0.10	-57.5%	0.10	-57.5%	0.10	-57.5%
MUSK	0.27	0.37	38.1%	0.39	43.4%	0.39	43.4%
RAIL	0.44	0.60	35.5%	0.59	32.3%	0.59	32.3%
HERO	0.52	0.52	-0.2%	0.51	-3.4%	0.50	-4.6%
DUCK	0.37	0.34	-8.8%	0.38	2.8%	0.42	12.7%
BEAV	0.58	0.36	-37.3%	0.32	-44.0%	0.30	-48.9%
COOT	0.27	0.39	47.7%	0.73	174.2%	0.73	174.2%
PARU	0.40	0.27	-33.3%	0.40	0.0%	0.41	1.4%
PROT	0.43	0.32	-24.8%	0.38	-12.6%	0.40	-6.4%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-6 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	T YR 1 HU	T YR 1 % CHANGE	T YR 15 HU	T YR 15 % CHANGE	T YR 50 HU	T YR 50 % CHANGE
				TARGET YEARS			
MALL	490.7	628.9	28.2%	644.9	31.4%	651.1	32.7%
GOOS	142.9	193.7	35.5%	196.7	37.6%	196.7	37.6%
BITT	290.5	305.3	5.1%	323.1	11.2%	311.3	7.1%
YLEG	95.1	0.0	-100.0%	0.0	-100.0%	0.0	-100.0%
MUSK	108.5	153.9	41.8%	159.9	47.3%	159.9	47.3%
RAIL	178.9	249.0	39.2%	243.1	35.9%	243.1	35.9%
HERO	415.4	420.1	1.1%	407.0	-2.0%	401.6	-3.3%
DUCK	145.2	132.4	-8.8%	149.2	2.8%	163.6	12.7%
BEAV	224.8	141.0	-37.3%	126.0	-44.0%	114.8	-48.9%
COOT	107.7	163.4	51.7%	303.5	181.7%	303.5	181.7%
PARU	155.6	103.7	-33.3%	155.6	0.0%	157.8	1.4%
PROT	167.1	125.6	-24.8%	146.0	-12.6%	156.4	-6.4%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-6 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	643.1
CANADA GOOSE	195.7
LEAST BITTERN	316.0
LESSER YELLOWLEGS	42.0
MUSKRAT	158.5
KING RAIL	243.3
GREEN-BACKED HERON	407.1
WOOD DUCK	151.7
BEAVER	125.3
AMERICAN COOT	280.5
NORTHERN PARULA	148.6
PROTHONOTARY WARBLER	146.8

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT A
ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDIT
FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO
DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-6 (Cont'd)

ROCK ISLAND DISTRICT CORPS OF ENGINEERS
FISH AND WILDLIFE SERVICE ROCK ISLAND

WILDLIFE HABITAT APPRAISAL GUIDE

PRINCETON WMA FUTURE WITH PROJECT

2-CELL MANAGEMENT OPTION

WITH MAST-TREE PLANTING

HABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND
4	G	GRASSLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	7	HERO	GREEN-BACKED HERON
2	GOOS	CANADA GOOSE	8	DUCK	WOOD DUCK
3	BITT	LEAST BITTERN	9	BEAV	BEAVER
4	YLEG	LESSER YELLOWLEGS	10	COOT	AMERICAN COOT
5	MUSK	MUSKRAT	11	PARU	NORTHERN PARULA
6	RAIL	KING RAIL	12	PROT	PROTHONOTARY WARBLER

DATA FILE NAMES	NUMBER OF SAMPLE SITES	PROJECT NAME
PRESENT = PRINCETN	7	PRINCETON HREP
TARGET YR 1 = PRINMAST	7	PRINCETON HREP
TARGET YR 15 = PRINMAST	7	PRINCETON HREP
TARGET YR 50 = PRINMAST	7	PRINCETON HREP

FILE PRINMAST CONTAINS 3 DATA SETS

THESE DATA FILES USE MATRIX WETLAND

TODAY'S DATE 02-17-1992

THESE DATA SETS ARE FOR FUTURE WITH PROJECT CONDTIONS

HABITAT TYPE ACRES

HABITAT TYPE	PRESENT 0	TARGET YEARS 1	15	50
NONFOREST WETLAND	404	461	461	461
BOTTOMLAND HARDWOODS-W	393	414	414	414
CROPLAND-WETLAND	179	97	97	97
GRASSLAND-WETLAND	68	72	72	72
TOTAL	1044	1044	1044	1044

FIGURE F- 7

ACRES OF AVAILABLE HABITAT

		TARGET YEARS					
	PRESENT	T YR 1		T YR 15		T YR 50	
SPECIES	ACRES	ACRES	% CHANGE	ACRES	% CHANGE	ACRES	% CHANGE
MALL	976.0	972.0	-0.4%	972.0	-0.4%	972.0	-0.4%
GOOS	651.0	630.0	-3.2%	630.0	-3.2%	630.0	-3.2%
BITT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
YLEG	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
MUSK	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
RAIL	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
HERO	797.0	875.0	9.8%	875.0	9.8%	875.0	9.8%
DUCK	393.0	414.0	5.3%	414.0	5.3%	414.0	5.3%
BEAV	393.0	414.0	5.3%	414.0	5.3%	414.0	5.3%
COOT	404.0	461.0	14.1%	461.0	14.1%	461.0	14.1%
PARU	393.0	414.0	5.3%	414.0	5.3%	414.0	5.3%
PROT	393.0	414.0	5.3%	414.0	5.3%	414.0	5.3%

AVAILABLE HABITAT IS THE TOTAL OF THE HABITAT TYPE ACRES USED BY THE SPECIES (NOT ALL SPECIES APPLY TO ALL HABITAT TYPES)

MEAN HABITAT SUITABILITY INDEX (HSI)

		TARGET YEARS					
	PRESENT	T YR 1		T YR 15		T YR 50	
SPECIES	INDEX	INDEX	% CHANGE	INDEX	% CHANGE	INDEX	% CHANGE
MALL	0.51	0.69	37.1%	0.71	40.5%	0.72	43.5%
GOOS	0.22	0.32	47.7%	0.33	50.1%	0.33	50.1%
BITT	0.72	0.74	2.3%	0.78	8.3%	0.75	4.3%
YLEG	0.24	0.10	-57.5%	0.10	-57.5%	0.10	-57.5%
MUSK	0.27	0.37	38.1%	0.39	43.4%	0.39	43.4%
RAIL	0.44	0.60	35.5%	0.59	32.3%	0.59	32.3%
HERO	0.52	0.53	0.5%	0.51	-2.6%	0.51	-2.1%
DUCK	0.37	0.34	-8.8%	0.36	-4.1%	0.41	10.7%
BEAV	0.58	0.34	-40.3%	0.32	-45.2%	0.30	-48.0%
COOT	0.27	0.39	47.7%	0.73	174.2%	0.73	174.2%
PARU	0.40	0.27	-33.3%	0.45	12.5%	0.44	9.7%
PROT	0.43	0.32	-24.8%	0.36	-16.1%	0.41	-4.1%

MEAN HSI = SUM AVERAGE HSI BY HABITAT TYPE X ACRES DIVIDED BY ACRES OF AVAILABLE HABITAT (ACRES USED BY THE SPECIES).
(i.e. MEAN HSI IS AVERAGE HSI WEIGHTED BY ACRES)

FIGURE F-7 (Cont'd)

HABITAT UNITS

SPECIES	PRESENT HU	TARGET YEARS T YR 1 HU	% CHANGE	T YR 15 HU	% CHANGE	T YR 50 HU	% CHANGE
MALL	492.9	672.8	36.5%	690.0	40.0%	704.4	42.9%
GOOS	141.9	202.8	42.9%	206.1	45.3%	206.1	45.3%
BITT	290.5	339.2	16.8%	358.9	23.6%	345.8	19.0%
YLEG	95.1	0.0	-100.0%	0.0	-100.0%	0.0	-100.0%
MUSK	108.5	171.0	57.5%	177.6	63.7%	177.6	63.7%
RAIL	178.9	276.6	54.6%	270.0	50.9%	270.0	50.9%
HERO	417.4	460.4	10.3%	446.4	6.9%	448.8	7.5%
DUCK	146.7	140.9	-3.9%	148.2	1.0%	171.0	16.6%
BEAV	227.1	142.8	-37.1%	131.2	-42.2%	124.3	-45.2%
COOT	107.7	181.5	68.5%	337.1	212.9%	337.1	212.9%
PARU	157.2	110.4	-29.8%	186.3	18.5%	181.7	15.6%
PROT	168.8	133.7	-20.8%	149.2	-11.6%	170.6	1.1%

HABITAT UNITS ARE HSI X ACRES (A MEASURE OF QUALITY X QUANTITY)
IF MEAN HSI = 0.10 THEN HABITAT UNITS ARE ZERO

FIGURE F-7 (Cont'd)

ANNUAL AVERAGE HABITAT UNITS FOR FUTURE WITH PROJECT CONDTIONS

SPECIES	ANNUAL AVE. HABITAT UNITS
MALLARD	690.5
CANADA GOOSE	205.0
LEAST BITTERN	350.7
LESSER YELLOWLEGS	46.6
MUSKRAT	175.9
KING RAIL	270.1
GREEN-BACKED HERON	449.1
WOOD DUCK	155.0
BEAVER	131.5
AMERICAN COOT	311.5
NORTHERN PARULA	173.0
PROTHONOTARY WARBLER	154.5

NOTE: THIS PROGRAM MUST BE RUN TWICE ONCE FOR FUTURE WITHOUT PROJECT AND ONCE FOR FUTURE WITH PROJECT CONDITIONS.
SUBTRACT AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITHOUT PROJECT CONDITIONS FROM AVERAGE ANNUAL HABITAT UNITS FOR FUTURE WITH PROJECT CONDITIONS TO DETERMINE THE CHANGE IN AVERAGE ANNUAL HABITAT UNITS WITH THE PROJECT.

FIGURE F-7 (Cont'd)

GEOTECHNICAL CONSIDERATIONS

A
P
P
E
N
D
I
X

G

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA
REHABILITATION AND ENHANCEMENT

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX G
GEOTECHNICAL CONSIDERATIONS

TABLE OF CONTENTS

List of Plates

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA
REHABILITATION AND ENHANCEMENT

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX G
GEOTECHNICAL CONSIDERATIONS

PURPOSE AND SCOPE

This appendix provides the general geology and specific geotechnical analysis pertinent to the project. The geological information in this report was obtained and condensed from geological survey reports, bulletins, circulars, and a review of the *Scott County Soil Survey*. The geotechnical information was derived from soil borings that were obtained by the Rock Island District Geotechnical Branch. All laboratory analyses were completed by Rock Island District Geotechnical Branch personnel, and the results were interpreted to define engineering characteristics of the soil.

The project site is presently operated by the Iowa Department of Natural Resources as a managed marshland. Water control is provided by a 16,000 gpm pump. The area is flooded every fall to provide habitat for migrating waterfowl; however, the number of acres that can be inundated is limited because of the topographic relief.

The goal of the project is to enhance wetland habitat. This is proposed to be accomplished by constructing an intermediate levee. The intermediate levee will allow independent water control to the two cells, thereby providing more habitat. To accomplish these goals, the existing pump plant will be relocated to provide water control to both cells. The existing perimeter levee will be rehabilitated to a 15-year event levee. The access road will be raised to a 10-year event levee to act as an overflow section to prevent overtopping erosion of the perimeter levee. It was determined that riprap would not be required because of the short duration of an overflow event before the hydraulic head is equalized.

LOCATION

The Princeton Wildlife Management Area is located on the west shore of the Mississippi River and bounded on the north by the Wapsipinicon River. The project area is situated north of Princeton, Iowa, at Mississippi River Mile 505 in Scott County, Iowa. The project area encompasses 1,129 acres of Mississippi bottomland in the Mississippi River Valley.

PHYSIOGRAPHY

The project area is on a broad regional structure known as the Mississippi River Arch. The Mississippi River Arch lies between the Forest City basin to the west and the Illinois basin to the east. A major inactive fault zone called the Plumb River fault crosses the Mississippi Valley north of the project site at Savanna, Illinois.

The oldest landscapes in the state occur at the project site where the surface materials have been exposed to the agents of erosion for 16,000 to 24,000 years. The principal surface materials on which the landscapes formed consist of silt loam or silty clay loam loess over loam till or clay paleosol. These surface materials are primarily glacial till, loess, and alluvium with exposed bedrock. This area was affected by major episodes of continental glaciation, which consists of deposits of the Pre-Illinoisan, Illinoisan, and Wisconsinan glacial stages, and also Aftonian and Yarmouth interglacial stages.

One of the prominent topographic features of the project area is the high, steep alluvial plain formed by the Wapsipinicon River. The Mississippi traverses the wide alluvial floodplain of an ancient river now occupied on the Iowa side by the Wapsipinicon. A high massive ridge of sand and loess stretches for nearly 4 miles along the south side Wapsipinicon floodplain near the project site.

BEDROCK STRATIGRAPHY

The bedrock of the project area consists of two Paleozoic Sequences of sedimentary rock. The older bedrock is Silurian age dolomite of the Niagaran Formation, which is approximately 300 feet thick. This dolomite was deposited in an environment of shallow marine reef and inter-reef facies. This depositional environment formed a bedrock which lacks even horizontal bedding and continuity. The character of the dolomite can vary from massive, porous, hard dolomite to irregularly bedded, vuggy, and brecciated dolomite.

The younger bedrock found in the area is Pennsylvanian age sandstone and shales with various gradations. Between the periods of the Devonian and Pennsylvanian, an erosional unconformity was formed on the Silurian dolomite. Silurian and Devonian surfaces were subjected to erosion and solution. This surface had topographic relief of up to 260 feet. This has been interpreted as forming in a warm, humid environment, which formed a landscape with all the features associated with Karst topography.

Deposition occurred again in the early Pennsylvanian era with an influx of clastic sediments filling channels and depressions with shale and sandstone. Cave and solution openings in the Devonian limestones and Silurian dolomites also were filled in with clay shales. There was less relief developed in the dolomites due to a greater resistance to solution.

PLEISTOCENE AND RECENT DEPOSITS

The buried bedrock in the vicinity has been considerably modified by Pleistocene glaciers that repeatedly covered the area during the past 1.2 million years. The Pleistocene Epoch began about 1 million years ago and ended about 5,000 years ago. The Pleistocene Ice Age is composed of four major glacial stages and three major interglacial stages.

The oldest glacial age, the Nebraskan, occurred 1,200,000 to 900,000 years ago. The Nebraskan drift ranges from 100 to 150 feet in thickness, but the deposits were removed by erosion prior to deposition of Kansan drift in the project area. A warm, climatic interval called the Aftonian Interglacial Age followed the retreat of the Nebraskan glacier.

The next glacial climate, producing the Kansan glacier, occurred from 700,000 to 600,000 years ago. Thick deposits of fine rock materials and outwash sand and gravel were left when this glacier melted away. The average thickness of the Kansan drift has been estimated to be 60 feet. The area near the project site has deposits of an unstratified mixture of boulders, cobbles, pebbles, sand, rock meal, and clay.

The Kansan Age was followed by the Yarmouthian interglacial age. During this period, erosion-carved valleys, hills, and soils were formed in the Kansan deposits.

The third glacial age is the Illinoisan. The Illinois drift was deposited about 350,000 years ago. This drift is relatively thin in the project area.

The Illinoisan Age was followed by the Sangamonian interglacial age. Illinoisan deposits were weathered, and soil developed.

The last and most recent glacial age, the Wisconsinan, began about 70,000 years ago. Wisconsinan silts and wind-blown loess were deposited from 22,000 to 7,000 years ago over the old glacial deposits. The loess, on the hills and upland surfaces, was derived from the Wisconsinan outwash in the nearby river valleys. It is generally at least 30 feet thick near the river bluffs.

SUBSURFACE EXPLORATIONS

During May 1990, 32 borings were performed at the project site. The borings were obtained with a CME-55 (ATV) drill rig using a 3-1/4 inch hollow stem auger and a 2-inch split spoon or a 2-inch continuous sampler. Seven borings were performed with a hand auger. Eleven borings were drilled 30 feet deep for evaluation of the existing levee, and 13 shallow borings were performed for confirmation of suitable borrow material and evaluation of potential ponding areas. The locations of the borings are shown on plate 2 and the boring logs are shown on plates 8 and 9 of the Definite Project Report.

One option considered was to construct a low perimeter levee on the west side of the project site to increase the ponding depth without flooding private land. Borings PWA-90-4 through PWA-90-8 were drilled to analyze the suitability as a foundation for a low levee with adjacent borrow. The top 7 to 16 feet of the borings display a lean to medium clay (CH or CH-CL) underlain by sand (SC or SP). Average water contents for the clay are 35 percent, which indicates a cohesion of 400 to 600 lbs/ft^2. Because of the potential of raising the ground water and impacting private land, this option was not pursued.

Borings PWA-90-1 through PWA-90-3 and PWA-90-9 through PWA-90-16 were performed to determine the suitability of this material as borrow for levee rehabilitation and evaluation for potential ponding areas. The material from these borings varied from hole to hole, from a fat clay (CH) to clayey sand (SC). Borings PWA-90-1 through PWA-90-3 consist of 6 feet of lean clay (CL) with average water contents of less than 30 percent. This would indicate a cohesion of 400 lbs/ft^2. This clay is underlain by medium to fine sand (SP). Such clay material should be appropriate for rehabilitation of the existing levee. Borings PWA-90-9 through PWA-90-11 consist of 2 to 6 feet of slightly organic fat clay (CH) underlain by sand. This material has water contents of 35 to 50 percent which indicates a strength of 300 lbs/ft^2. Borings PWA-90-12 through PWA-90-16 consist of about 4 feet of clayey sand (SC) underlain by medium to fine sand (SP). Borings PWA-90-17 through PWA-90-24 were drilled through the existing levee to examine the materials for slope stability. The borings also were used to investigate the foundation material for underseepage analysis. The borings primarily consisted of 11 to 22 feet of lean clay (CL) or medium clay (CL-CH) with shear strengths of 400 to 500 lbs/ft^2. This is underlain by medium to fine sand (SP). This material should perform well as levee material and has accomplished this objective with few problems. The only reported problems have been erosional distress in a few areas where the river runs along the levee toe. These areas will require riprap protection.

Soil strength was determined by correlating water content and classification with historic information (see plate G-1). Plate G-1, used to determine shear strengths, was developed from testing completed on undisturbed samples taken in alluvial soils along the Mississippi River. Water content below the water table is an indication of the void ratio which is related to density for similar soils. Considering that this clay material is going to be used for rehabilitation of a levee that has been performing adequately, it should cause no problems.

Borings were not taken through the railroad embankment because of logistics. The railroad does not want the liability of people on their property. A visual inspection of the area was made and surface samples were obtained. Borings PWA-90-12 and PWA-92-1 were close to the railroad embankment. This information was used to determine the configuration to use for the slope stability analysis.

GROUND WATER

The key water-bearing formation (aquifer) at the project site is the Silurian-Devonian aquifer, which is composed primarily of porous and fractured carbonate rocks of the Niagaran and Alexandrian series (Silurian) and Cedar Valley and Wapsipinicon formation (Devonian). The aquifer lies beneath glacial drift and averages 200 to 350 feet in thickness, and is composed of carbonate strata. The porosity and permeability of these strata are produced by secondary openings and fractures, joints, brecciated zones, and solution openings. Water level observations were monitored during the drilling operations; they are noted on the boring logs from the site. Water levels encountered in the marsh ranged from above the ground surface to 4 feet below. Water entered the holes at the clay-sand interface at 6 to 9 feet below the surface. Water levels encountered through the levee ranged from 6 to 12 feet below the surface with water entering the hole at 12 to 15 feet below the surface.

Because of the ground water elevations, dewatering will be required for construction of the structures. The minimal variation of the ground water and the elevation of the foundation will lend itself to the use of well points for dewatering, although this will be left up to the contractor.

A study of the ground water elevations was undertaken to evaluate the potential impact to surrounding non-government properties if low-head levees were constructed on the west side of the project site to increase ponding depths. A series of three monitoring wells was installed in August 1990. The wells were installed next to borings PWA-90-5 through PWA-90-7. Water levels were monitored from August 1990 through December 1991. Evaluation of the data determined that rainfall is the controlling factor in ground water levels at the project site. However, because of the pervious nature of the sand strata, raising the ponding elevation may impede the flow of water out of surrounding lands. To avoid potential conflicts with private property in the area, this option was not pursued.

PROPOSED EMBANKMENTS

The proposed project includes levee rehabilitation and construction of a low-head levee. The perimeter levee will be rehabilitated to provide a uniform cross section.

An intermediate levee will be constructed to provide independent water control in the northern and southern units.

The levee rehabilitation will consist of providing a uniform elevation and cross section for 3.1 miles of existing levee. The levee will be reconstructed to a 15-year flood elevation. The perimeter levee cross section will have a 10-foot top width with 1V on 4H side slopes from station 0+00 to approximately station 102+00. An access road will be on top from station 102+00 to the end of the levee. This will have a 12-foot top width with 1V on 4H slopes.

The intermediate levee will be constructed to an elevation 4 feet higher than the existing ground. The cross section will have a 10-foot top width with 1V on 4H side slopes.

The site must be prepared before material can be placed for new construction or rehabilitation. All vegetation and other deteriorated material must be stripped to a depth of 6 inches. All tap roots, lateral roots, and trees within the work area will be removed to a depth of 3 feet.

All borrow material for the embankments will be placed semicompacted. A 15-percent overbuild will be designated in the specifications to allow for anticipated settlement of the intermediate levee.

BORROW MATERIAL

The selected borrow sites are shown on plate 2 of the Definite Project Report. Borings from the southern area show 6 to 14 feet of medium to lean clay and should provide suitable material for levee reconstruction. Borings from the proposed borrow sites in the northern areas show sand and lean clay. Additional subsurface investigations will be completed prior to plans and specifications to delineate the actual limits of excavation for borrow material. This will ensure that only appropriate materials will be used for levee reconstruction. The majority of the fill is going to be used to flatten the slopes to aid future maintenance. Minimal compaction i.e., only construction traffic, will ensure adequate shear strength (300 to 500 lbs/ft^2).

Material for construction of the intermediate levee will come from adjacent borrow. Hand augers were completed to identify the materials. Evaluation of the samples show lean (CL) to fat (CH) clay and will be appropriate for construction of low-head levees (approximately 4 feet high).

All borrow material is classified as a lean (CL) to fat (CH) clay. Typical permeabilities for lean to fat clays are in the range of 10^{-6} to 10^{-8} centimeters/second. This is considered impervious for design considerations.

FOUNDATIONS FOR STRUCTURES

Boring PWA-92-5 was completed to evaluate the location for the proposed pump relocation, as well as the stoplog structure and turnaround area. Review of the boring log shows that the top 2 feet is a clayey sand. Below this is 10 feet of medium clay which changes to a medium to fine sand. The sand continues to the bottom of the boring with intermittent layers of gravel. The clay had an average of three "N" blow counts, with an average of 12 to 15 "N" blow counts in the top 11 feet of sand. An examination of the water contents for the clay indicates a cohesion of 400 to 600 lbs/ft^2. A average strength of 500 lbs/ft^2 was used to determine the bearing capacity of the soil. The ultimate bearing capacity of the soils at the pump station and stoplog structure is approximately 2,850 lbs/ft^2. This was determined by using the Terzaghi-Meyerhoff bearing capacity equation. For design, a bearing capacity of 1,500 lbs/ft^2 was used. Blow counts in the sand indicate a medium dense sand. A medium to fine sand of medium density will have a phi angle of approximately 32 degrees. For design purposes, a phi angle of 30 degrees was used.

The stoplog structure has been designed with a spread footing; the weight of the structure will be less than adjacent fill. The pump station has been designed with a spread footing with sheetpile used to provide stability from sliding. Because of the low pressures imposed by the structures on the soil it was determined that spread footings would be used for the structures. The wing walls of the pump station will be founded on sand. Dewatering will be required to complete construction of the wing walls. Considering the strength of the soils and the minimal weight of the structures, no foundation problems are anticipated. Any unsuitable material that may be encountered during excavation will be removed and will be replaced with appropriate fill and compacted to a density equal to or greater than the surrounding soil.

SETTLEMENT

The perimeter levee is not being raised. The rehabilitation will provide a uniform and stable cross section; therefore, settlement will not be a concern.

The intermediate levee will be constructed to an elevation 4 feet higher than the existing ground. No settlement problems are anticipated. The section will be overbuilt by 15% to account for expected future settlement.

The pump platform will be constructed on the existing perimeter levee. The outlet will be in the intermediate levee at the same location as the proposed stoplog structure. The minimal increase in loading is not expected to induce any appreciable settlement. Therefore, no settlement associated distress is anticipated.

SLOPE STABILITY

The stability of the proposed slopes was considered as well as the road/overflow section. The stability of the railroad also was considered because the new operating scenario will pond 6 to 12 more inches of water against the toe of the railroad bed. The stability of the slopes was analyzed by the modified Swedish method for circular Arc Slope Stability Analysis according to EM 1110-2-1902 "Engineering Design Stability of Earth and Rockfill Dams," dated April 1970. Conservative shear strengths were assumed for the most severe configuration of the foundation and embankment.

The perimeter levee near station 90+00 was found to be the most critical for slope stability analysis for the end of construction condition. The worst case scenario was considered, with the river at elevation 580.5 (the elevation of the overflow section). Successive trials of various circular sliding surfaces were analyzed. A determination of the critical failure surface having the lowest factor of safety was made. The minimum factor of safety computed for the perimeter levee is 2.04 using CENCR-ED-G's slope stability program. This exceeds the 1.3 minimum required by EM-1110-2-1913, "Design and Construction of Levees," dated March 31, 1978. A check was performed using UTEXAS2, and the factor of safety was calculated to be 1.99. This slope stability analysis is shown on plate G-2.

The stability of the road/overflow section was considered. The road has been in place for several years and all consolidation is probably complete. Considering the overbuilt (compared to standard levee sections) section of over 22 feet wide, the minimal raise of less than 2 feet, and the 1:4 slopes, it was deemed unnecessary to perform a slope stability analysis. Normal construction traffic will provide adequate compaction of the levee raise materials. By inspection, the road/overflow section will have no slope stability associated distress.

RAILROAD EMBANKMENT

The Davenport, Rock Island, and North Western Railroad raised concerns in a letter about possible slope stability problems and erosional distress caused be increasing the ponding elevation at the toe of the railroad embankment.

Although no borings were taken through the railroad embankment, a visual examination of the embankment and borings close to the embankment were used to determine the strengths and configuration to use for the slope stability analysis. The railroad fill was a coarse gravel with clay, so a phi of 40 degrees was used for the gravel. The clayey sand foundation has been loaded since construction of the railroad, so all consolidation has probably taken place. A conservative shear strength of 500 lbs/ft^2 was selected for this material. The sand base was determined to be a medium to fine sand. This was given a conservative phi angle of 30 degrees.

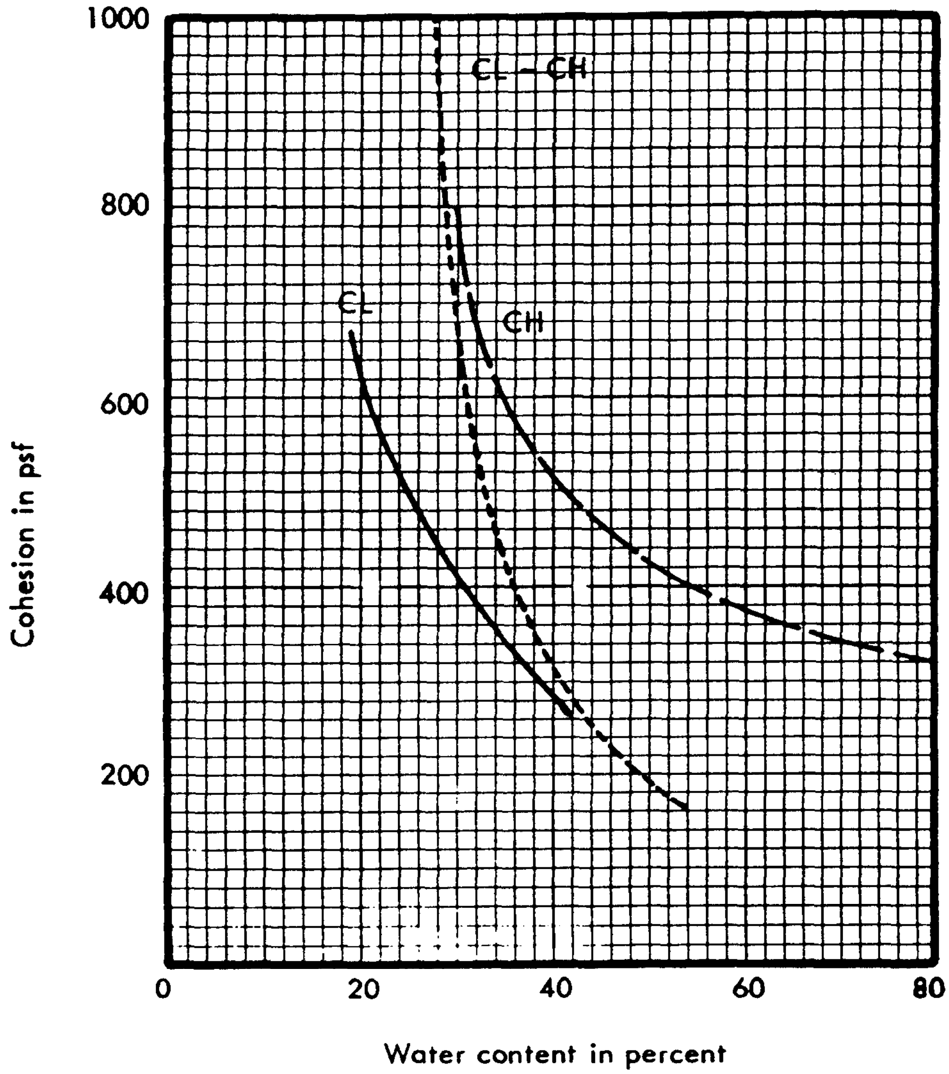
The stability of the railroad embankment was analyzed to determine if the additional water ponded at the toe would have any effect. Two conditions were analyzed. The first condition is with the water (and ground water) at elevation 576, which is the current operating condition. The second condition is with the water (and ground water) at elevation 577.5. This is the elevation that may be needed to occasionally kill back the woody growth expected to encroach into the project area. A surcharge of 1,150 lbs/ft^2 was added to the top of the embankment to simulate a train load. This loading was arrived at by discussing the situation with Mr. Leif Thorsen from the Soo Line Railroad. He does the engineering for the Davenport, Rock Island, and North Western Railroad.

The factors of safety were virtually identical, with a factor of safety of 1.44 for the initial condition and 1.41 for the high water condition. This was checked with UTEXAS2 and correlated favorably with factors of safety of 1.44 and 1.40, respectively. This exceeds the 1.3 minimum required by EM 1110-2-1913. No slope stability problems are expected with the railroad embankment. The slope stability analysis of the railroad embankment is shown on plates G-3 and G-4.

The possibility of erosional distress was investigated. Due to the limited water depth at the toe (1 foot or less) and the abundance of vegetation, no erosional distress is anticipated.

SEEPAGE

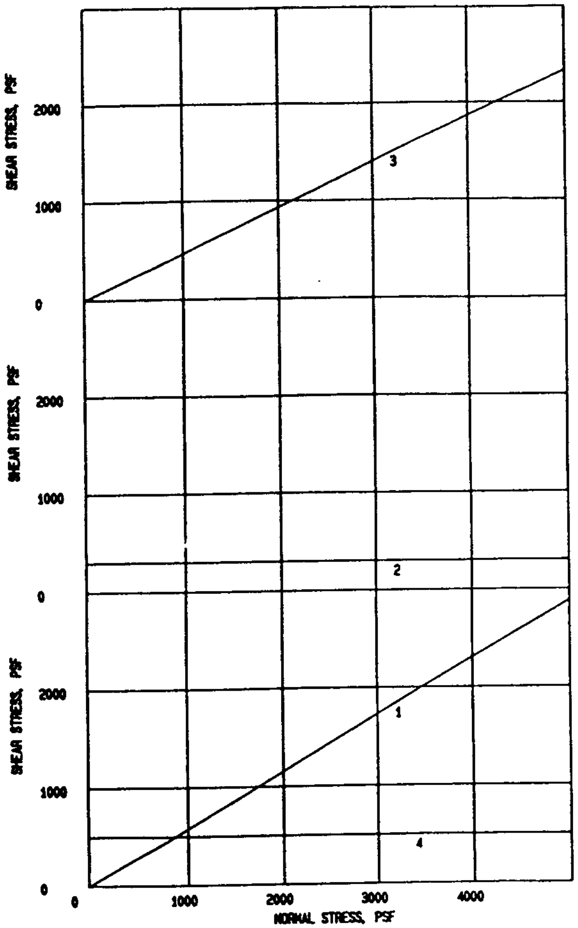
An underseepage analysis was completed to assess the amount of pumping that will be required to maintain the ponding at a constant elevation. The scenario used was with the river at flat pool (elevation 573) and the project operating at normal pool (elevation 575 for the southern unit and 576 for the northern unit). It is estimated that the underseepage from the project site to the river will amount to 3,100 gpm. The calculations are shown on plates G-5 through G-11, and the cross section used is shown on plate G-11. The seepage calculations were performed using EM 1110-2-1913, "Design and Construction of Levees," dated March 31, 1978, with modifications resulting from the "Minutes of Geotechnical Conference" held at the Rock Island District on April 29-30, 1976. The methodology of the underseepage analysis is the result of continuing documentation of performance of existing levees during high water events from Dubuque, Iowa, to Hamburg, Illinois. Permeability of the substratums was determined by D_{10} correlations (see plate G-10). The seepage calculations do not take into consideration any seepage that may take place at the fringes of the ponded water. The minimal change in operating procedures (1 foot increase in elevation) will not increase the seepage a significant amount. Evaporation was considered and it was assumed that the wet fall weather would make up for any evaporation that may take place. Past operation has shown that seepage has not been a problem, so it should not be a problem in the future.



NOTE:

1. Cohesive shear strength curves derived from shear strength data supplied by Rock Island District for Mississippi River alluvial soils in the District

COHESIVE SHEAR STRENGTH VS WATER CONTENT



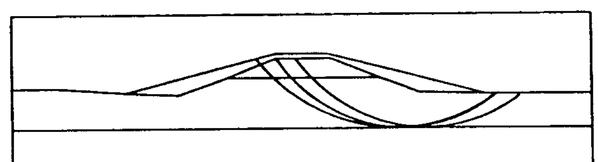
DESIGN ENVELOPES

MATERIAL		SOIL WT. LBS./CUFT		SHEAR STRENGTH							
				Q		R		S		(R+S)/2	
		MOIST	SAT.	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF
SAND SC and SP	1	115.00	115.00	30.00	.00						
CLAY CL-CH	2	120.00	120.00	.00	300.00						
SC BROWN CLAYEY SAND	3	115.00	120.00	25.00	.00						
UNCOMPACTED FILL	4	120.00	125.00	.00	500.00						

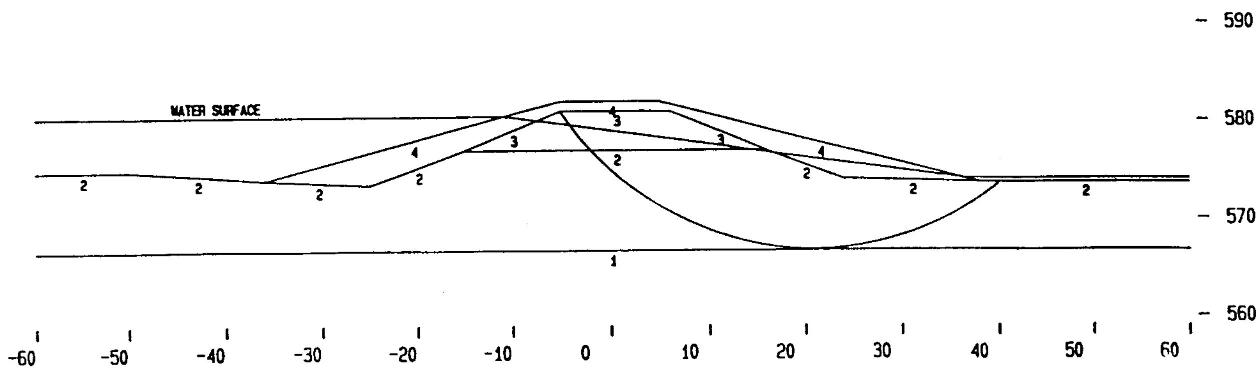
CIRCLE FAILURE SURFACE
USE CORPS OF ENGINEERS METHODS

TANGENT TO ELEV 566.80
TRIAL ARCS

RADIUS OF CIRCLE	CENTER OF CIRCLE		F.S.	
	DISTANCE FROM ℄	ELEV	Q	
			Ψ= .00	
30.80	20.90	597.60	2.04	
32.40	25.70	599.20	2.13	
35.50	19.30	602.30	2.11	

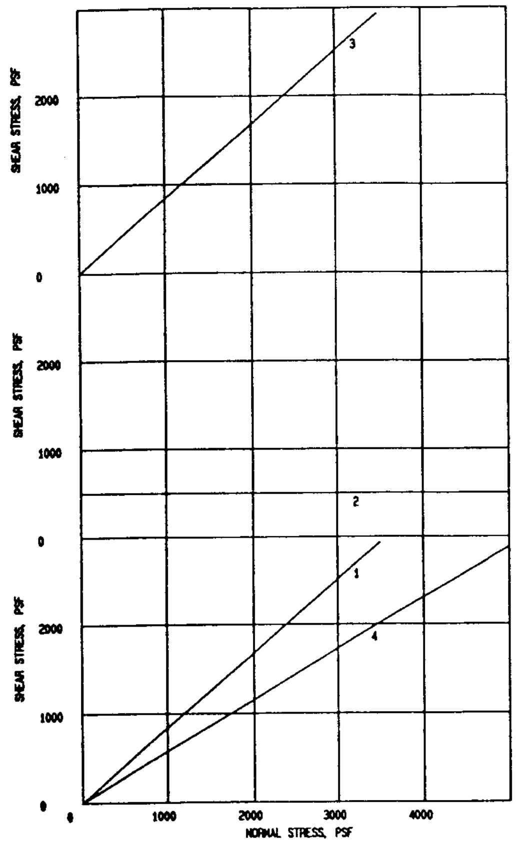

RANGE OF TRIAL FAILURE SURFACES

NOTES:
(1) ANALYSES WERE RUN ACCORDING TO EM 1110-2-1902 DATED APRIL 1970
(2) PSI=SIESMIC COEFFICIENT USED IN THE ANALYSES



PRINCETON EMP
PRINCETON, IOWA
SECTION AT STA 80+00
GENE RAND NOVEMBER 1982
END OF CONSTRUCTION

PLATE G-2



DESIGN ENVELOPES

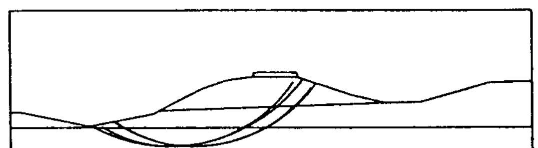
PRINCETON EWP
PRINCETON, IOWA
RR EMBANKMENT WATER AT 576
REVE RAND NOVEMBER 1982
END OF CONSTRUCTION

MATERIAL		SOIL WT. LBS./CUFT		SHEAR STRENGTH							
				Q		R		S		(R+S)/2	
		MOIST	SAT.	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF	PHI DEGREES	COHESION PSF
RR LOAD	1	1150.00	1150.00	40.00	.00						
CLAYEY SAND	2	120.00	120.00	.00	500.00						
RR FILL	3	140.00	140.00	40.00	.00						
SAND BASE	4	115.00	115.00	30.00	.00						

CIRCLE FAILURE SURFACE
USE CORPS OF ENGINEERS METHODS

TANGENT TO ELEV 569.50
TRIAL ARCS

RADIUS OF CIRCLE	CENTER OF CIRCLE DISTANCE FROM ℄	CENTER OF CIRCLE ELEV	F.S. Q ψ= .00	
33.60	-22.50	603.10	1.44	
33.60	-17.50	603.10	1.72	
34.40	-17.60	603.90	1.73	
38.60	-23.30	608.10	1.46	


RANGE OF TRIAL FAILURE SURFACES

NOTES:
(1) ANALYSES WERE RUN ACCORDING TO EM 1110-2-1902 DATED APRIL 1970
(2) PSI=SIESMIC COEFFICIENT USED IN THE ANALYSES

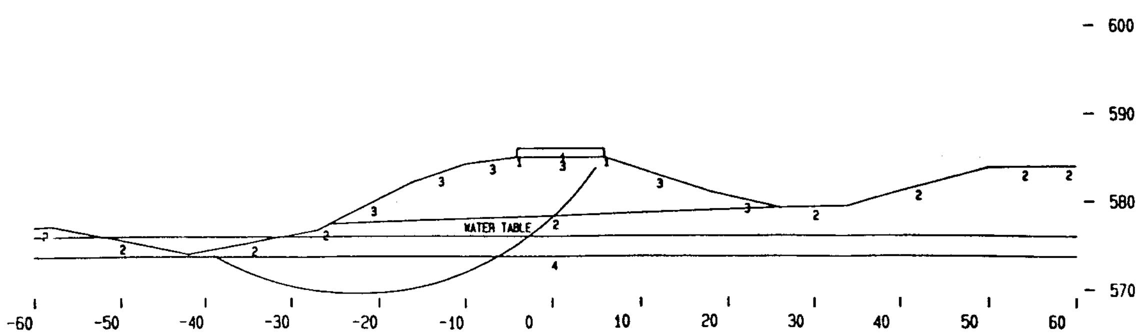
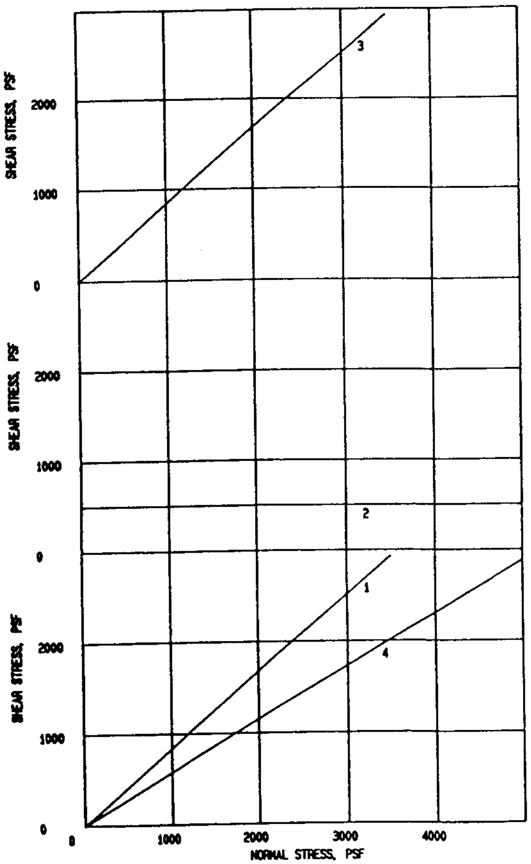


PLATE G-3



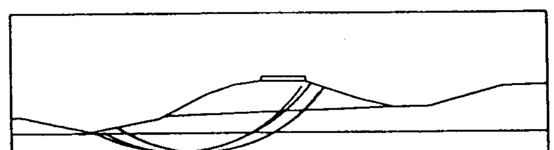
DESIGN ENVELOPES

MATERIAL		SOIL WT. LBS./CUFT MOIST	SAT.	SHEAR STRENGTH Q PHI DEGREES	Q COHESION PSF	R PHI DEGREES	R COHESION PSF	S PHI DEGREES	S COHESION PSF	(R+S)/2 PHI DEGREES	(R+S)/2 COHESION PSF
RR LOAD	1	1150.00	1150.00	40.00	.00						
CLAYEY SAND	2	120.00	120.00	.00	500.00						
RR FILL	3	140.00	140.00	40.00	.00						
SAND BASE	4	115.00	115.00	30.00	.00						

CIRCLE FAILURE SURFACE
USE CORPS OF ENGINEERS METHODS

TANGENT TO ELEV 569.50
TRIAL ARCS

RADIUS OF CIRCLE	CENTER OF CIRCLE DISTANCE FROM ℄	CENTER OF CIRCLE ELEV	F.S. Q ψ= .00	
33.60	-22.50	603.10	1.41	
33.60	-17.50	603.10	1.67	
34.40	-17.60	603.90	1.68	
38.50	-23.30	608.00	1.43	



RANGE OF TRIAL FAILURE SURFACES

NOTES:
(1) ANALYSES WERE RUN ACCORDING TO EM 1110-2-1902 DATED APRIL 1970
(2) PSI=SIESMIC COEFFICIENT USED IN THE ANALYSES

PRINCETON EMP
PRINCETON, IOWA
RR EMBANKMENT WATER AT 577.5
BEHE RAND NOVEMBER 1982
END OF CONSTRUCTION

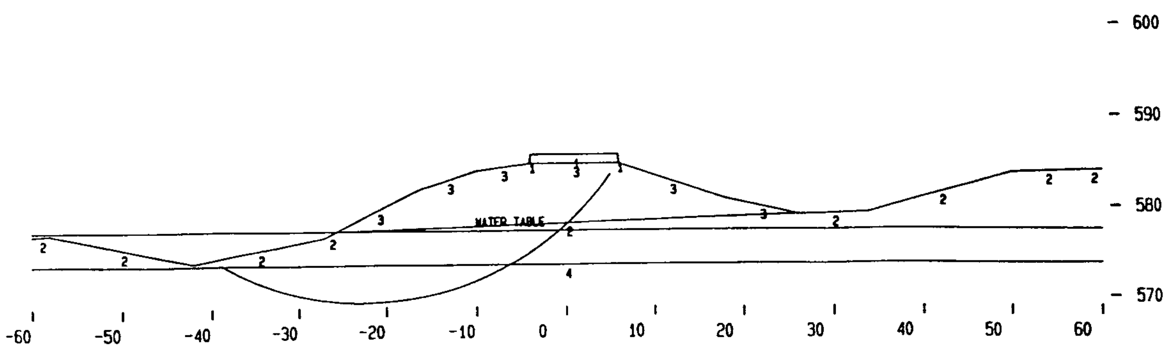


PLATE G-4

Subject: Seepage Princeton EMP		Date: JAN 13 1993
Computed by: Gene Rand	Checked by: SZ	Sheet 1 of 6

Transform Pervious Strata

Class	Elev	D_{10}	ΔD	k_h	$(\Delta D)(K_h)$	$\frac{k_h}{k_v}$	k_v	$\frac{\Delta D}{k_v}$
CL-CH	573.5-568	–	5.5	2×10^{-6}	–	–	–	–
SP	549-568	.22	19	.2	3.8	2	.1	190
SP	539-549	.31	10	.4	4.0	1	.4	25
SP	521-539	.18	18	.18	3.2	3	.06	300
					$\Sigma = 11.0$			$\Sigma = 515$

$$D = \sqrt{\Sigma(\Delta D)(k_h) * \Sigma\left(\frac{\Delta D}{k_v}\right)} = \sqrt{(11)(515)} = \underline{75 \text{ feet}}$$

$$K_f = \sqrt{\Sigma(\Delta D)(k_h) / \Sigma\left(\frac{\Delta D}{k_v}\right)} = \sqrt{\frac{11}{515}} = \underline{0.15 \text{ ft/min}}$$

Case 5 Semipervious Riverside top Stratum

$Q = \$ K_f H$ EQ B-11

Design & Construction of Levees 31 March 78
EM 1110-2-1913

$$\$ = \frac{d}{X_1 + L_2 + .43d} \quad \text{EQ B-21}$$

OR

R.I.D. Nomenclature

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

NCR Form 1 Aug 80 381b

STATION		60+00-102+00	102+00-164+00
HEAD	H	3	2
TRANS PERVIOUS FOUNDATION	D	75	75
TRANS BLANKET THICKNESS L.S.	D_{bL}	0	0
NAT BLANKET THICKNESS R.S.	D_{bR}	5.5	5.5
NAT. BLANKET LENGTH L.S	L_L	0	0
NAT BLANKET LENGTH R.S.	L_R	∞	∞
K_F/K_{bL} LANDSIDE	A	100	100
K_F/K_{BL} RIVERSIDE	B	800	800
$(A*D_{bL}*D)^{.5}$	C_L	0	0
$(B*D_{bR}*D)^{.5}$	C_R	575	575
$C_R*\tanh(L_R/C_R)$	L_1	575	575
0.44*D	L_3	33	33
BASE WIDTH	L_2	80	80
$L_1+L_2+L_3$	L_S	688	688
$C_L/\tanh(L_L/C_L)$	L_E	0	0

Subject		Date
Computed by	Checked by	Sheet of

Q station 60+00-102+00

$Q = \$ K_f H$

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

$$\$ = \frac{75}{575 + 80 + 33 + 0} = .11$$

$Q = (.11)(.15)(3) = 0.05(7.48) = 0.37$ gal/min/ft

Q station 102+00-164+00

$Q = (.11)(.15)(2) = 0.03(7.48) = 0.25$ gal/min/ft

$Q_{Tot} = 0.37(4200) + .25(6200)$

$= 3100$ gal/min

30 April 1976

Procedure for Transformation of Pervious Foundation

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

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

where

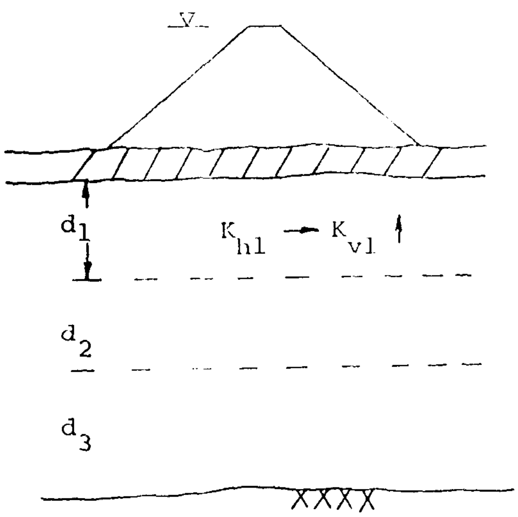
d (1,2,3....n) = increment (1,2,3....n) of depth of pervious strata

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

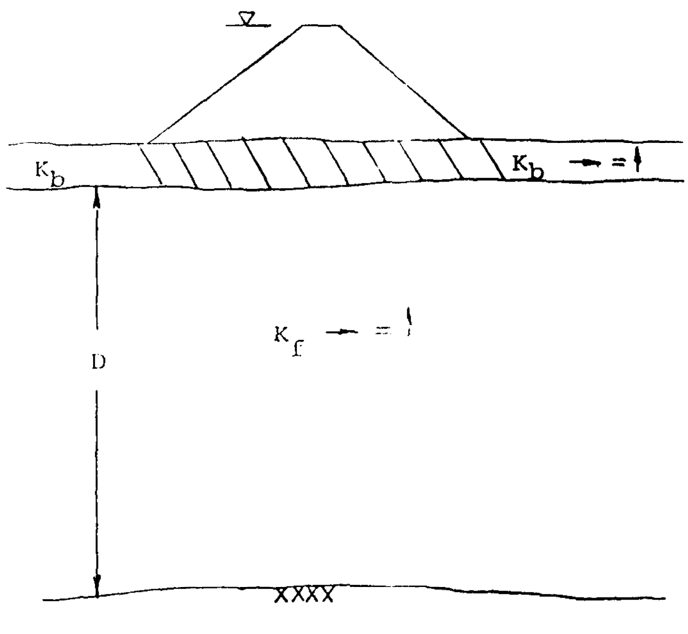
K_v (1,2,3....n) = vertical permeability for corresponding increment (1,2,3....n) of pervious strata

K_h (1,2,3....n)/K_v (1,2,3....n) = 1 if $D_{10} > 0.30$
= 2 if $0.20 < D_{10} \leq 0.30$
= 3 if $D_{10} < 0.20$

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



NATURAL



TRANSFORMED

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

Notes:

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

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

(c) Procedure and computation on separate sheets.

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

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

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

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

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

(i) Transformed thickness as for (e).

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

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

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

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

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

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

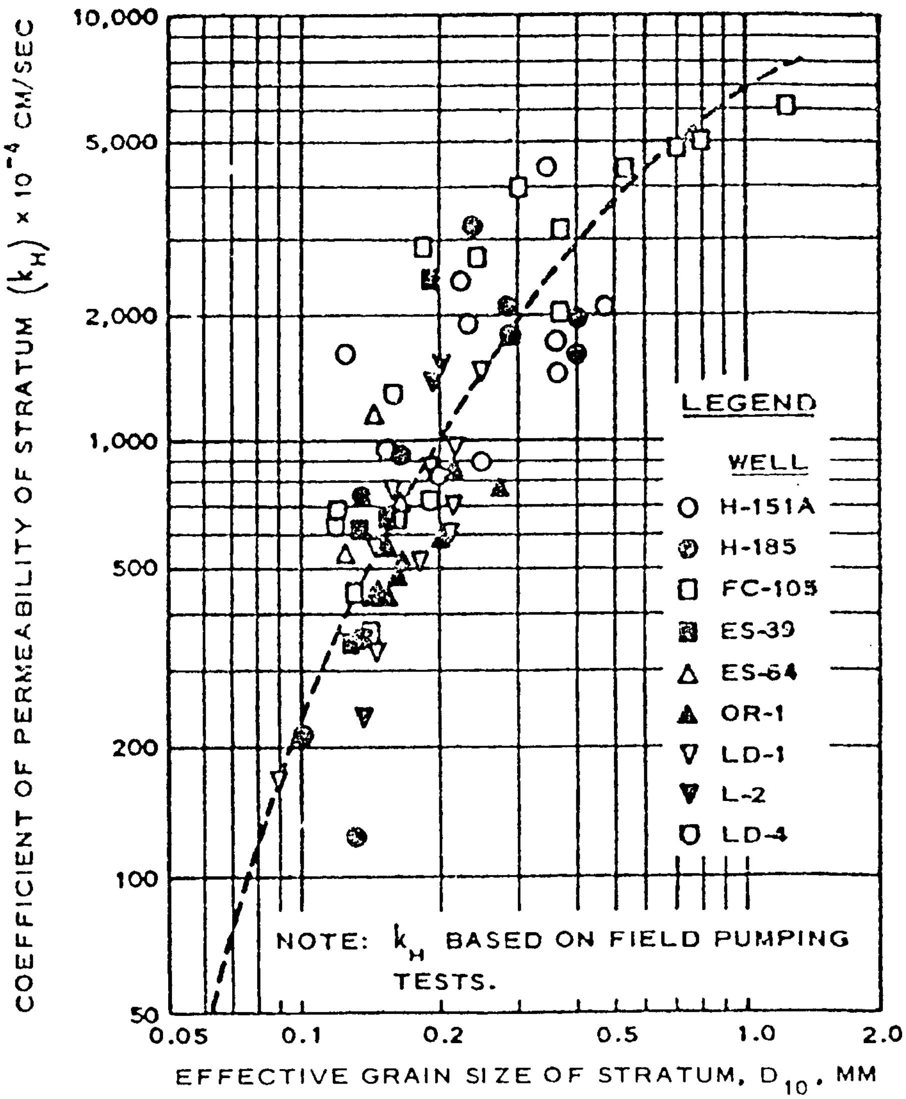
(p) γ_{bL} is submerged unit weight of landside blanket cover and berm (use 53 p.c.f.). γ_W is 62.4 p.c.f.

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

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

(s) Minimum 3.0 ft.

(t) Minimum 20 ft.



(b) Effective grain size, D_{10}, versus coefficient of permeability, k_H (from WES TM No. 3-424, ref. A-3b(2)

STATION 102+00

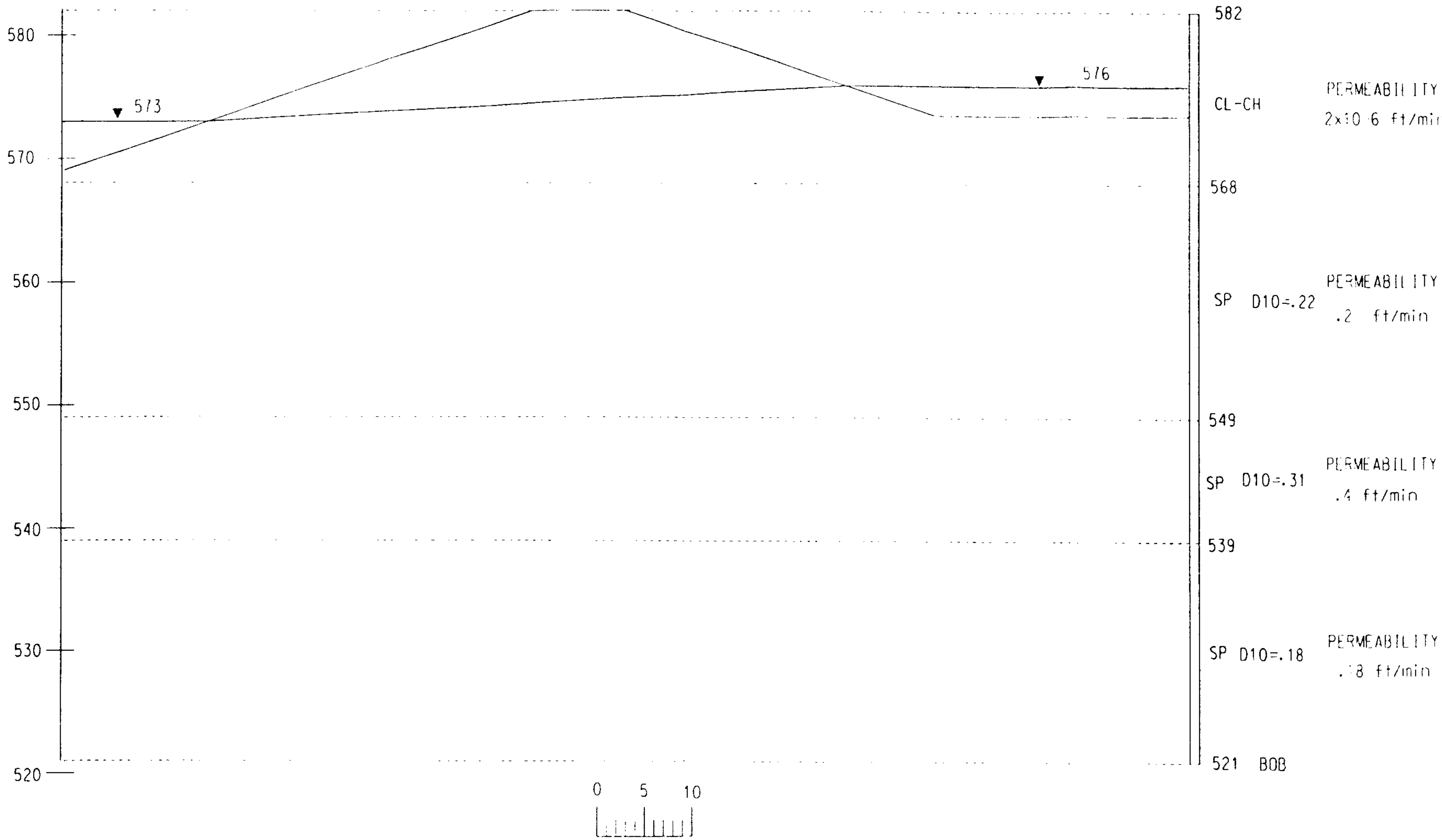


PLATE G-11

APPENDIX H

HYDROLOGY AND HYDRAULICS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX H
HYDROLOGY AND HYDRAULICS

TABLE OF CONTENTS

List of Tables

List of Plates

TABLE OF CONTENTS (Cont'd)

List of Plates (Cont'd)

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
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PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX H
HYDROLOGY AND HYDRAULICS

CLIMATE

The climate in east-central Iowa is characterized by extreme temperatures and moderate precipitation. The National Weather Service operates a weather station in Fulton, Illinois, which has 42 years of record. Temperatures range from a maximum of 102 degrees Fahrenheit in the summer to a minimum of -23 degrees Fahrenheit in the winter.

Most of the precipitation occurs in the summer months, with April, May, June, and July normally the wettest months, having a monthly average of over 4 inches. Winters are normally the driest parts of the year. The average annual precipitation is 36 inches, and the average annual snowfall is 21 inches. Table H-1 below lists the appropriate monthly precipitation at the Fulton gage.

TABLE H-1

Normal and Extremes of Monthly Precipitation

	Total Precipitation					Snowfall		
Month	Normal Inches	Record Inches	Max. Year	Record Inches	Min. Year	Normal Inches	Record Inches	Max. Year
Jan	1.57	6.54	65	.12	81	6.10	27.0	79
Feb	1.49	3.34	51	.26	69	4.45	14.0	50
Mar	2.77	6.90	85	.25	58	3.21	12.1	65
Apr	3.81	7.67	81	.65	86	0.77	6.0	70
May	3.78	8.93	70	.81	64	0.00		
Jun	4.51	9.39	74	.40	65	0.00		
Jul	4.14	7.65	51	.91	55	0.00		
Aug	3.06	9.70	81	.49	74	0.00		
Sep	3.70	11.24	61	.00	79	0.00		
Oct	2.60	7.40	86	.01	64	0.05	2.0	67
Nov	2.45	10.22	85	.43	53	1.21	6.2	51
Dec	2.07	5.77	82	.24	58	5.25	15.5	51

HYDROLOGY

PROFILES

Mississippi River discharge frequency relationships and corresponding water surface elevations were developed by the Rock Island District, Corps of Engineers, in cooperation with the St. Paul and St. Louis Districts for the Upper Mississippi River Basin Commission. They are published in a report entitled *Upper Mississippi River Water Surface Profiles, River Mile 0.0 to River Mile 847.5.* Plate H-1 shows the profiles for the study area from this report. Elevation frequency relationships for selected locations in the study area are shown below in table H-2.

TABLE H-2

Elevation Frequency for Princeton HREP Study Area

	Elevations for Various Locations and Frequencies		
Frequency	**RM 504.0 D/S End of Project**	**RM 505.0**	**RM 506.5 U/S End of Project**
5-Yr	578.7	579.1	579.7
10-Yr	580.3	580.7	581.3
25-Yr	582.0	582.5	583.1
50-Yr	583.3	583.8	584.4
100-Yr	584.4	584.8	585.5
200-Yr	585.6	586.0	586.7
500-Yr	587.0	587.4	588.0

DURATION CURVES

An elevation duration value is the percentage of time that historically an elevation is equalled or exceeded. Elevation duration relationships at river mile 505.0 were computed for the months of January through July, as shown on plates H-2 and H-3. Computations for the year are shown on plate 4 of the main report. The year-round normal elevation is about 573.0 feet.

STAGE HYDROGRAPHS

Daily stage hydrographs for river mile 505.0 are shown on plates 4 through 7 of the main report for the period of record 1966 through 1989.

HISTORICAL OVERTOPPING EVENTS

These records and records of the 1965 flood were viewed to see how many times the 10- and 25-year flood elevations at river mile 505.0 have been exceeded. In the past 25 years, from 1965 to 1989, the 10-year flood elevation of 580.7 and the 25-year flood elevation of 582.4 have each been exceeded only once. This occurred in April of 1965 with an elevation of 583.6.

HYDRAULIC EVALUATION OF PROPOSED PROJECT

OVERTOPPING ANALYSIS

The purpose of this evaluation is to adequately size the inflow capabilities of the system so that, in the event of a Mississippi River flood which overtops the levee, the interior of the levee is filled when the levee is overtopped. This is to protect the levee from failing due to a head between the river and the levee interior water surface elevations at the time of overtopping.

Four possible inflow methods were considered. They consisted of:

a. Modifying the road at the downstream end of the project to use as an overflow spillway, making it at an elevation lower than the remaining levee perimeter.

b. Using the existing gated culverts to let water into the system as the river rises in advance of levee overtopping.

c. Using the existing pump station to pump water into the system in advance of levee overtopping.

d. Installing a tainter gate system near the pump station. These could be operated to also aid in filling the system in advance of levee overtopping.

Upon further analysis, it was determined that a desirable overflow scenario could be attained by using the overflow spillway in conjunction with the gated culverts. Using the existing pump and installing a tainter gate are expensive alternatives and are not needed to provide adequate overtopping protection. They are therefore dropped from further consideration.

The two variables in the operating scenarios were the spillway length and the river elevation at which point the culverts would be opened. The spillway (road) is limited to a length of 2,300 feet, so any length less than this figure would be acceptable. The culvert opening elevation is governed by the amount of time that a levee overtopping event could be forecast in advance of it actually occurring. That is, the culverts would not be opened unless it was a certainty that the levee interior would be inundated.

The constants in the operating scenarios were the spillway crest elevation, the rate of rise of the river, the elevation storage relationship of the interior of the levee, and the culverts. The spillway crest is set at an elevation of 580.3, the 10-year Mississippi River flood elevation. The rest of the levee will be at an elevation of 581.3, and higher at the upstream end of the project. The rate of rise used in the analysis was modeled after the 1965 flood. It was felt that modeling an actual event would be more accurate than modeling a hypothetical one. The 1965 flood was a 100-year flood in this reach of the Mississippi River. The elevation storage relationship of the interior of the levee is shown on plate H-4. There are two 36-inch culverts, each with a gate on them. They have an invert elevation of 570.5. The combined elevation flow capacity of these culverts is shown on plate H-5. An additional 36-inch-diameter reinforced concrete pipe (RCP) culvert with a flow line at elevation 573.25 in the north cell is not considered in this analysis.

The spillway elevation of 580.3 matches a 10-year flood elevation. Current forecasting methods used at the Rock Island District enable a flood event with a recurrence interval of 10 years to be predicted 1 to 2 weeks in advance. Therefore, a flood event which overtops the proposed emergency spillway can be forecast 1 to 2 weeks in advance. In this overtopping analysis, the 1-week figure was selected as a conservative number. Therefore, for this analysis in simulating the 1965 flood, the culverts were opened 1 week in advance of the Mississippi River reaching elevation 580.3, or elevation 576.4.

The results of modeling the 1965 flood are shown on plate H-6. The modeling begins at midday on April 16, 1965, when the Mississippi River is at an elevation of 576.5. The modeling ends at midday on April 24, 1965, when the Mississippi River is at elevation 581.3, or when the outer levee begins to overtop. The interior fills with flow through the culverts as the Mississippi River rises. The emergency spillway begins to overtop on day 23.75 (elevation 580.3). The head differential between the Mississippi River and the south cell water elevation is 3.2 feet. At day 24.1, the south cell elevation has reached 578.0 and the cross dike begins to overtop. The head differential between the south and north cells is 0.9 foot at this point and the head differential between the south cell and the river is 2.6 feet. The depth of water on the emergency spillway is 0.3 foot. The water elevations in the north and south cells reach equilibrium at day 24.3. At day 24.5, the head differential between the river and the south and north cells is 1.0 foot, and the depth of water on the emergency spillway is 0.7 foot. At day 24.65, the water levels equalize at elevation 581.3 and the outer levee begins to overtop.

RIPRAP ANALYSIS

The overtopping of the emergency spillway causes concern about possible erosion on the interior side of the emergency spillway, as water flows down the slope into the interior of the leveed area. From the above overtopping analysis, during an overtopping event the maximum depth on the spillway will be 0.8 foot and the time from when overtopping begins until the two water levels equalize will be about 24 hours.

The Waterways Experiment Station of the U.S. Army Corps of Engineers has published a report entitled *A Study of Embankment Performance During Overtopping, Technical Report GL-91-23*, November 1991. The report presents case studies of actual overtopping events and the effect of those events upon the embankments. The report also presents mathematical models of embankment overtopping.

The case studies shown in the report were for embankments of 15 feet or greater. Generally speaking, a breach of the embankment occurred when the depth on the embankment was 4 feet or greater or when the overtopping occurred over a period of 1 week or more. Breaches did occur when one of the two above conditions were not met.

Therefore, it appears that the emergency spillway will not breach in an overtopping event and no riprap should be required on the spillway. The report also suggests that the more compacted an embankment is the more resistant it is to erosion, that vegetation on the slope delays the initiation of erosion, and that the more sediment in the inflowing water the less abrasive the water will be to the soil slope. This embankent will be highly compacted as it will be used to drive vehicles on. The inflowing water will have a high sediment load as Mississippi River water has a higher sediment load during floods. Vegetation should be provided on the slope and be properly maintained.

TYPICAL OPERATING SCENARIOS

The proposed project will change the current operation from a 1-cell to a 2-cell configuration by constructing a cross dike. The stoplog structure will be constructed in the cross dike to allow water to pass between the two cells. A 36-inch gatewell will be built in the north cell to give the capability to pass flow to and from the Mississippi River.

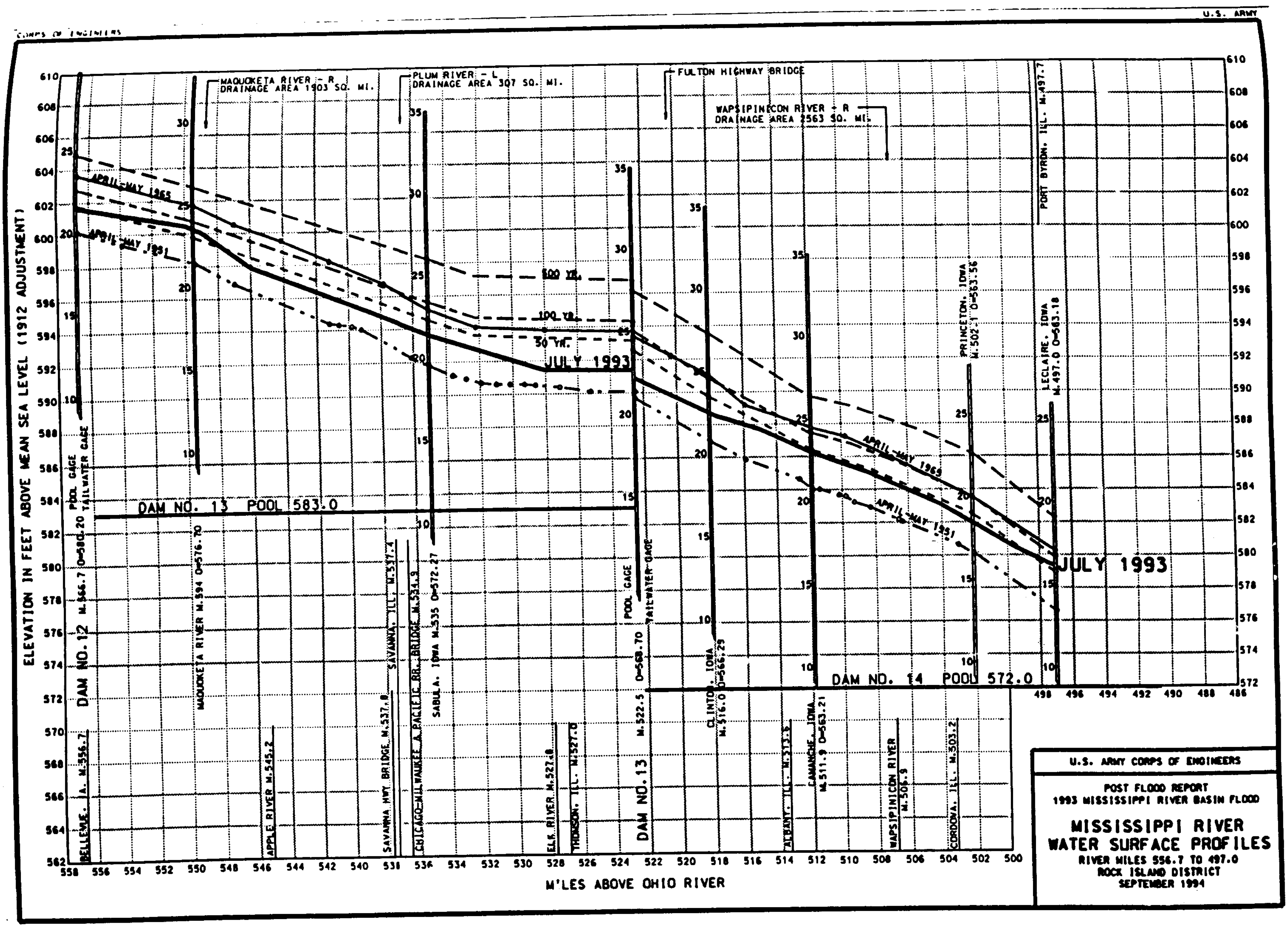
An analysis was performed to evaluate different methods of operating the project. The analysis included the above features as well as the existing two gated culverts connecting the south cell to the Mississippi River. Also included was the existing 16,000 gpm pump which will be relocated from the south cell. Filling and emptying times for one and two cells using the pump and/or culverts were calculated. The south cell will be filled to an elevation of 575.0 with maximum operating level of 576.5. The north cell will be filled to an elevation of 576.0 with a maximum operating level of 576.5.

The various operating schemes which were analyzed are described below in table H-3, along with the calculated times to perform the operation. The results are shown graphically on plates H-7 through H-18.

TABLE H-3

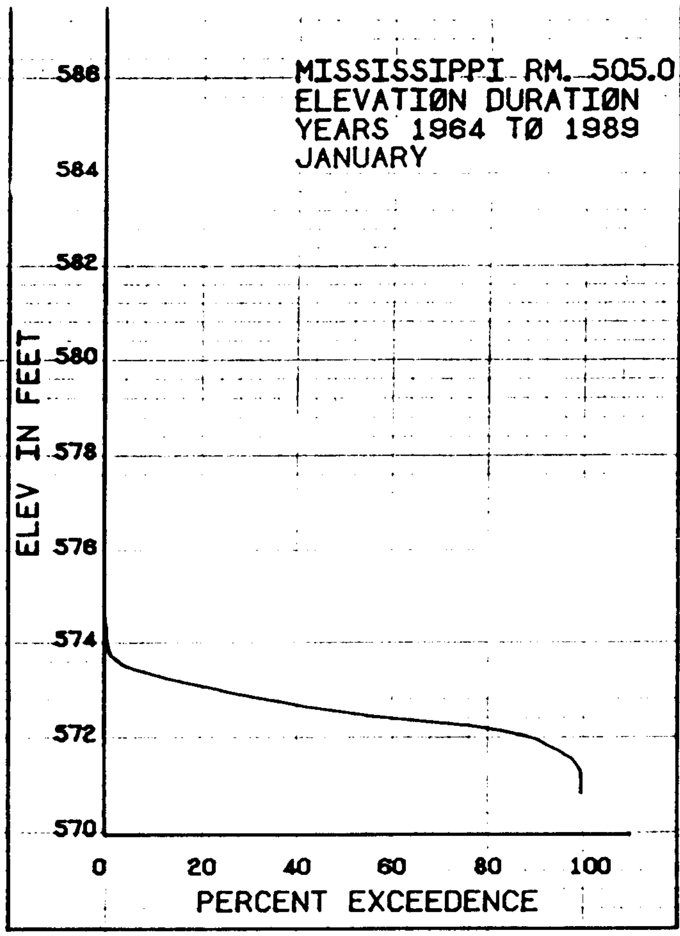
Computed Operation Timing

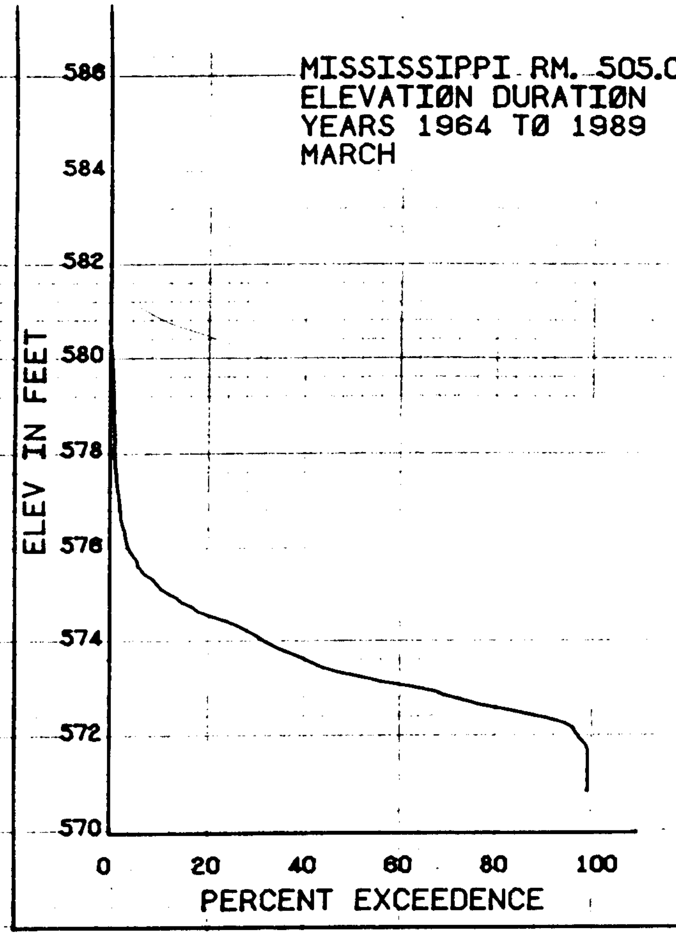
Ref. Plate	Operation	Time (Days) South Cell	Time (Days) North Cell
H-7	Fill South Cell to Elev. 575.0 with Pump	5	--
H-8	Fill South Cell to Elev. 575.5 with Pump	8	--
H-9	Fill North Cell to Elev. 576.0 with Pump	--	7
H-10	Fill North Cell to Elev. 576.5 with Pump	--	10
H-11	Fill South Cell to Elev. 575.0 and North Cell to Elev. 576.0 with Pump	7	12
H-12	Drain South Cell from Elev. 575.0 with South Cell Culverts	3	--
H-13	Drain North Cell from Elev. 576.0 with North Cell Culvert	--	25
H-14	Drain South Cell from Elev. 575.0 and North Cell from Elev. 576.0 with South Cell Culverts	8	25
H-15	Drain South Cell from Elev. 575.0 and North Cell from Elev. 576.0 with South Cell and North Cell Culverts	4	4
H-16	Fill South Cell to Elev. 575.0 with South Cell Culverts with Mississippi River at Elev. 576.0	2	--
H-17	Fill North Cell to Elev. 576.0 with North Cell Culvert with Mississippi River at Elev. 576.0	--	7
H-18	Fill South Cell to Elev. 575.0 and North Cell to Elev. 576.0 with South Cell and North Cell Culverts with Mississippi River at Elev. 576.0	2	7

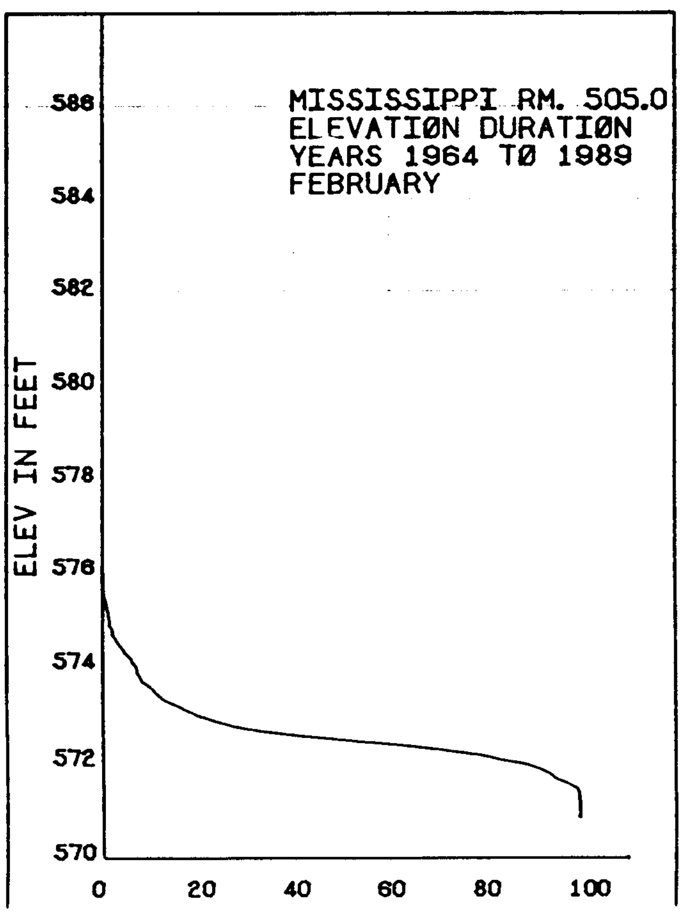


CORPS OF ENGINEERS
U.S. ARMY
ELEVATION IN FEET ABOVE MEAN SEA LEVEL (1912 ADJUSTMENT)
MILES ABOVE OHIO RIVER
MAQUOKETA RIVER - R
DRAINAGE AREA 1903 SQ. MI.
PLUM RIVER - L
DRAINAGE AREA 307 SQ. MI.
FULTON HIGHWAY BRIDGE
WAPSIPINECON RIVER - R
DRAINAGE AREA 2563 SQ. MI.
APRIL-MAY 1965
APRIL-MAY 1951
500 YR.
100 YR.
50 YR.
JULY 1993
DAM NO. 13 POOL 583.0
DAM NO. 14 POOL 572.0
POOL GAGE
TAILWATER GAGE
DAM NO. 12 M.556.7 0=580.20
MAQUOKETA RIVER M.549.4 0=576.70
SABULA, IOWA M.535 0=572.27
DAM NO. 13 M.522.5 0=568.70
CLINTON, IOWA M.516.0 0=566.29
CAMANCHE, IOWA M.511.9 0=563.21
PRINCETON, IOWA M.502.1 0=563.56
LECLAIRE, IOWA M.497.0 0=563.18
PORT BYRON, ILL. M.497.7
BELLEVUE, IA. M.556.7
APPLE RIVER M.545.2
SAVANNA HWY BRIDGE M.537.8
SAVANNA, ILL. M.537.4
CHICAGO-MILWAUKEE & PACIFIC RR. BRIDGE M.534.9
ELK RIVER M.527.8
THOMSON, ILL. M.527.0
ALBANY, ILL. M.513.6
WAPSIPINICON RIVER M.506.9
CORDOVA, ILL. M.503.2
U.S. ARMY CORPS OF ENGINEERS
POST FLOOD REPORT
1993 MISSISSIPPI RIVER BASIN FLOOD
MISSISSIPPI RIVER
WATER SURFACE PROFILES
RIVER MILES 556.7 TO 497.0
ROCK ISLAND DISTRICT
SEPTEMBER 1994

PLATE H-1


MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
JANUARY
ELEV IN FEET
570 572 574 576 578 580 582 584 586
0 20 40 60 80 100
PERCENT EXCEEDENCE


MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
MARCH
ELEV IN FEET
570 572 574 576 578 580 582 584 586
0 20 40 60 80 100
PERCENT EXCEEDENCE


MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
FEBRUARY
ELEV IN FEET
570 572 574 576 578 580 582 584 586
0 20 40 60 80 100

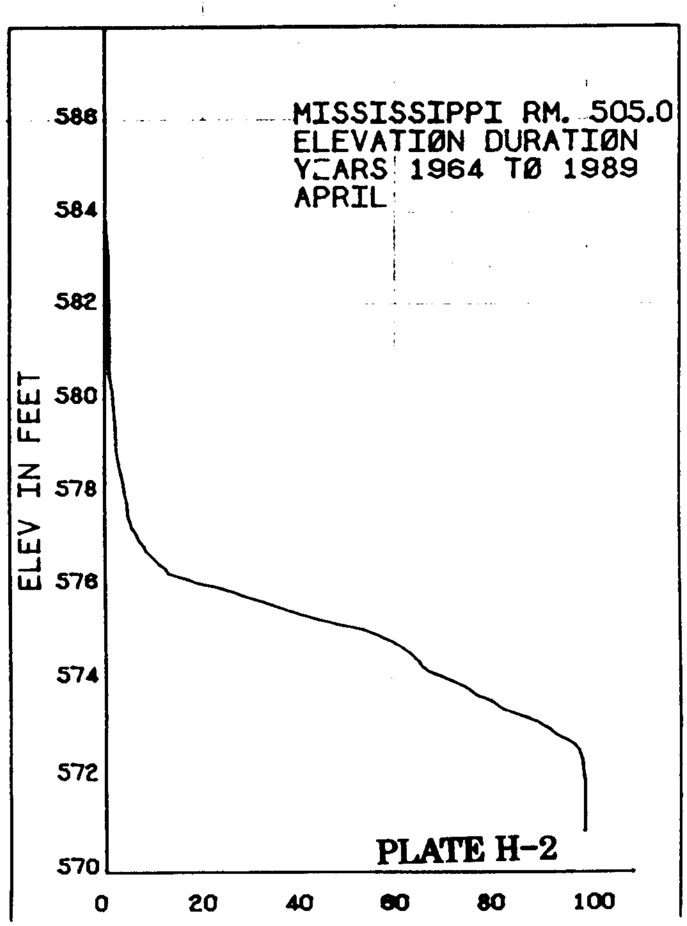
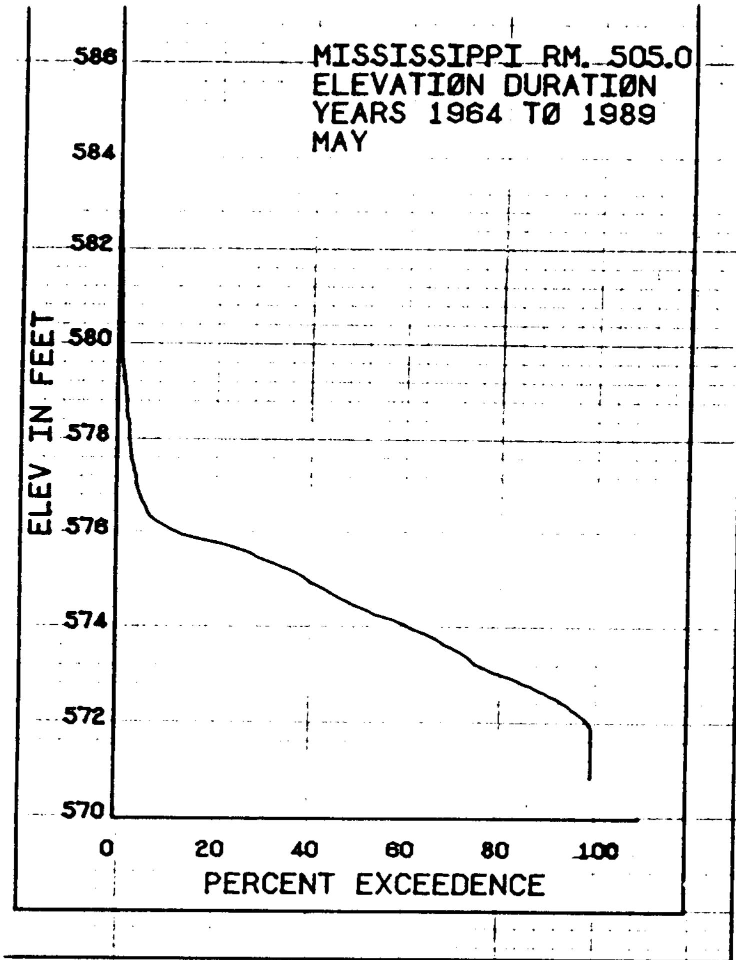
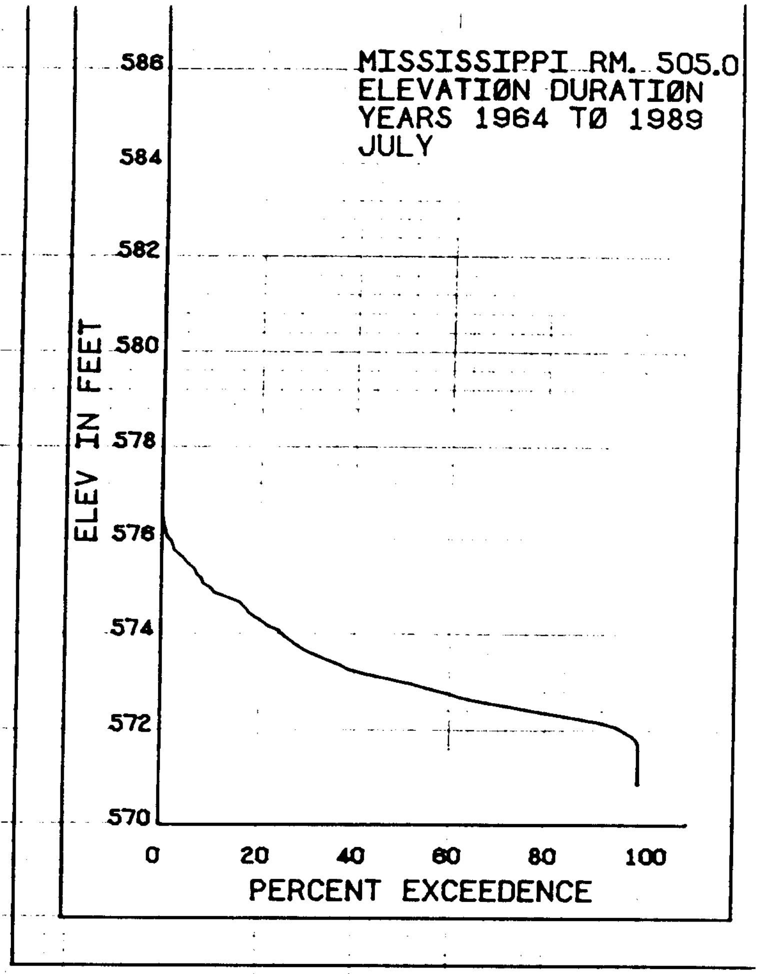

MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
APRIL
ELEV IN FEET
570 572 574 576 578 580 582 584 586
0 20 40 60 80 100

PLATE H-2


MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
MAY
ELEV IN FEET
586
584
582
580
578
576
574
572
570
0
20
40
60
80
100
PERCENT EXCEEDENCE


MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
JULY
ELEV IN FEET
586
584
582
580
578
576
574
572
570
0
20
40
60
80
100
PERCENT EXCEEDENCE

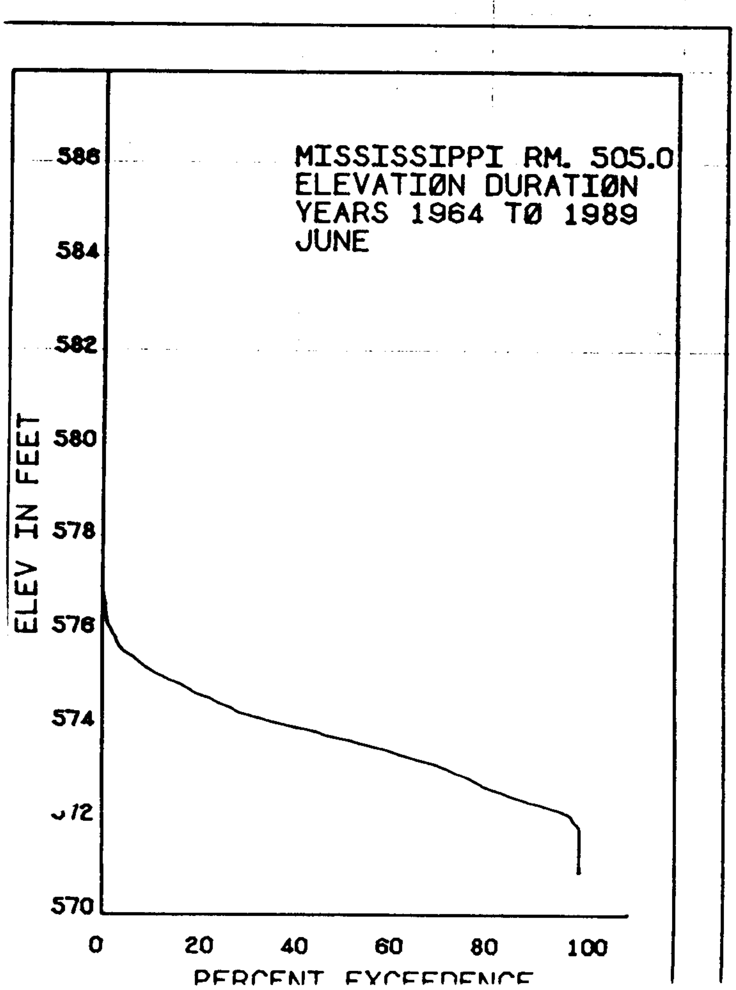

MISSISSIPPI RM. 505.0
ELEVATIØN DURATIØN
YEARS 1964 TØ 1989
JUNE
ELEV IN FEET
586
584
582
580
578
576
574
570
0
20
40
60
80
100

PLATE H-3

PRINCETON EMP

ELEVATION - STORAGE

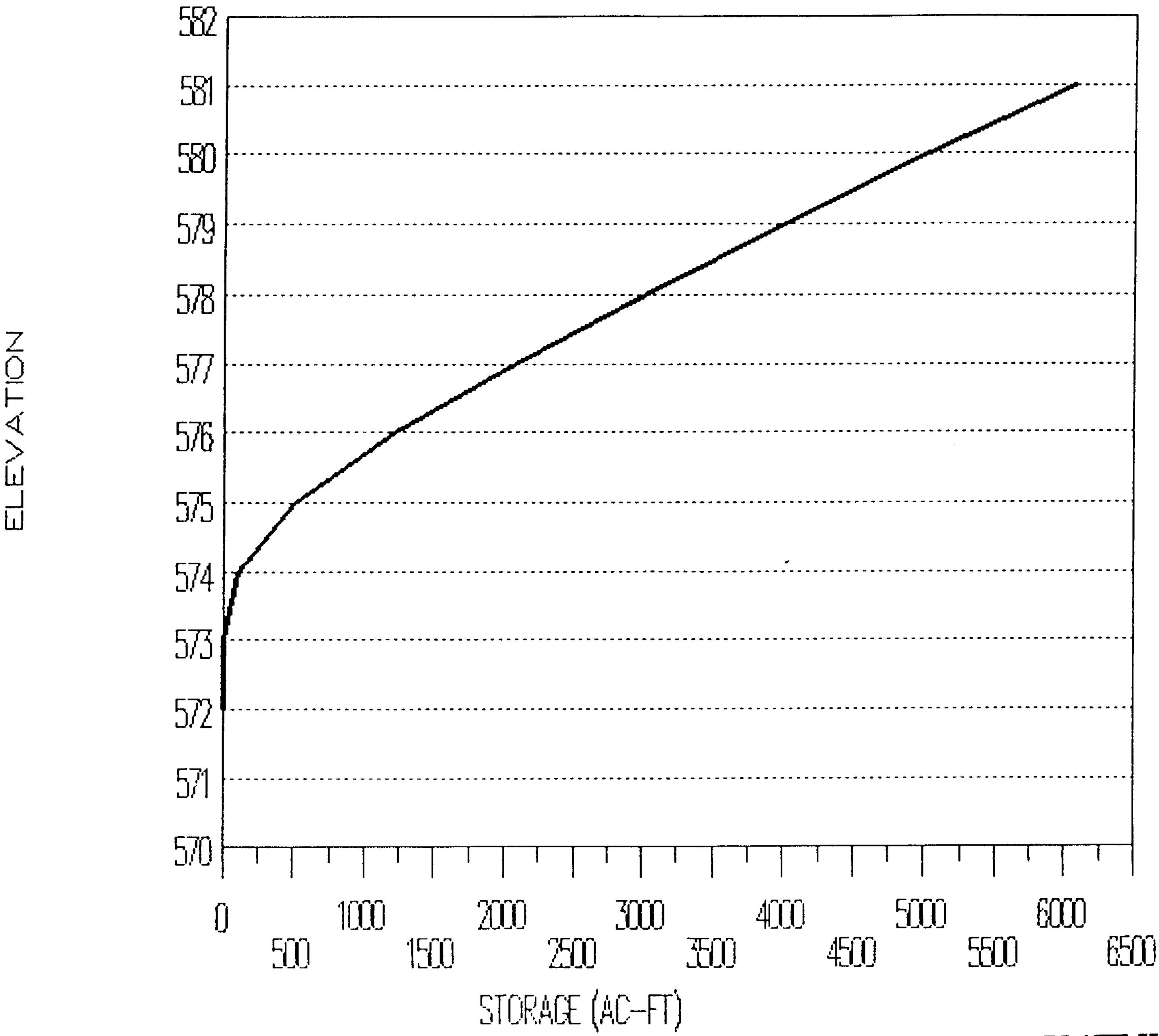


PLATE H-4

PRINCETON EMP
CULVERT RATING CURVES
VARIOUS TAILWATER ELEVATIONS

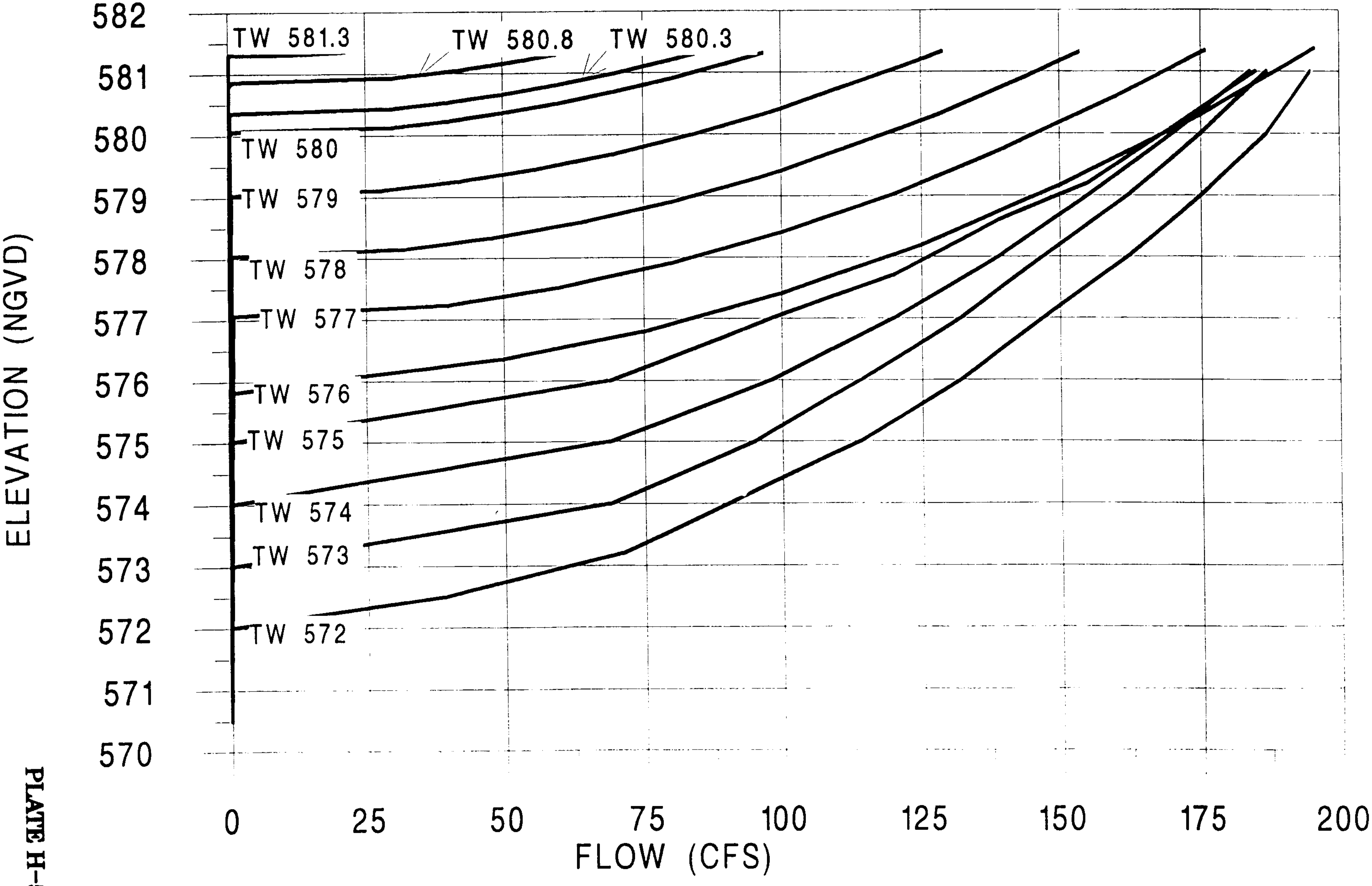


PLATE H-5

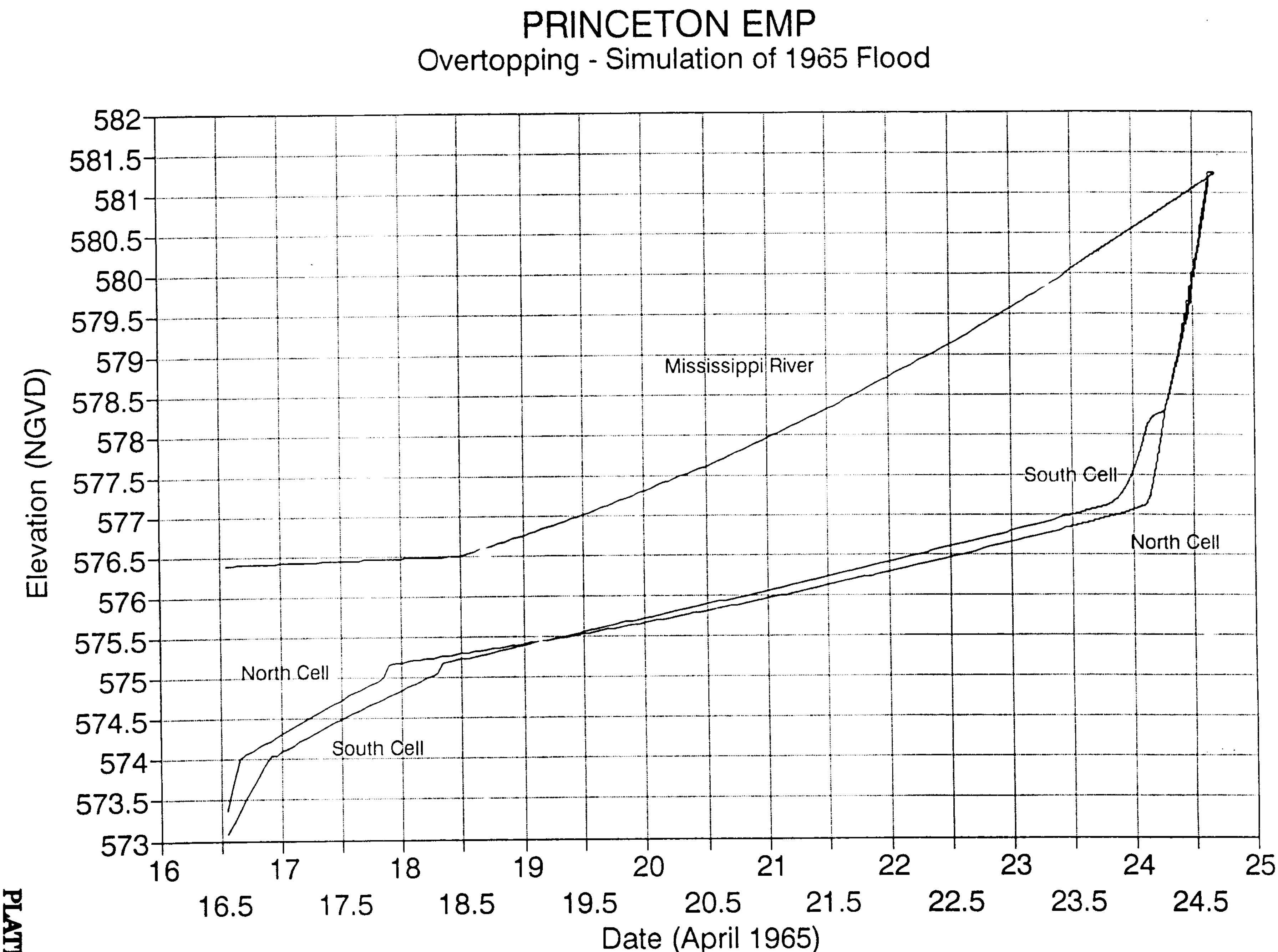

PRINCETON EMP
Overtopping - Simulation of 1965 Flood
Elevation (NGVD)
Date (April 1965)
Mississippi River
South Cell
North Cell
North Cell
South Cell
582
581.5
581
580.5
580
579.5
579
578.5
578
577.5
577
576.5
576
575.5
575
574.5
574
573.5
573
16
16.5
17
17.5
18
18.5
19
19.5
20
20.5
21
21.5
22
22.5
23
23.5
24
24.5
25

PLATE H-6

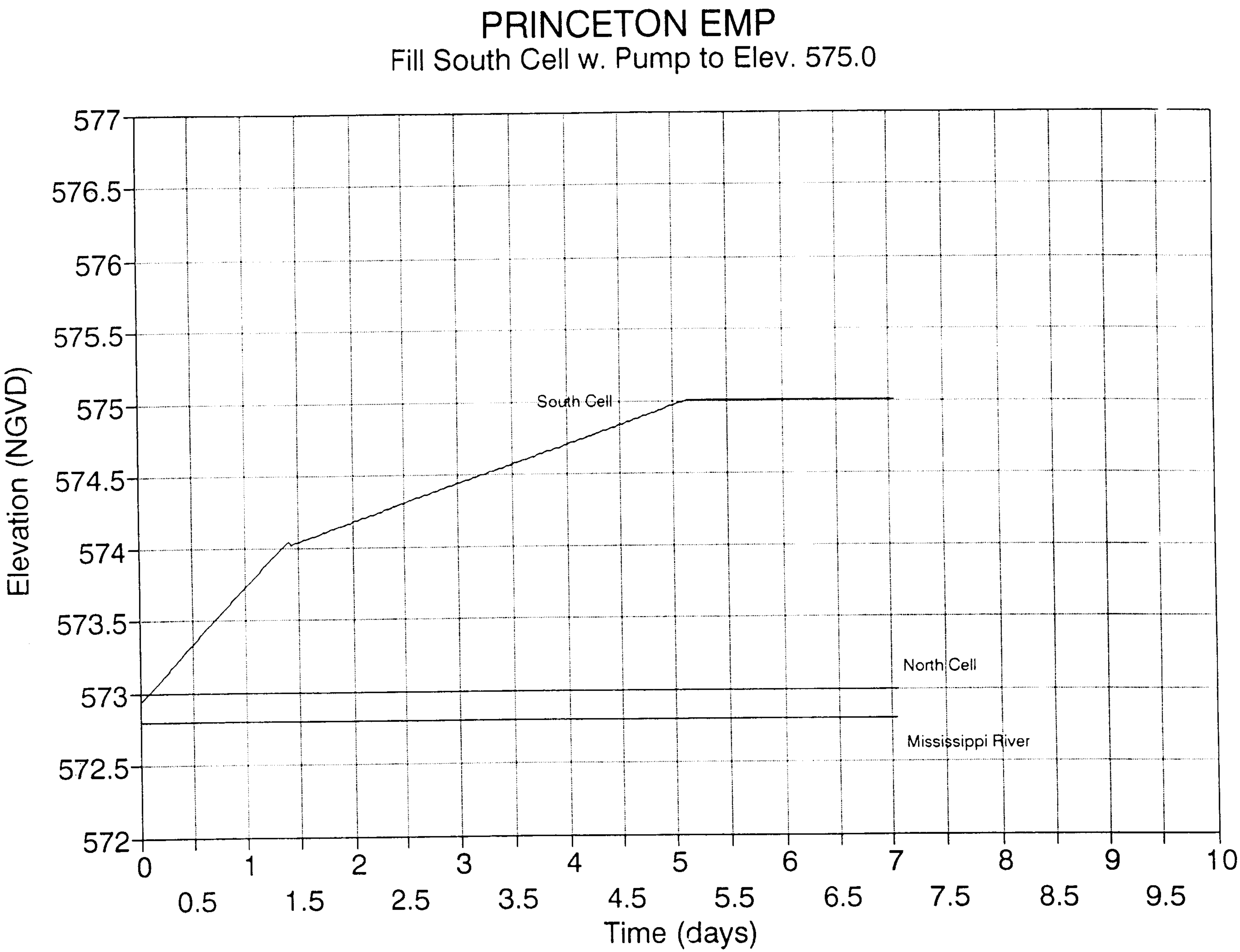

PRINCETON EMP
Fill South Cell w. Pump to Elev. 575.0
Elevation (NGVD)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
Time (days)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
South Cell
North Cell
Mississippi River

PLATE H-7

PRINCETON EMP

Fill South Cell w. Pump to Elev. 575.5

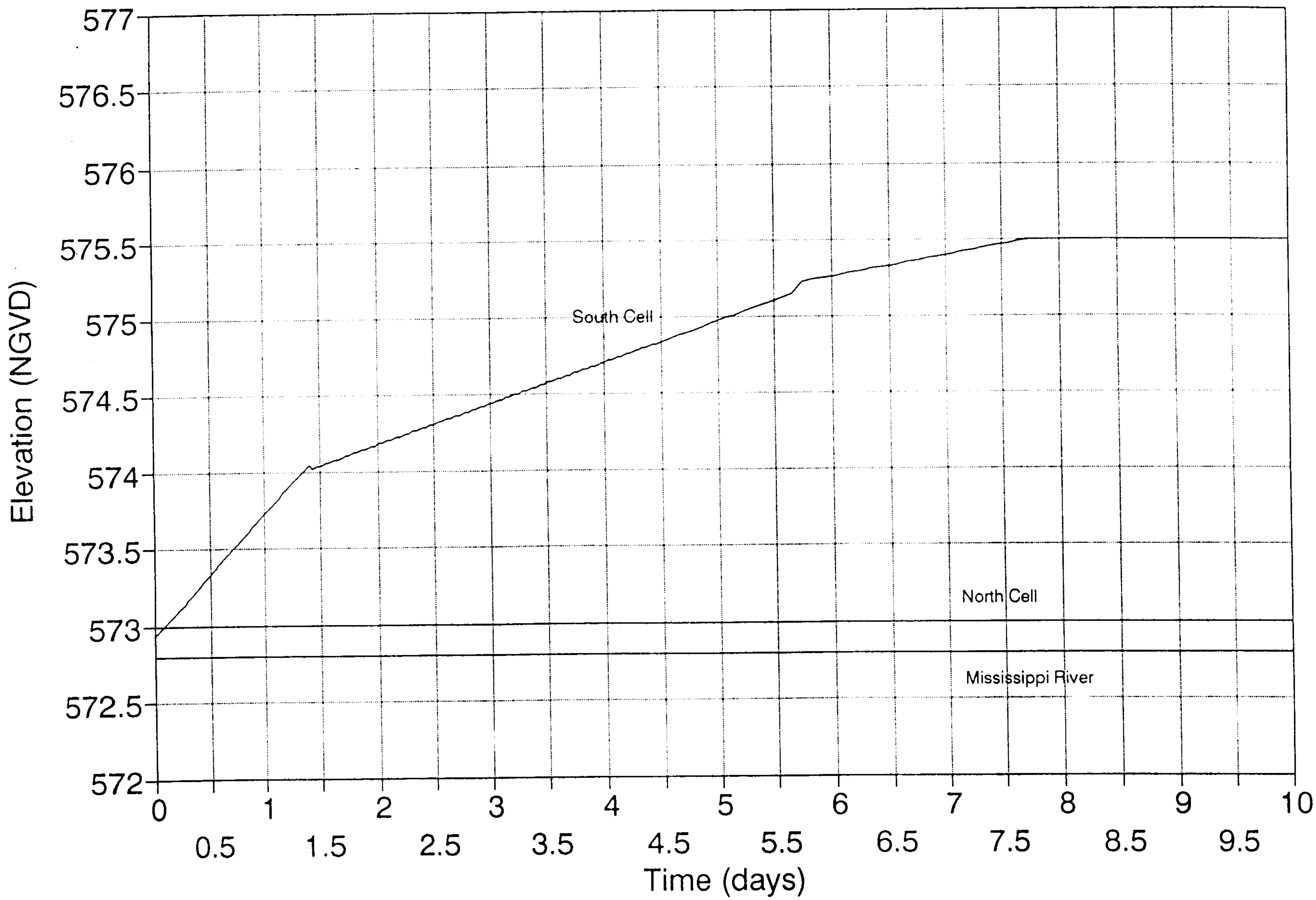
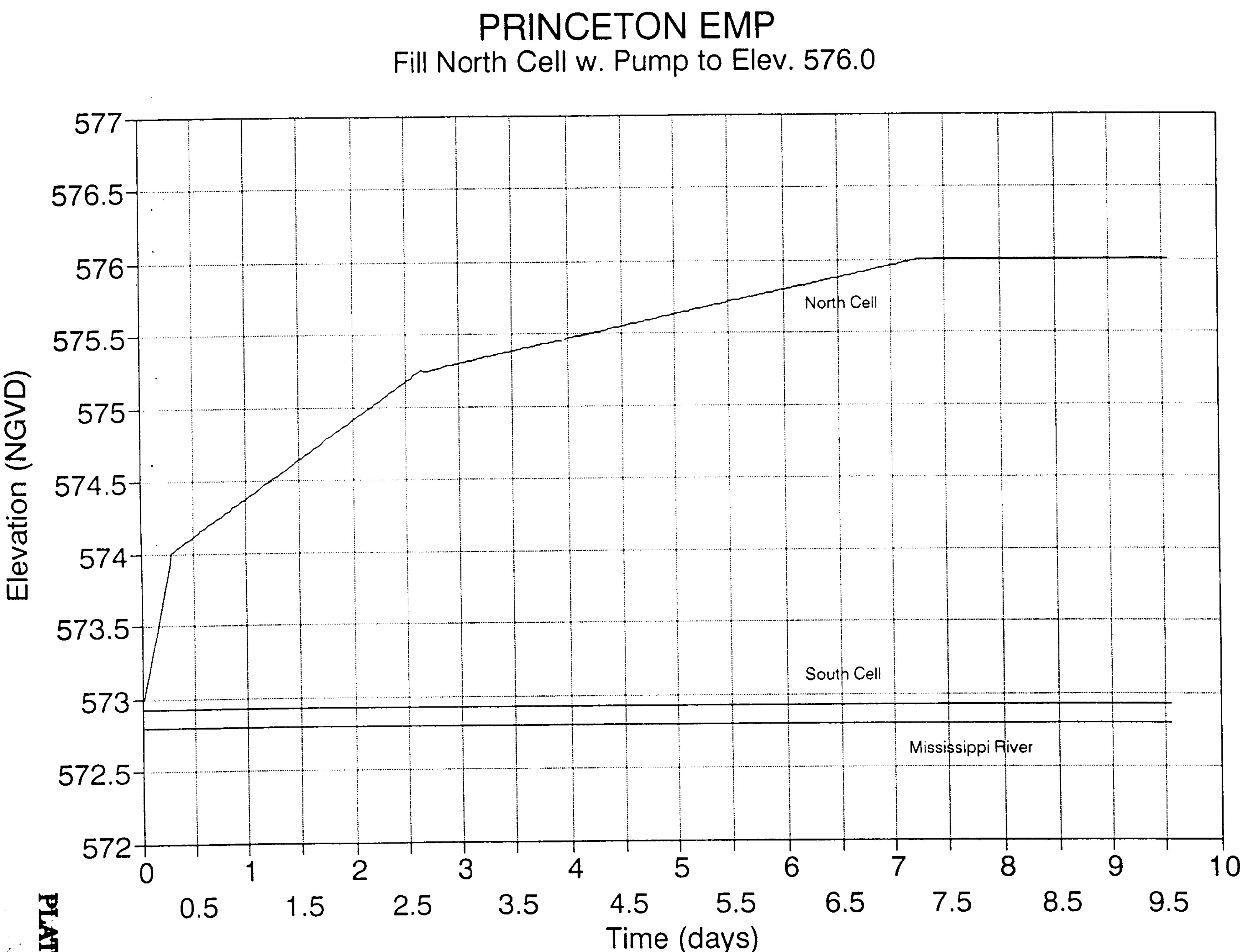


PLATE H-8



PRINCETON EMP
Fill North Cell w. Pump to Elev. 576.0
Elevation (NGVD)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
North Cell
South Cell
Mississippi River
0
1
2
3
4
5
6
7
8
9
10
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
Time (days)

PLATE H-9

PRINCETON EMP

Fill North Cell w. Pump to Elev. 576.5

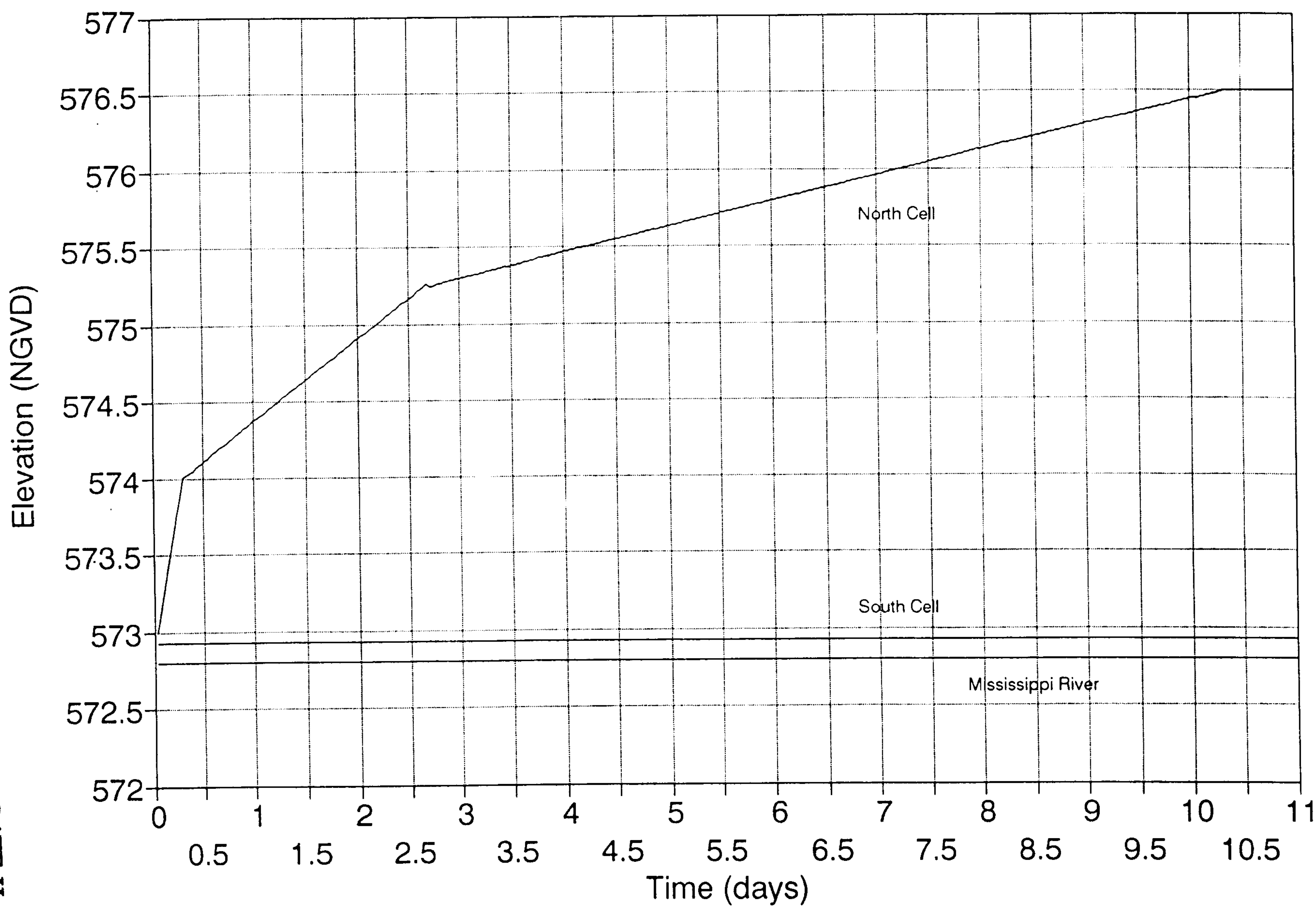


PLATE H-10

PRINCETON EMP
Fill South and North Cells

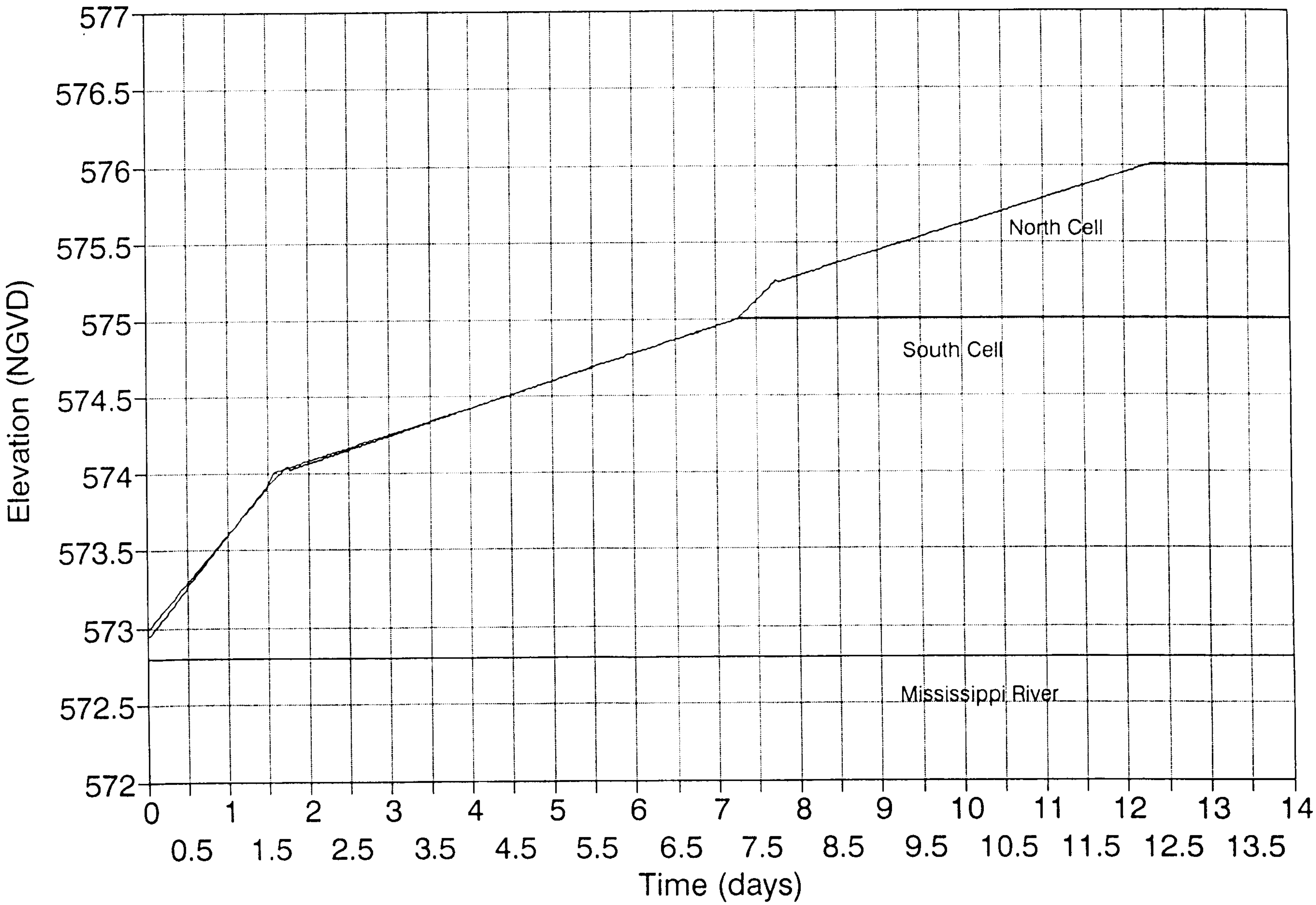


PLATE H-11

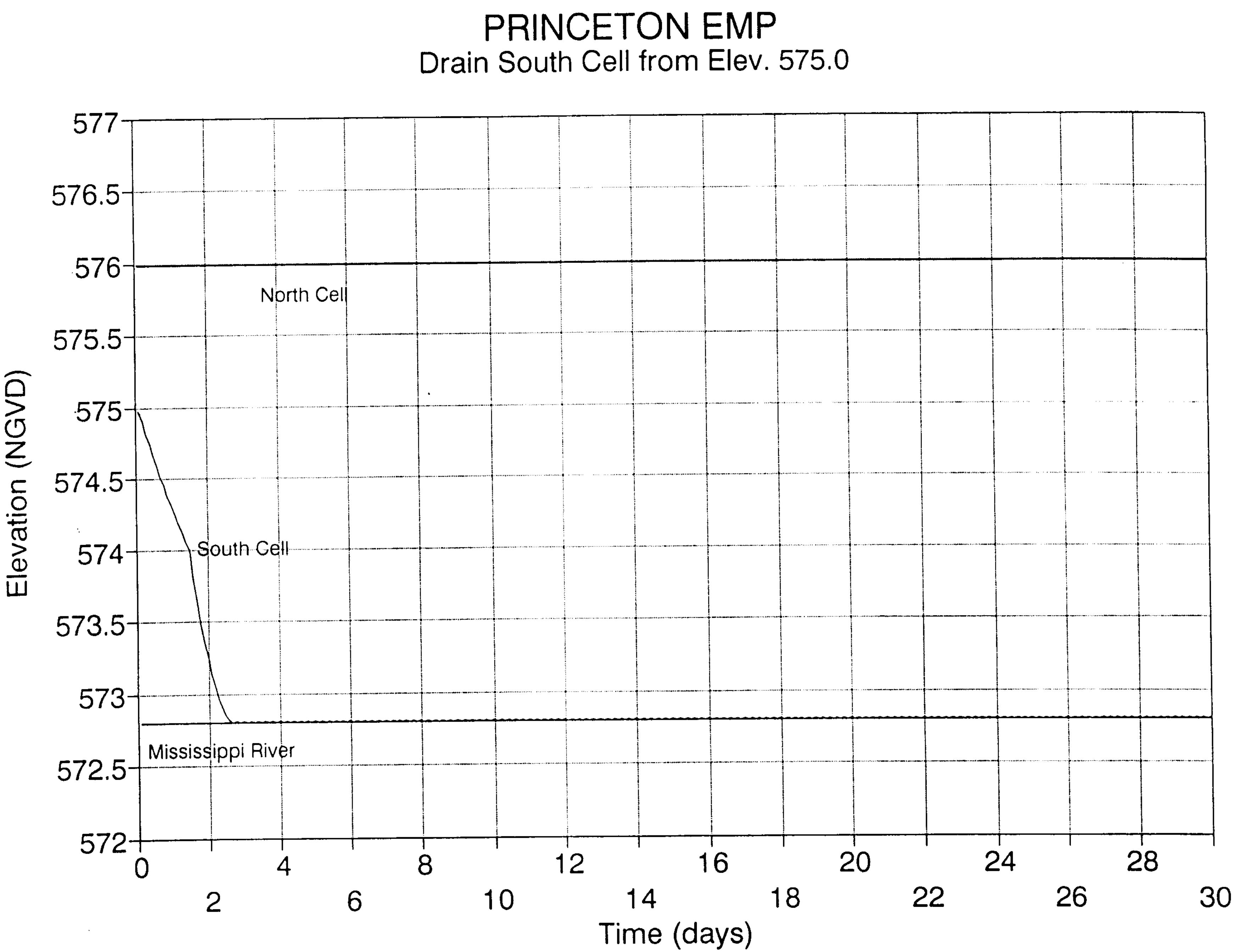

PRINCETON EMP
Drain South Cell from Elev. 575.0
Elevation (NGVD)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
North Cell
South Cell
Mississippi River
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Time (days)

PLATE H-12

PRINCETON EMP
Drain North Cell from Elev. 576.0

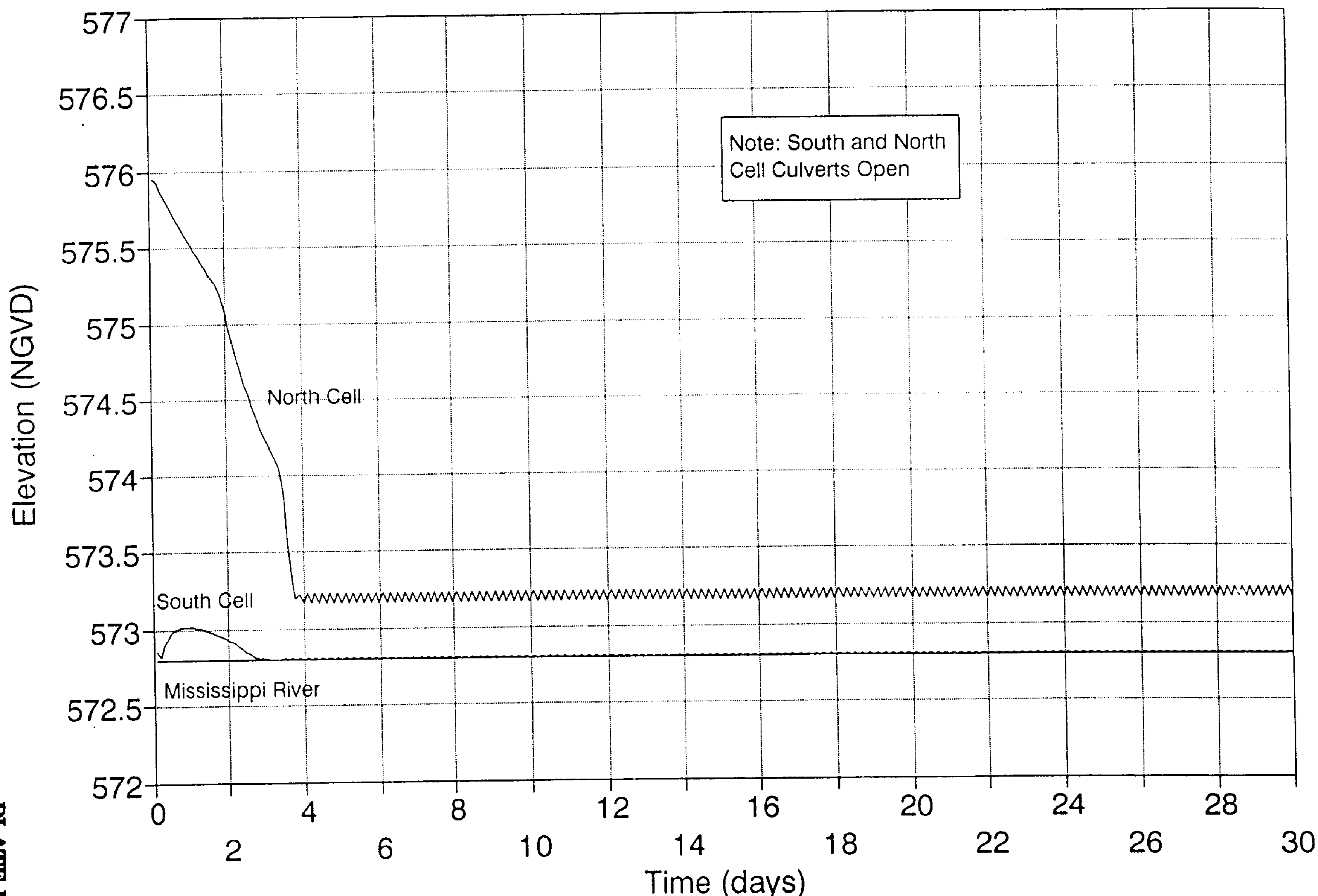
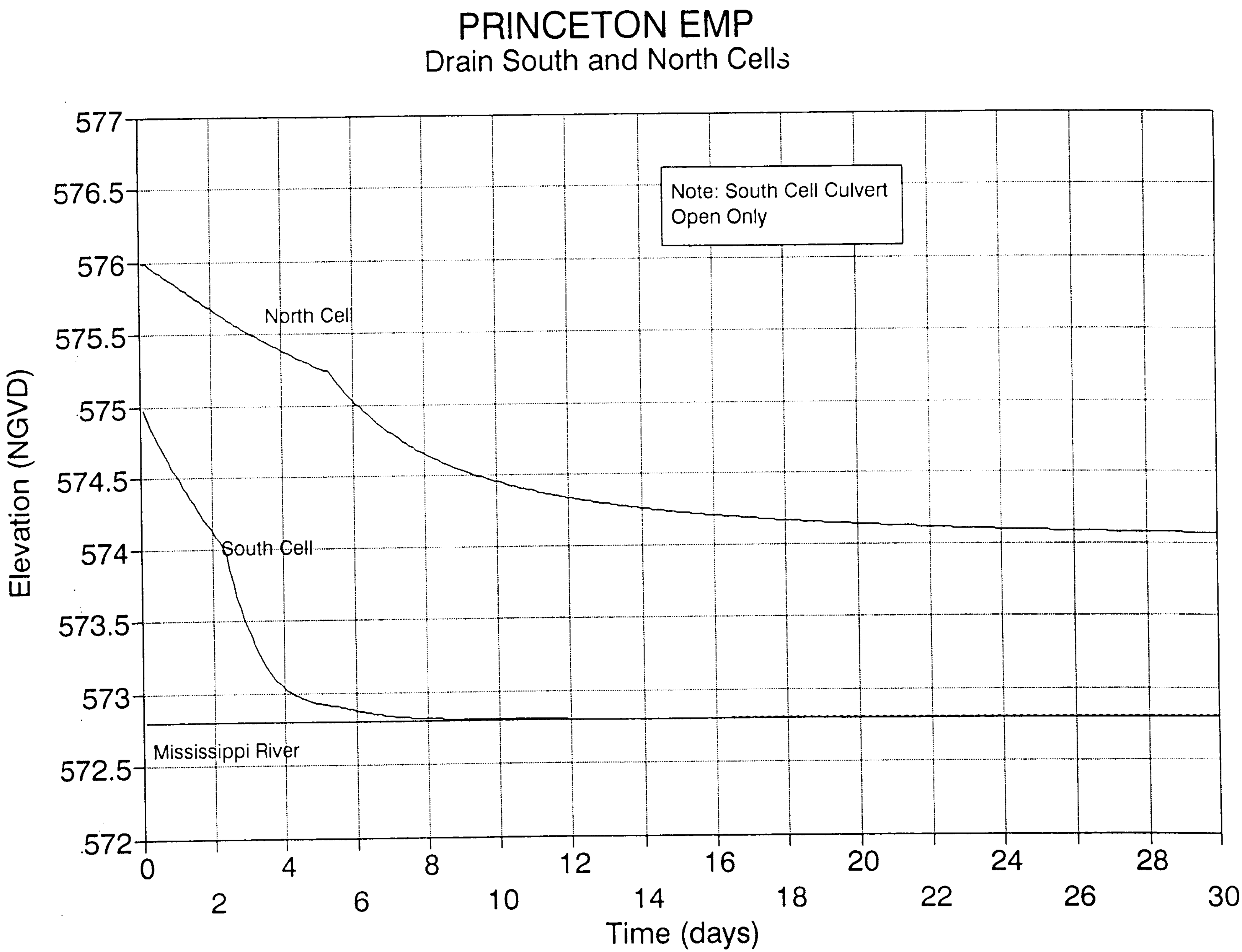
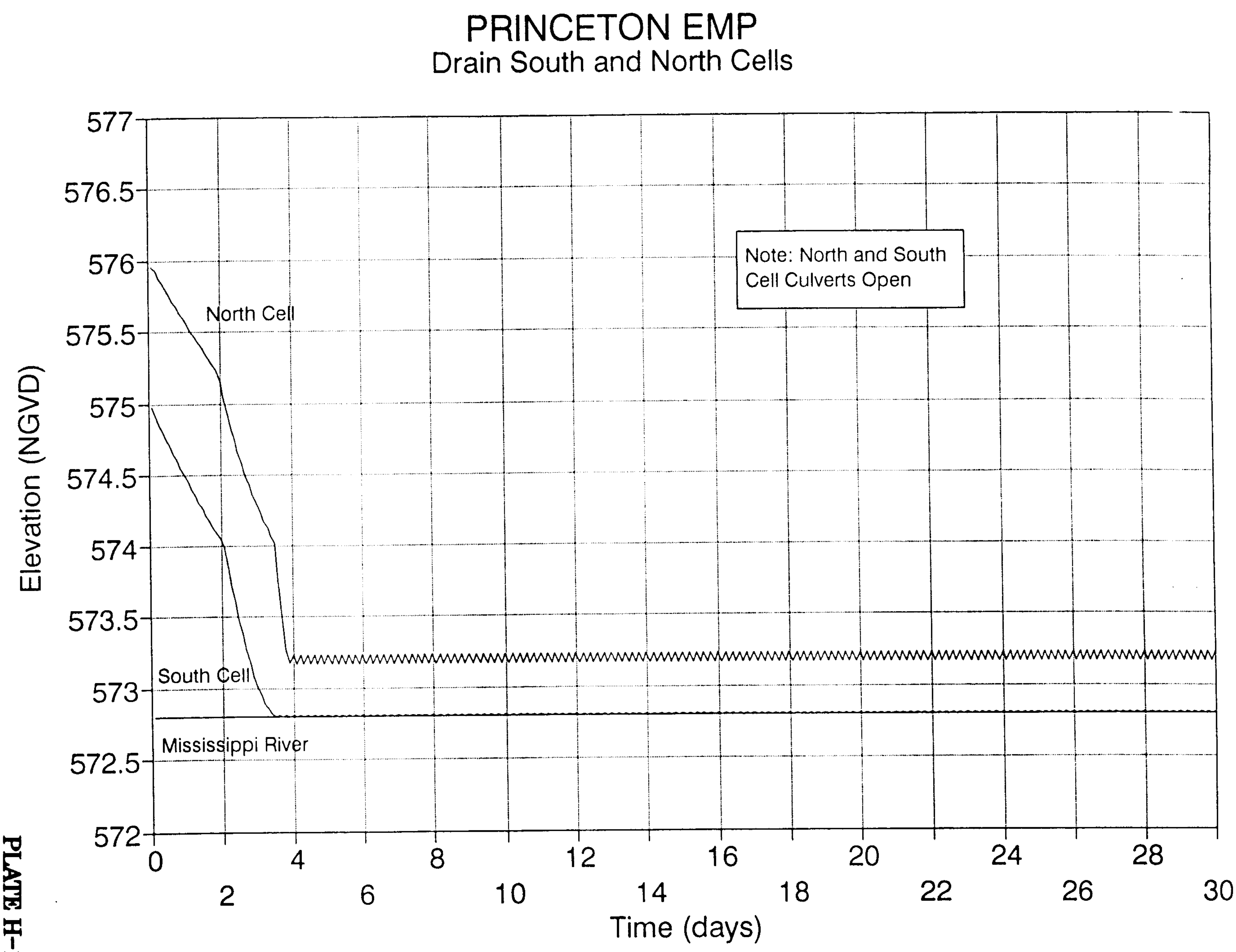


PLATE H-13



PRINCETON EMP
Drain South and North Cells
Note: South Cell Culvert Open Only
North Cell
South Cell
Mississippi River
Elevation (NGVD)
Time (days)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

PLATE H-14


PRINCETON EMP
Drain South and North Cells
Note: North and South Cell Culverts Open
North Cell
South Cell
Mississippi River
Elevation (NGVD)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Time (days)

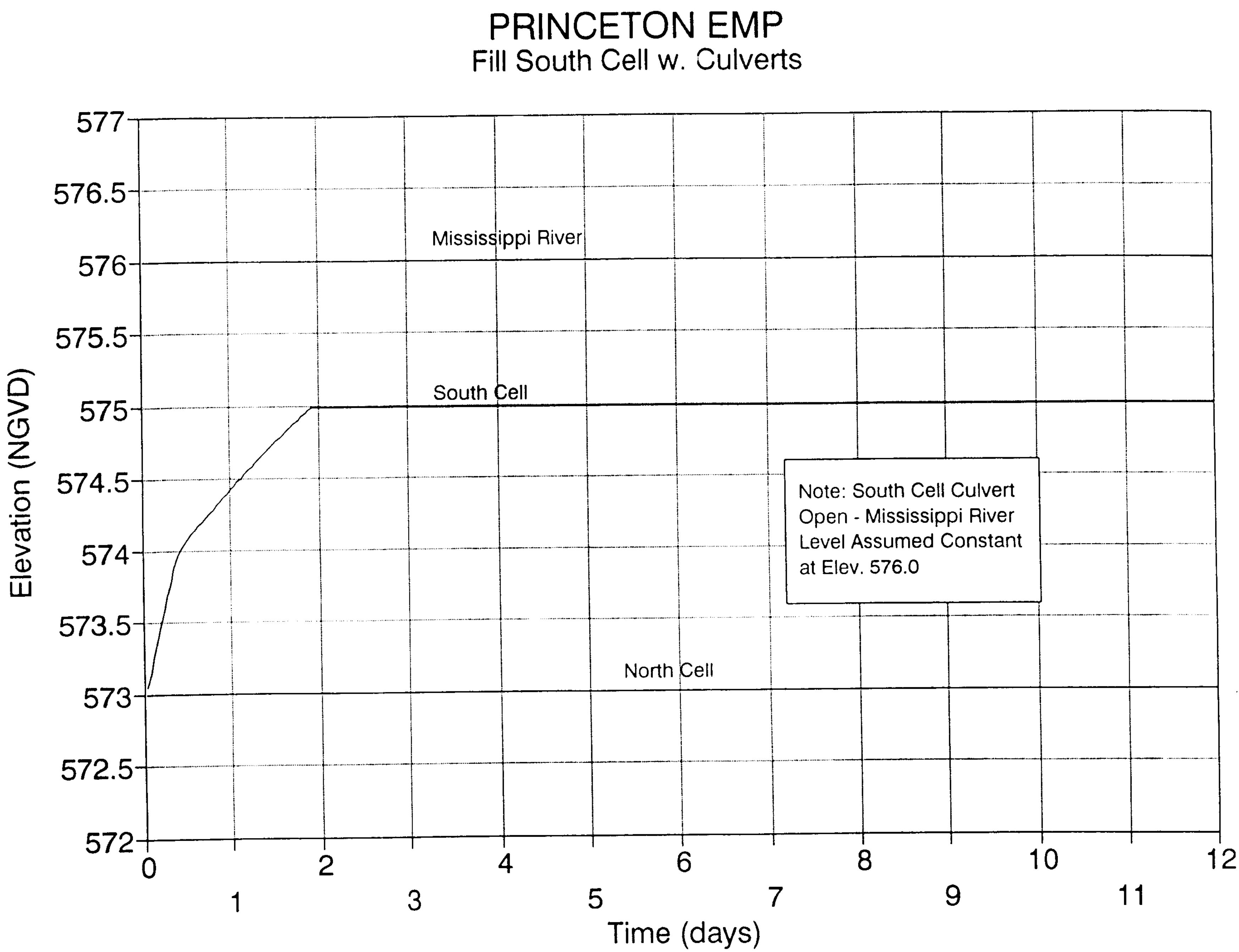

PRINCETON EMP
Fill South Cell w. Culverts
Elevation (NGVD)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
Mississippi River
South Cell
North Cell
Note: South Cell Culvert Open - Mississippi River Level Assumed Constant at Elev. 576.0
0
1
2
3
4
5
6
7
8
9
10
11
12
Time (days)

PLATE H-16

PRINCETON EMP
Fill North Cell w. Culverts

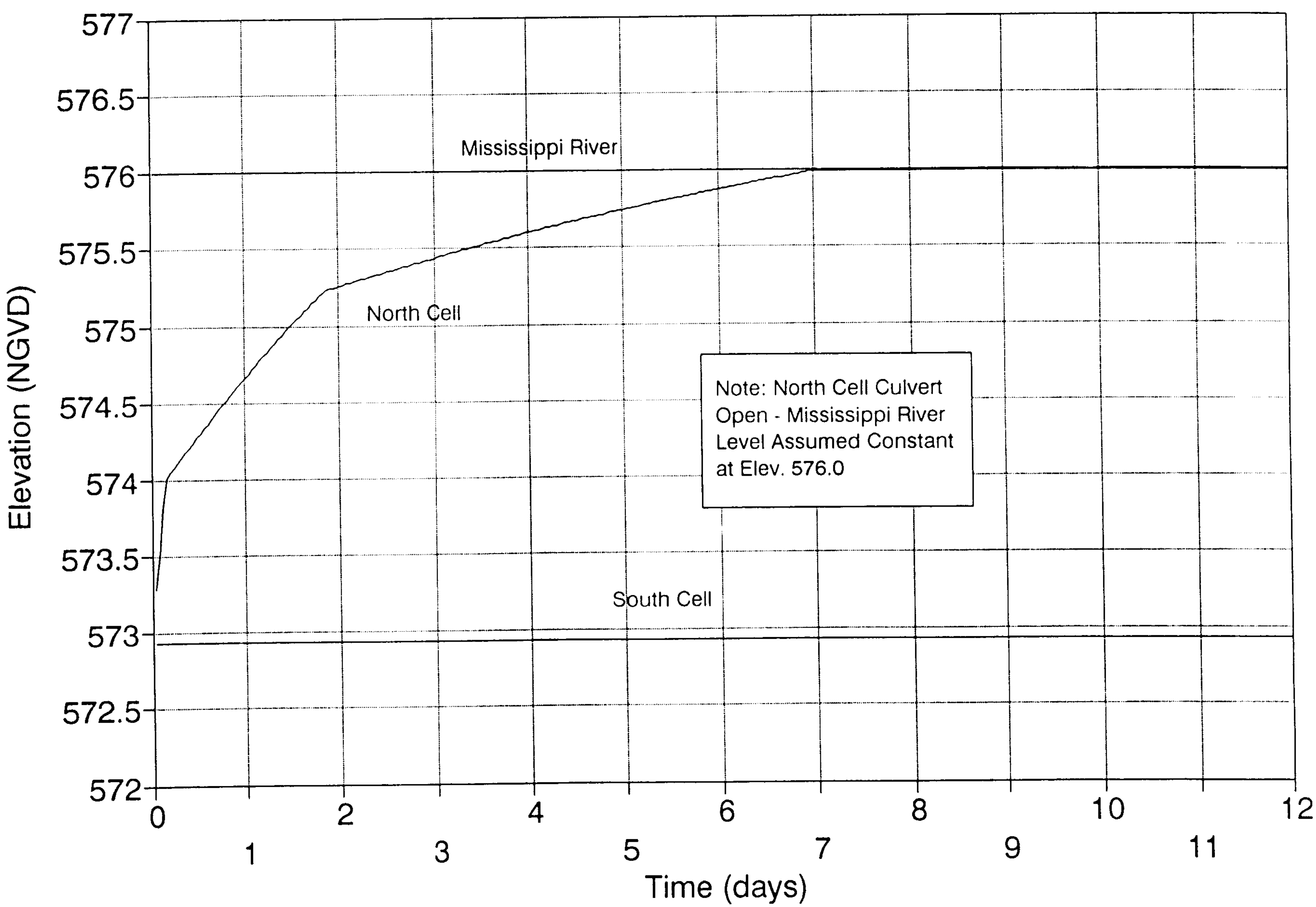


PLATE H-17

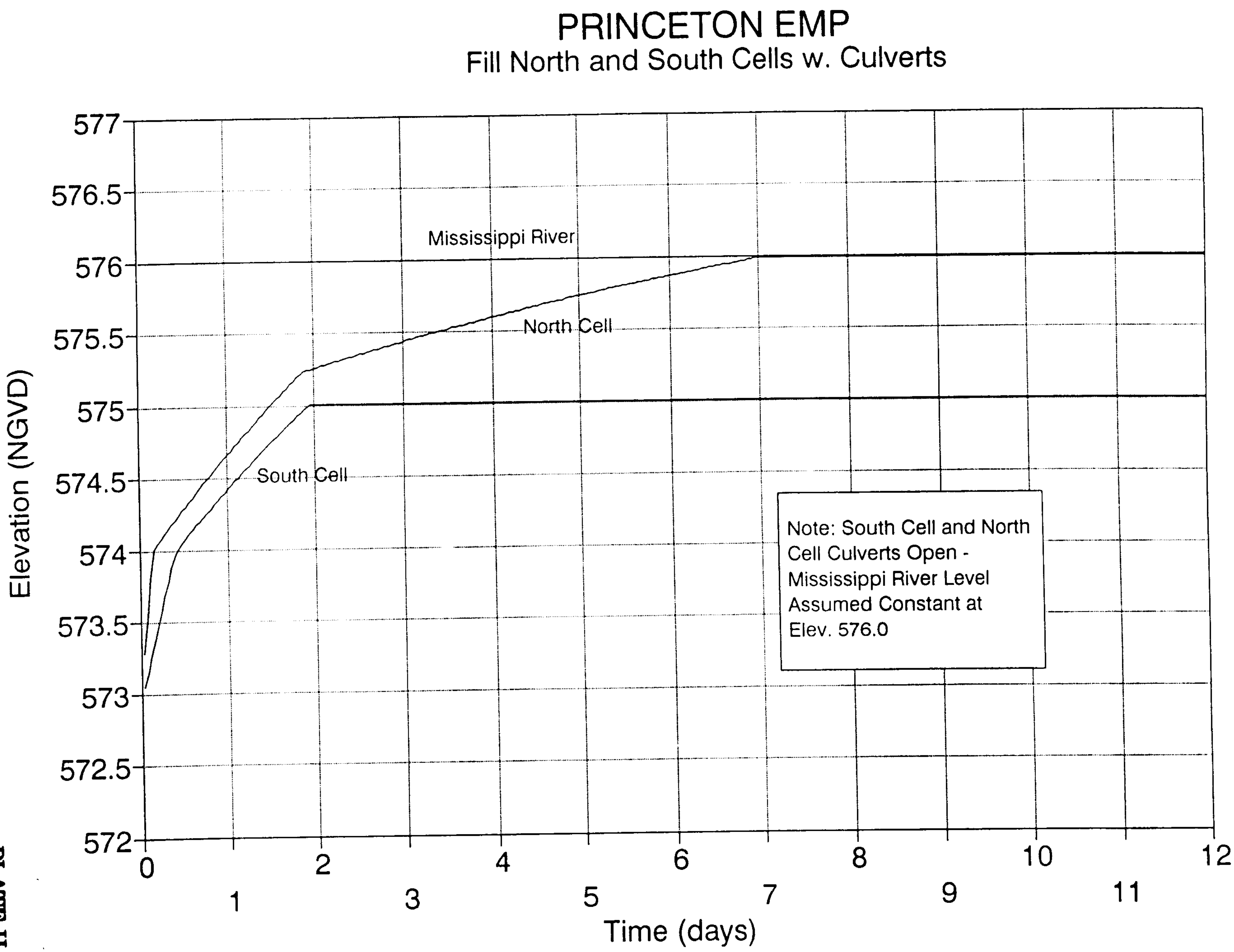

PRINCETON EMP
Fill North and South Cells w. Culverts
Elevation (NGVD)
Time (days)
577
576.5
576
575.5
575
574.5
574
573.5
573
572.5
572
0
1
2
3
4
5
6
7
8
9
10
11
12
Mississippi River
North Cell
South Cell
Note: South Cell and North Cell Culverts Open - Mississippi River Level Assumed Constant at Elev. 576.0

PLATE H-18

STRUCTURAL CONSIDERATIONS

A P P E N D I X

I

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)**

PRINCETON WILDLIFE MANAGEMENT AREA

**POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA**

APPENDIX I
STRUCTURAL CONSIDERATIONS

GENERAL

This appendix presents the design of the structures in the project to illustrate typical calculations which will be undertaken to complete the structural design for final plans and specifications. Computations are shown for the pump intake structure and the stoplog structure.

CRITERIA

The reinforced concrete hydraulic structures in the project will be designed following the current ACI Building Code and ETL 1110-2-312, Strength Design Criteria for Reinforced Concrete Hydraulic Structures. Concrete pipe strength requirements will be determined following procedures recommended in the Concrete Pipe Design Manual by the American Concrete Pipe Association and EM 1100-2-2902, Conduits, Culverts and Pipes. A few miscellaneous structural steel items in the project will be designed in accordance with EM 1110-1-2101, Working Stresses for Structural Design.

MATERIAL SELECTION

Concrete structures will be designed for 28-day compressive strength of 3,500 psi. Concrete reinforcement will be deformed billet-steel bars conforming to ACI 615, grade 60 requirements. Structural steel will meet ASTM-A36, and steel sheet piling will meet ASTM-A328.

Subject Princeton EMP		Date Mar 92
Computed by C. Johnson	Checked by	Sheet 1 of

Stop Log Structure

Check Buoyancy

Assume worst case stop log in upstream end upper pool at 576.5 lower pool at 574.0

Concrete

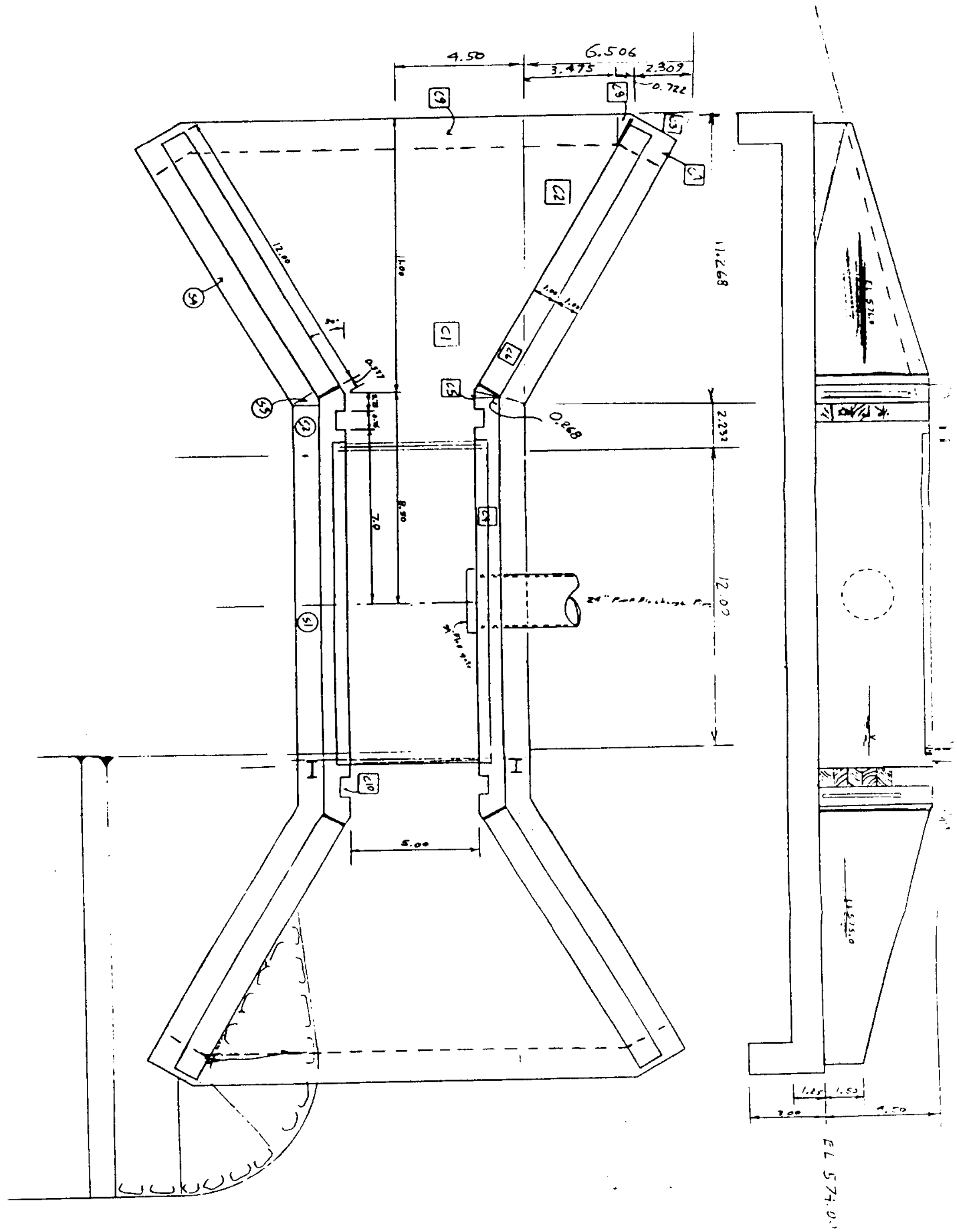
C1	9 * 39 * 1.25 * 150	65812
C2	(4) * ½ * 11.268 * 6.506 * 1.25 * 150	27,491
C3	-(4) * ½ * 2 * 1.155 * 1.25 * 150	- 866
C4	(2) * 1 * 16.464 * 4.5 * 150	22,226
C5	(8) * ½ * 1.0 * 0.268 * 4.5 * 150	724
C6	(4) * 1 * 12 * (4.5+1.5)/2 * 150	21,600
C7	(4) * 2 * 1.443 * 1.75 * 150	3,030
C8	(4) * ½ * 1.25 * 0.722 * 1.75 * 150	474
C9	(2) * 15.95 * 1.25 * 1.75 * 150	10,467
C10	-(4) * 0.75 * 0.33 * 4.5 * 150	- 675
		150,283 lbs

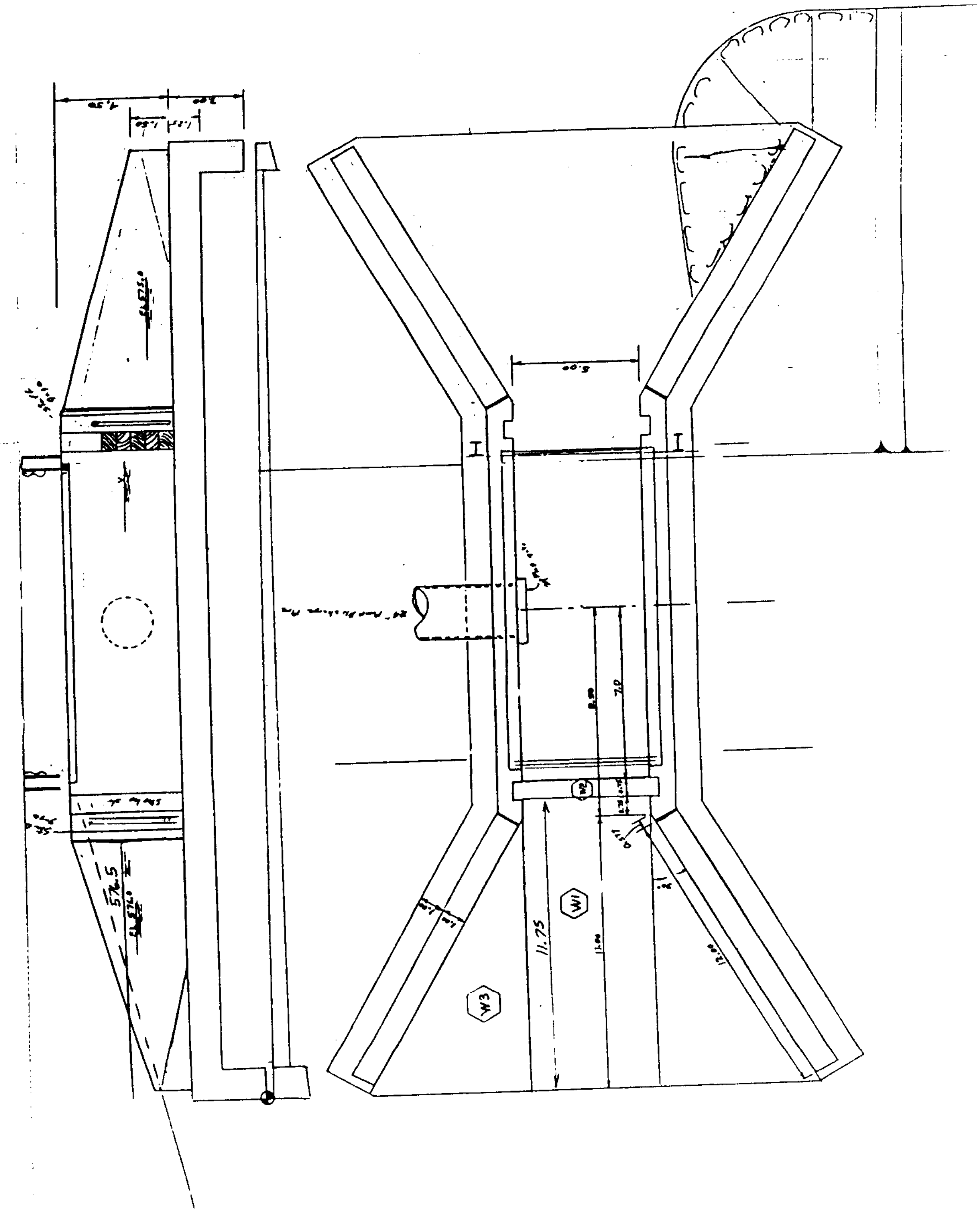
Soil Down

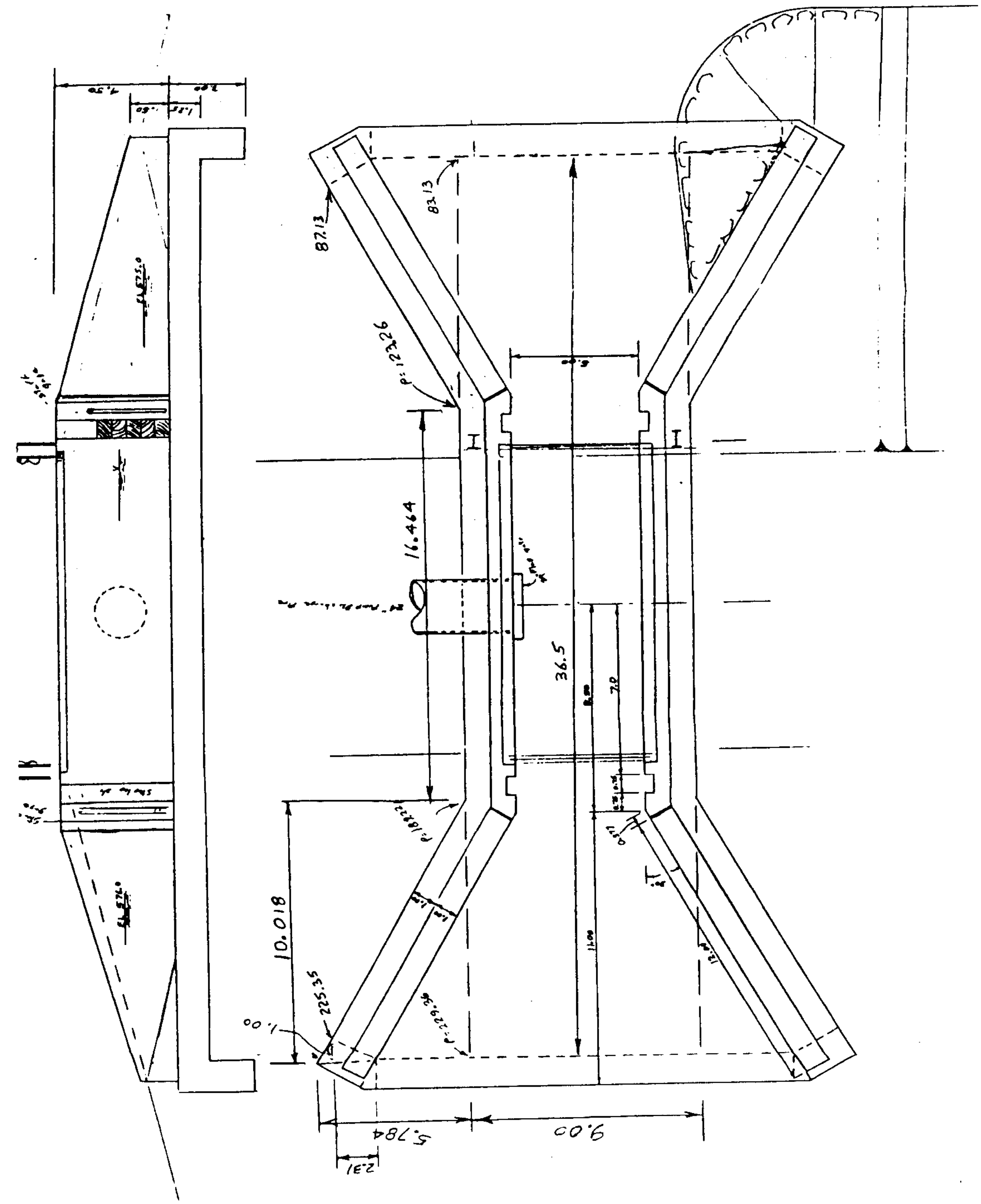
S1	(2) * 12.0 * 1.0 * 4.5 * 125	13,500
S2	(4) * 2.232 * 1 * 4.0 * 125	4,464
S3	(8) * 1.0 * 0.268 * 4.0 * 125	1,072
S4	(4) * 12.0 * 1.0 * $\left(\frac{4+1}{2}\right)$ * 125	15,000
		34,036

soil & Concrete down ↓ 184,319 ↓ lbs @ 19.5 ft = 3,594,220

NCR Form 381b
1 Aug 80


4.50
6.506
3.475
2.309
0.722
11.268
12.00
2.232
0.268
5.00
EL 574.0'


11.75
W1
W3
57.5



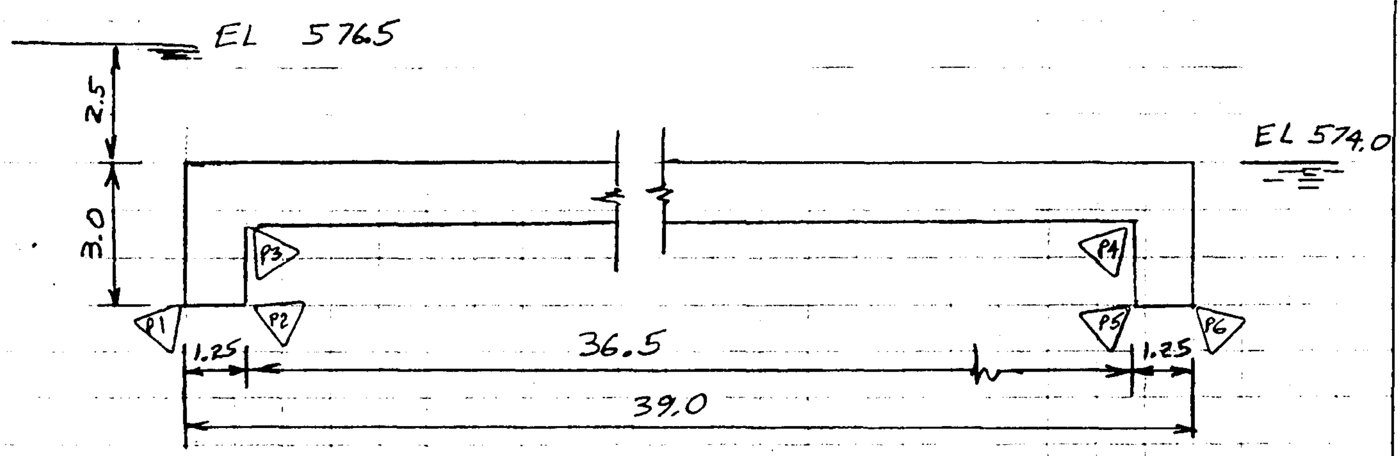
16.464
36.5
10.018
9.00
5.784
2.31
225.35
87.13
83.13
7.0

Subject: Princeton EMP		Date: Mar 92
Computed by: C. Johnson	Checked by	Sheet 5 of

Water down

		Force (lbs)	arm (ft)	Moment (ft-lbs)
W1	5 * 11.75 * 2.5 * 62.5	9180	5.875	53,932
W2	5.667 * 0.75 * 2.5 * 62.5	664	12.125	8,051
W3	(2) * ½ * 11.0 * 6.35 * 2.5 * 62.5	10,914	3.667	40,022
		20,758 ↓ lbs		102,005

Uplift



seepage length = 39.0

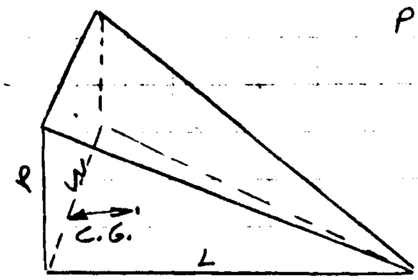
pressure gradient = 2.5*62.5/39 = 4.00641 lbs/ft

	Static		Dynamic	Total Pressure
P1	3.0*62.5 =	187.5	39*4.00641 = 156.25	343.75
P2	3.0*62.5 =	187.5	37.75*4.00641 = 151.24	338.74
P3	1.25*62.5 =	78.125	" " = 151.24	229.36
P4	1.25*62.5 =	78.125	1.25*4.00641 = 5.008	83.13
P5	3.0*62.5 =	187.5	" " = 5.008	192.51
P6	3.0*62.5 =	187.5	0 = 0	187.50

Subject: Princeton EMP		Date: Mar 92
Computed by: C. Johnson	Checked by	Sheet 6 of

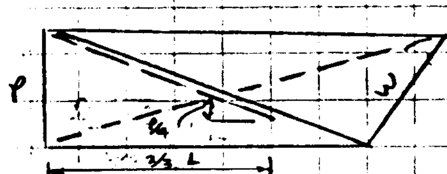
Volume & Center of Gravities
"Machinery's Handbook 16th Ed page 311

P = pressure



$Vol = \frac{1}{3} * W * L * P$

$C.G. = \frac{1}{4} * L$

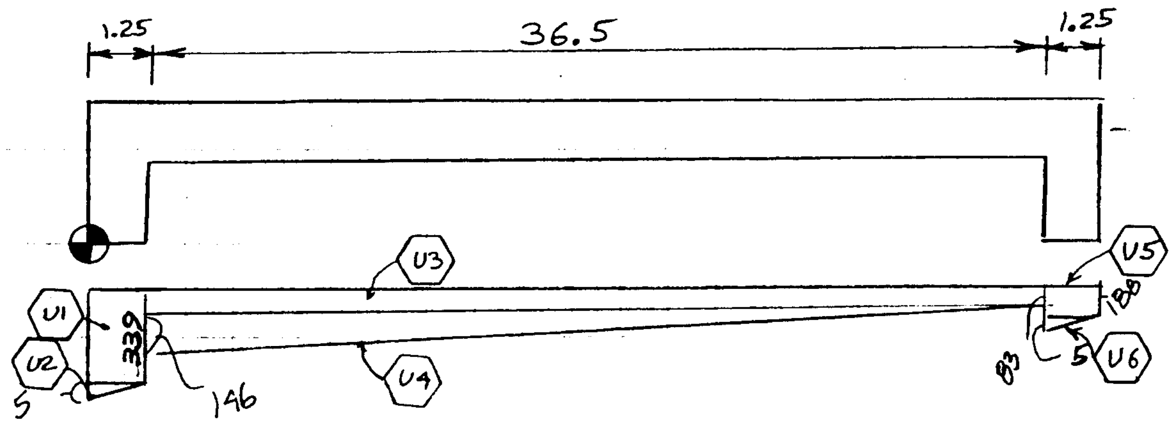


$Vol = \frac{1}{2} * W * L * \frac{1}{3} * P = \frac{1}{6} * W * L * P$

$C.G = \frac{3}{4} * \frac{2}{3} * L = \frac{1}{2} L$

NCR Form 381b
1 Aug 80

Subject: Princeton EMP		Date: Mar 92
Computed by: C. Johnson	Checked by	Sheet 7 of



Uplift

		Force (lbs)	Arm (ft)	Moment (ft-lbs)
U1	C7+C8+C9			
	(2)*1.443*2.0*(339)	1957	≈ 1.25	2,446
	(2)*½*1.25*0.722*(339)	306	0.4167	128
	15.95*1.25*(339)	6759	0.625	4,224
U2	(2)*1.443*2.0*(½*5)	14	≈ 1.00	14
	(2)*½*1.25*0.722*(⅔*5)	3	0.5	1
	15.95*1.25*(½*5)	50	0.4167	21
U3	9*36.5*83	27,265	19.5	531,668
	(2)*½*5.784*10.018*189 =	10,951	4.589	50,254
	−(2)*½*1*2.31*189	−437	1.583	−692
	(2)*½*5.784*10.018*83	4,809	34.411	165,494
	−(2)*½*1*2.31*83	−192	37.417	−7,184
U4	9*36.5*½*(229−83)	23,980	13.417	321,740
	(2)*½*⅓*5.784*10.018*(229−189)	773	3.755	2,903
	−(2)*½*⅓*1*2.31*(229−225)	−3	1.5	−5
	(2)*½*⅙*5.784*10.018*(123−83)	386	32.74	12,638
	−(2)*½*⅙*1*2.31*(87−83)	−2	37.25	−75

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1 Aug 80

Subject: Princeton EMP		Date: Mar 92
Computed by: C. Johnson	Checked by	Sheet 8 of

	Force (lbs)	Arm (ft)	Moment (ft-lbs)
U5 (2) * 1.443 * 2.0 * (188)	1085	≈ 37.75	40,959
(2) * ½ * 1.25 * 0.722 * (188)	170	38.58	6,559
15.95 * 1.25 * (188)	3748	38.375	143,830
U6 (2) * 1.443 * 2.0 * (½ * 5)	14	≈ 38.0	532
(2) * ½ * 1.25 * 0.722 * (⅓ * 5)	2	38.75	78
15.95 * 1.25 * (½ * 5)	50	38.167	1908

uplift summary

	Force	Moment
U1	9,022	6798
U2	67	36
U3	42,396	739,954
U4	25,134	337,201
U5	5,003	191,348
U2	66	2,518
	81,688 lbs ↑	1,277,855 (ft-lbs)

	Force	Arm	Moment
concrete ↓	150,283 ↓	19.5	2,930,519
soil ↓	34,036 ↓	19.5	663,702
Water down ↓	-20,758 ↓		102,005
uplift ↑	81,688 ↑		1,277,855
	123,389 ↓		2,418,371

$X = 2{,}418{,}371 / 123{,}389 = 19.60$ within Kern

NCR Form 381b
1 Aug 80

Subject: Princeton EMP		Date: Mar 92
Computed by: C. Johnson	Checked by	Sheet 9 of

Area of Base

$9*39 = 351$

$(4)*\frac{1}{2}*5.74*11.268 = 129.357$

$-(4)*\frac{1}{2}*1*1.732 = -3.464$

476.893 sq. ft.

Moment of Inertia of Base

	I_o	$A d^2$	I_{Tran}
$9*39^3/12 =$	44,489		
$(4)*5.784*11.268^3/36 =$	919	$(129.357)*(8.232+\frac{2}{3}*11.268)^2 =$	32,064
$-(4)*1.732*1^3/36 =$	0	$(-3.464)*(19.5-0.33)^2$	-1,273
	45,408		30,791

$I_{TOTAL} = 45,408 + 30,791 = 76,199 \ ft^4$

Foundation soil pressure

$\sigma = \frac{P}{A} \pm \frac{Mc}{I}$

$= \frac{123,389}{476.893} \pm \frac{123389*(19.6-19.5)*19.5}{76,199}$

$= 258.7 \pm 3.2$

$= 261.9$ psf & 255.5 psf ok

Subject Princeton EMP		Date Mar 92
Computed by C. Johnson	Checked by	Sheet 10 of

Sliding

The entire stop log structure will be built on one foundation slab. There will be monolith joints in the walls. For sliding to take place the wing wall and base slabs would have to be pushed thru the levee. As the head differential is only 2.5 feet a detailed sliding analysis is not needed.

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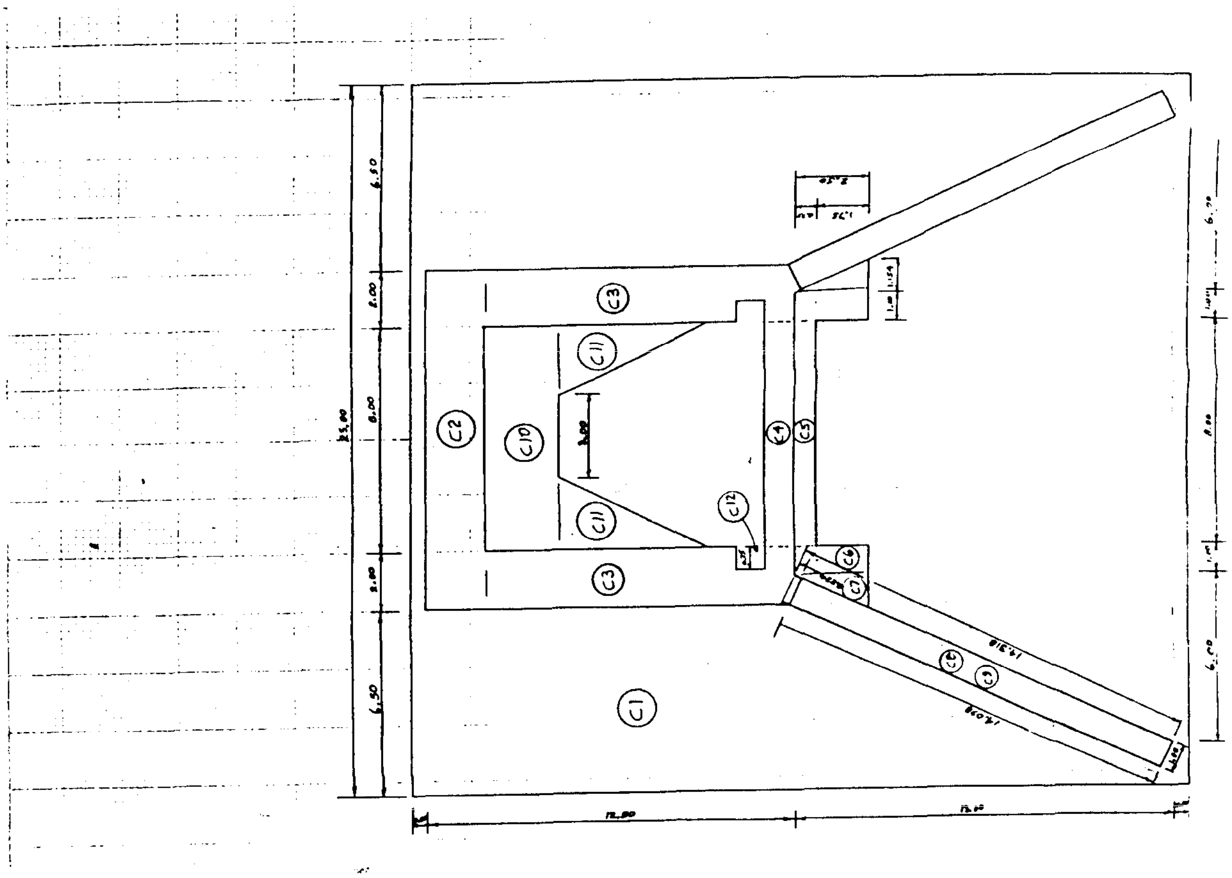
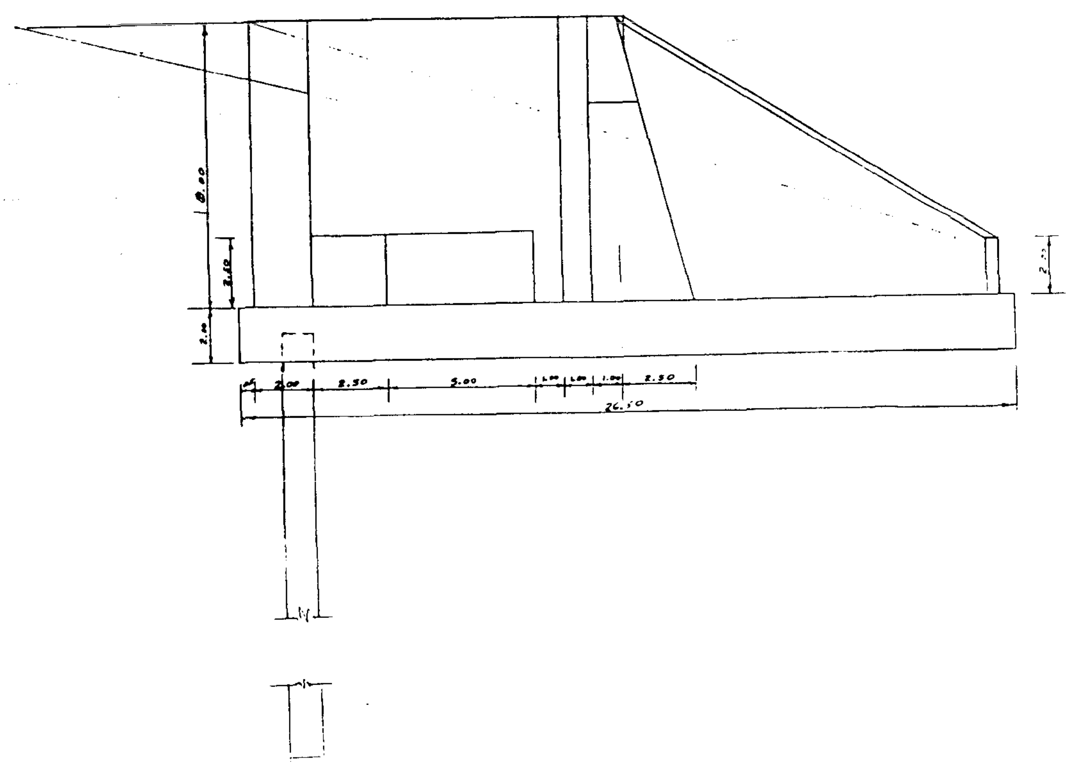
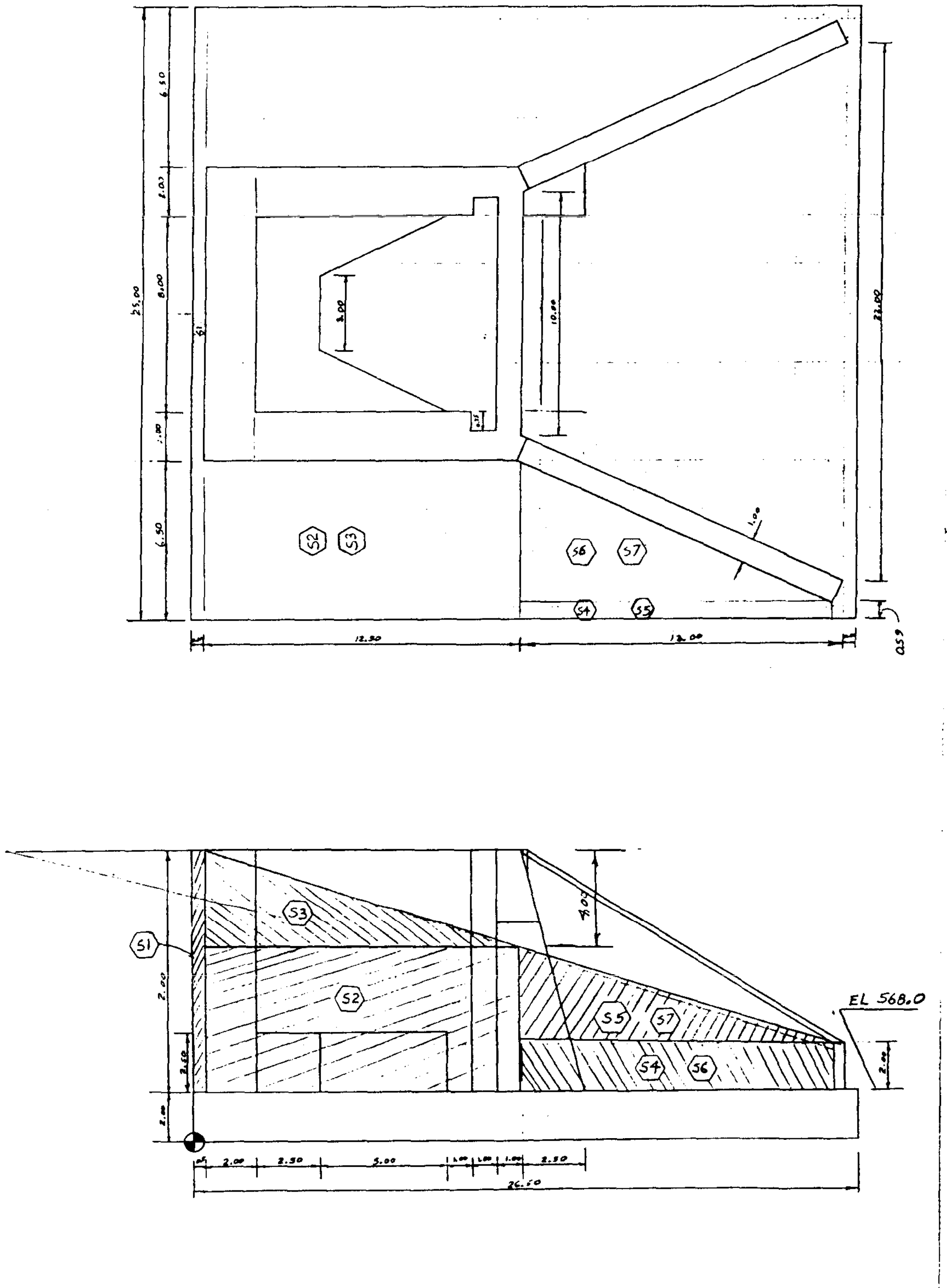
1 Aug 80


C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12


8.00
2.50
2.00
5.00
26.50


S1
S2
S3
S4
S5
S6
S7
EL 568.0
4.00
2.00
12.50
12.00
26.50
2.00
2.50
5.00
1.00
2.50

Subject: Princeton EMP - Pump Station		Date: Apr 92
Computed by: C. Johnson	Checked by	Sheet 13 of

Concrete

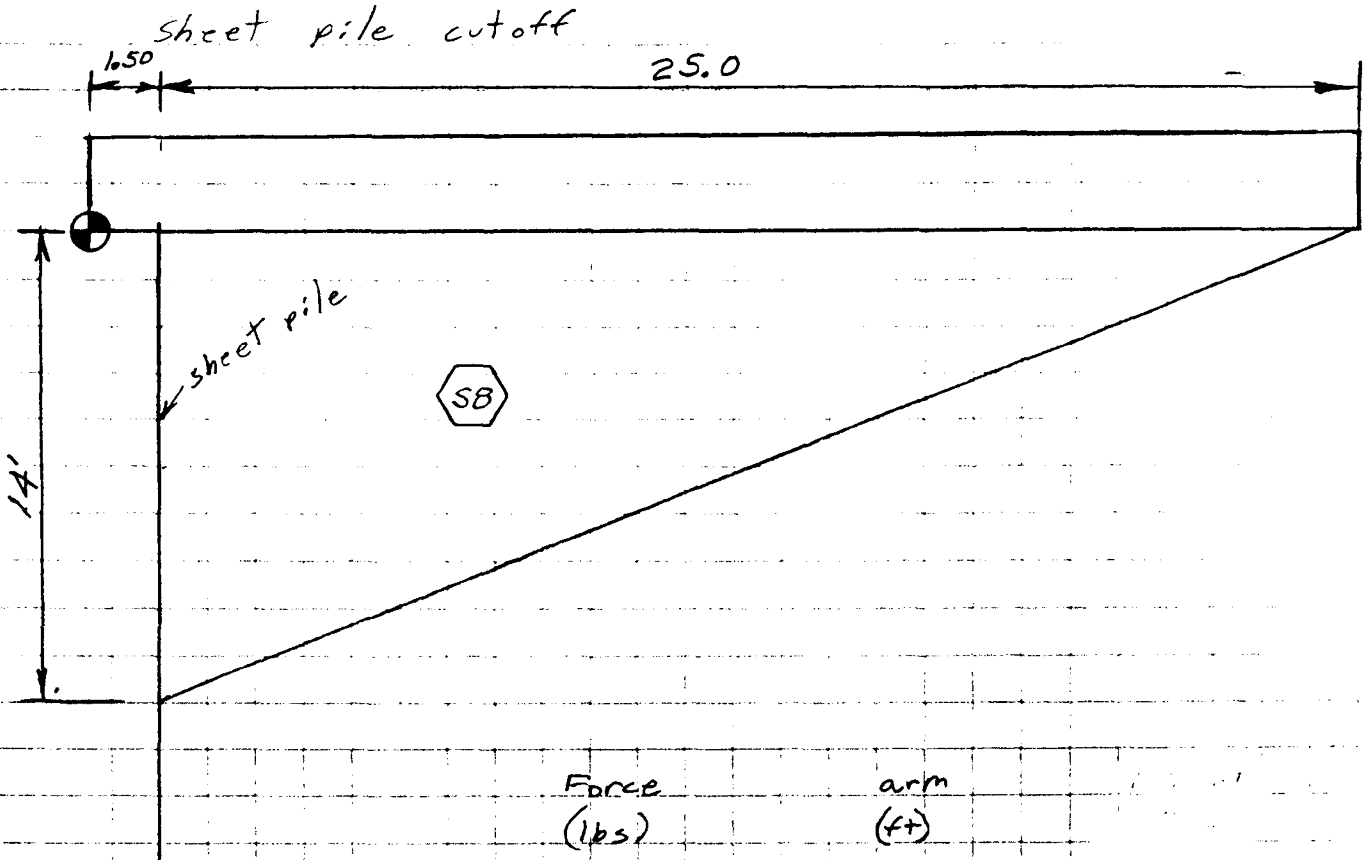
		Force (lbs)	Arm (ft)	Moment (ft-lbs)
C1	25* 26.5*2.0 *150	198,750	13.25	2,633,438
C2	12 * 2 * 10.0 * 150	36,000	1.50	54,000
C3	(2)*2 * 9.5*10.0 *150	57,000	7.25	413,250
C4	12 *1 * 4.0 * 150	7,200	12.50	90,000
C5	½ * 8 *1* 4.0 * 150	2,400	13.333	32,000
C6	(2)*½*1* 2.5 * 10 *150	3,750	13.833	51,874
C7	(2)* ⅓ * ½ * 1.154*2.5*10*150	1,442	14.25	20,548
C8	(2)*14.1* 1 *2 *150	8,460	19.5	164,970
C9	(2)*½* 14.1 *1*8 * 150	16,920	17.333	293,280
C10	8 *2.5 *2.5 *150	7,500	3.75	28,125
C11	(2)*½*2.5*5*25*150	4,688	6.667	31,250
C12	-(2)* 0.75*1.0*10* 150	-2,250	11.50	-25,875
		341,860		3,786,860

Soil Down

		Force	Arm	Moment
S1	0.5* 25* 10 * 120	15,000	0.5	7,500
S2	(2)*12.5 *6.5 * 6 * 120	117,000	6.75	789,750
S3	(2)* ½* 12.5*6.5*4* 120	39,000	4.667	182,000
S4	(2)*13.5* 0.59*2* 120	3,823	19.75	75,508
S5	(2)* ½*12.5*0.59* 4*120	3,540	17.167	60,771
S6	(2)* ½* 5.91* 12.5 * 2*120	17,730	17.167	304,371
S7	(2) * ½ * 5.91 * 12.5 * ⅓*4*120	11,820	16.125	190,598
		207,913		1,610,498

NCR Form 381b
1 Aug 80

Subject		Date
Computed by	Checked by	Sheet 14 of



		Force (lbs)	arm (ft)
58	½*14*25.0*120	21,000	9.83333

Subject		Date
Princeton EMP - Pump Station		April 92
Computed by C. Johnson	Checked by	Sheet 16 of

Load Case I
Landside water @ EL 577.0 — River at 572.0 (flat pool)

Load Case II
571.0 — 566.0 (Loss flat pool) (water @ bottom of footing)

Case I

Uplift

		Force (lbs)	Arm (ft)	Moment (ft-lbs)
U1	25 * 26.5 * 6 * 62.5	248,438	13.25	-3,291,804
U2	½ * 25 * 26.5 * 5 * 62.5	103,516	8.833	- 914,391
		351,954 ↑		-4,206,195

Water Down

		Force (lbs)	Arm (ft)	Moment (ft-lbs)
W1	(2) * ½ * 11 * 5.077 * 4 * 62.5	13,962	22.8333	318,799
W2	(2) * 11 * 2.154 * 4 * 62.5	11,847	21.0	248,787
W3	≈ (2) * ½ * 2.154 * 1 * 4 * 62.5	538	15.167	8,160
W4	8 * 14.5 * 4 * 62.5	29,000	19.25	558,250
W5	≈ (2) * ½ * 0.59 * 7.17 * 2 * 62.5	529	24.11	12,754
W6	(2) * ½ * ⅓ * 6.25 * 2.88 * 2 * 62.5	750	22.455	16,841
		56,626 ↓		1,163,591

Case II Uplift

		Force (lbs)	Arm (ft)	Moment (ft-lbs)
U2	½ * 25 * 26.5 * 5 * 62.5	103,515 ↑	8.8333	-914,[illegible]9

NCR Form 381b
1 Aug 80

Subject		Date
Computed by	Checked by	Sheet 17 of

Load for CSLIDE Computer program
(1 width

Concrete

vertical $\frac{341,860}{25} = 13,674$ lbs ↓ @ $\frac{3,785,860}{341,860} = 11.077$ ft

Soil down

$\frac{207,913}{25} = 8,316$ lbs ↓ @ $\frac{1,610,498}{207,913} = 7.746$ ft

Water Down

$\frac{56,626}{25} = 2,265$ lbs ↓ @ $\frac{1,163,591}{56,626} = 20.549$ ft

NCR Form 381b
1 Aug 80

```
100 TITL    PRINCETON EMP - PUMP STATION
110 STRU  4  0.0    552.0    1.
120    0.0       552.0
130    0.0       578.0
140   26.5       578.0
150   26.5       566.0
160  SOLT   1   4   30.    0    0.120     578.0
180  -110.     578.5
190   -36.     582.0
200   -24.     582.0
210    -8.     578.0
220  SORT   1   1   30.    0    0.120     568.0
240   100.0    568.0
250  SOST   30.   0
260  METH  2
270  WATR   577.0    572.0   0.0625
280  VPLO   11.077      13.674
290  VPLO    7.746       8.316
300  VPLO   20.549       2.265
305  VPLO    9.833      21.0
310  END
```

PROGRAM CSLIDE - ECHOPRINT

DATE: 92/04/15 TIME: 7.49.27

PRINCETON EMP - PUMP STATION

MULTI FAILURE PLANE ANALYSIS

SEEPAGE FORCE BY LINE OF CREEP, GRADIENT
COMPUTED USING SHORTEST SEEPAGE PATH

NO OF CORNERS IN STRUCTURE ----------	4
DENSITY OF CONCRETE -----------------	.0000(KCF)
DENSITY OF WATER --------------------	.0625(KCF)
WATER LEVEL LEFT SIDE ---------------	577.00(FT)
WATER LEVEL RIGHT SIDE --------------	572.00(FT)
NO. OF SOIL LAYERS LEFT SIDE --------	1
N^ OF SOIL LAYERS RIGHT SIDE -------	1

ELEV. OF WEDGE-STRUCTURE INTERSECTION
ON ACTIVE SIDE OF STRUCTURE ---------552.000(FT)

STRUCTURE INFORMATION

POINT	X-COORD	Y-COORD
1	.00	552.00
2	.00	578.00
3	26.50	578.00
4	26.50	566.00

LEFTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	578.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD	POINT NO. 2 X-COORD	POINT NO. 2 Y-COORD	POINT NO. 3 X-COORD	POINT NO. 3 Y-COORD
1	-110.00	578.50	-36.00	582.00	-24.00	582.00

LAYER NO	POINT NO. 4 X-COORD	POINT NO. 4 Y-COORD
1	-8.00	578.00

SOIL DATA BELOW STRUCTURE

FRICTION ANGLE --------- 30.00
COHESION --------------- .0000

RIGHTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	568.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD
1	100.00	568.00

VERTICAL POINT LOADS

X-COORDINATE MAGNITUDE

(FT)	(KIPS)
11.08	13.674
7.75	8.316
20.55	2.265
9.83	21.000

PROGRAM CSLIDE - FINAL RESULTS

DATE: 92/04/15 TIME: 7.49.50

PRINCETON EMP - PUMP STATION

MULTIPLE FAILURE PLANE ANALYSIS

SEEPAGE FORCE COMPUTED BY LINE OF CREEP

WEDGE NUMBER	HORIZONTAL LOADS LEFT SIDE (KIPS)	HORIZONTAL LOADS RIGHT SIDE (KIPS)	VERTICAL LOAD (KIPS)
1	.000	.000	.000
2	.000	.500	45.255
3	.000	.000	.719

WATER PRESSURES ON WEDGES

LEFTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)

1	.000	1.425

STRUCTURAL WEDGE

X-COORD. (FT)	PRESSURE (KSF)
.00	1.425
26.50	.386

RIGHTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)
3	.250	.386

WEDGE NUMBER	FAILURE ANGLE (DEG)	TOTAL LENGTH (FT)	WEIGHT OF WEDGE (KIPS)	SUBMERGED LENGTH (FT)	UPLIFT FORCE (KIPS)
1	-42.2	44.661	51.873	37.218	26.524
	27.848	29.971	.000	29.971	27.144
	34.8	3.504	.345	3.504	1.114

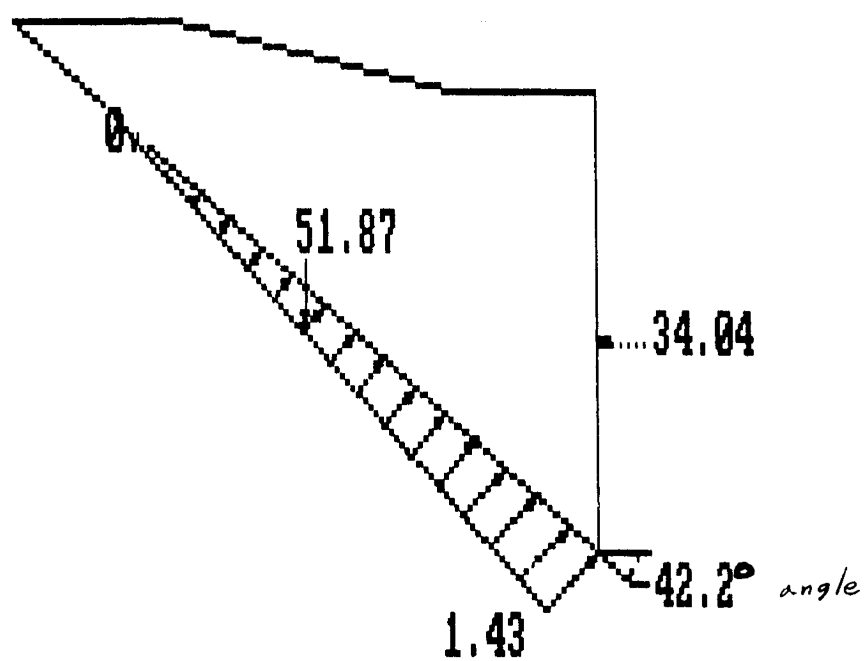
WEDGE NUMBER	NET FORCE ON WEDGE (KIPS)
1	-34.041
2	33.225
3	.816

SUM OF FORCES ON SYSTEM ---- .000

FACTOR OF SAFETY ----------- 2.085

PRINCETON EMP - PUMP STATION

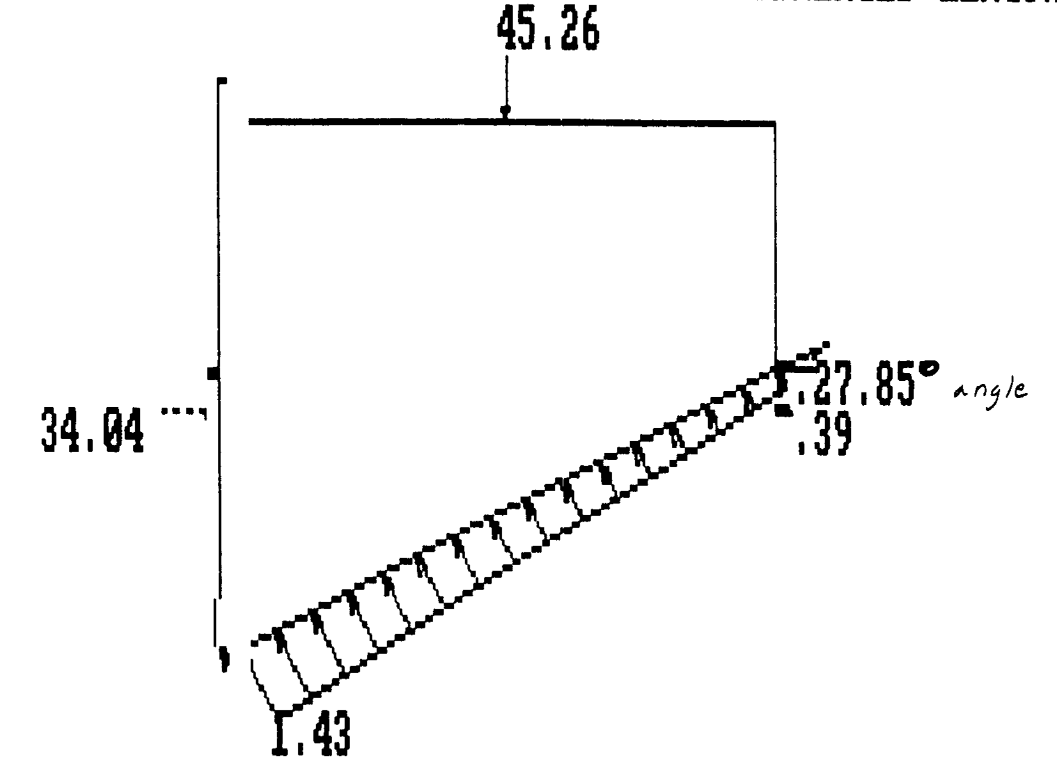
WEDGE 1 FS = 2.085 SUBMERGED LENGTH = 37.22



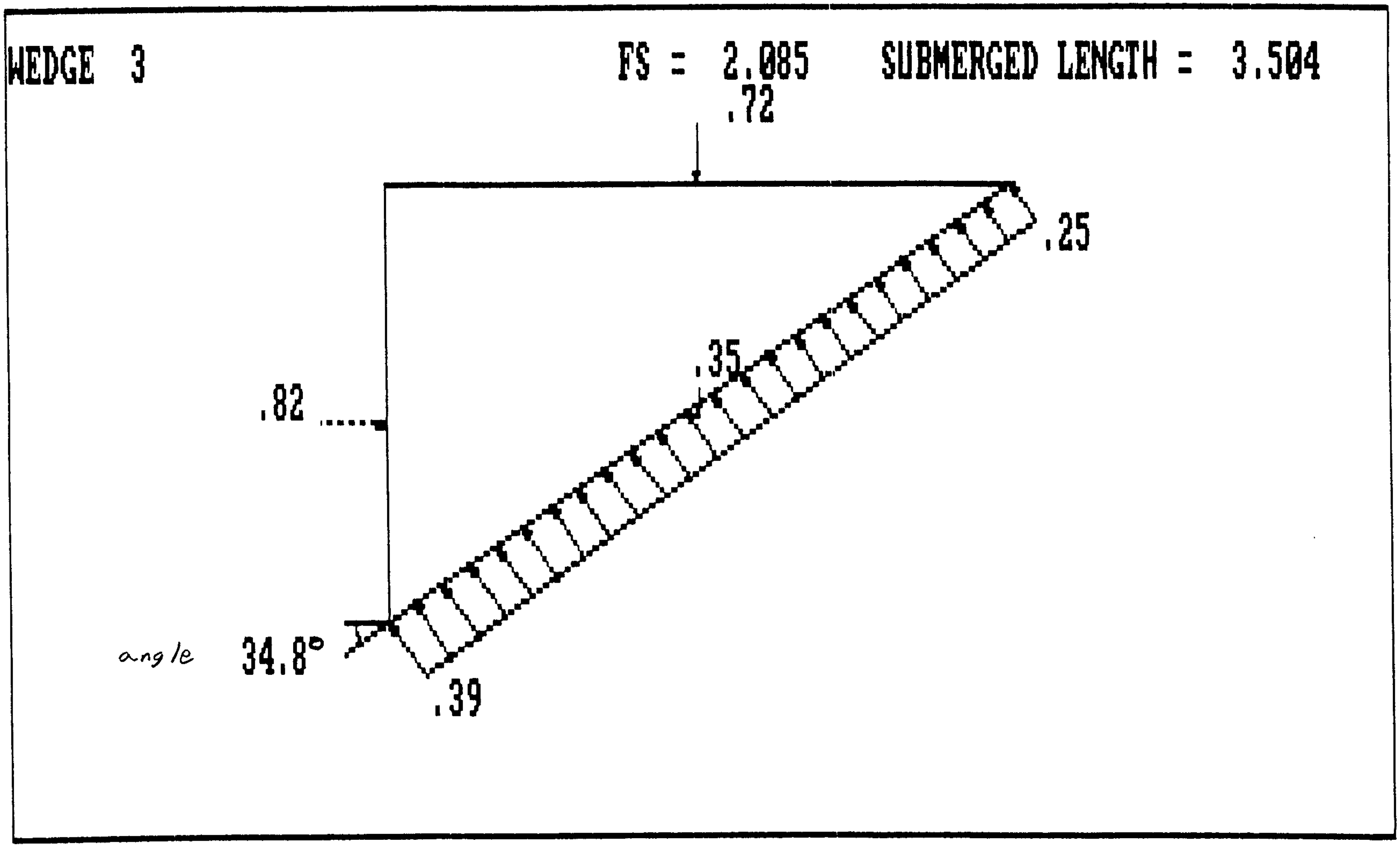
PRINCET
WEDGE 1

PRINCETON EMP - PUMP STATION

STRUCTURAL WEDGE FS = 2.085 SUBMERGED LENGTH = 29.97



PRINCETON EMP - PUMP STATION



```
100 TITL    PRINCETON EMP - PUMP STATION
110 STRU  4  0.0   552.0   1.
120    0.0      552.0
130    0.0      578.0
14    26.5      578.0
150   26.5      566.0
160  SOLT   1   4   30.   0   0.120     578.0
180  -110.    578.5
190   -36.    582.0
200   -24.    582.0
210    -8.    578.0
220  SORT   1   1   30.   0   0.120     568.0
240   100.0   568.0
250  SOST   30.   0
260  METH  2
270  WATR   571.0     566.01   0.0625
280  VPLO   11.077     13.674
290  VPLO    7.746      8.316
305  VPLO    9.833     21.0
310  END
```

PROGRAM CSLIDE - ECHOPRINT

DATE: 92/04/20   TIME: 14.35.54

PRINCETON EMP - PUMP STATION

MULTI FAILURE PLANE ANALYSIS

SEEPAGE FORCE BY LINE OF CREEP, GRADIENT
COMPUTED USING SHORTEST SEEPAGE PATH .

NO OF CORNERS IN STRUCTURE ---------- 4
DENSITY OF CONCRETE ----------------- .0000(KCF)
DENSITY OF WATER -------------------- .0625(KCF)
WATER LEVEL LEFT SIDE --------------- 571.00(FT)
WATER LEVEL RIGHT SIDE -------------- 566.01(FT)
NO. OF SOIL LAYERS LEFT SIDE -------- 1
NO OF SOIL LAYERS RIGHT SIDE ------- 1

ELEV. OF WEDGE-STRUCTURE INTERSECTION
ON ACTIVE SIDE OF STRUCTURE ---------552.000(FT)

STRUCTURE INFORMATION

POINT	X-COORD	Y-COORD
1	.00	552.00
2	.00	578.00
3	26.50	578.00
4	26.50	566.00

LEFTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	578.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD	POINT NO. 2 X-COORD	POINT NO. 2 Y-COORD	POINT NO. 3 X-COORD	POINT NO. 3 Y-COORD
1	-110.00	578.50	-36.00	582.00	-24.00	582.00

LAYER NO	POINT NO. 4 X-COORD	POINT NO. 4 Y-COORD
1	-8.00	578.00

SOIL DATA BELOW STRUCTURE

FRICTION ANGLE --------- 30.00
COHESION -------------- .0000

RIGHTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	568.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD
1	100.00	568.00

VERTICAL POINT LOADS

X-COORDINATE MAGNITUDE

(FT)	(KIPS)
11.08	13.674
7.75	8.316
9.83	21.000

PROGRAM CSLIDE - FINAL RESULTS

DATE: 92/04/20 TIME: 14.36.12

PRINCETON EMP - PUMP STATION

MULTIPLE FAILURE PLANE ANALYSIS

SEEPAGE FORCE COMPUTED BY LINE OF CREEP

	HORIZONTAL LOADS		
WEDGE NUMBER	LEFT SIDE (KIPS)	RIGHT SIDE (KIPS)	VERTICAL LOAD (KIPS)
1	.000	.000	.000
2	.000	.000	42.990
3	.000	.000	.000

WATER PRESSURES ON WEDGES

LEFTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)
1	.000	1.067

STRUCTURAL WEDGE

X-COORD. (FT)	PRESSURE (KSF)
.00	1.067
26.50	.001

RIGHTSIDE WEDGES

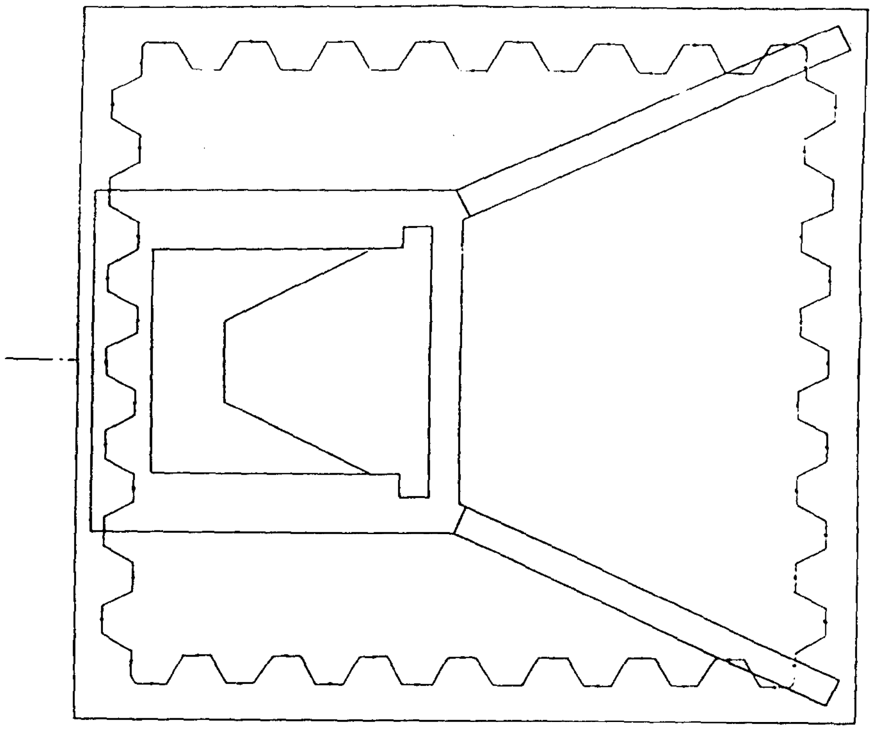
WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)
3	.000	.001

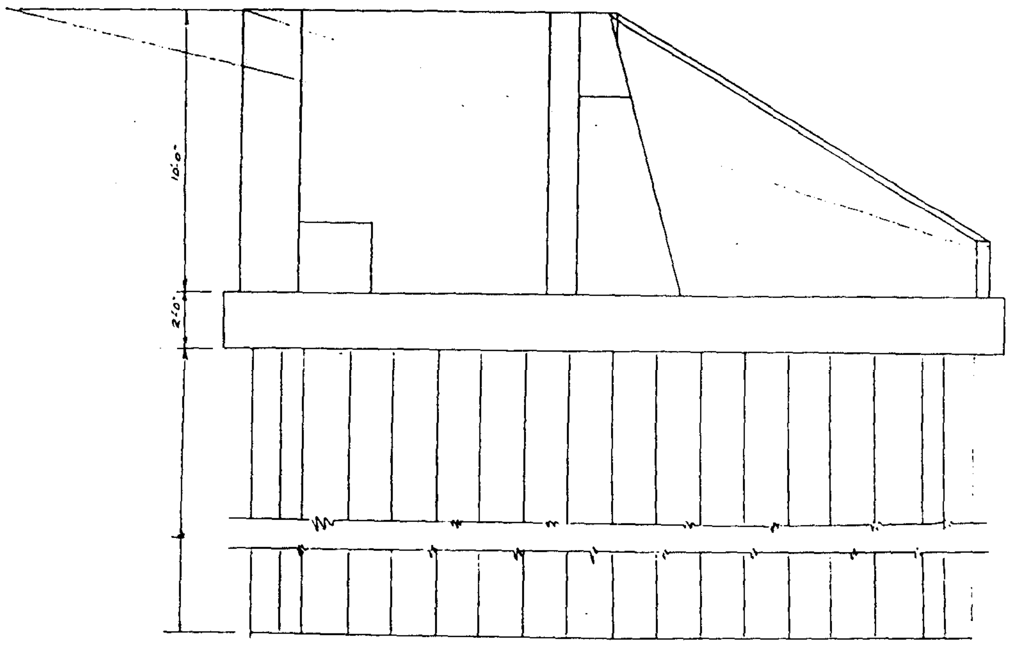
WEDGE NUMBER	FAILURE ANGLE (DEG)	TOTAL LENGTH (FT)	WEIGHT OF WEDGE (KIPS)	SUBMERGED LENGTH (FT)	UPLIFT FORCE (KIPS)
1	-41.6	45.186	53.141	28.617	15.261
2	27.848	29.971	.000	29.971	15.993
[illegible]	38.4	3.220	.303	.016	.000

WEDGE NUMBER	NET FORCE ON WEDGE (KIPS)
1	-32.837
2	32.458
3	.380

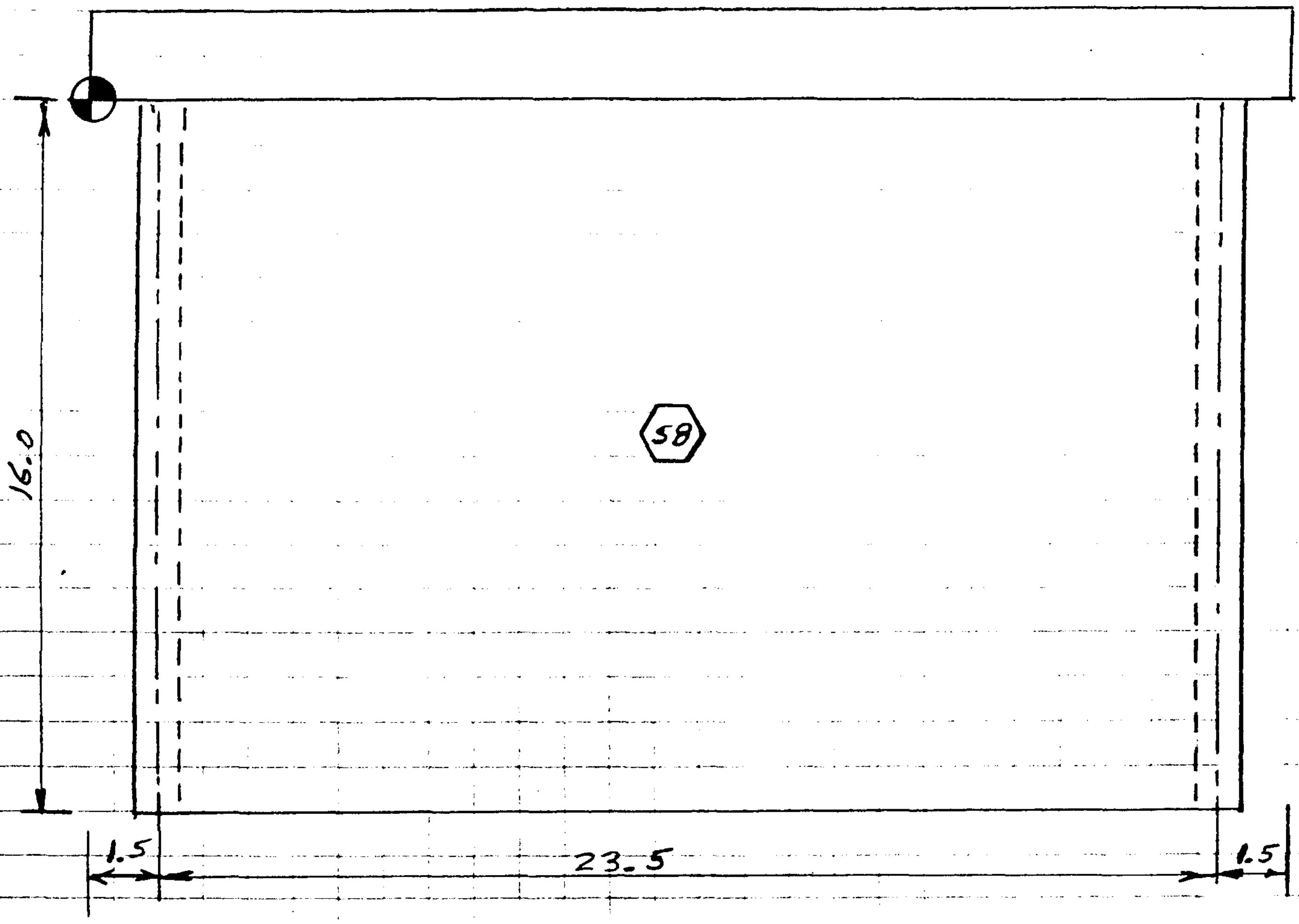
SUM OF FORCES ON SYSTEM ---- .001

FACTOR OF SAFETY ----------- 2.491




10'-0"
2'-0"

Subject: Princeton EMP - Pump Station		Date: April 92
Computed by: C. Johnson	Checked by	Sheet 32 of



(58) $23.5 * 16 * 120 = \underline{\underline{45,120 \text{ lbs/lin.ft.}}}$ @ $\frac{26.5}{2} = \underline{\underline{13.25 \text{ ft}}}$

```
100 TITL   PRINCETON EMP - PUMP STATION
110 STRU  4  0.0   550.0   1.
120     0.0      550.0
130     0.0      578.0
140    26.5      578.0
150    26.5      550.0
160  SOLT   1   4   30.   0   0.120    578.0
180  -110.    578.5
190   -36.    582.0
200   -24.    582.0
210    -8.    578.0
220  SORT   1   1   30.   0   0.120    568.0
240   100.0   568.0
250  SOST   30.   0
260  METH  2
270  WATR   577.0    572.0    0.0625
280  VPLO   11.077     13.674
290  VPLO    7.746      8.316
300  VPLO   20.549      2.265
305  VPLO   13.25      45.120
310  END
```

PROGRAM CSLIDE - ECHOPRINT

DATE: 92/04/21 TIME: 14.11.28

PRINCETON EMP - PUMP STATION

MULTI FAILURE PLANE ANALYSIS

SEEPAGE FORCE BY LINE OF CREEP, GRADIENT
COMPUTED USING SHORTEST SEEPAGE PATH .

NO OF CORNERS IN STRUCTURE ---------- 4
DENSITY OF CONCRETE ----------------- .0000(KCF)
DENSITY OF WATER -------------------- .0625(KCF)
WATER LEVEL LEFT SIDE --------------- 577.00(FT)
WATER LEVEL RIGHT SIDE -------------- 572.00(FT)
NO. OF SOIL LAYERS LEFT SIDE -------- 1
NO OF SOIL LAYERS RIGHT SIDE ------- 1

ELEV. OF WEDGE-STRUCTURE INTERSECTION
ON ACTIVE SIDE OF STRUCTURE ---------550.000(FT)

STRUCTURE INFORMATION

POINT	X-COORD	Y-COORD
1	.00	550.00
2	.00	578.00
3	26.50	578.00
4	26.50	550.00

LEFTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	578.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD	POINT NO. 2 X-COORD	POINT NO. 2 Y-COORD	POINT NO. 3 X-COORD	POINT NO. 3 Y-COORD
1	-110.00	578.50	-36.00	582.00	-24.00	582.00

LAYER NO	POINT NO. 4 X-COORD	POINT NO. 4 Y-COORD
1	-8.00	578.00

SOIL DATA BELOW STRUCTURE

FRICTION ANGLE --------- 30.00
COHESION --------------- .0000

RIGHTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	568.00

LAYER NO	POINT NO. 1 X-COORD	POINT NO. 1 Y-COORD
1	100.00	568.00

VERTICAL POINT LOADS

X-COORDINATE MAGNITUDE

(FT)	(KIPS)
11.08	13.674
7.75	8.016
20.55	2.265
13.25	45.120

PROGRAM CSLIDE - FINAL RESULTS

DATE: 92/04/21 TIME: 14.11.44

PRINCETON EMP - PUMP STATION

MULTIPLE FAILURE PLANE ANALYSIS

SEEPAGE FORCE COMPUTED BY LINE OF CREEP

	HORIZONTAL LOADS		
WEDGE NUMBER	LEFT SIDE (KIPS)	RIGHT SIDE (KIPS)	VERTICAL LOAD (KIPS)
1	.000	.000	.000
2	.000	.500	69.375
3	.000	.000	5.972

WATER PRESSURES ON WEDGES

LEFTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)

1	.000	1.569

STRUCTURAL WEDGE

X-COORD. (FT)	PRESSURE (KSF)
.00	1.569
26.50	1.454

RIGHTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)
3	.250	1.454

WEDGE NUMBER	FAILURE ANGLE (DEG)	TOTAL LENGTH (FT)	WEIGHT OF WEDGE (KIPS)	SUBMERGED LENGTH (FT)	UPLIFT FORCE (KIPS)
1	-43.4	46.573	57.291	39.296	30.838
	.000	26.500	.000	26.500	40.057
3	37.0	29.910	25.798	29.910	25.478

WEDGE NUMBER	NET FORCE ON WEDGE (KIPS)
1	-39.323
2	8.870
3	30.453

SUM OF FORCES ON SYSTEM ---- .000

FACTOR OF SAFETY ----------- 2.022

```
100 TITL   PRINCETON EMP - PUMP STATION
110 STRU  4  0.0   550.0   1.
120    0.0      550.0
130    0.0      578.0
140   26.5      578.0
150   26.5      550.0
160  SOLT   1   4   30.   0   0.120    578.0
180  -110.    578.5
190   -36.    582.0
200   -24.    582.0
210    -8.    578.0
220  SORT   1   1   30.   0   0.120    568.0
240   100.0   568.0
250  SOST   30.   0
260  METH  2
270  WATR   571.0    566.0    0.0625
280  VPLO   11.077      13.674
290  VPLO    7.746       8.316
300  VPLO   20.549       2.265
305  VPLO   13.25       45.120
310  END
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  PROGRAM CSLIDE - ECHOPRINT
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DATE: 92/04/21                        TIME: 14.22.44


  PRINCETON EMP - PUMP STATION


MULTI  FAILURE PLANE ANALYSIS

SEEPAGE FORCE BY LINE OF CREEP, GRADIENT
COMPUTED USING SHORTEST SEEPAGE PATH .


NO OF CORNERS IN STRUCTURE ----------        4
DENSITY OF CONCRETE -----------------    .0000(KCF)
DENSITY OF WATER --------------------    .0625(KCF)
WATER LEVEL LEFT SIDE ---------------   571.00(FT)
WATER LEVEL RIGHT SIDE --------------   566.00(FT)
NO. OF SOIL LAYERS LEFT SIDE --------        1
N   OF SOIL LAYERS RIGHT SIDE -------        1

ELEV. OF WEDGE-STRUCTURE INTERSECTION
ON ACTIVE SIDE OF STRUCTURE ---------550.000(FT)



STRUCTURE INFORMATION
---------------------

POINT        X-COORD        Y-COORD
-----        -------        -------


    1            .00         550.00
    2            .00         578.00
    3          26.50         578.00
    4          26.50         550.00

 LEFTSIDE SOIL DATA
 ------------------
```

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	578.00

LAYER	POINT NO. 1		POINT NO. 2		POINT NO. 3	
NO	X-COORD	Y-COORD	X-COORD	Y-COORD	X-COORD	Y-COORD
1	-110.00	578.50	-36.00	582.00	-24.00	582.00

LAYER	POINT NO. 4	
NO	X-COORD	Y-COORD
1	-8.00	578.00

SOIL DATA BELOW STRUCTURE

FRICTION ANGLE --------- 30.00
COHESION --------------- .0000

RIGHTSIDE SOIL DATA

LAYER NO.	FRICTION ANGLE (DEG)	COHESION (KSF)	UNIT WEIGHT (KCF)	ELEV AT STRUCTURE (FT)
1	30.00	.0000	.120	568.00

LAYER	POINT NO. 1	
NO	X-COORD	Y-COORD
1	100.00	568.00

VERTICAL POINT LOADS

X-COORDINATE MAGNITUDE

(FT)	(KIPS)
11.08	13.674
7.75	8.316
20.55	2.265
13.25	45.120

PROGRAM CSLIDE - FINAL RESULTS

DATE: 92/04/21 TIME: 14.23.04

PRINCETON EMP - PUMP STATION

MULTIPLE FAILURE PLANE ANALYSIS

SEEPAGE FORCE COMPUTED BY LINE OF CREEP

WEDGE NUMBER	HORIZONTAL LOADS LEFT SIDE (KIPS)	HORIZONTAL LOADS RIGHT SIDE (KIPS)	VERTICAL LOAD (KIPS)
1	.000	.000	.000
2	.000	.000	69.375
3	.000	.000	.000

WATER PRESSURES ON WEDGES

LEFTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)

1	.000	1.209

STRUCTURAL WEDGE

X-COORD. (FT)	PRESSURE (KSF)
.00	1.209
26.50	1.079

RIGHTSIDE WEDGES

WEDGE NO.	TOP PRESSURE (KSF)	BOTTOM PRESSURE (KSF)
3	.000	1.079

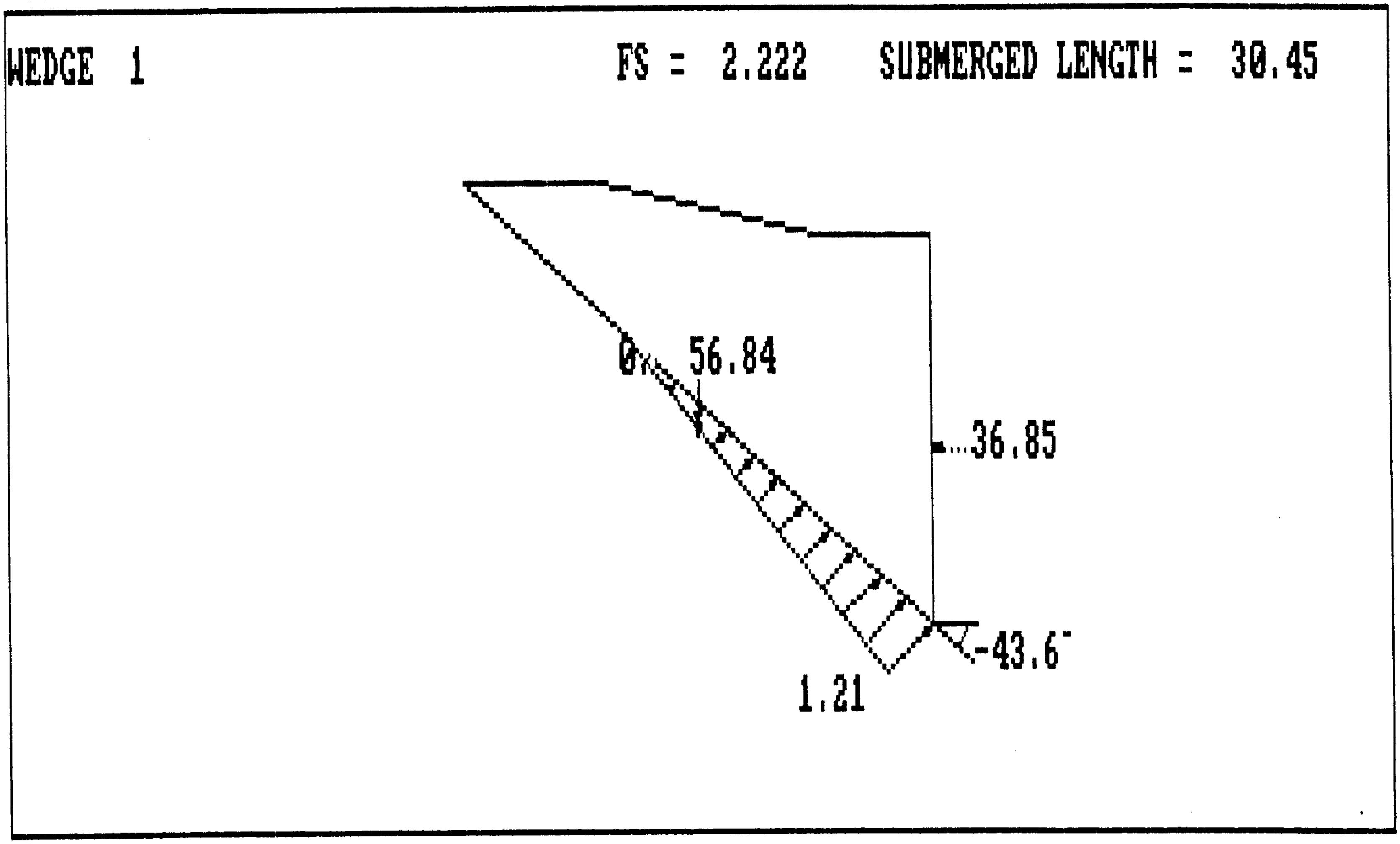
WEDGE NUMBER	FAILURE ANGLE (DEG)	TOTAL LENGTH (FT)	WEIGHT OF WEDGE (KIPS)	SUBMERGED LENGTH (FT)	UPLIFT FORCE (KIPS)
1	-43.6	46.402	56.838	30.451	18.410
	.000	26.500	.000	26.500	30.315
3	37.7	29.435	25.153	26.164	14.112

WEDGE NUMBER	NET FORCE ON WEDGE (KIPS)
1	-36.849
2	10.147
3	26.702

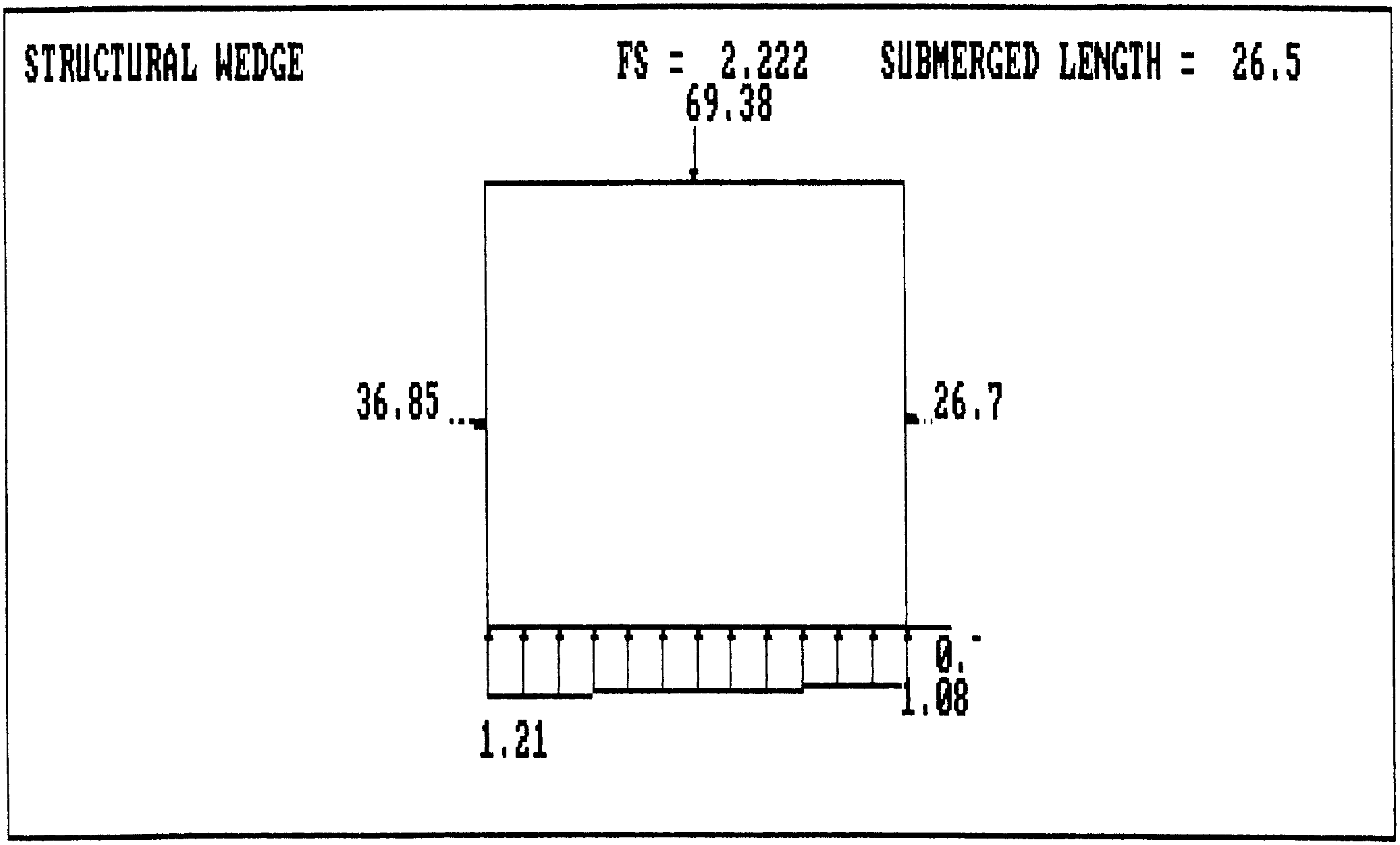
SUM OF FORCES ON SYSTEM ---- .000

FACTOR OF SAFETY ----------- 2.222

PRINCETON EMP - PUMP STATION



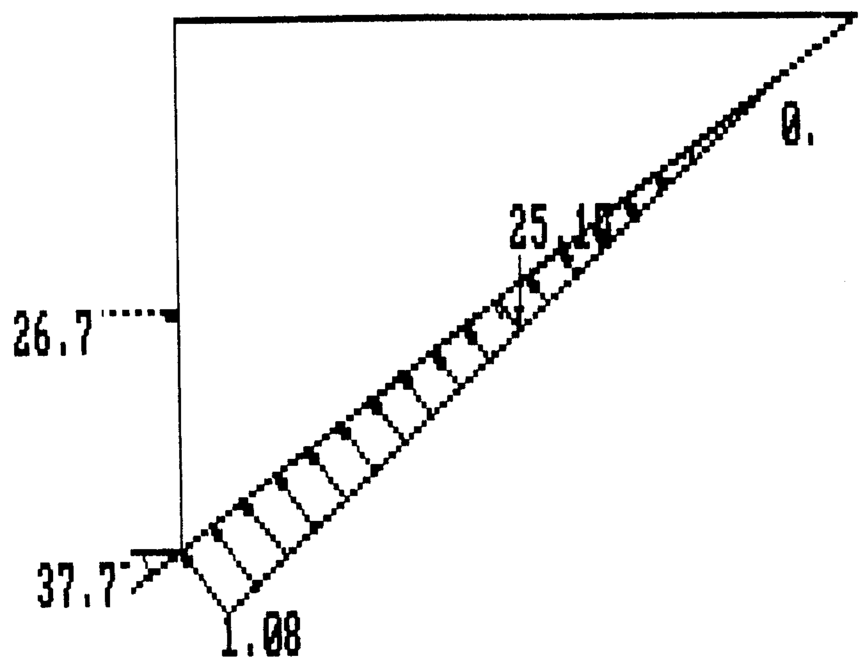
PRINCETON EMP - PUMP STATION



PRINCETON EMP - PUMP STATION

WEDGE 3

FS = 2.222 SUBMERGED LENGTH = 26.16



Hole No. PWA-92-5

DRILLING LOG	DIVISION NC	INSTALLATION RID	SHEET 1 OF 3 SHEETS

1. PROJECT: Pamlico Wildlife Area
2. LOCATION (Coordinates or Station)
3. DRILLING AGENCY: IADCO
4. HOLE NO. (As shown on drawing title and file number): PWA-92-5
5. NAME OF DRILLER: Pat, Jeff Oothman
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK —
9. TOTAL DEPTH OF HOLE 60.8'
10. SIZE AND TYPE OF BIT H.S. / RB
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL CME55
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 16 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER -6.6'
16. DATE HOLE: STARTED 2-10-92 | COMPLETED 2-10-92
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR: George Miller

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Br. clayey sand			H.S 0-12.5 RB+mud 12.5-
	2.0					
			Br. mottled med clay. w/I.O. stiff		2.5	2" S.S, 4,7,9 16
					S1	3.0-4.0
			Change to gray mottled med. cly.		4.0	HS
					5.0	2" S.S. 3,3,3 6
					S2	5.5-6.5
					6.5	poor Recovery. HS
					7.5	2" S.S. 3,2,3 5
			Lighter gray. Trace sand this sample.		S3	8.0-9.0
					9.0	poor Recovery. HS
			Softer material		10.0	2" SS. 3,3,3 6
			More sand w/Depth		S4	
					11.5	10.5-11.5 HS
					12.5	2" SS. 1,2,1 3
			Gr. med-fine sand.		S5	
					14.0	13.0-14.0 RB w/mud
					15.0	2" S.S. 1,6,9 15
	15.7		Br. orange med-fine sand (coarser gradation) Trace gravel?		S6	
					16.5	RB w/mud
					19.3	2" SS 4,6,6 12
	20.0				S7	

M 1836 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) | PROJECT I-46 | HOLE NO.

Hole No.

PROJECT Primecta Wildlife Area	INSTALLATION RFD			SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Br. orange med - fine sand trace gravel		S7 (cont) 20.8	19.8 - 20.8
						RB w/ mud
			(Color change to Brown) (this sample.		24.3 S8 25.8	2" S.S. 4, 7, 9 16 24.8 to 25.8
			poss. occ gravel			RB w/ mud
			gravel ———— Br. fine sand ———		29.3 S9 S9A 30.8	2" S.S. 4, - Cave in? 13 - 30.3 - 30.8
						RB w/ MUB Added more Bentonite
			Br. medium to fine sand with gravel Trace organic material?		34.3 S10 35.8	2" S.S. 5, 9 15 34.8 35.8
						RB w/ mud
			Br. medium to fine sand, occ. gravel layer		39.3 S11 40.8	2" SS 4, 9 25 39.8 40.8
						RB w/ mud
	44.0					

I-47

ENG FORM 1836-A

GPO: 1969 OF—329-245

PROJECT

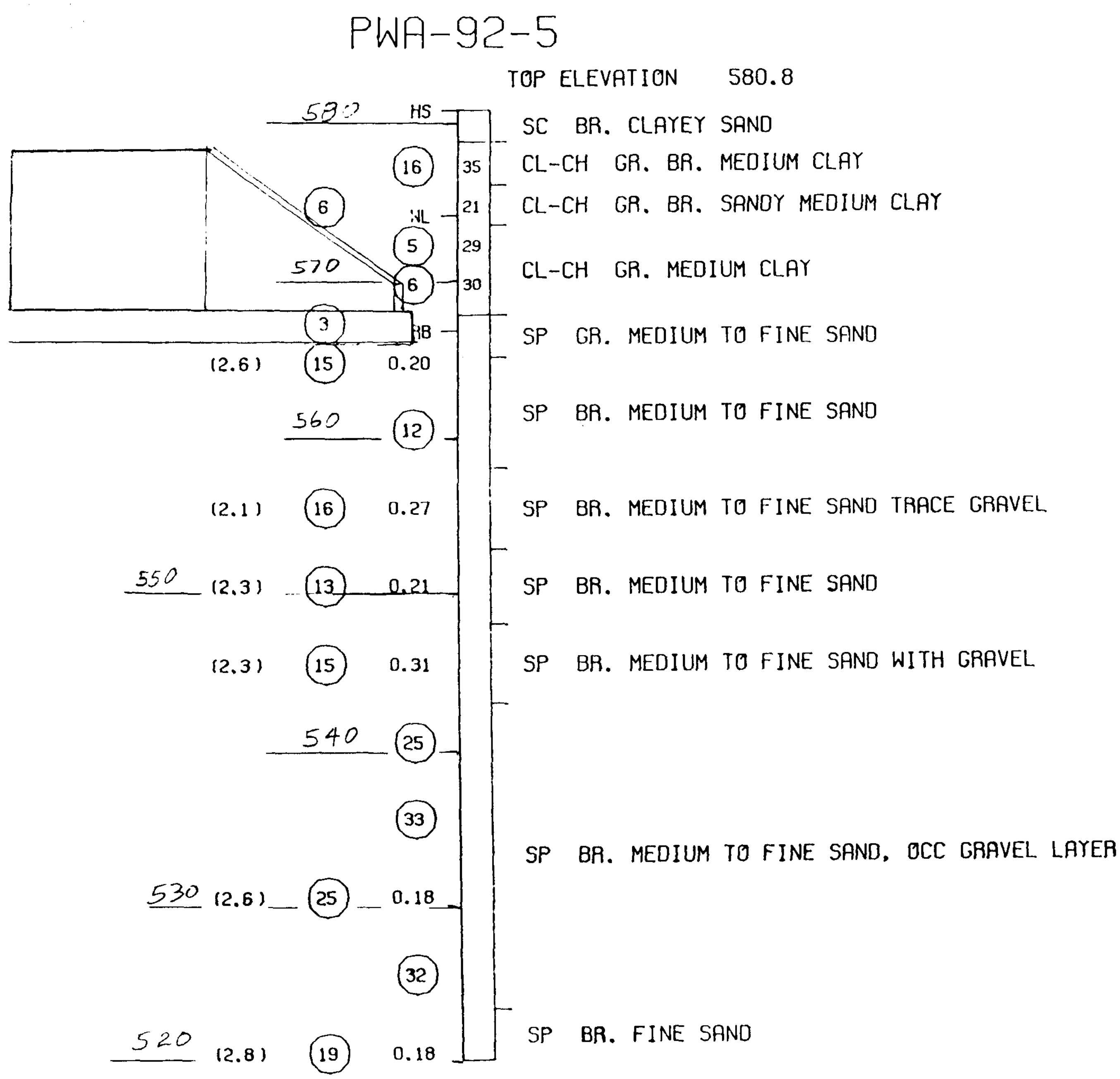
HOLE NO. PWA-92-5

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. PWA-92-5

PROJECT: Princeton ... | INSTALLATION: RFD. | SHEET 5 OF 7 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	44.0		Br. med.-fine sand ... occ. gravel layer ... (gravel)		44.3 S12 45.8	2"SS. 6, 13, 20. 44.8-45.8 33
						RB w/ mud
			Coarse gravel layers while drilling		49.3	
			gravel bottom of spoon		S13 50.8	2"SS 11, 13, 12 25 49.8-50.8
						RB w/ mud
					54.3 S14 55.8	2"S.S. 13, 19, 13 32 54.8-55.8
						RB w/mud
			Fine gradation (gravel washout to top of spoon samples)		59.3 S15 60.8	2"SS 4, 8, 11 19 59.8-60.8
	60.8		Bottom of Boring			
	15					

MT 1836-A | PROJECT | HOLE NO. PWA-92



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LEVEE CENTERLINE
10 FEBUARY 1992

PRINCETON WILDLIFE AREA EMP PROJECT

SCALE: 1IN=10 FT

Subject		Date
Princeton · EMP-Pump Station		April 92
Computed by C. Johnson	Checked by	Sheet 45 of

Construction Loading

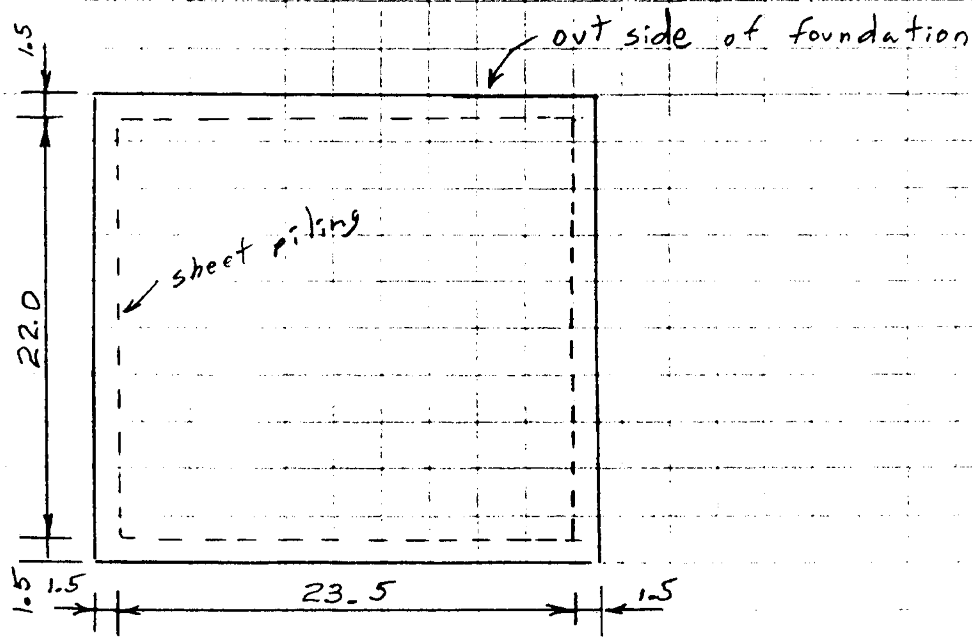
Active soil pressure use $K_{at\ rest} = 0.5$ 12 ft high & 25 ft wide

$P_r = \frac{1}{2} * 12^2 * 0.5 * 120 * 25 = 108,000$ lbs →

$M_{P_r} = 4 * 108,000 = 432,000$ ft-lbs

	Vertical (lbs)	Horizontal (lbs)	Moment ft-lbs
Concrete	341,860 ↓		3,786,860 ↻
Soil Down	207,913 ↓		1,610,498 ↻
Soil Pressure		108,000 →	432,000 ↻
	549,773 ↓	108,000 →	5,829,358 ↻

$\bar{X} = 5,829,358 / 549,773 = 10.60$ ft.



NCR Form 1 Aug 80 381b

Subject: Princeton EMP - Pump Station		Date: April 92
Computed by: C. Johnson	Checked by	Sheet 46 of

only use the area inside of the sheet-piling for analysis.

Area = $22 * 23.5 = 517$ sq. ft.

$I = \frac{22 * 23.5^3}{12} = 23{,}793 \ ft^4$

$e = 26.5/2 - 10.60 = 2.65$ ft

Moment $= 2.65 * 549{,}773 = 1{,}456{,}898$ ft-lbs

soil pressure

$\sigma = \frac{P}{A} \pm \frac{Mc}{I}$

$\frac{549{,}773}{517} \pm \frac{1{,}456{,}898 * 11.75}{23{,}793}$

$1{,}063 \pm 719 \longrightarrow 1782$ psf & 344 psf

$= 0.891$ Ton/sq. ft & 0.172 ton/sq. ft.

Subject: Princeton EMP - Pump Station		Date: April 92
Computed by: C. Johnson	Checked by	Sheet 47 of

Design as a raft foundation

Ref: "Foundation Engineering" 2 Ed. Peck, Hanson & Thornburn

Correct N value for overburden (Eq 5.3 page 114)

overburden pressure = $6.5' * 120 = 780$

$9.0 * (120 - 62.5) = 518$

1298 psf. $= 0.65$ Tons/sq.ft.

$C_N = 0.77 \log_{10} \frac{20}{P} = 0.77 \log_{10} \frac{20}{0.65} = 1.15$

Nvalue Boring (PWA - 92-5) $= \frac{(15+12+16+13)}{4} = 14$

Corrected Nvalue: $N_r = 1.15 * 14 = 16$

Correction for watertable elevation $C_w = 0.5$

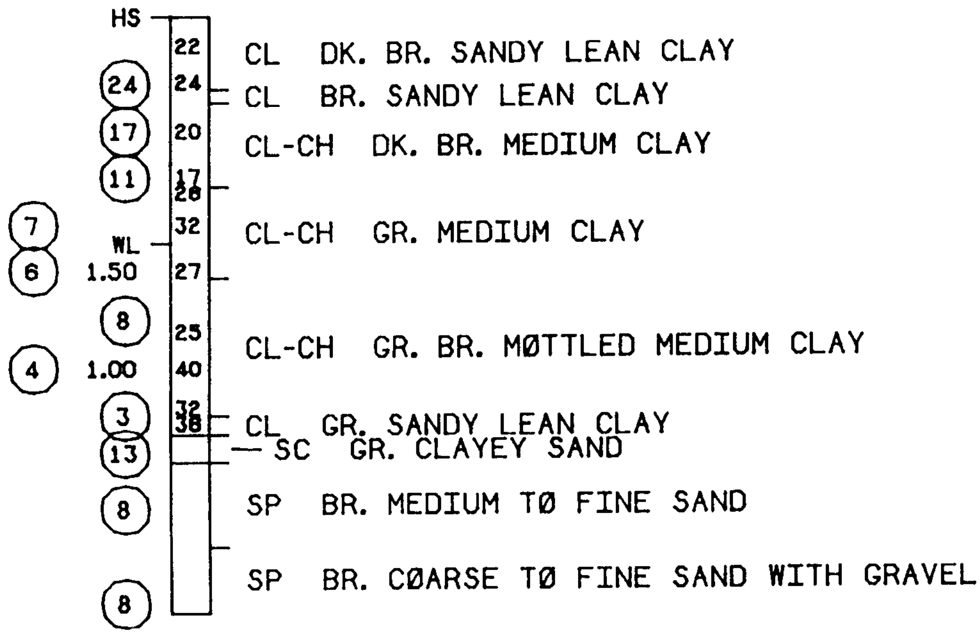
$q_a = 0.22 * N = 0.22 * 16 = 3.52$ Tons/sq. ft.

coorection for watertable $q_a = 0.5 * 3.52 = 1.76$ tons/sq. ft.

NCR Form 381b
1 Aug 80

PWA-90-24

TØP ELEVATIØN 583.6



STA. 163+30
7' L
1 JUNE 1990

PRINCETØN WILDLIFE AREA EMP PRØJECT

SCALE: 1IN= 10FT

DETAILED ESTIMATE OF COST

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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX J
DETAILED ESTIMATE OF COST

1. **General.** Table 14-1 of the main text contains the detailed cost estimate prepared for the Princeton Wildlife Management Area, Rehabilitation and Enhancement Project at Mississippi River Miles 504.0 - 506.5, including Federal construction, planning, engineering, and design, and construction management costs. The current working estimate (CWE) prepared for this Definite Project Report (DPR) level study was developed after review of project plans, discussion with the design team members, and review of costs for similar construction projects. The Micro-Computer Aided Cost Estimating System (M-CACES), incorporating local wage and equipment rates, was utilized to assemble and calculate project element cost. Costs, including appropriate contingencies, are presented in accordance with EC 1110-2-536, Civil Works Project Cost Estimating - Code of Accounts.

2. **Price Level.** Project element cost are based on June 1993 prices. These costs are considered fair and reasonable to a well-equipped and capable contractor and include overhead and profit. Calculation of the Fully Funded Estimate (FFE) was done in accordance with guidance from CECW-B, dated 25 Jan 93, for Factors for Updating Study/Project Cost Estimates for FY 1995 Budget Submission.

3. **Contingency Discussion.** After review of project documents and discussion with personnel involved in the project, cost contingencies were developed which reflect the uncertainty associated with each cost item. Per EC 1110-2-263, these contingencies are based on qualified cost engineering judgment of the available design data, type of work involved and uncertainties associated with the work and schedule. Costs were not added to contingency amounts to cover items which are identified project requirements. The following discussion of major project features indicates the basis for contingency selection and assumptions made. For other elements not addressed below, the assignment of contingencies was deemed appropriate to account for the uncertainty in design and quantity calculation and further discussion is not included.

a. Feature 06, Fish and Wildlife Facilities.

The quantities for this work were developed by the Design and Cost Engineering Branches.

06.-.-.- Perimeter Levee Improvement, Overflow Roadway Improvement and Cross Dike Construction. This work consist of improving the existing perimeter levee including the overflow section. Embankment material will be added, existing levee slopes will be regraded, and the levee section will be seeded. The Cross Dike Construction involves building approximately 5,400 lineal feet of small, 4-foot-high levee which will be seeded. Some adjacent material will be used for construction of the levees, but the majority of material will come from borrow sites within the refuge area. It was assumed that scrapers would be used to excavate and haul material to the levee construction sites. A 36-inch gatewell and small stoplog and intake structures will be constructed for a water source and flow control. Their estimated costs include provisions for dewatering during their construction. This work requires standard construction methods and techniques and is assigned a 30-percent contingency.

The average contingency for the project's construction is 30.0 percent.

b. Feature 30, Planning, Engineering & Design.

The engineering and design for this project includes all planning and design work necessary to complete the Definite Project Report and construction plans and specifications. This cost also includes engineering support during construction, and preparation of as-built drawings and operation and maintenance manuals. The design effort for the construction was analyzed to determine the man-year effort required. This estimate is based upon monies expended to date, discussions between the project engineer and project manager, and historical data and experience gained on other projects of similar nature.

c. Feature 31, Construction Management.

Construction management includes studies and analyses of project reports, plans and specifications, and conferences of construction staff to become familiar with design requirements; biddability, contractibility, and operability reviews; preaward activities to acquaint prospective bidders with the nature of the work; administration of construction contracts; administration of A/E contracts which provide for supervision and inspection; establishment of bench marks and baselines required for layouts of construction, relocations, and clearing; review of shop drawings, manuals, catalog cuts, and other information submitted by the construction contractor; assure specifications compliance by supervision and inspection on construction work, conferences with the contractors to coordinate various features of the project and enforce compliance with schedules; sampling and testing during construction phase to determine suitability and compliance with plans and specifications; negotiate with the contractor on all contract modifications, including preparation of all contract documents required therefore; estimate quantities, determine periodic payments to contractors, and prepare, review and approve contract payments; review and approve construction schedules and progress charts; prepare progress and completion reports; project management and administration not otherwise identified; and district overhead. These costs may be incurred at the job site, an area office, or at the District Office. For the construction of the Princeton Refuge Rehabilitation and Enhancement EMP Project, the estimated cost of construction management is $250,000 for a construction contract of about 2-year duration and an estimated value of $2.5 million.

LITERATURE CITED

APPENDIX K

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-10F)

PRINCETON WILDLIFE MANAGEMENT AREA

POOL 14, MISSISSIPPI RIVER MILES 504.0 THROUGH 506.5
SCOTT COUNTY, IOWA

APPENDIX K
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MARVIN HUBBELL IL DEPT OF CONSERVATION 524 SOUTH SECOND STREET 3RD FLOOR PLANNING ROOM 310 SPRINGFIELD, IL 62706	1	1	1			1
JEFF JANVRIN WISCONSIN DEPT OF NATURAL RESOURCES 3550 MORMON COULEE ROAD LA CROSSE, WI 54601	1	1	1			1
STEVE JOHNSON MISS RIV SYS COORDINATOR MINNESOTA DEPT OF NATURAL RESOURCES DIVSION OF WATER - BOX 32 500 LAFAYETTE ROAD ST. PAUL, MN 55155-4032		1				
STEVE JOHNSON IA-IL GAS & ELECTRIC - EVIR SERVICES PO BOX 4350 DAVENPORT, IA 52808		1				

1/ I - DRAFT COORDINATION DOCUMENTS
II - PUBLIC REVIEW DOCUMENTS
III - ADMINISTRATION APPROVAL DOCUMENTS
IV - CONSTRUCTION PLANS AND SPECIFICATIONS
V - OPERATIONS AND MAINTENANCE INSTRUCTIONS
VI - PROJECT PERFORMANCE EVALUATION DOCUMENTS

Princeton, Iowa

	I	II	III	IV	V	VI 1/
RICHARD N. LEE **RR1 BOX 274** **OQUAWKA, IL 61469**		1				
KEN LUBINSKI **US FWS - ENVIR MANAGEMENT TECH CTR** **575 LESTER DRIVE** **ONALASKA, WI 54650**	1	1	1			1
RICHARD NELSON FIELD SUPERVISOR **US FISH AND WILDLIFE SERVICE** **4469 48TH AVENUE COURT** **ROCK ISLAND, IL 61201**	1	1	1			1
BILL REDDING **SIERRA CLUB** **214 NORTH HENRY STREET SUITE 203** **MADISON, WI 53703**		1				
RANDY ROBINSON **IOWA DEPT OF NATURAL RESOURCES** **51576 GREEN ISLAND ROAD** **GREEN ISLAND, IA 52064**		1				
THOMAS ROGERS **PRINCETON MARINA** **PO BOX 101** **PRINCETON, IA 52768**		1				
ART ROSELAND WILDLIFE BIOLOGIST **IOWA DEPT OF NATURAL RESOURCES** **RR #2, PO BOX 269** **Manchester, IA 52057**		1				
DON E. SCHMIDT **1610 HWY 67** **PRINCETON, IA 52763**		1				
RON SEYMOUR **INTERSTATE POWER CO** **201 NORTH 2ND ST** **CLINTON, IA 52732**		1				
ROBERT SHEETS **IA DEPARTMENT OF NATURAL RESOURCES** **County Court House 201 West Platt** **MAQUOKETA, IA 52060**	1	1	1	1	1	1
RICHARD SMITH **BOX 183** **PRINCETON, IA 52768**		1				
EMILY SMITH **ILLINOIS LEAGUE OF WOMEN VOTERS** **4428 42ND AVENUE** **ROCK ISLAND, IL 61201**		1				

1/ I - DRAFT COORDINATION DOCUMENTS
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IV - CONSTRUCTION PLANS AND SPECIFICATIONS
V - OPERATIONS AND MAINTENANCE INSTRUCTIONS
VI - PROJECT PERFORMANCE EVALUATION DOCUMENTS

Princeton, Iowa

	I	II	III	IV	V	VI 1/
HOLLY STOERKER **DIRECTOR UPPER MISS RIVER BASIN ASSN** **415 HAMM BUILDING** **408 ST PETER STREET** **ST. PAUL, MN 55102**	1	1	1			1
NORM STUCKY **ENVIRONMENTAL COORDINATOR** **MO DEPARTMENT OF CONSERVATION** **2901 WEST TRUMAN BLVD - PO BOX 180** **JEFFERSON CITY, MO 65102**	1	1	1			1
GLEN SUITER **PRINCETON LANDING INC** **335 RIVER DRIVE** **PRINCETON, IA 52768**		1				
KEVIN SZCODRONSKI **IA DEPT OF NAT RESOURCES-PLNG BUR** **WALLACE STATE OFFICE BUILDING** **900 EAST GRAND AVENUE** **DES MOINES, IA 50319**	1	1	1			1
RALPH TURKLE **IA DEPT OF NATURAL RESOURCES** **SURFACE & GROUNDWATER PROT BUREAU** **WALLACE STATE OFFICE BUILDING** **DES MOINES, IA 50319**		1				
RICHARD VANDERHORN - PRES **IZAAK WALTON LEAGUE** **11 COLUMBIA COURT** **DAVENPORT, IA 52804**		1				
LARRY WARGOWSKY **UPPER MISSISSIPPI RIVER NTL** **WILDLIFE & FISH REFUGE** **POST OFFICE BUILDING** **SAVANNA, IL 61074**	1	1	1	1	1	1
EDWIN WINBORN **CHAIRMAN COUNTY BOARD OF SUPERVISORS** **SCOTT COUNTY COURT HOUSE** **416 W 4TH STREET** **DAVENPORT, IA 52801**		1				
LIEUTENANT JOHN KAHLER SUPERVISOR **US COAST GUARD MARINE SAFETY DETACHMENT** **131 E 4TH ST - ROOM 332** **DAVENPORT, IA 52801**		1				

1/ I - DRAFT COORDINATION DOCUMENTS
II - PUBLIC REVIEW DOCUMENTS
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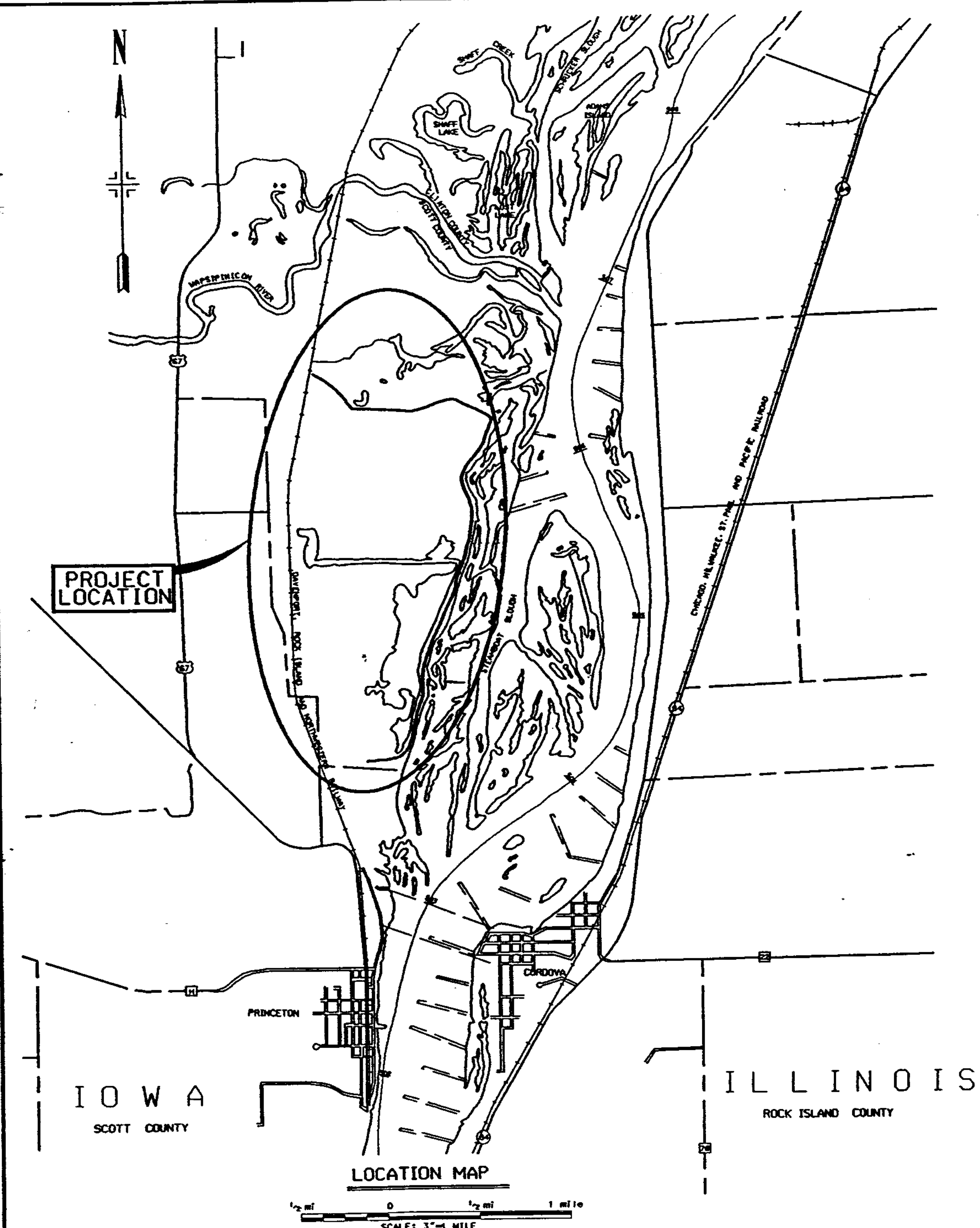
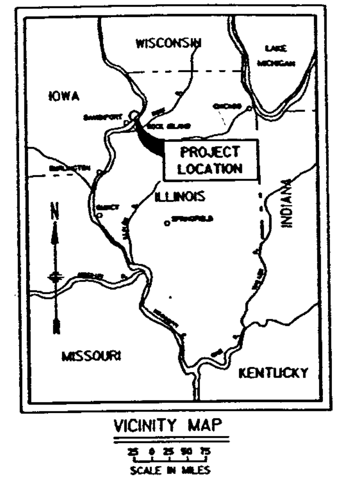
IV - CONSTRUCTION PLANS AND SPECIFICATIONS
V - OPERATIONS AND MAINTENANCE INSTRUCTIONS
VI - PROJECT PERFORMANCE EVALUATION DOCUMENTS

Princeton, Iowa

	I	II	III	IV	V	VI 1/
DISTRIBUTION -- INTERNAL						
District Engineer **US Army Engineer District Rock Island** **Clock Tower Building PO Box 2004** **Rock Island, IL 61204-2004**						
ATTN: CENCR-DE	1	1	1			1
CENCR-CD	1	1	1	11	1	1
CENCR-CD-J		1	1	1		1
CENCR-CT	1	1	1	1		
CENCR-ED	1	1	1	1	1	1
CENCR-ED-C				1		
CENCR-ED-D	1	1	1	1	1	1
CENCR-ED-DE				5		
CENCR-ED-DN	3	3	3	1	1	1
CENCR-ED-DS	1	1	1	1	1	1
CENCR-ED-G	1	1	1	1	1	1
CENCR-ED-H	1	1	1	1	1	1
CENCR-ED-HH	1	1	1	1	1	1
CENCR-ED-HQ	1	1	1		1	1
CENCR-ED-T				1		
CENCR-IM-CL			2			
CENCR-IM				1		
CENCR-OC				1		
CENCR-OD	1	1	1	1	1	1
CENCR-OD-R	1	1	1	1	1	1
CENCR-OD-RM	1	1	1	1	1	1
CENCR-PA	1	1	1			1
CENCR-PD	2	2	2			2
CENCR-PD-E	1	10	10	1	1	1
CENCR-PD-W (NILES)	2	2	2	1	1	1
CENCR-PP-M (KO[illegible]ALCZY[illegible])	1	1	1		1	1
CENCR-PP-P				1		1

1/ I - DRAFT COORDINATION DOCUMENTS
II - PUBLIC REVIEW DOCUMENTS
III - ADMINISTRATION APPROVAL DOCUMENTS
IV - CONSTRUCTION PLANS AND SPECIFICATIONS
V - OPERATIONS AND MAINTENANCE INSTRUCTIONS
VI - PROJECT PERFORMANCE EVALUATION DOCUMENTS



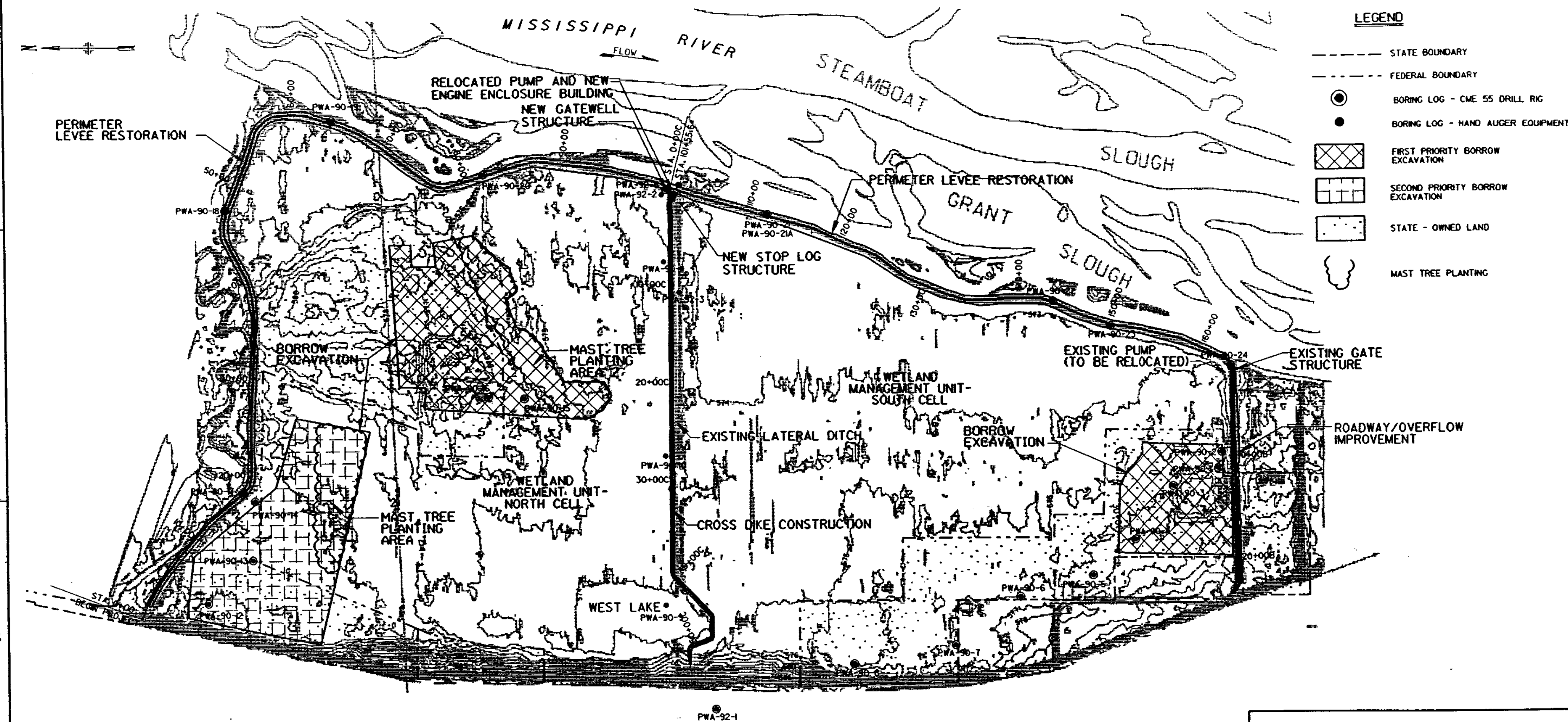


Revisions			
Symbol	Description	Date	Approved

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

Designed by: BLK	UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 14 RIVER MILES 504 THRU 506.4 PRINCETON WILDLIFE MANAGEMENT AREA
Drawn by: TPD	
Checked by: BLK	LOCATION MAP
Reviewed by: DJH	Scale: AS SHOWN
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Date: 19 SEP. 1994
	Drawing Code:
	Sheet reference number: X-2
	Solicitation Number: DACW25-9 -B-
	Sheet 2 of

PLATE 1



RECOMMENDED PLAN

500 250 0 500 1000FT
SCALE: 1"= 500'

Symbol	Revisions Description	Date	Approved

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

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

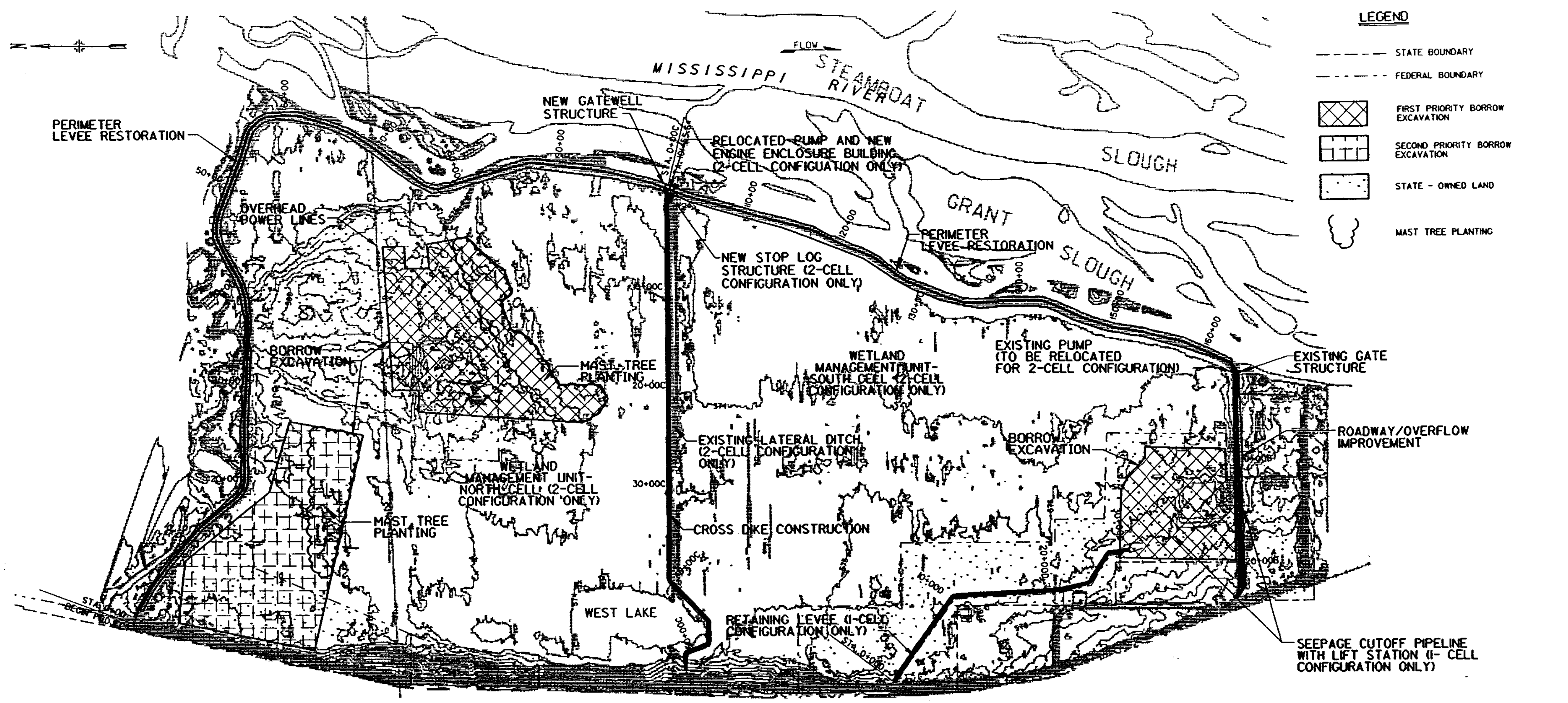
US Army Corps of Engineers Rock Island District

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

RECOMMENDED PLAN

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-1
Solicitation Number: DACW25-9 -B-
Sheet 3 of

PLATE 2



POTENTIAL FEATURES PLAN

500 250 0 500 1000FT
SCALE: 1"- 500'

Symbol	Revisions Description	Date	Approved

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

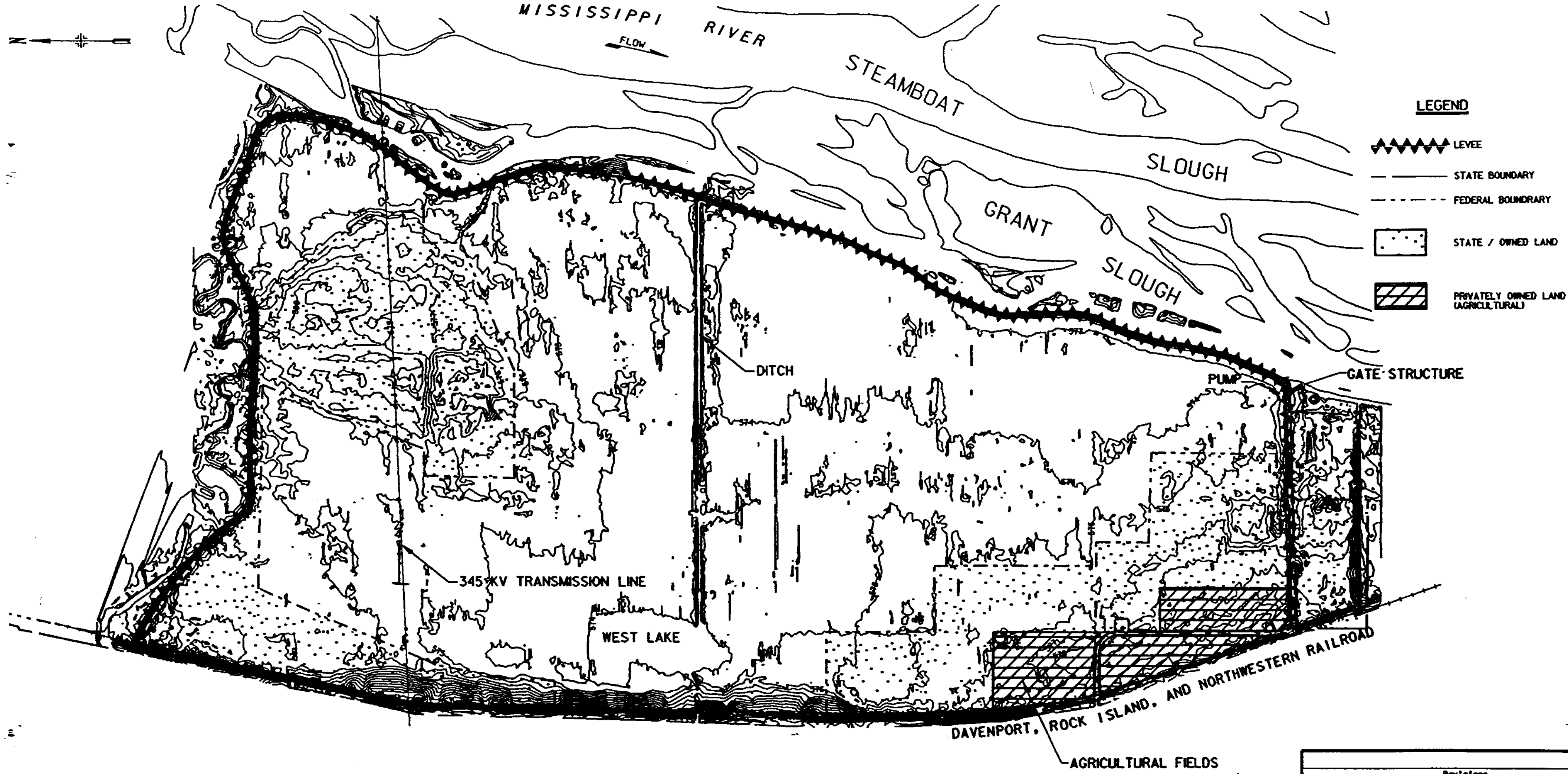
US Army Corps of Engineers
Rock Island District

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

POTENTIAL FEATURES PLAN

Designed by: BLK	Scale: AS SHOWN
Drawn by: TPD	Date: 19 SEP. 1994
Checked by: BLK	Drawing Code:
Reviewed by: DJH	Sheet reference number: C-2
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Solicitation Number: DACW25-9 -B-
	Sheet 4 of

PLATE 3



SITE PLAN

500 250 0 500 1000FT
SCALE: 1"- 500'

Revisions			
Symbol	Description	Date	Approved

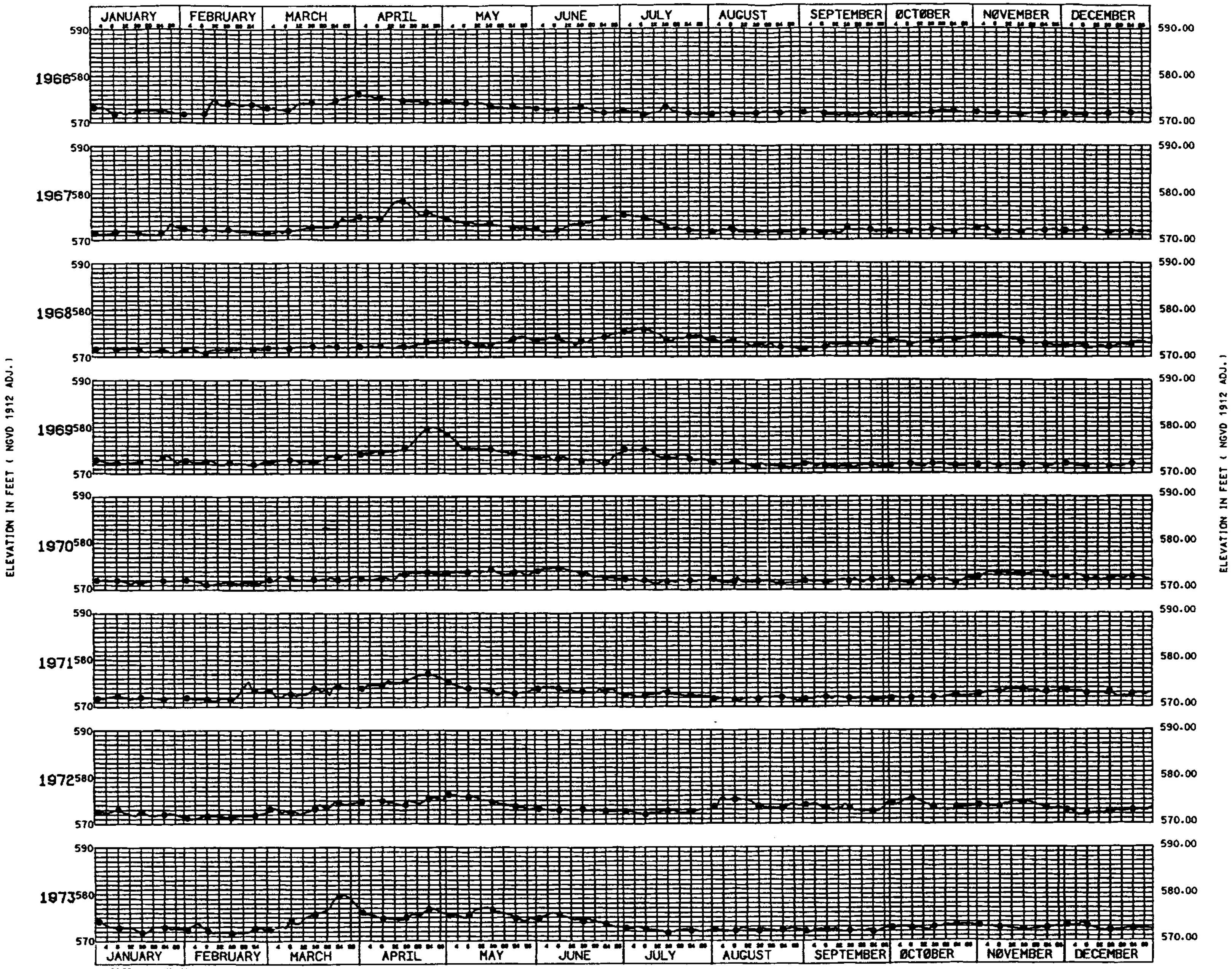
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

EXISTING CONDITIONS
SITE PLAN

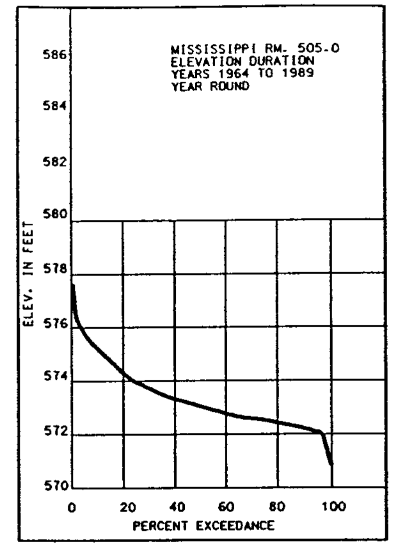
Designed by: BHW	
Drawn by: TRB	
Checked by: BLK	
Reviewed by: DJH	Scale: AS SHOWN
	Date: 19 SEP. 1994
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Drawing Code:
Sheet reference number:	Solicitation Number: DACW25-9 -B-
	Sheet of

PLATE 3a



NØTE-

HYDRØGRAPH
MISSISSIPPI RIVER MILE 505



Revisions			
Symbol	Description	Date	Approved

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

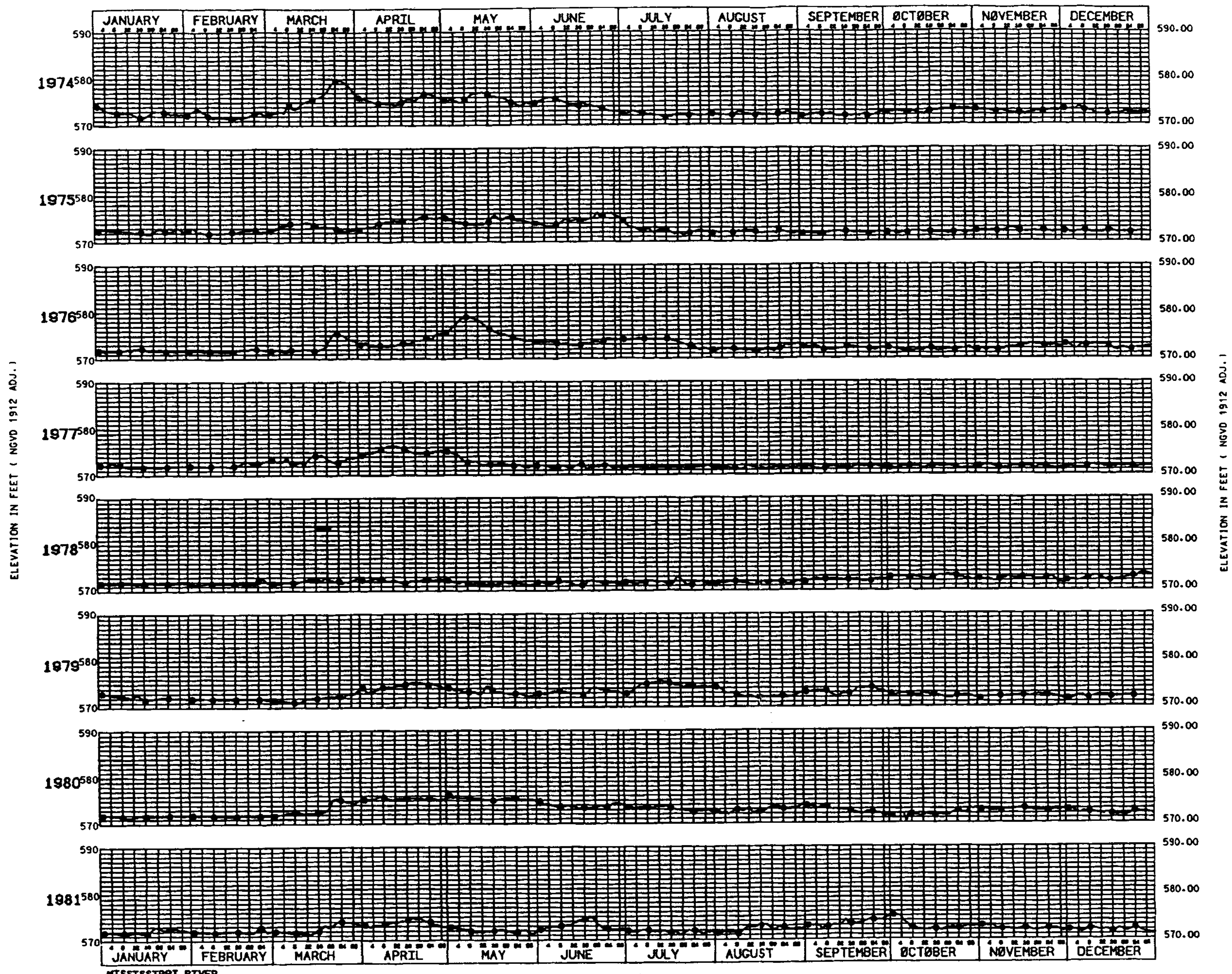
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

HYDRAULIC DATA I

Designed by: WWK
Drawn by: BJG
Checked by: WWK
Reviewed by: GEJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-3
Solicitation Number: DACW25-9 -8-
Sheet 5 of

PLATE 4



NØTE-

HYDRØGRAPH
MISSISSIPPI RIVER MILE 505

Revisions			
Symbol	Description	Date	Approved

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

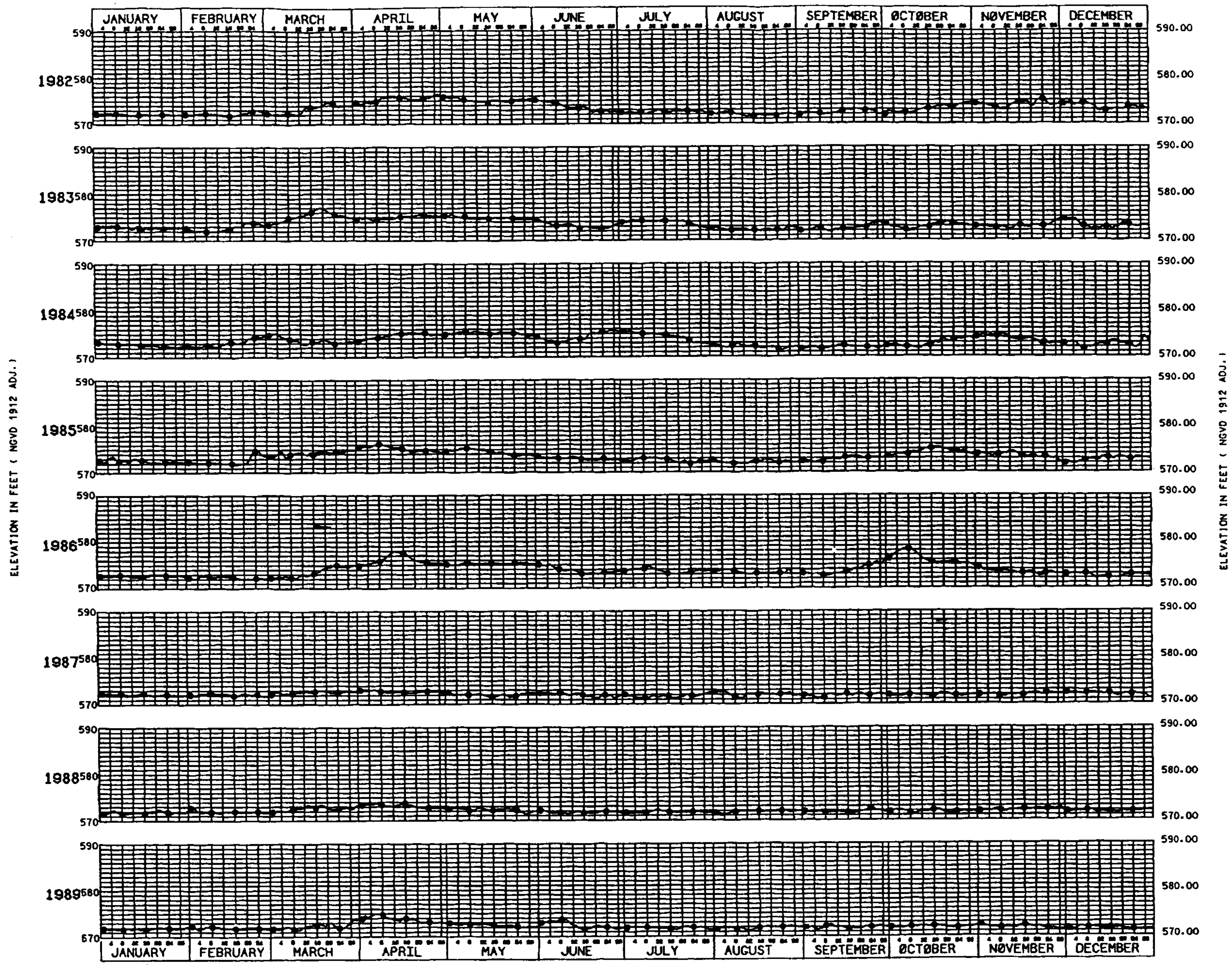
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

HYDRAULIC DATA II

Designed by: WWK
Drawn by: BJG
Checked by: WWK
Reviewed by: GEJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-4
Solicitation Number: DACW25-9 -8-
Sheet 6 of

PLATE 5



HYDRØGRAPH
MISSISSIPPI RIVER MILE 505

Revisions			
Symbol	Description	Date	Approved

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

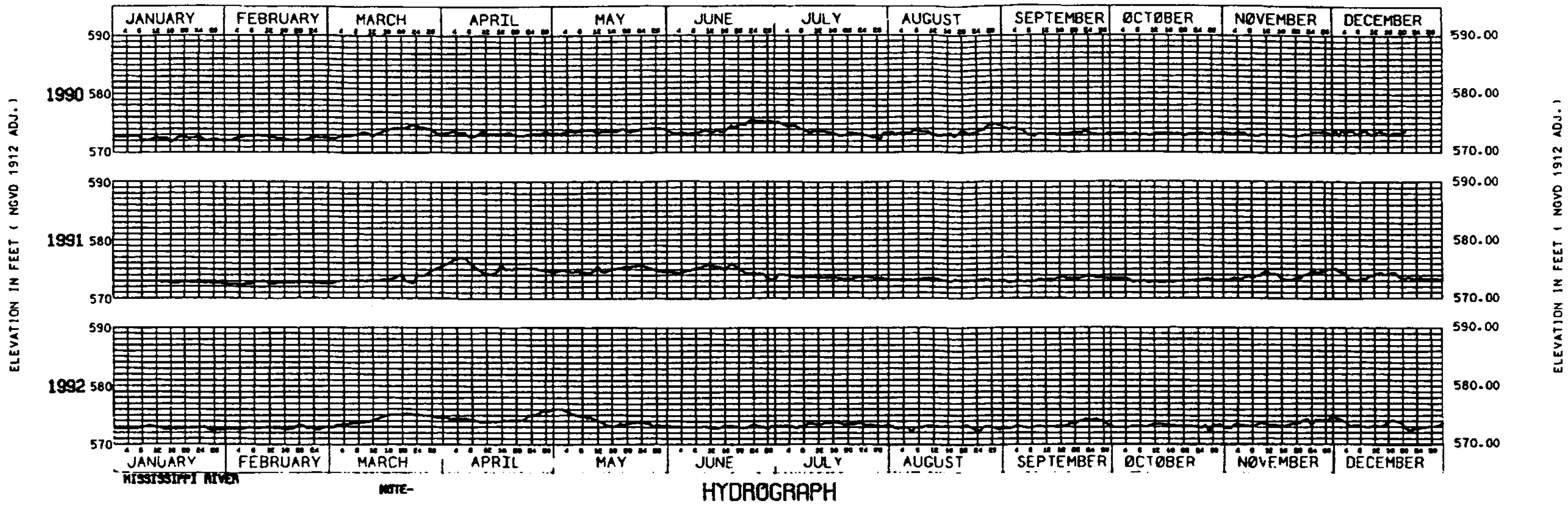
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

HYDRAULIC DATA III

Designed by: WWK
Drawn by: BJG
Checked by: WWK
Reviewed by: GEJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-5
Solicitation Number: DACW25-9 -6-
Sheet 7 of

PLATE 6



HYDROGRAPH
- RIVER MILE 505

Revisions			
Symbol	Description	Date	Approved

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

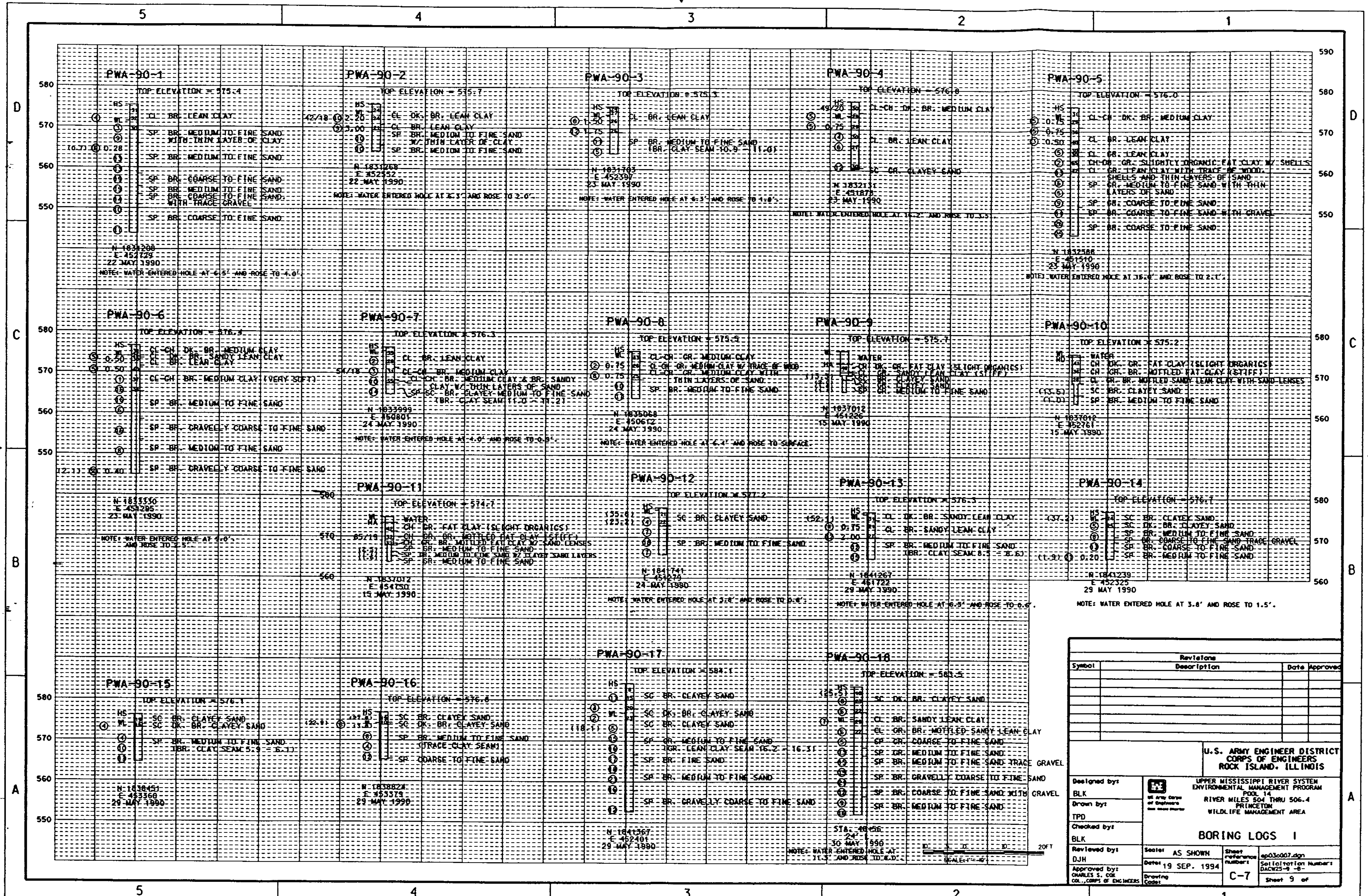
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

HYDRAULIC DATA IV

Designed by: WWK
Drawn by: BJC
Checked by: WWK
Reviewed by: GEJ
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

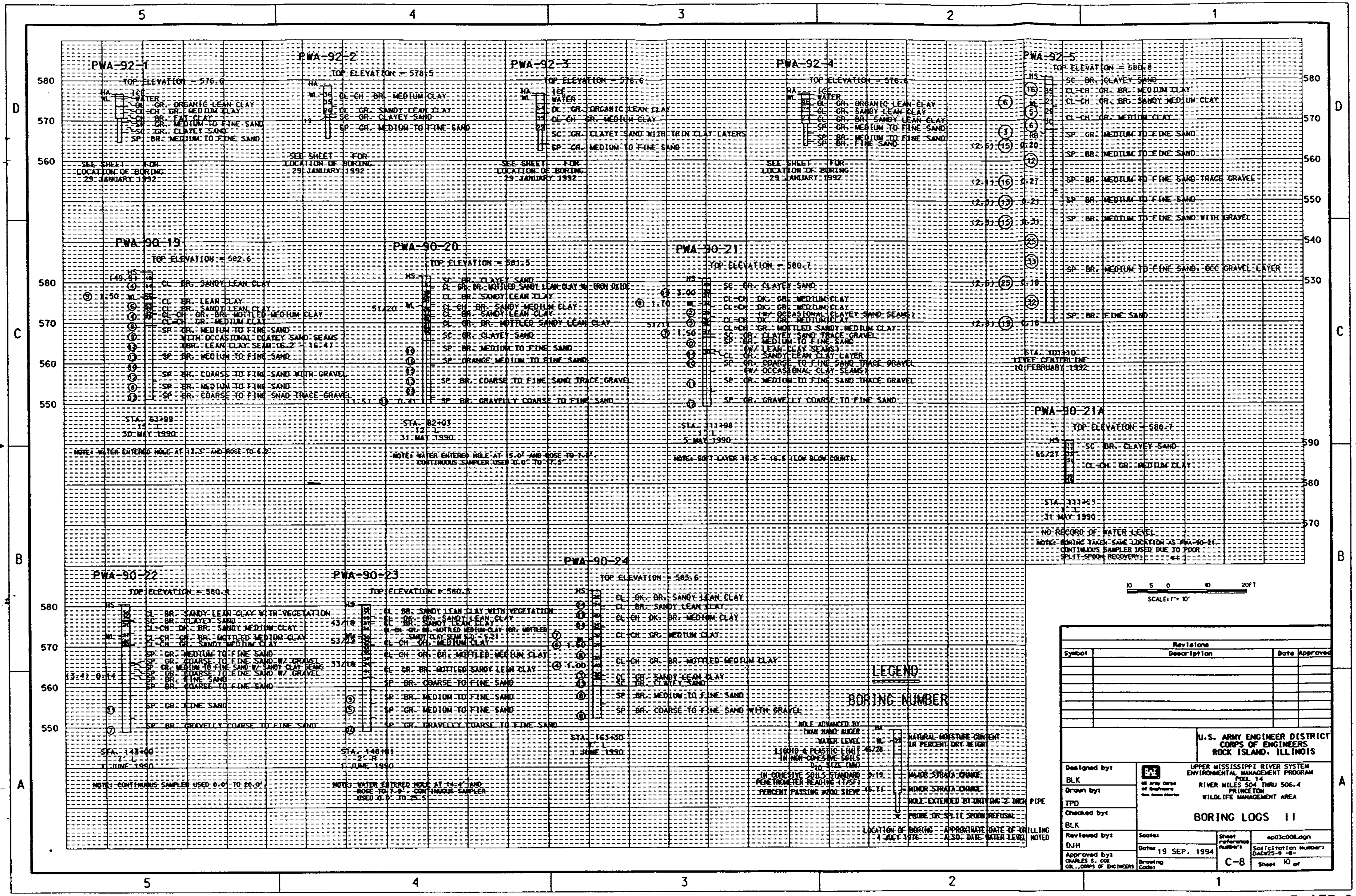
Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-6
Solicitation Number: DACW25-9 -6-
Sheet 8 of

PLATE 7



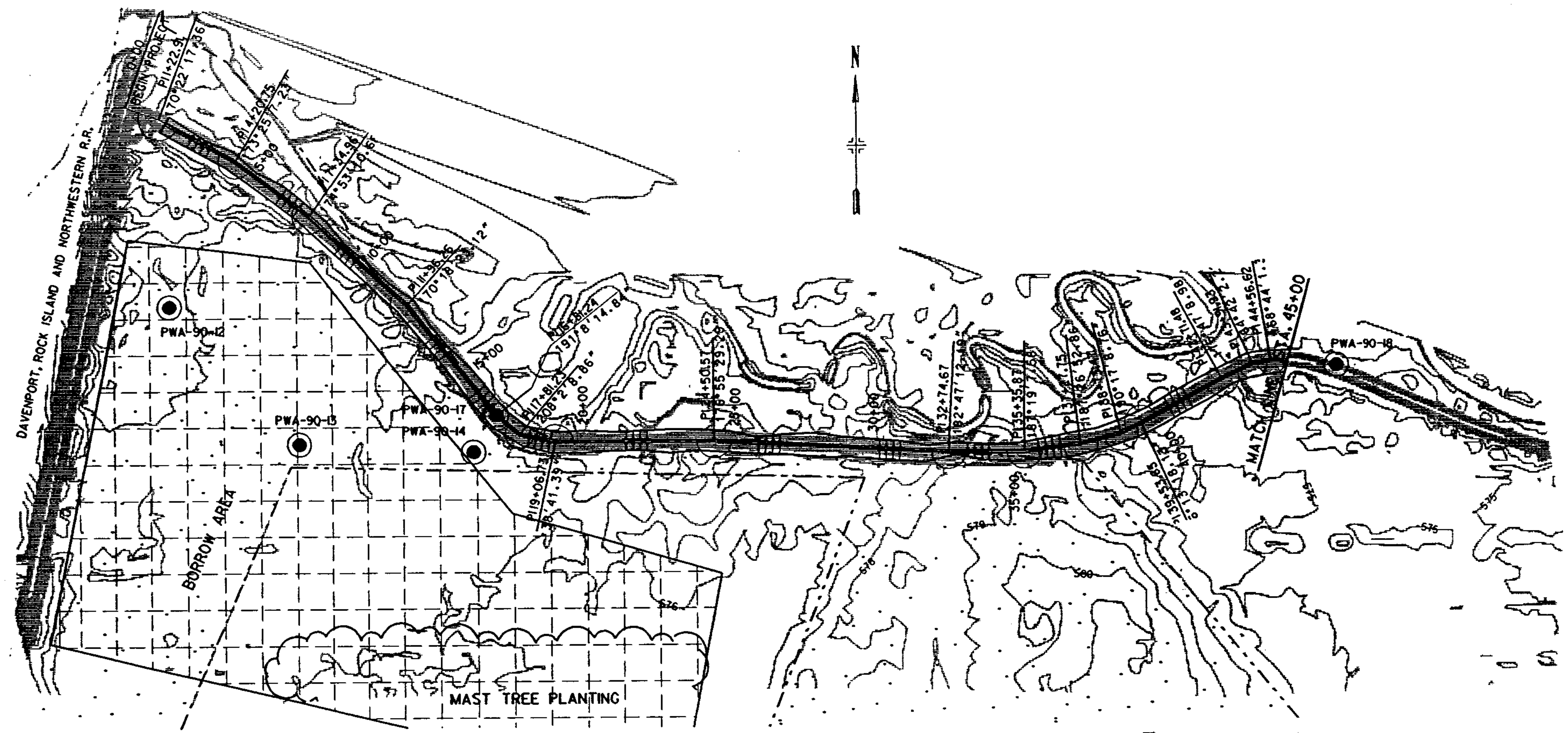
PWA-90-1
PWA-90-2
PWA-90-3
PWA-90-4
PWA-90-5
PWA-90-6
PWA-90-7
PWA-90-8
PWA-90-9
PWA-90-10
PWA-90-11
PWA-90-12
PWA-90-13
PWA-90-14
PWA-90-15
PWA-90-16
PWA-90-17
PWA-90-18
NOTE: WATER ENTERED HOLE AT 3.8' AND ROSE TO 1.5'.
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by: BLK
Drawn by: TPD
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA
BORING LOGS I
Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-7
ep03c007.dgn
Solicitation Number: DACW25-9 -8-
Sheet 9 of

PLATE 8



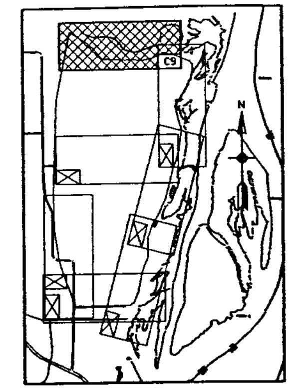
PWA-92-1
TOP ELEVATION = 576.6
SEE SHEET FOR LOCATION OF BORING
29 JANUARY 1992
PWA-92-2
TOP ELEVATION = 578.5
SEE SHEET FOR LOCATION OF BORING
29 JANUARY 1992
PWA-92-3
TOP ELEVATION = 576.6
SEE SHEET FOR LOCATION OF BORING
29 JANUARY 1992
PWA-92-4
TOP ELEVATION = 576.6
SEE SHEET FOR LOCATION OF BORING
29 JANUARY 1992
PWA-92-5
TOP ELEVATION = 580.8
10 FEBRUARY 1992
PWA-90-19
TOP ELEVATION = 582.6
STA. 63+99
30 MAY 1990
PWA-90-20
TOP ELEVATION = 583.5
STA. 82+03
31 MAY 1990
PWA-90-21
TOP ELEVATION = 580.7
STA. 111+98
5 MAY 1990
NOTE: SOFT LAYER 16.5 - 16.6 (LOW BLOW COUNT).
PWA-90-21A
TOP ELEVATION = 580.7
STA. 111+63
31 MAY 1990
NO RECORD OF WATER LEVEL
PWA-90-22
TOP ELEVATION = 580.3
STA. 143+00
1 JUNE 1990
NOTE: CONTINUOUS SAMPLER USED 0.0' TO 20.0'.
PWA-90-23
TOP ELEVATION = 580.3
STA. 148+61
1 JUNE 1990
PWA-90-24
TOP ELEVATION = 583.6
STA. 163+30
1 JUNE 1990
LEGEND
BORING NUMBER
HOLE ADVANCED BY CHAN HAND AUGER
WATER LEVEL
NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT
MAJOR STRATA CHANGE
MINOR STRATA CHANGE
HOLE EXTENDED BY DRIVING 2 INCH PIPE
PROBE OR SPLIT SPOON REFUSAL
LOCATION OF BORING 4 JULY 1976
APPROXIMATE DATE OF DRILLING ALSO DATE WATER LEVEL NOTED
10 5 0 10 20FT
SCALE: 1"= 10'
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by: BLK
Drawn by: TPD
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA
BORING LOGS II
Scale:
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-8
ep03c008.dgn
Solicitation Number: DACW25-9 -8-
Sheet 10 of

PLATE 9



PLAN

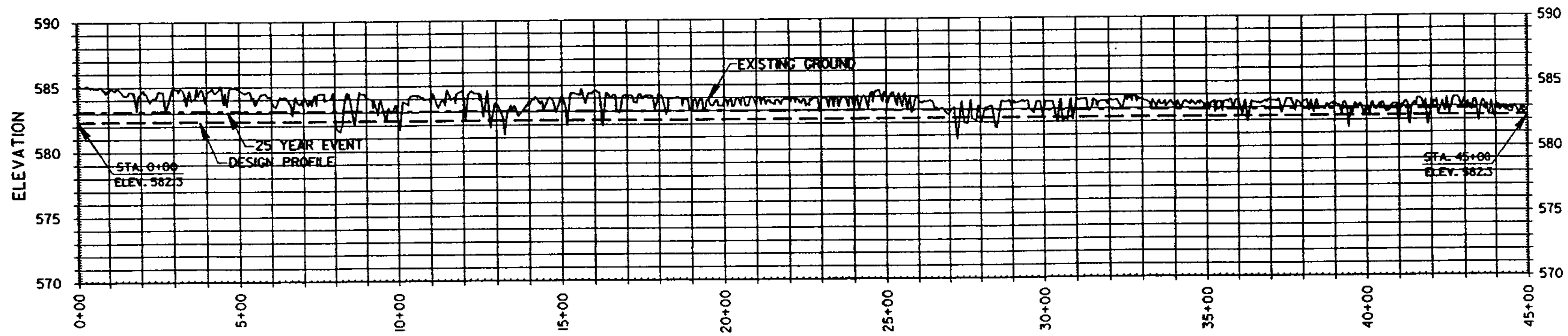
SCALE: 1"= 200'



KEY PLAN

LEGEND

- - - - - STATE BOUNDARIES
— - - — - - FEDERAL BOUNDARIES



PERIMETER LEVEE PROFILE

Revisions			
Symbol	Description	Date	Approved

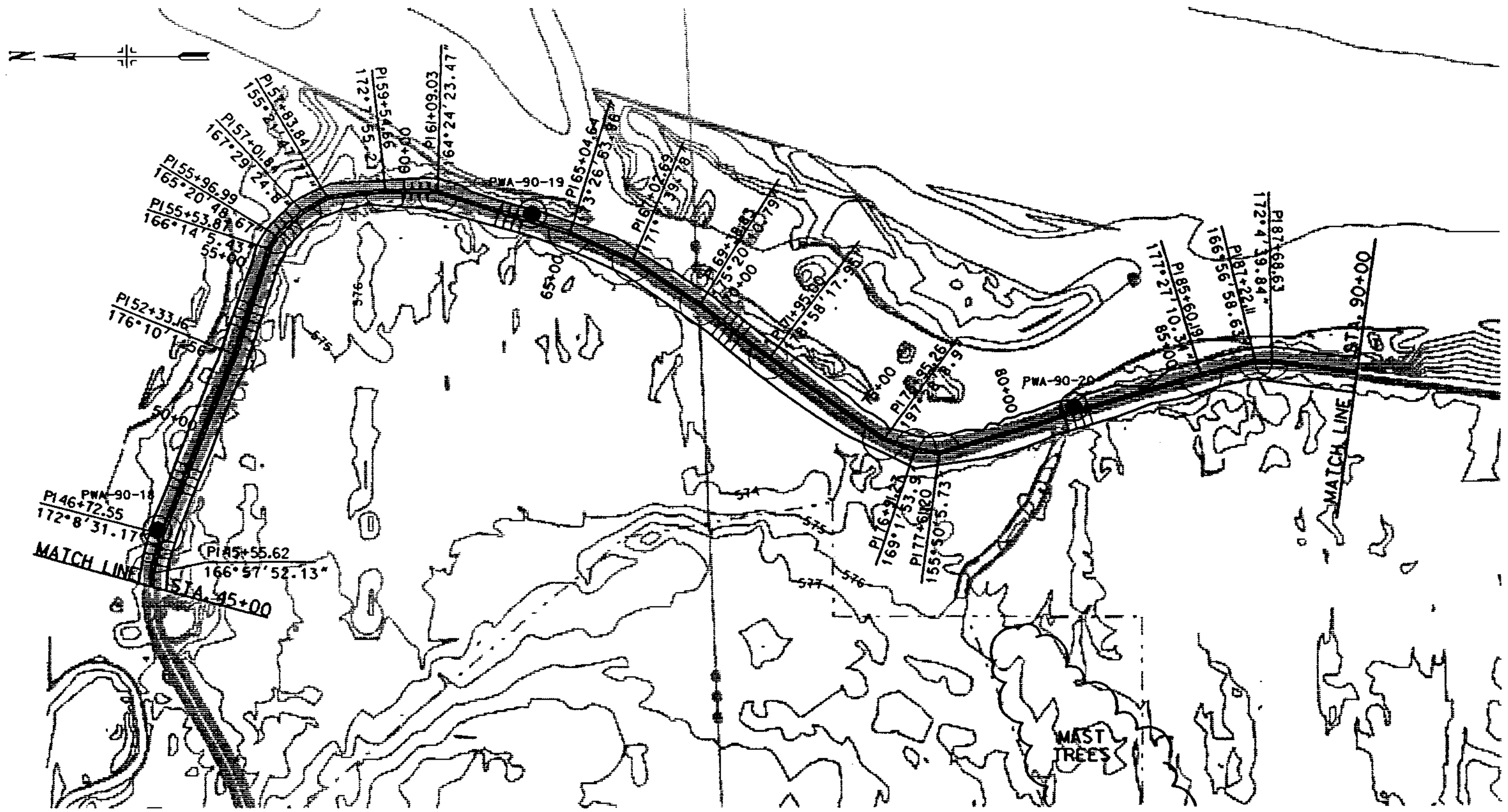
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

PERIMETER LEVEE PLAN AND PROFILE STA. 0+00 TO STA. 45+00

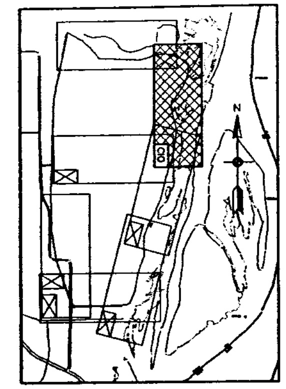
Designed by: BLK
Drawn by: TPD
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX, COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-9
Solicitation Number: DACW25-9 -B-
Sheet 10 of



PLAN

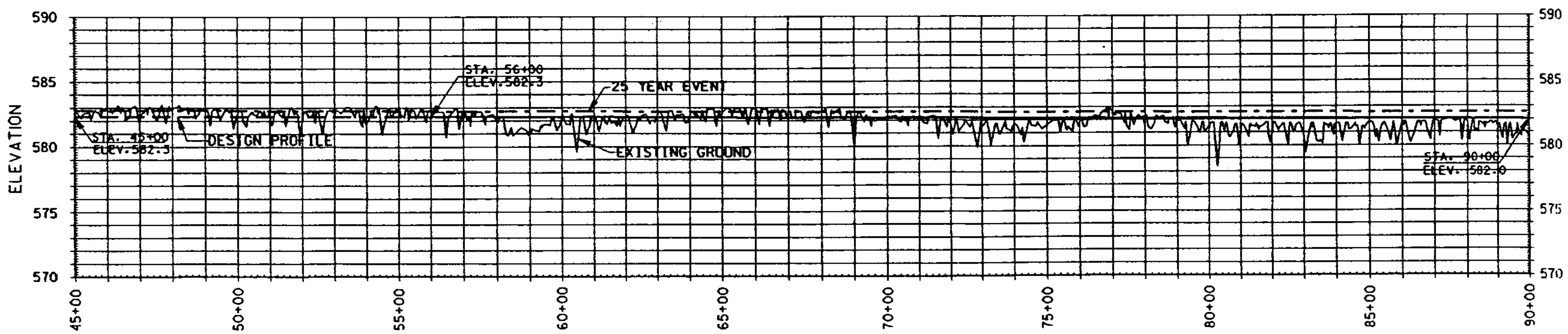
200 100 0 200 400FT
SCALE: 1"= 200'



LEGEND

STATE BOUNDARIES

FEDERAL BOUNDARIES



PERIMETER LEVEE PROFILE

Revisions			
Symbol	Description	Date	Approved

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

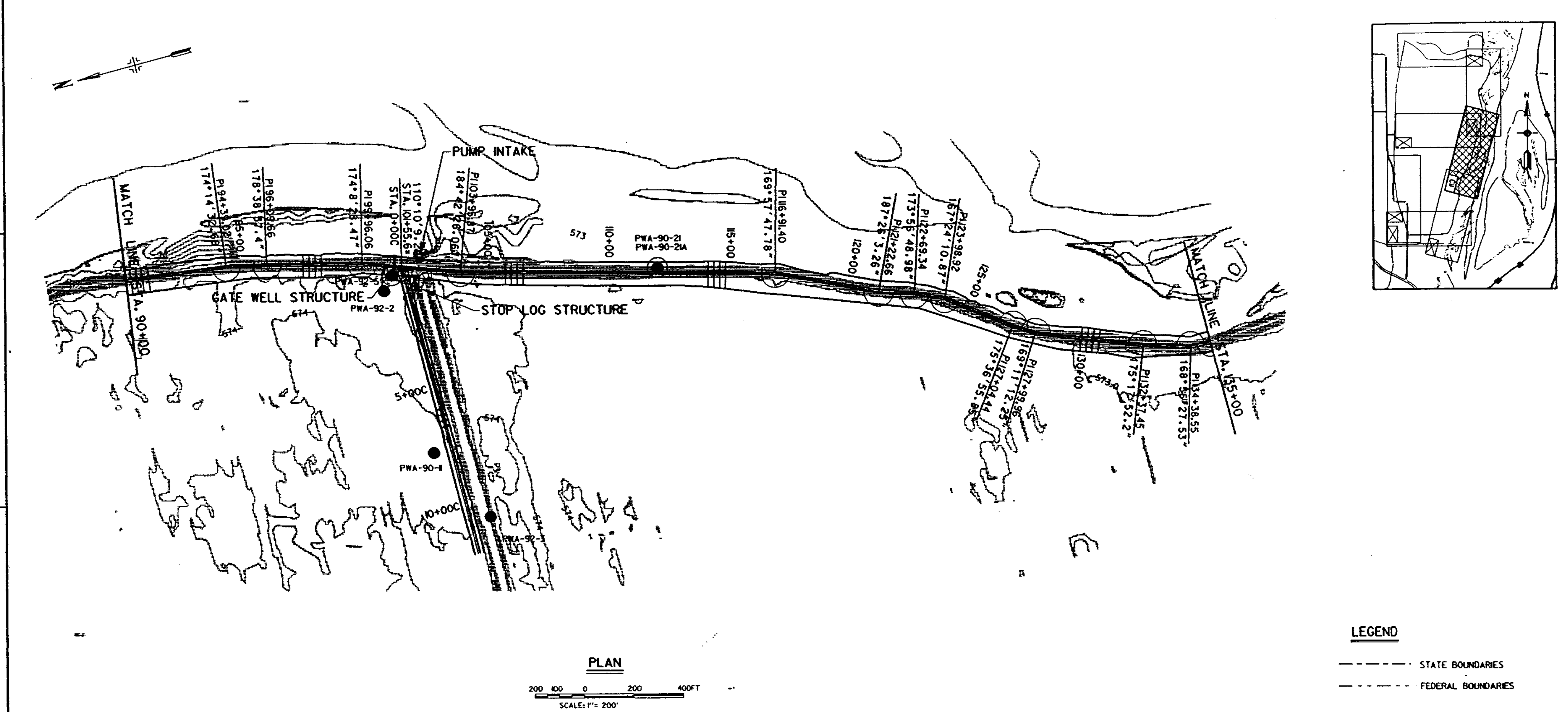
US Army Corps of Engineers

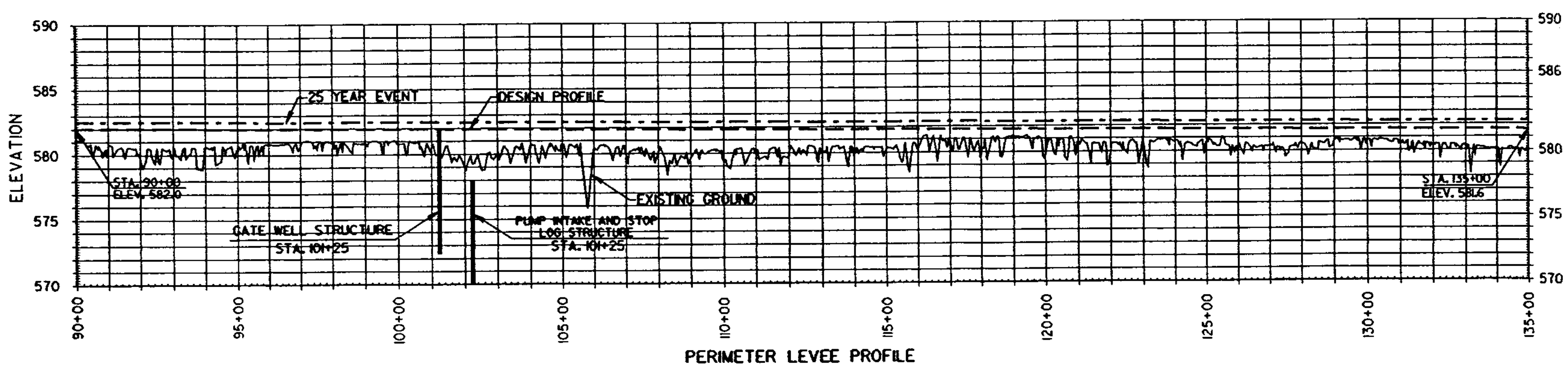
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

PERIMETER LEVEE PLAN AND PROFILE STA. 45+00 TO STA. 90+00

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

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-10
Solicitation Number: DACW25-9 -B-
Sheet 11 of





Revisions			
Symbol	Description	Date	Approved

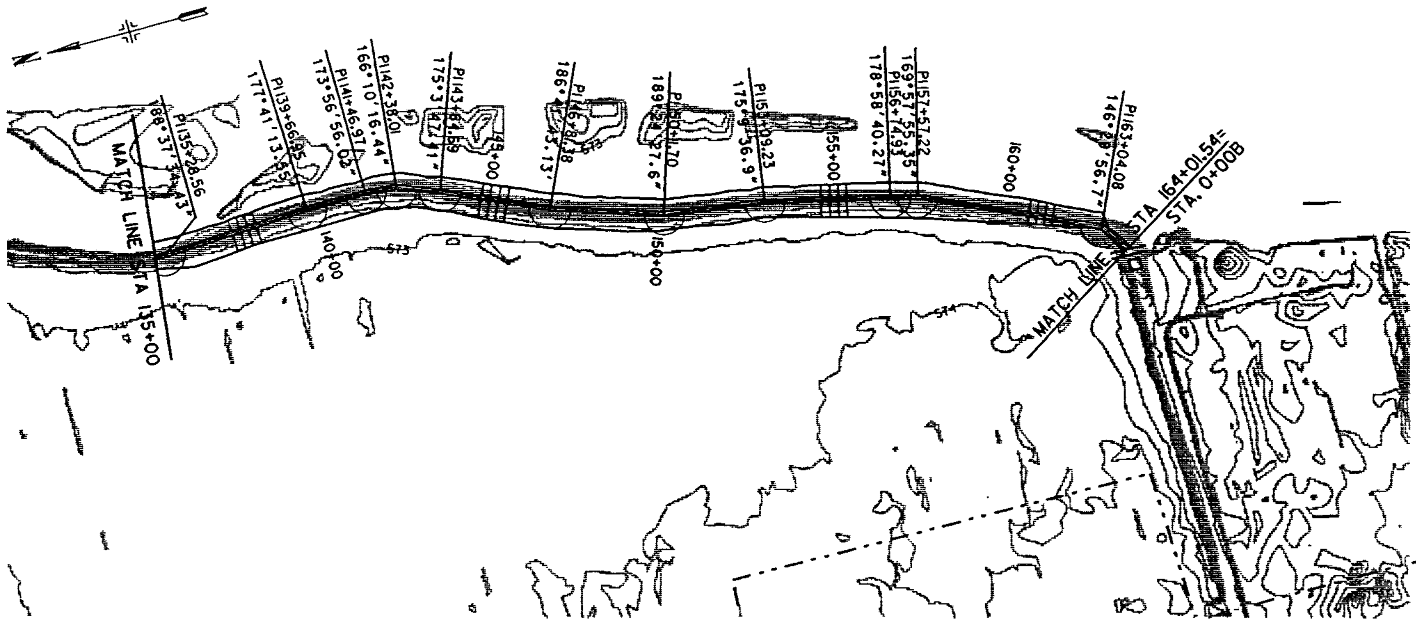
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

US Army Corps of Engineers

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

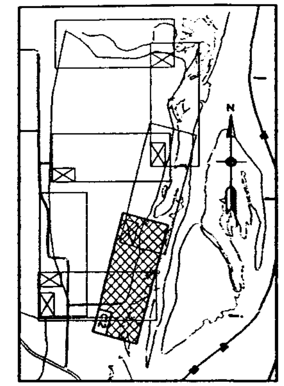
PERIMETER LEVEE PLAN AND PROFILE STA. 90+00 TO STA. 135+00

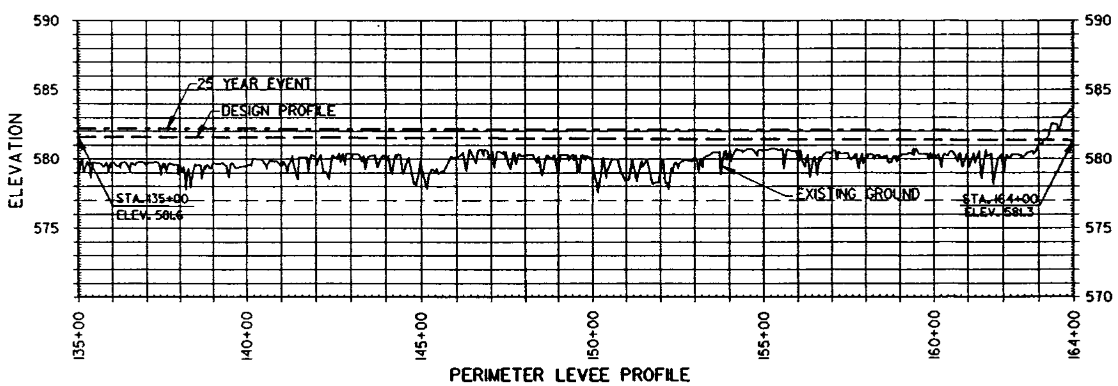
Designed by:	BLK
Drawn by:	TPD
Checked by:	BLK
Reviewed by:	DJH
Approved by:	CHARLES S. COX COL., CORPS OF ENGINEERS
Scale:	AS SHOWN
Date:	19 SEP. 1994
Drawing Code:	
Sheet reference number:	C-11
Solicitation Number:	DACW25-9 -B-
Sheet 12 of	



PLAN

200 100 0 200 400FT
SCALE: 1"= 200'





PERIMETER LEVEE PROFILE

LEGEND

— — — — STATE BOUNDARIES
— · · — · · FEDERAL BOUNDARIES

Revisions			
Symbol	Description	Date	Approved

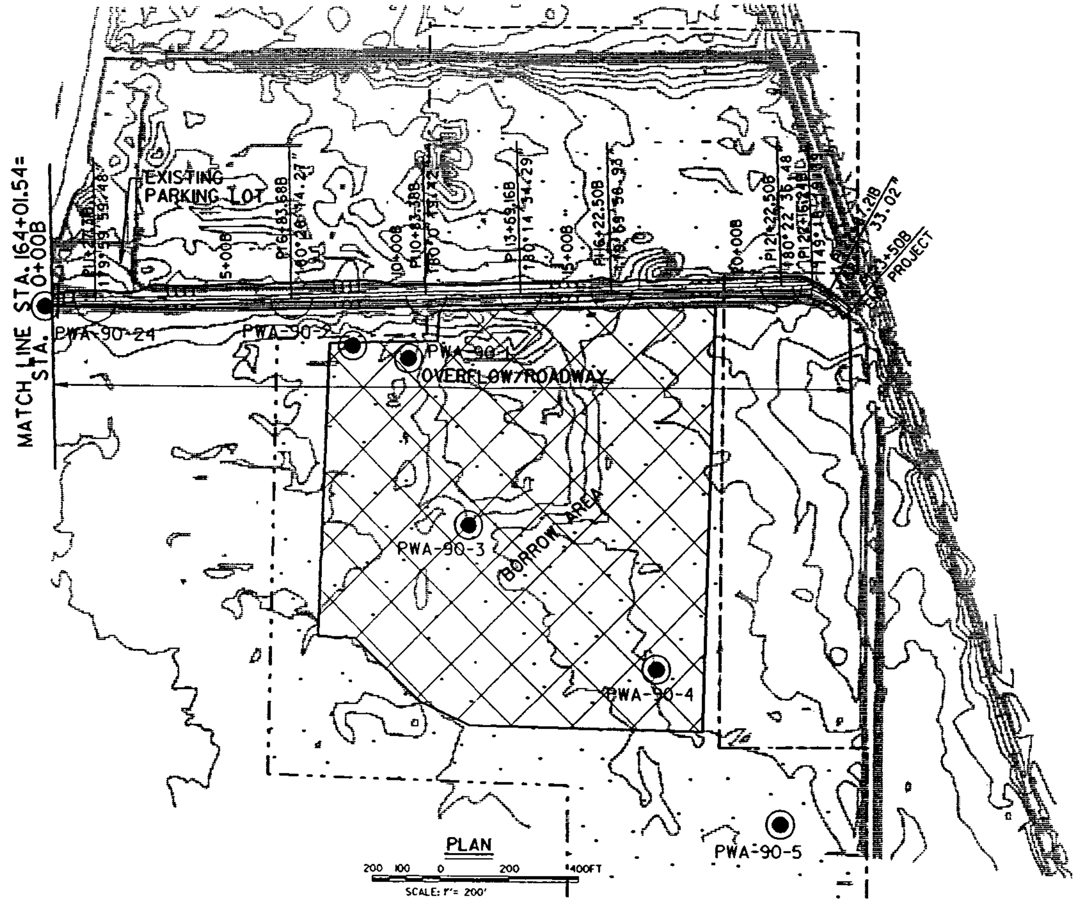
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

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

US Army Corps of Engineers

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA
PERIMETER LEVEE
PLAN AND PROFILE
STA. 135+00 TO STA. 164+00

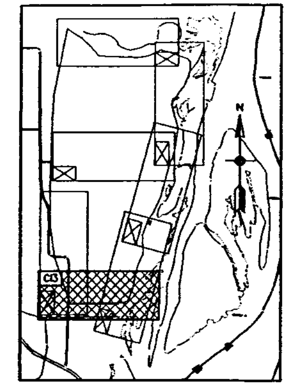
Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-12
Solicitation Number: DACW25-9 -B-
Sheet 13 of



PLAN

200 100 0 200 400FT

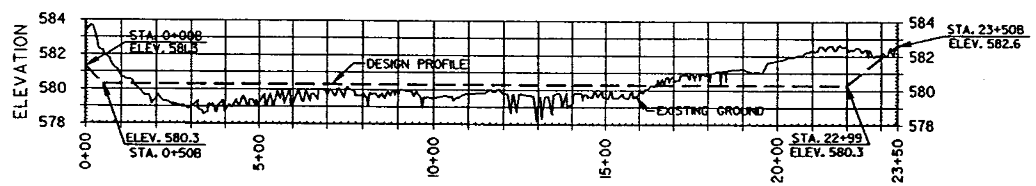
SCALE: 1"= 200'



LEGEND

STATE BOUNDRIES

FEDERAL BOUNDRIES



ROADWAY/OVERFLOW PROFILE

Revisions			
Symbol	Description	Date	Approved

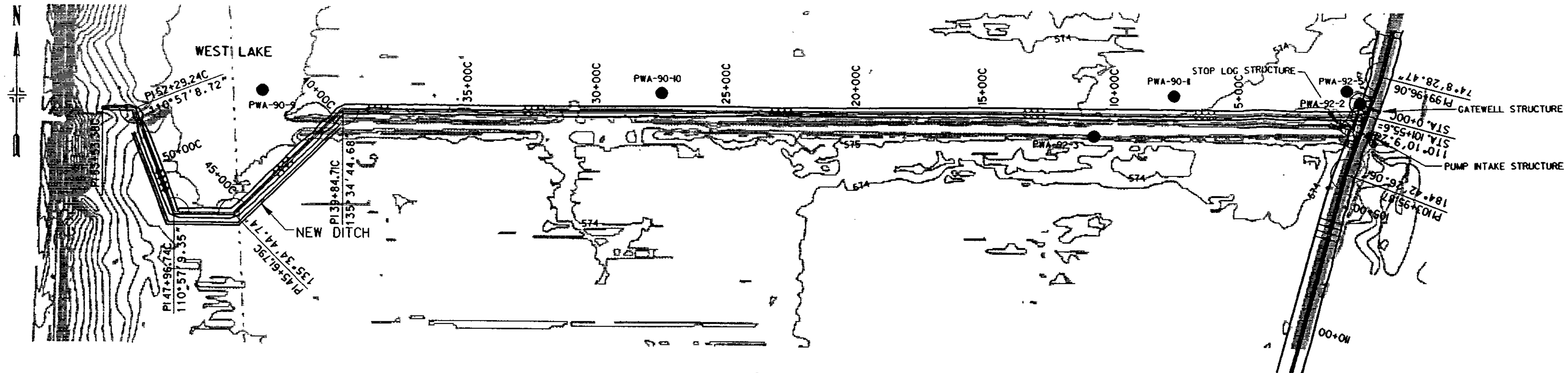
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: BLK	UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 14 RIVER MILES 504 THRU 506.4 PRINCETON WILDLIFE MANAGEMENT AREA OVERFLOW/ROADWAY PLAN & PROFILE STA. 0+00B TO STA. 23+50B
Drawn by: TPD	
Checked by: BLK	
Reviewed by: DJH	Scale: AS SHOWN
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Date: 19 SEP. 1994
	Drawing Code:

Sheet reference number: C-13

Solicitation Number: DACW25-9 -8-

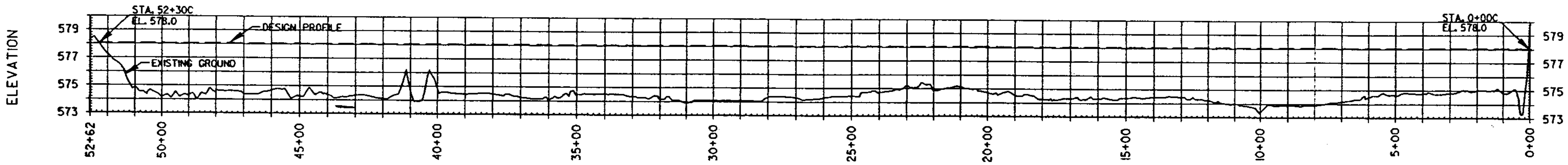
Sheet 14 of



PLAN

200 100 0 200 400FT

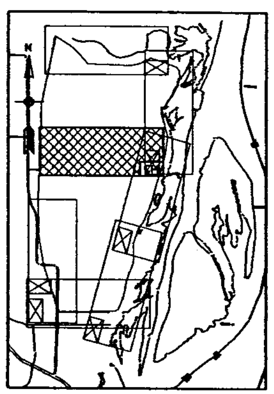
SCALE: 1"= 200'



CROSS DIKE PROFILE

LEGEND

- STATE BOUNDARIES
- FEDERAL BOUNDARIES

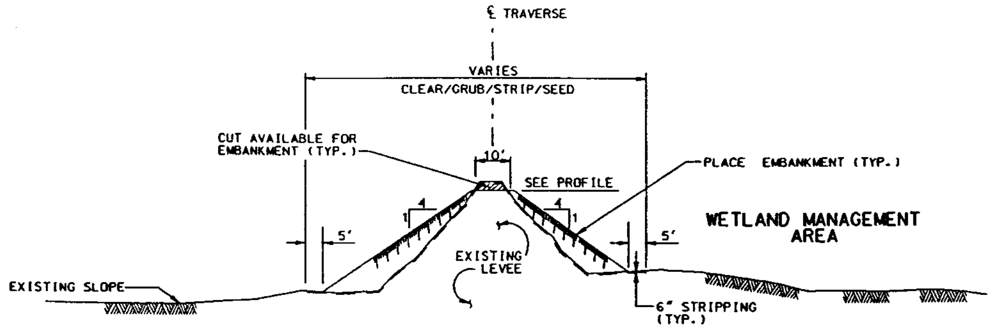


KEY PLAN

Revisions			
Symbol	Description	Date	Approved

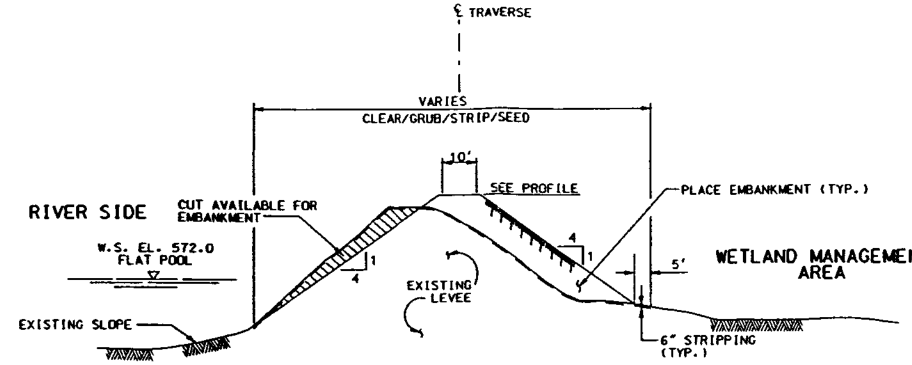
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: BLK	US Army Corps of Engineers — UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 14 RIVER MILES 504 THRU 506.4 PRINCETON WILDLIFE MANAGEMENT AREA **CROSS-DIKE PLAN AND PROFILE STA. 0+00C TO STA. 53+53C**
Drawn by: TPD	
Checked by: BLK	
Reviewed by: DJH	Scale: AS SHOWN
	Date: 19 SEP. 1994
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Drawing Code:
Sheet reference number: C-14	Solicitation Number: DACW25-9 -B-
	Sheet 15 of



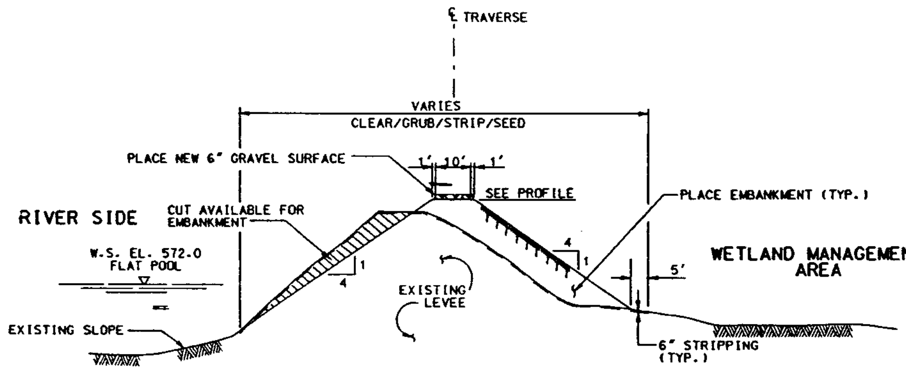
TYPICAL PERIMETER LEVEE

STA. 0+00 TO STA. 60+00±



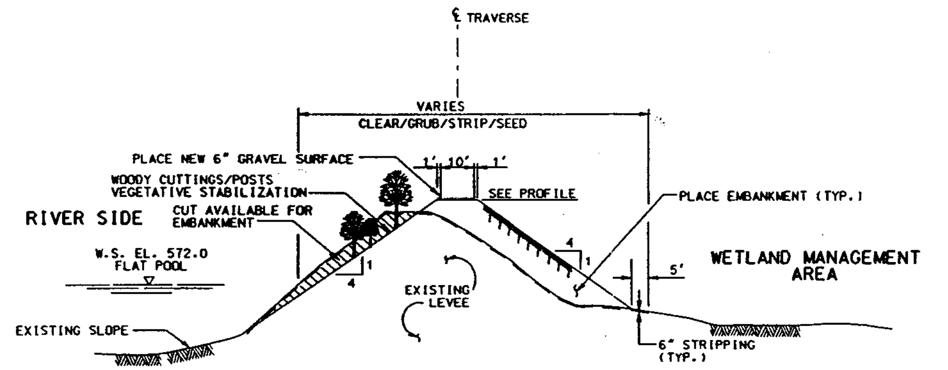
TYPICAL PERIMETER LEVEE

STA. 60+00± TO STA. 100+00±



TYPICAL PERIMETER LEVEE

STA. 105+00± TO STA. 164+00±



PERIMETER LEVEE WITH VEGETATIVE STABILIZATION

SELECTED STATIONS

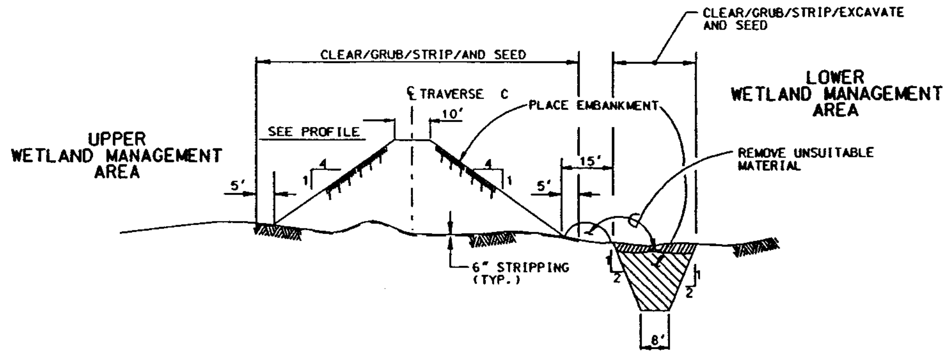
Revisions			
Symbol	Description	Date	Approved

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

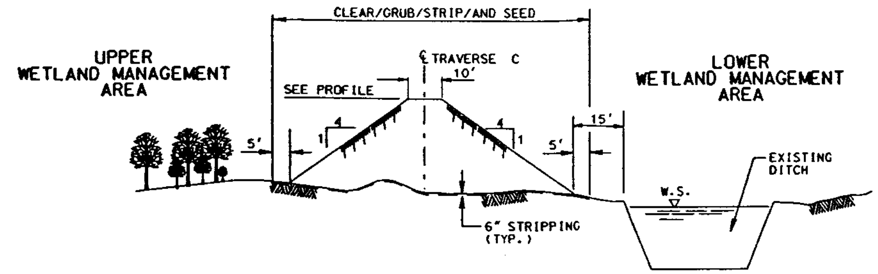
TYPICAL LEVEE SECTIONS I

Designed by:	BLK
Drawn by:	TPD
Checked by:	BLK
Reviewed by:	DJH
Approved by:	CHARLES S. COX COL., CORPS OF ENGINEERS
Scale:	NO SCALE
Date:	19 SEP. 1994
Drawing Code:	
Sheet reference number:	C-15
Solicitation Number:	DACW25-9 -6-
Sheet 16 of	



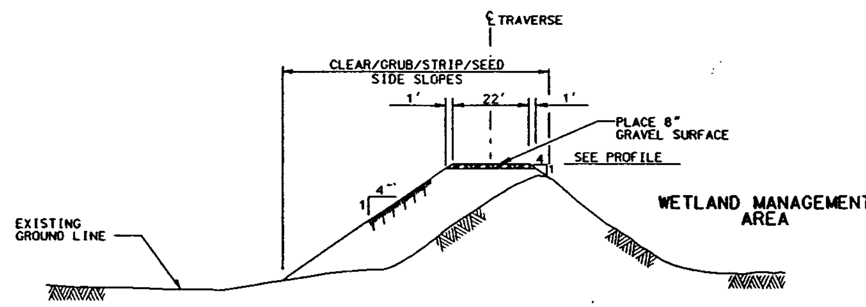
TYPICAL CROSS DIKE LEVEE SECTION

(WEST END)
STA. 0+00C TO STA. 53+53.38C



TYPICAL CROSS DIKE LEVEE SECTION

(EAST END)
STA. 0+00C TO STA. 53+53.38C



PERIMETER LEVEE (OVERFLOW ROADWAY)

STA. 165+00± TO END OF PROJECT

Revisions			
Symbol	Description	Date	Approved

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

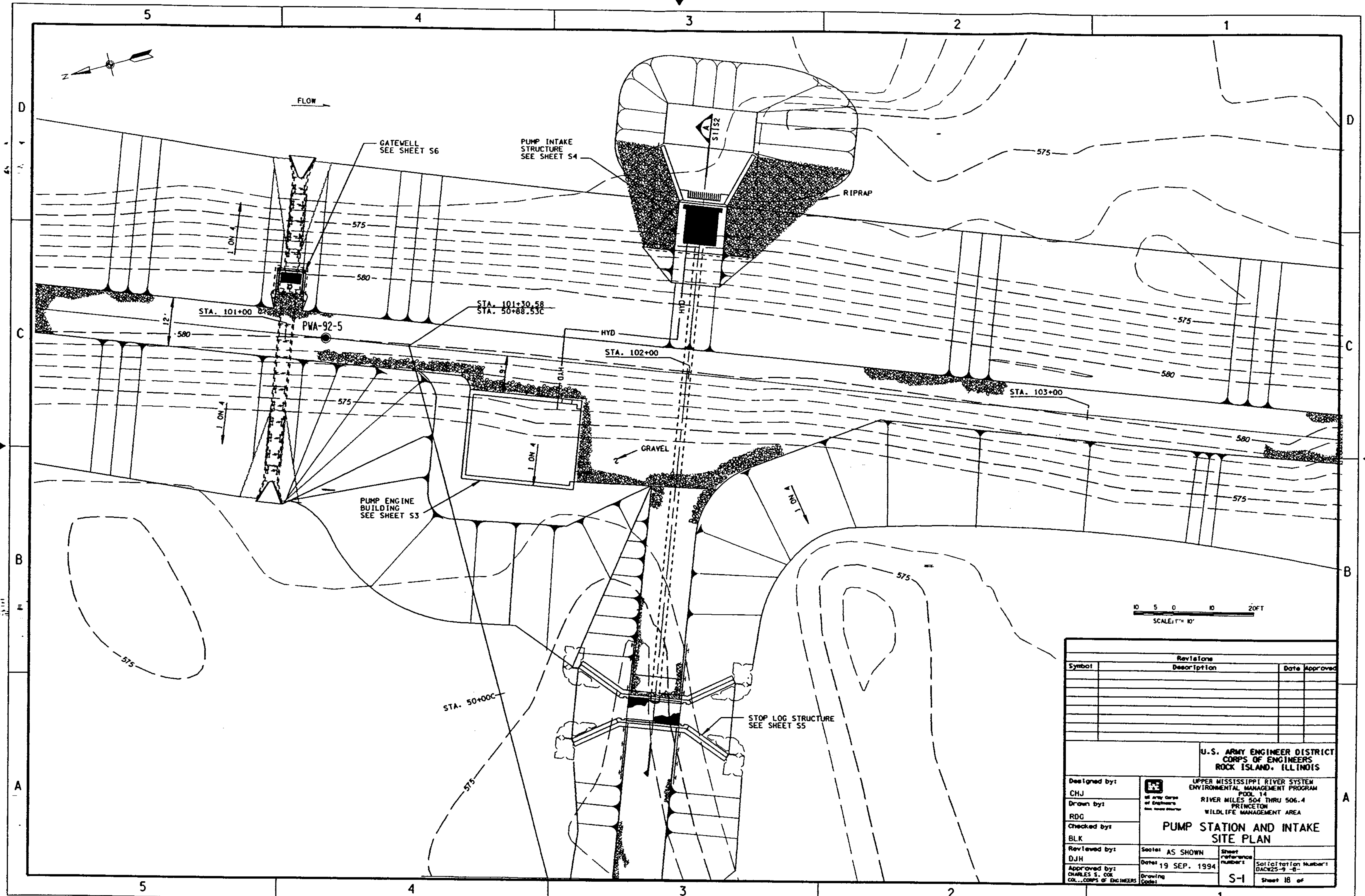
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

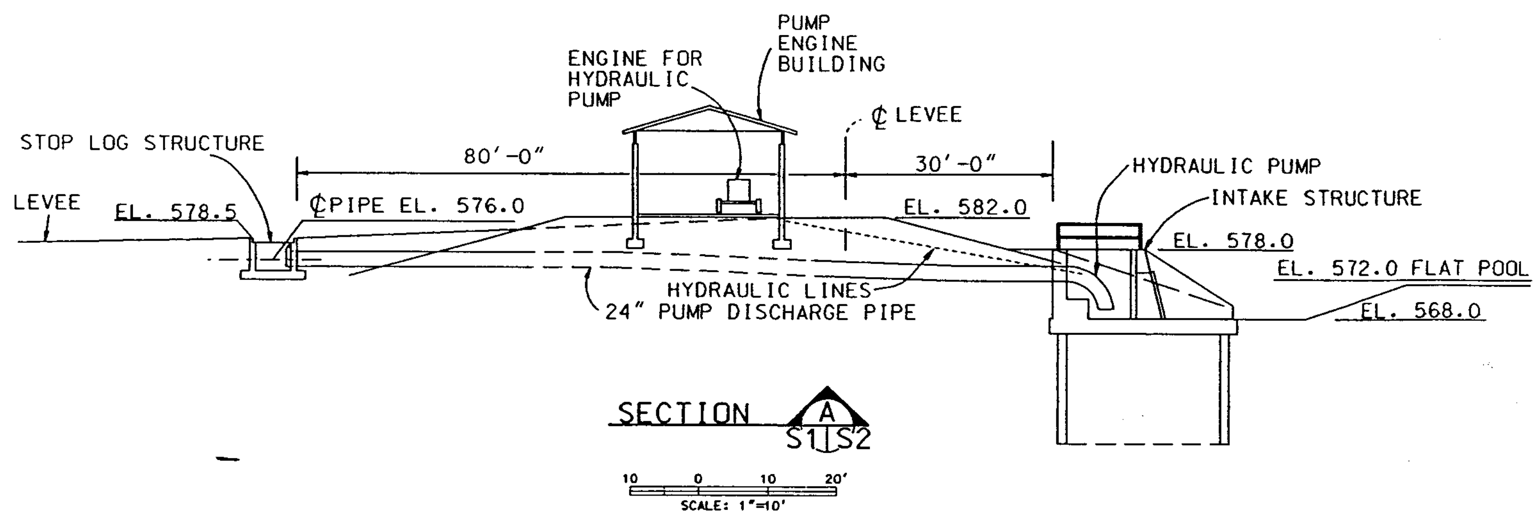
TYPICAL LEVEE SECTIONS II

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

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: C-16
Solicitation Number: DACW25-9 -B-
Sheet 17 of

PLATE 17


FLOW
GATEWELL
SEE SHEET S6
PUMP INTAKE
STRUCTURE
SEE SHEET S4
RIPRAP
575
580
1 ON 4
STA. 101+00
12'
PWA-92-5
STA. 101+30.58
STA. 50+88.53C
HYD
STA. 102+00
STA. 103+00
9'
GRAVEL
PUMP ENGINE
BUILDING
SEE SHEET S3
STA. 50+00C
STOP LOG STRUCTURE
SEE SHEET S5
SCALE: 1"= 10'
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by:
CHJ
Drawn by:
RDG
Checked by:
BLK
Reviewed by:
DJH
Approved by:
CHARLES S. COX
COL., CORPS OF ENGINEERS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA
PUMP STATION AND INTAKE
SITE PLAN
Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number:
S-1
Solicitation Number:
DACW25-9 -B-
Sheet 18 of



Revisions			
Symbol	Description	Date	Approved

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

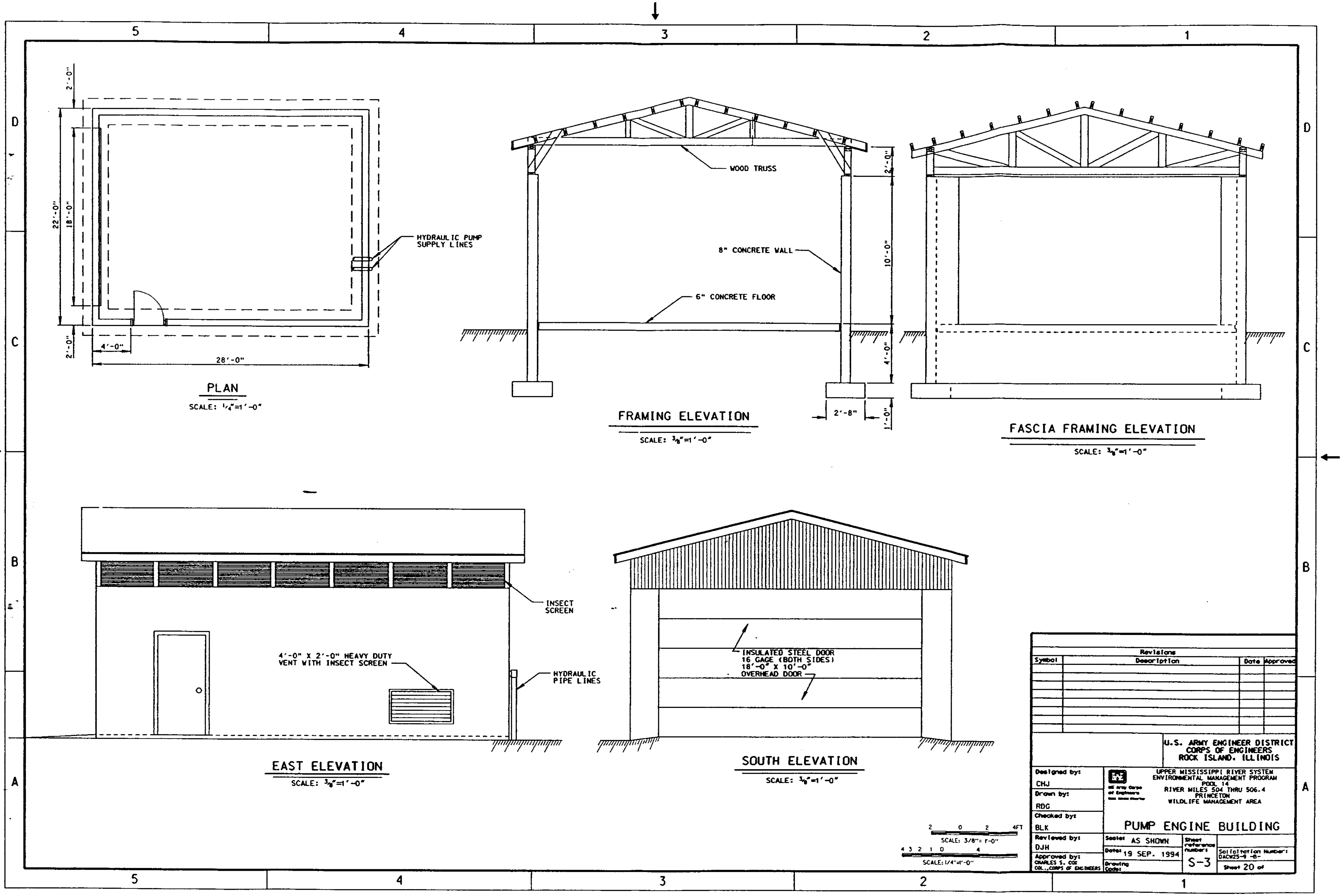
Designed by: CHJ
Drawn by: RDG
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

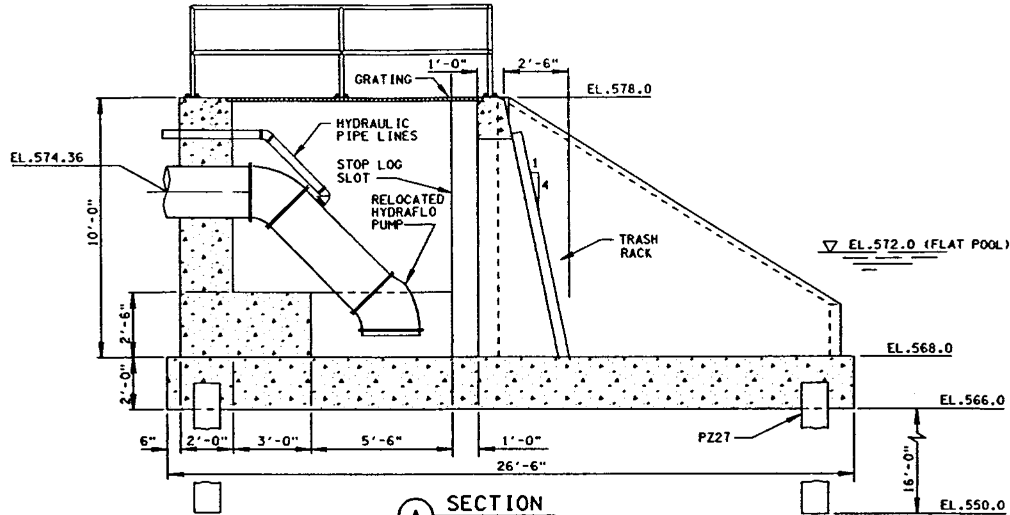
PUMP STATION AND INTAKE SECTION

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: S-2
ep03/ep03a002.dgn
Solicitation Number: DACW25-9 -B-
Sheet 19 of

PLATE 19

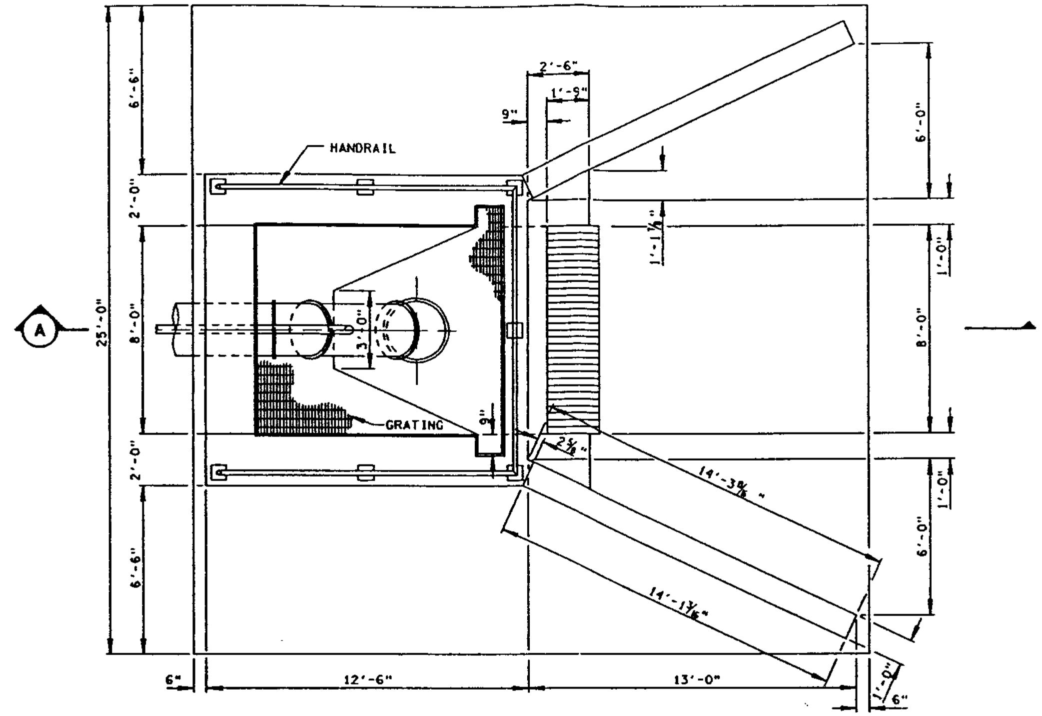


PLAN
SCALE: 1/4"=1'-0"
2'-0"
22'-0"
18'-0"
4'-0"
28'-0"
HYDRAULIC PUMP SUPPLY LINES
WOOD TRUSS
8" CONCRETE WALL
6" CONCRETE FLOOR
2'-0"
10'-0"
4'-0"
2'-8"
1'-0"
FRAMING ELEVATION
SCALE: 3/8"=1'-0"
FASCIA FRAMING ELEVATION
SCALE: 3/8"=1'-0"
INSECT SCREEN
4'-0" X 2'-0" HEAVY DUTY VENT WITH INSECT SCREEN
HYDRAULIC PIPE LINES
EAST ELEVATION
SCALE: 3/8"=1'-0"
INSULATED STEEL DOOR
16 GAGE (BOTH SIDES)
18'-0" X 10'-0"
OVERHEAD DOOR
SOUTH ELEVATION
SCALE: 3/8"=1'-0"
SCALE: 3/8"=1'-0"
SCALE: 1/4"=1'-0"
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by: CHJ
Drawn by: RDG
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA
PUMP ENGINE BUILDING
Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: S-3
Solicitation Number: DACW25-9 -B-
Sheet 20 of



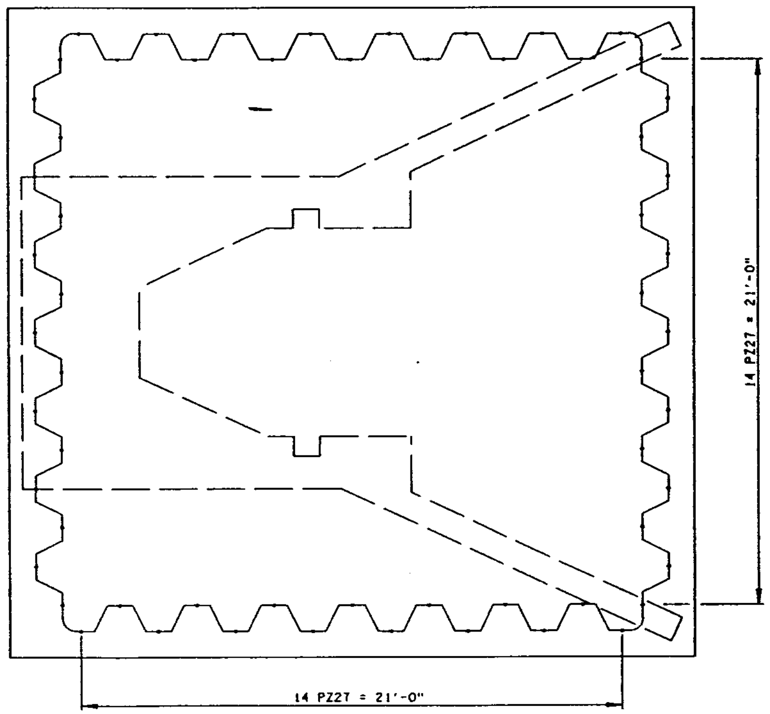
A SECTION

SCALE: 3/8"=1'-0"



PLAN

SCALE: 3/8"=1'-0"



FOUNDATION PLAN

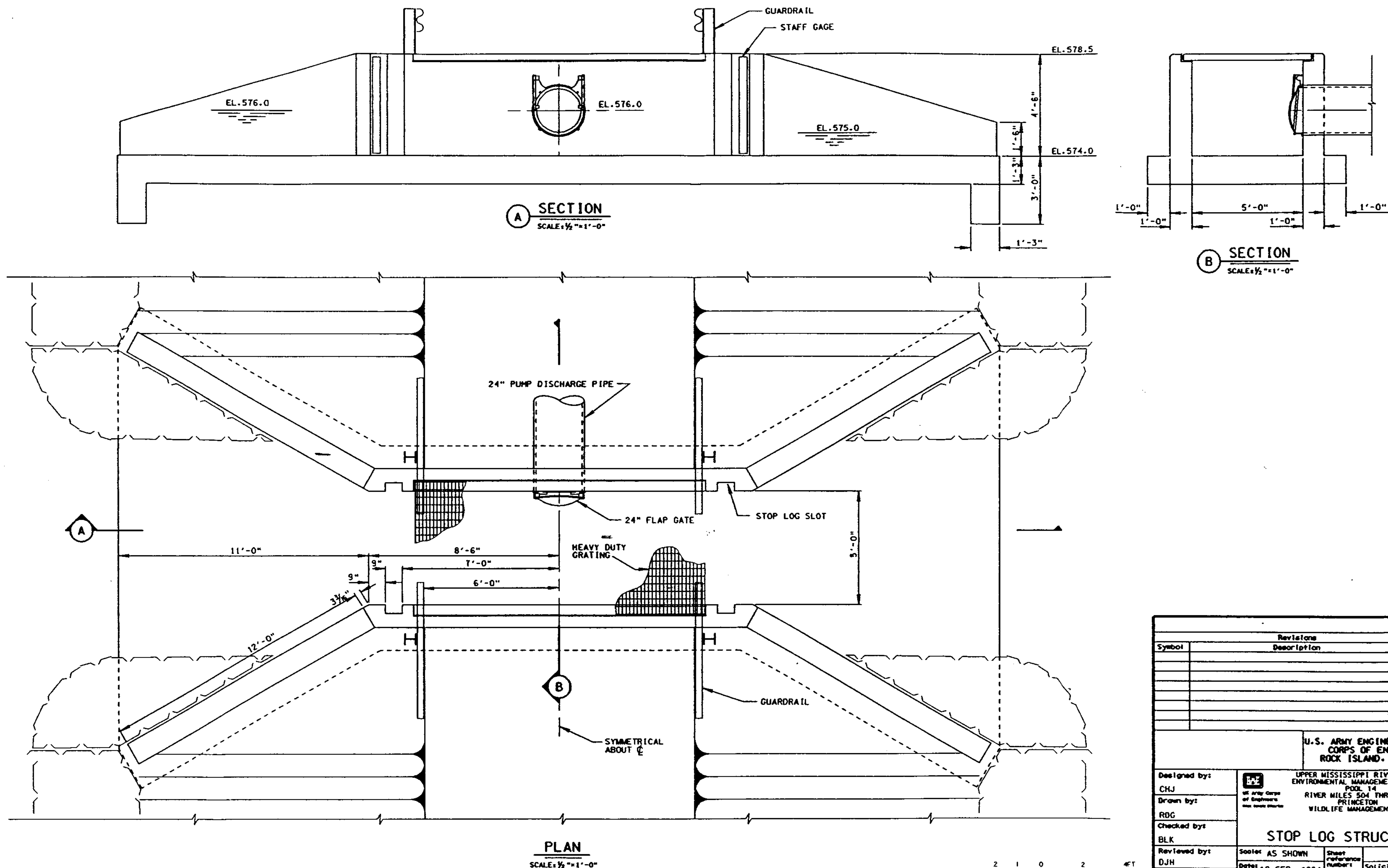
Revisions			
Symbol	Description	Date	Approved

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

INTAKE STRUCTURE PLAN AND ELEVATION

Designed by: CHJ	Scale: AS SHOWN
Drawn by: RDG	Date: 19 SEP. 1994
Checked by: BLK	Sheet reference number: S-4
Reviewed by: DJH	Solicitation Number: DACW25-9 -B-
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS	Sheet 21 of
Drawing Code:	



Revisions			
Symbol	Description	Date	Approved

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

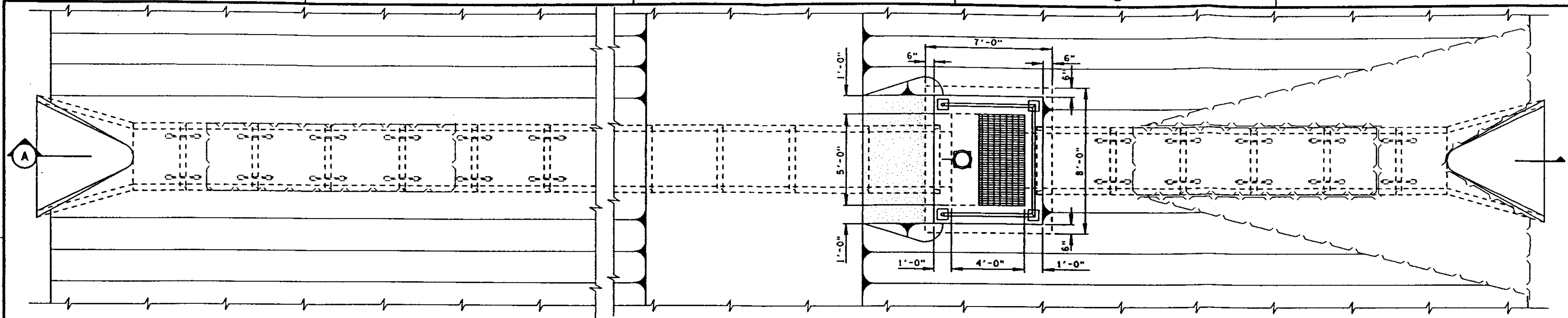
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

STOP LOG STRUCTURE

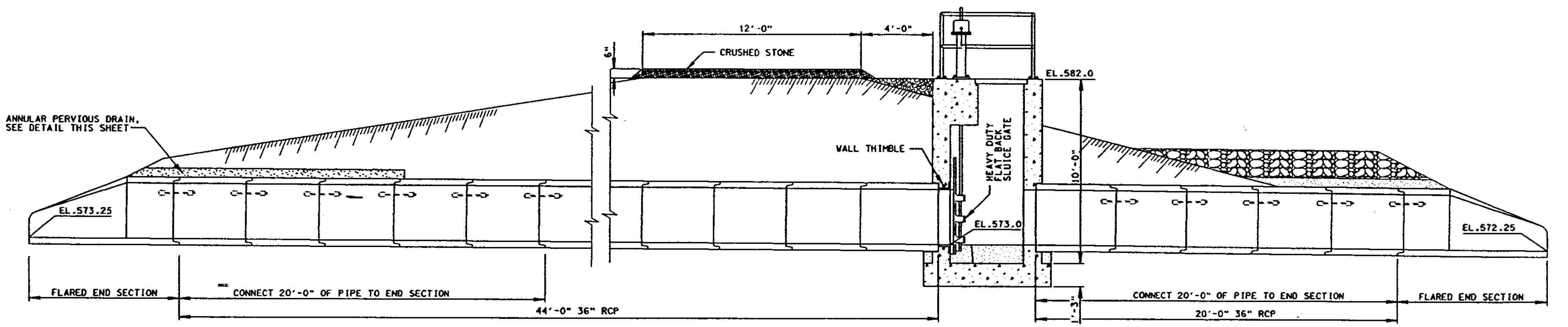
Designed by: CHJ
Drawn by: ROG
Checked by: BLK
Reviewed by: DJH
Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date: 19 SEP. 1994
Drawing Code:
Sheet reference number: S-5
Solicitation Number: DACW25-9 -0-
Sheet 22 of

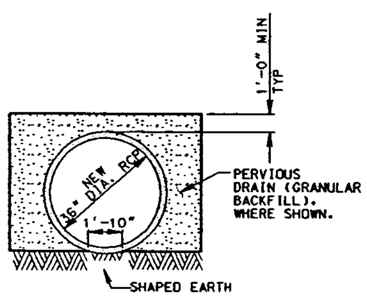
PLATE 22



PLAN
SCALE: 3/8"=1'-0"



A SECTION
SCALE: 3/8"=1'-0"



BEDDING AND DRAIN DETAIL
SCALE: 1/2"=1'-0"

SCALE: 3/8"=1'-0"

Revisions			
Symbol	Description	Date	Approved

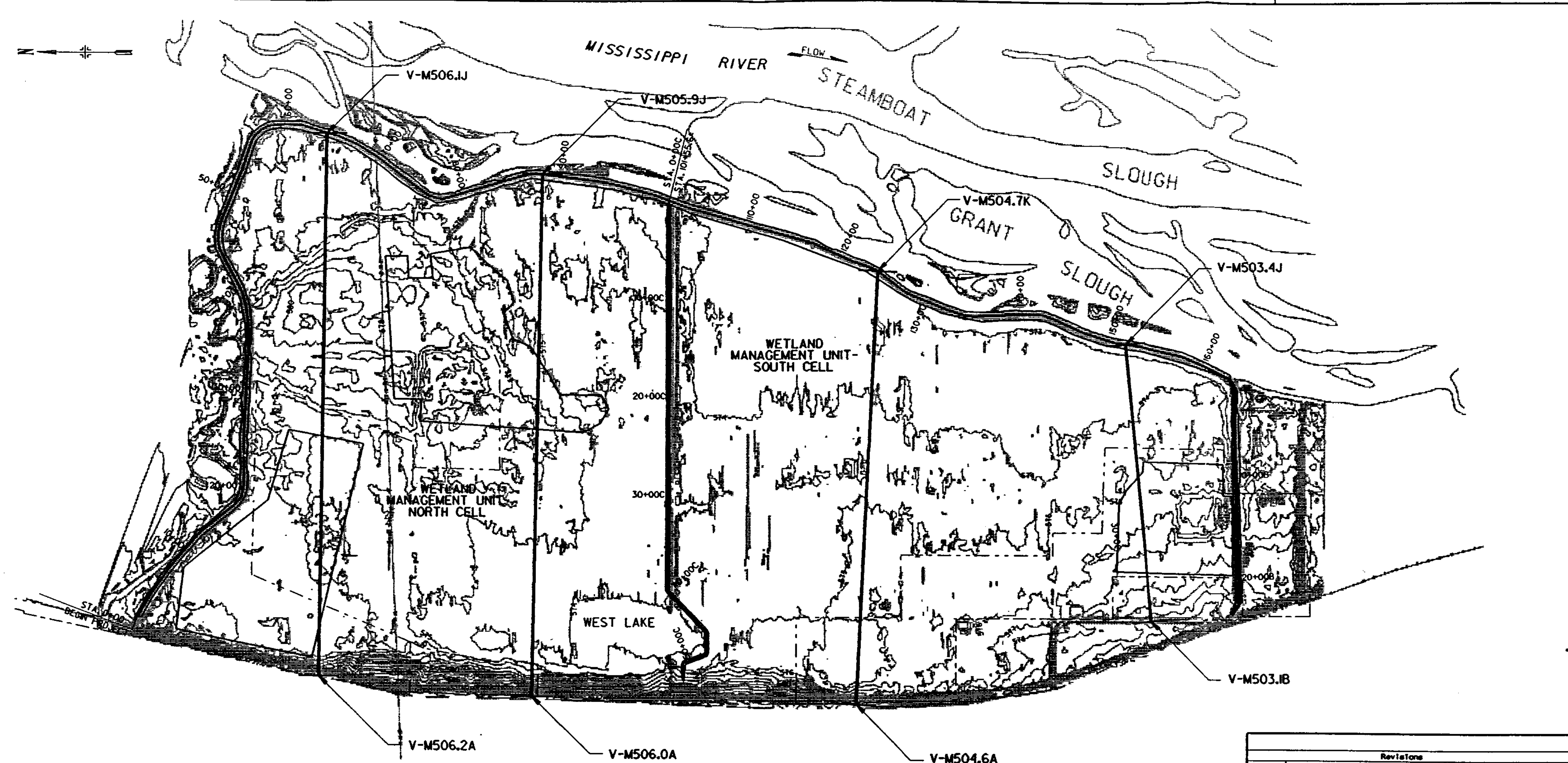
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

GATEWELL
PLAN AND ELEVATION

Designed by:	CHJ
Drawn by:	RDG
Checked by:	BLK
Reviewed by:	DJH
Approved by:	CHARLES S. COX COL., CORPS OF ENGINEERS
Scale:	AS SHOWN
Date:	19 SEP. 1994
Sheet reference number:	S-6
Solicitation Number:	DACW25-9 -B-
Sheet	23 of

PLATE 23



MONITORING PLAN

500 250 0 500 1000FT

SCALE: 1"= 500'

TYPE OF MEASUREMENT

TRANSECT

V=VEGETATION

LOCATION CODE

-M ----- =MISSISSIPPI RIVER

-.545.8 =RIVER MILE

------ M =ALPHA DESIGNATOR

Z =LEFT DESCENDING BANK

A =RIGHT DESCENDING BANK

Revisions			
Symbol	Description	Date	Approved

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

Designed by: BLK

Drawn by: TPD

Checked by: BLK

Reviewed by: DJH

Approved by: CHARLES S. COX COL., CORPS OF ENGINEERS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 14
RIVER MILES 504 THRU 506.4
PRINCETON
WILDLIFE MANAGEMENT AREA

MONITORING PLAN

Scale: AS SHOWN

Date: 19 SEP. 1994

Drawing Code:

Sheet reference number: MP-1

Solicitation Number: DACW25-9 -8-

Sheet 24 of

PLATE 24