UPPER MISSISSIPPI RIVER SYSTEM-

ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT (SL-3) WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

PHARRS ISLAND
HABITAT REHABILITATION PROJECT

POOL 24
UPPER MISSISSIPPI RIVER
PIKE COUNTY, MISSOURI
FINAL

JUNE 1990

US Army Corps of Engineers
St. Louis District

Partners in Progress

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM DEFINITE PROJECT REPORT (SL-3) WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

PHARRS ISLAND WETLAND HABITAT REHABILITATION

POOL 24, MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

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St. Louis District
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June 1990

EXECUTIVE SUMMARY

The Pharrs Island wetland complex is located in Mississippi River Pool 24, about three miles upstream from Lock and Dam 24. It consists of approximately 525 acres of Federal lands and water. The area is managed for fish and wildlife purposes by the Missouri Department of Conservation (MDOC) under cooperative agreements between the state and the Department of Interior, and between the Department of Interior and the Corps of Engineers.

Pool 24 is located within a major flight corridor for millions of migrating waterfowl. The most abundant duck in the Mississippi flyway is the mallard, and within the Upper Mississippi River, Pool 24 is one of the most important areas for this species. The importance of this area is highlighted by the North American Waterfowl Management Plan's designation of the Upper Mississippi River as one of the waterfowl habitat areas of major concern in the U.S. The plan notes that on-going habitat loss is of concern in areas used by waterfowl for rest stops during migration and for wintering.

Commerical and sport fishing are important activities on the UMRS, including the Pool 24 area. Both commercial and sport fish have specific life requirements, and extensive backwaters are needed for their optimum feeding and reproduction. Biologists are concerned that the continuing loss of Upper Mississippi River System (UMRS) backwater habitat could result in a future reduction in the numbers and diversity of these fishes.

The Comprehensive Master Plan for the Management of the Upper Mississippi River System identified sedimentation as the most significant resource problem affecting the river system (UMRBC 1982). The Great River Environmental Action Team (GREAT II, 1980) estimated that most off-channel habitats within the Pools 20-25 reach of river would be completely filled with sediments within the next century. Compared to other UMRS pools, Pool 24 has little existing off-channel water habitat.

The Pharrs Island complex illustrates well the ongoing conversion process in Pool 24 from water-to-land habitat. As the lower (growing) end of Pharrs Island achieves a more stable configuration, it is anticipated that the island's non-forested wetlands habitat will eventually disappear. During the 15-year period between 1972 and 1987, the conversion of water-to-land within the complex proceeded at a rate of 3 acres per year. At this rate, all interior non-forested wetlands habitat would be expected to disappear from the project area during the next 50 years.

The Pharrs wetland complex is also affected by fluctuations in pool stage. These water elevations can fluctuate by a number of feet above and below normal pool stage, and for extended periods of time. A drop in water elevation can cause a drawdown action (with a resulting loss of young fish and eggs) that lowers the utility of the island's shallow interior wetlands for fish spawning and rearing. Water level fluctuations can also impact the production of aquatic plants, and the availability of these plants as a food source to waterfowl.

In addition to acreage shifts, evidence of habitat degradation at the Pharrs Island site exists in the form of hunter blind counts. The number of blinds in the project area decreased from 51 in 1957 to 24 in 1987, a rate of nearly 1 blind per year.

To retard the deposition of sediment into the project area, and to provide additional backwater habitat, a 10,200-foot long rock dike would be constructed. The upstream end of the dike would be bull-nose shaped, (crown

elevation 453 NGVD) and would then trail in a southeasterly direction to the downstream end of the project (tapering from 453 NGVD to 449 NGVD). The dike would be constructed entirely of graded stone "A" along the trail dike segment, but along the bull-nose portion it would consist of an A-stone exterior covering with a gravelly-red clay interior. The A-stone providing protection from river currents, ice and debris, the gravelly-red clay providing protection against sediment thru seepage. The trail dike being parallel rather than perpendicular to the river flow was not judged to need special seepage control.

To provide a means for controlling water levels on the island, about 8,255 feet of levee would be constructed. This levee would supplement existing segments of natural levee along the island's perimeter. This construction would bring the entire island perimeter to a minimum grade of 452 NGVD. In addition to water control, the levee system would also help provide sediment protection to the island. The new levee would consist of a long lower island segment (3,950 feet long), two intermediate length mid-island segments adjacent to the navigation channel (an upstream segment 1,760 feet long, and a downstream segment 1,495 feet long), and a number of smaller slough closure segments (totaling 1,050 feet) along the upper island. A 100-foot wide vegetative buffer would be included between the longer levee segments and the island's shoreline to safeguard eagle perch sites. About 43 acres of borrow area would be required just landward of the levee construction zones. These borrow areas would serve as future non-forested wetland management sites. Forty-six acres of younger-aged tree vegetation would be cleared from lower elevation (449 to 450 NGVD) areas to further expand non-forested wetland habitat.

In addition to the levee, a 36-inch culvert drain with a gatewell protected sluice gate, and a 15,000 GPM portable pump would be provided for water control on the island. Installation of the gated drain would be accomplished using a cofferdam; this drain would be used primarily for the discharge of interior waters, and for the input of water up to the elevation of normal pool (449 NGVD). The pump would enable the raising of water levels from normal pool to 451 NGVD.

To facilitate the input and output of water, 5 segments of interior island slough would be dredged for a combined total length of 12,000 feet, a width of 25 feet, and a bottom elevation of 446 NGVD. Three 500-foot segments along this ditch system would be opened to a bottom width of 50 feet, with depth to 443 NGVD to serve as summer fish refuges. Approximately 10 acres of forest, distributed between two interior island locations, would be cleared and the site perimeter bermed. These areas would be used to contain the slough dredged material.

To improve aquatic habitat cover within the new backwater area, 200 clumps of cedar trees would be weighted and suitably anchored to the shore to prevent movement. To permit the access of MDOC service boats (and at MDOC's discretion, recreational craft) to the island's interior, a boat pullover device would be provided.

The two goals of the project are to enhance migratory waterfowl habitat, and to enhance habitat for slackwater fishes. Specific objectives for attaining the waterfowl goal are (1) decreasing sedimentation into the island's wetlands, (2) providing a means to control water levels on the island independent of river stage, (3) increasing reliable food production for waterfowl (particularly moist soil plant species), and (4) increasing total wetland values (i.e., habitat units) for migratory waterfowl. Objectives for the fisheries goal are (1) increasing the quantity of river slackwater

habitat, (2) reducing the potential for backwater sedimentation, (3) increasing the photic zone, (4) increasing the available cover, and (5) increasing the total habitat values for slackwater fishes.

Four project alternatives were considered: Alternative A, No Federal Action; Alternative B, Wetland Excavation; Alternative C, Navigation Dike Modification; and Alternative D, Wetland Protection System. TABLE ES-1 provides a summary comparison of the various plans in relationship to the project planning goals and objectives. Alternative A was rejected, since it would do nothing to alter the sedimentation, water level, and off-channel water problems that must be addressed if habitat is to be improved. Large-scale excavation (Alternative B) was considered unacceptable; it would not alter future sedimentation, it would not permit any means of regulating water levels within the complex, it would not increase off-channel water habitat, and the potential for applying habitat management practices would be severely limited. Dike modification (Alternative C) would not be feasible due to the depth of the existing navigation structures, and would not provide the stable bullet-shaped nose needed to protect the head of the island from erosion. Alternative D was found to be fully responsive to the project objectives, and was designated as the Selected Plan. Most importantly, it would significantly reduce the sedimentation rate, it would provide a reliable means of water control, it would increase the pool's off-channel water acreage, and it would provide conditions compatible with traditional habitat management practices. Specific Alternative D options considered in detail included: dikes, levees, borrow areas, dredging and disposal areas, drains, gates, pumps, vegetation clearing, fish refuges and cedar tree fish habitat structures.

The proposed project is located on lands managed as a National Wildlife Refuge by the Missouri Department of Conservation under a Cooperative Agreement with the U. S. Fish and Wildlife Service. Accordingly, under Section 906 (e) of the 1986 WRDA, implementation funding would be 100 percent Federal. The U. S. Fish and Wildlife Service and MDOC will assure that operation and maintenance (including repair and replacement) will be accomplished in accordance with Section 906 (e) of the 1986 WRDA. Annual operation and maintenance costs are estimated at $19,563.

The project would eliminate approximately 96 percent of the future input of sediment into the island complex that results from the frequent lower elevation flood events. This sediment reduction would greatly extend the utility of the complex as fish and wildlife habitat. The levee, in combination with the gated drain, would provide limited control over water levels that would enable a greater productivity and availability of food plants for migratory waterfowl in the fall. Approximately 188 acres of interior wetland would be directly affected by water level manipulation to a maximal elevation of 451 NGVD.

Typically, water levels would be drawn down by MDOC in June for germination of natural or aerially seeded plants benefiting waterfowl (such as smartweed and Japanese millet). Water levels would later be raised, allowing the plant seed heads to remain above water. The levee system would prevent the more frequent lower elevation flood events from destroying the food crop, thus increasing the island complex's capacity to provide food. The large, deep sediment protected off-channel water area created by the project would provide an important, much needed, spawning, rearing and wintering habitat for large slackwater fish populations. The project would provide at least some ingress and egress of fish to the Pharrs Island interior wetlands. TABLES ES-2 and ES-3 provide a quantification of the habitat output of each project

plan. The overall contribution of the Selected Plan to waterfowl, as represented by the mallard, would be a net gain of +118 average annual habitat units (AAHU's). For large slackwater fish, the gain would be 61 AAHU's.

TABLE ES-4 provides a comparison of project costs by Alternative Plan. From this table, it is clear that Plan B would have no advantages over Plan D. Plan B provides no net waterfowl benefits, and the cost per fisheries habitat unit is more than twice that determined for Plan D.

The incremental costs of the major features of Plan D are presented in TABLE ES-5. This table shows that the single major improvement to waterfowl enhancement is from the inclusion of a water control system with a gain of +100 AAHU's at a cost of $520/AAHU. The table also shows that the annual cost of waterfowl enhancement per AAHU gained increases somewhat with the addition of the borrow and clearing features to a water control system. However, considering the positive increase in habitat units and the much improved habitat diversity (i.e., mix of fall flooded forested and non-forested wetlands), the inclusion of these measures in the Selected Plan is considered justified.

The single major contributor to fisheries enhancement in Plan D is the dike structure with +57 AAHU's at a cost of $1,946/AAHU. This cost reveals fisheries enhancement to be more costly than waterfowl enhancement. However, this is not surprising considering the generally more adverse physical conditions that face structural applications in an aquatic environment (e.g., strong currents, deep water and ice). The addition of summer fish refuges and cedar tree habitat structures to Plan D resulted in a net decrease in the cost/AAHU; thus, it was clear that these features are justified.

A detailed description of each component of the Selected Plan and its habitat benefits is provided by TABLE ES-6.

In addition to its substantial habitat gains, the project is innovative. The levee system design is an attempt to work with the river system to achieve a low cost means of increasing habitat values. The design recognizes and takes advantage of the river's own capacity to create levees. The river's natural levees need only be supplemented with sections of new levee (built to a similar elevation) to provide a biologically beneficial means of controlling water levels and sediment inflow. Perhaps even more innovative is the dike design concept. This structure provides a means of creating critical backwater habitat where none presently exists. This technique may become increasingly valuable in the future as more and more backwaters become extinguished by sedimentation. This method of backwater development is an attractive management alternative to deepwater dredging, which is far more costly, and in the long-term is far less effective.

It is proposed that the following information be collected by the Corps to evaluate the performance of the project: sediment data, river stage data, vegetation data, interior water levels data, habitat appraisal data, dissolved oxygen data, turbidity data, and cover type data. In addition, qualitative observations made by the site manager (i.e., MDOC) will also be provided via the annual management plan required under the General Plans Lands Cooperative Agreement.

The District Engineer has reviewed the project outputs, and has determined that implementation of the identified plan is justified, and is in the Federal interest. Approval for construction of the Pharrs Island habitat rehabilitation project is recommended by the St. Louis District Engineer at a 100 percent Federal cost (under the provisions of PL 99-662) estimated to

total $2,783,250. The District Engineer further recommends that $187,500 of these funds be allocated as quickly as possible so that the preparation of Plans and Specifications can begin in FY 1991.

TABLE ES-1

PLAN RELATIONSHIPS TO PROJECT GOALS/OBJECTIVES

Alternative 1/	Migratory Waterfowl Habitat Enhancement				Slackwater Fish Habitat Enhancement				
	Reduce Island Sedimentation	Provide Water Control	Increase Reliable Food Production	Increase Wetland Values For Waterfowl	Increase Slackwater Acres	Reduce Sedimentation Potential	Increase Photic Zone	Increase Cover	Increase Slackwater Values For Fish
Plan A No Federal Action	N	N	N	N	N	N	N	N	N
Plan B Wetlands Excavation	S	N	S	S	N	N	N	N	N
Plan D Wetlands Protection	Y	Y	Y	Y	Y	Y	Y	Y	Y

N = Little or no contribution to planning objective.
S = Some contribution to planning objective.
Y = Important contribution to planning objective.

1/ Plan C not shown since it was determined to be engineeringly infeasible.

TABLE ES-2

PLAN COMPARISONS SUMMARY
FOR AVERAGE ANNUAL HABITAT UNITS (AAHU'S)

Habitat	AAHU's Plan A (No Action)	Plan B (Wetlands Excavation)	Plan D (Wetlands Protection)
Mallard			
Non-Forested Wetland	3	8 (+5)	92 (+89)
Forested Wetland	33	28 (-5)	56 (+23)
River	16	16 (0)	22 (+6)
Total	52	52 (0)	170 (+118)
Large Slackwater Fishes			
All Habitats - Spawning	113	132 (+19)	187 (+74)
All Habitats - Rearing	134	153 (+19)	192 (+58)
All Habitats - Adult	153	174 (+21)	204 (+51)
Average	133	153 (+20)	194 (+61)

(#) = Net Change
From No Action Plan

TABLE ES-3

PLAN COMPARISONS SUMMARY
FOR AVERAGE ANNUAL HABITAT ACRES (AAHA'S)

Habitat	AAHA's		
	Plan A (No Action)	Plan B (Wetlands Excavation)	Plan D (Wetlands Protection)
Wildlife			
Non-Forested Wetland	33	81	159
Forested Wetland	332	285	207
River	160	160	160
Fisheries			
Main Channel Border	103	103	2
Slough	35	64	213
Side Channel	56	56	0

TABLE ES-4

PLAN COMPARISONS SUMMARY
FOR PROJECT COSTS

Evaluation Factor	Waterfowl			Fisheries		
	No Action	Plan B	Plan D	No Action	Plan B	Plan D
Annual Cost ($)	0	0	72,834	0	87,372	112,476
AAHU's Gain	0	0	118	0	20	61
$/AAHU's Gain	0	0	617	0	4,369	1,844

AAHU = Average Annual Habitat Unit

TABLE ES-5

PLAN D-INCREMENTAL COSTS SUMMARY

Alternative Feature	Annual Cost ($) 1/	Incremental Annual Cost ($)	Average Annual Habitat Gain (AAHU's)		Average Annual Cost/Habitat Gain ($/AAHU)		Percent of Fall Flooded Wetlands Acres that are Non-Forested
			Total	Incremental	Total	Incremental	
Waterfowl Enhancement							
Water Control 3/	52,003	52,003	100	100	520	531	17
Borrow 2/	60,817	8,814	108	8	563	1,102	36
Clearing 2/	72,834	12,017	118	10	617	1,202	59
Fisheries Enhancement							
Dike	110,914	110,914	57	57	1,946	1,946	
Summer Refuge	111,351	437	59	2	1,887	219	
Cedar Trees	112,476	1,125	61	2	1,844	563	

1/ Costs include construction item costs plus contingencies, but no E&D and S&A costs.

2/ MDOC has specified that for optimal site management, that at least 50 percent of the island's fall flooded wetlands should be in non-forested habitat. Both the borrow and clearing features are needed to attain this condition.

3/ This feature includes collectively the subcomponents of levee, culvert, dredging and disposal, and pump. These subcomponents taken together form a functionally inseparable unit from a habitat standpoint. All are vital to the water control function. Optimization of each component is discussed in Section 5 of the DPR.

TABLE ES-6

PLAN D-FEATURES DESCRIPTION AND HABITAT BENEFITS

Project Feature	Description	Habitat Benefits
Water Control	This feature has the sub-somponents levee, culvert, dredging and disposal, and pump. The levee would be a low profile structure (earthen across land, gravelly-red clay across water) consisting of a number of separate segments supplementing the island's existing natural levee. Minimum grade of overall levee system is 452 NGVD. Combined length of levee segments is 8,255 feet. The gated culvert would be 48-inches in diameter, and the portable pump would have a capacity of 15,000 GPM. Approximately 12,000 feet of ditch would be cut 25 feet wide and two feet deep to a depth of 446 NGVD. A total of about 10 acres of disposal site would be created to contain the dredged material from interior dredging. The retention berm surrounding the site would be 4-7 feet in height.	A levee system would contribute to an estimated 10-fold reduction in the rate of sedimentation on the island, thus greatly increasing wetland longevity. In combination with the levee, a gated culvert, and a portable pump, would also be needed to make possible the control of water levels on the island. Dredging would ensure adequate drainage within the interior wetlands. For cost reasons, the disposal areas need to be located on site, but they do reduce somewhat the amount of potentially floodable forested habitat for mallards. However, due to the subsequent higher and drier conditions at these sites, it is feasible to recontour these areas and plant them with pin oaks and pecans to provide additional (unquantified) habitat improvement for other species such as deer and turkey. The water control feature would permit sufficient water control to enable a much increased and reliable food production for waterfowl. For the mallard, a gain of 100 AAHU's over that of a future without a project is anticipated. This feature is the project's single greatest contributor to mallard habitat improvement. The water control feature concept is innovative from the standpoint that it recognizes, and uses to advantage, the river's own capacity to create levees along its shoreline.

TABLE ES-6 (CONTINUED)

Project Feature	Description	Habitat Benefits
Borrow	Sites excavated to 0.5-1.0 foot deep as a source of earthen material for levee construction. Approximately 5 sites, covering a total of 43 acres would furnish the needed material.	Vegetation clearing and excavation for borrow pits would increase the island's non-forested wetland habitat by an additional 38 acres. The inclusion of on-site borrow pits (a necessity for a cost-effective project) would add an additional +8 AAHU's for mallards.
Clearing	Approximately 46 acres of vegetation would be removed from the lowest elevation land areas (i.e., 449 to 450 NGVD).	Removal of this early succession vegetation would further expand non-forested habitat within the project area. Clearing would provide an additional +10 AAHU's for mallards.
Dike	A 10,200 foot long structure, including a 6,750 foot long bull-nose segment (Crown elevation 453 NGVD), and a 3,450 foot long trailing segment (Crown elevation 453 NGVD tapering to 449.4 NGVD).	This structure provides approximately 200 acres of sediment and current protected shallow and deepwater backwater habitat. The dike would contribute to a net gain of +57 AAHU's for large slackwater fish (including most of the important sport and commercial fish). Significant gains would accrue to all fish life stages and for all seasons, but particularly for spring spawning. The dike concept is innovative in that it provides a simple and potentially effective means of creating new backwater habitat. Such an ability may become increasingly important in the future as the river's backwaters are lost to sedimentation.
Summer Refuges	Three selected locations, each 500 feet in length, would be further cut to a width of 50 feet and a bottom elevation of 443 NGVD.	The fish refuges would afford protection to fish during the summer stress period (low water, high temperature, low

TABLE ES-6 (CONTINUED)

Project Feature	Description	Habitat Benefits
		dissolved oxygen). Quantification of the refuge contribution showed a gain of +2 AAHU's.
Cedar Trees	About 200 clumps of cedar trees would be appropriately weighted and anchored to serve as improved fish cover within the project backwater.	The contribution of cedar trees for large slackwater fish habitat improvement would be approximately +2 AAHU's.
Boat Pullover	A roller/pulley operated device would be provided for the transport of boats over the project levee.	The device is necessary to provide O&M access to interior wetlands by MDOC management personnel.

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PHARRS ISLAND
WETLAND HABITAT REHABILITATION

POOL 24, MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

1. INTRODUCTION.

a. Purpose. The purpose of this Definite Project Report (DPR) is to present a detailed proposal for the rehabilitation of wetlands at Pharrs Island. 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. The Environmental Assessment (EA) for the project is integrated with the DPR.

b. Authority. Public Law (PL) 95-502 authorized the construction of a new dam and 1,200-foot lock at Alton, Illinois, and directed the Upper Mississippi River Basin Commission to prepare a Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Upper Mississippi River Basin Commission (UMRBC) completed the Master Plan report and submitted it to Congress on 1 January 1982. The report recommended an environmental management program that included construction of habitat rehabilitation and enhancement projects.

The 1985 Supplemental Appropriations Bill (PL 99-88), signed into law by President Reagan on 15 August 1985, provided initial authorization and appropriations for that environmental management program. A more comprehensive authorization was later provided by Section 1103 of the Water Resources Development Act of 1986 (PL 99-662). 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...

c. Project Selection Process.

(1) Eligibility Criteria. The Master Plan, completed by the UMRBC in 1981, served as the basis for recommendations (including the UMRS-EMP) subsequently enacted into law by the Water Resources Development Act of 1986. A design memorandum (or implementation document) did not exist at the time of enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the UMRS-EMP in January 1986. The USFWS, Region 3, and the five affected states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated in the development of that plan through the Upper Mississippi River Basin Association (UMRBA). Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addendums.

The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies resulted in the following conclusions:

(a) 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...."

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

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

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

(2) Selection Process. In the past, projects have been nominated and ranked for inclusion in the St. Louis District's habitat projects program by the respective state conservation agencies, and the USFWS, based on agency management objectives. MDOC ranked the Pharrs Island project third in importance behind the Clarksville Refuge and Dresser Island projects.

d. Scope of Study. The geographical scope of the study is limited to the Pharrs Island area near Clarksville, Missouri. All project features considered would require Federal lands only, no state-owned lands or private lands would be involved. Various field surveys were conducted during the study, these included topographic, baseline and profile, hydrographic, soils (borings), habitat, and cultural resources surveys.

e. Coordination. The DPR report was developed in coordination with the USFWS (with both the Marion and Rock Island, Illinois offices), MDOC (project sponsor), and various other Federal and state agencies, and the public.

2. EXISTING ENVIRONMENTAL CONDITIONS AND FUTURE WITHOUT.

The following section presents information on the existing environment in the area affected by the project. Where relevant, a discussion is included on the environmental conditions if no project action is taken (i.e., the future without).

a. Location. The Pharrs Island wetland complex is located in mid-river, Mississippi River Pool 24, near river mile 276, Pike County, Missouri (FIGURE 1 and PLATE 1). Locks and Dam 24 at Clarksville, Missouri, is located 2.6 miles downstream of the island. The complex includes approximately 525 acres of lands and waters contained within and between Pharrs Island and an area referred to in the pre-pool impoundment era as Island 461. Today, Island 461 is fragmented into five small islands.

Originally acquired for the 9-foot navigation project, the complex is now managed as part of the Mark Twain National Wildlife Refuge (MTNWR) by the Missouri Department of Conservation (MDOC) under Cooperative Agreements between the Department of Interior and the Corps of Engineers. The MTNWR was established for conservation, maintenance, and management of wildlife resources and their habitats (16 U.S.C., Sect. 663(a)). The primary objectives of the MTNWR are to (1) provide migrating waterfowl with food, water, and protection during fall and spring months, and (2) to improve and maintain existing habitat to perpetuate optimum annual production of wood ducks. Secondary objectives are to (1) provide food, water, and protection to wintering waterfowl, (2) maintain balanced populations of all resident wildlife species, (3) maintain portions of the refuge river bottom habitat in its natural virgin state, and (4) to provide limited day-use recreation where and when such activities are compatible with primary objectives of the refuge.

MDOC maintains a bank-side parking and access area (maintained for recreational and O&M purposes) off of Highway 79, across the river from the island's midpoint. There are no permanent facilities or habitat improvements within the complex.

b. Physiography-Topography. Pharrs Island lies in the floodplain of the Mississippi River and consists of alluvial material. It is relatively flat, with elevations ranging from about 449 to 455.3 feet NGVD (National Geodetic Vertical Datum). Normal pool level is approximately 449 NGVD.

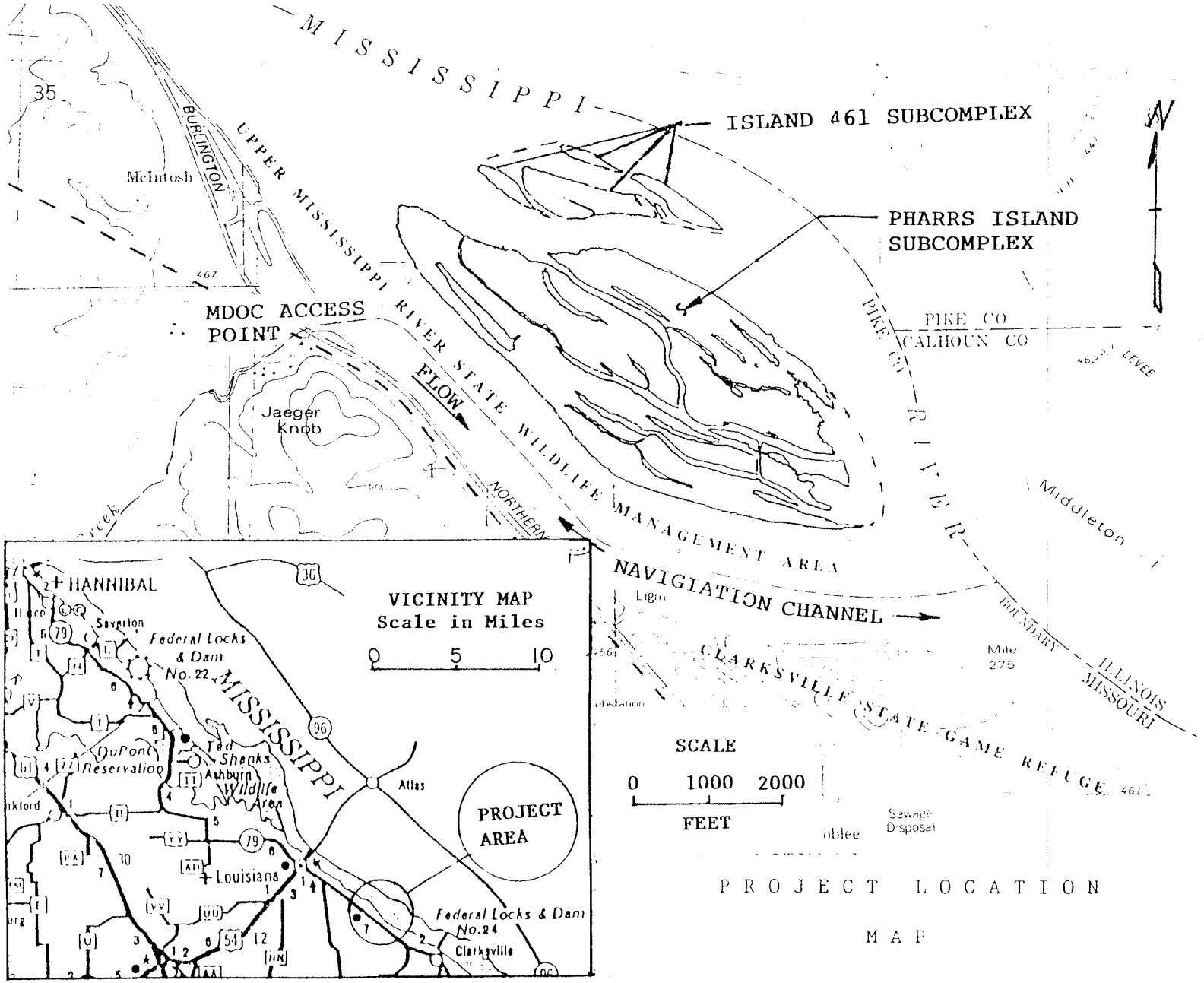

MISSISSIPPI
ISLAND 461 SUBCOMPLEX
PHARRS ISLAND SUBCOMPLEX
MDOC ACCESS POINT
FLOW
UPPER MISSISSIPPI RIVER STATE WILDLIFE MANAGEMENT AREA
NAVIGATION CHANNEL
CLARKSVILLE STATE GAME REFUGE
PIKE CO
CALHOUN CO
ILLINOIS
MISSOURI
BURLINGTON
McIntosh
Jaeger Knob
Middleton
Mile 275
VICINITY MAP
Scale in Miles
0 5 10
HANNIBAL
Federal Locks & Dam No. 22
MISSISSIPPI
Ted Shanks Wildlife Area
DuPont Reservation
Louisiana
Atlas
PROJECT AREA
Federal Locks & Dam No. 24
Clarksville
SCALE
0 1000 2000
FEET
PROJECT LOCATION MAP

Figure 1

The wetland area is anticipated to change in the future if a project is not implemented; additional filling of the island's interior wetlands would occur as a result of sediment deposition during each minor flood event-eventually raising the elevation of the island.

c. Hydrology/Hydraulics/Water Quality.

Because of the low velocities through the navigation pools at normal flows, the sediment load consists of silts and clays which settle very slowly. During floods, when open-river conditions exist, the sand load increases significantly, and so too does sandbar building. Deposition in the pools occurs at all times, but is most severe during floods. The Comprehensive Master Plan for the Management of the Upper Mississippi River System (UMRBC, 1982) identified sedimentation as the most significant resource problem affecting the river system. The Great River Environmental Action Team (GREAT II, 1980) estimated that most off-channel water habitats within the Pool 20-25 reach of river will be completely filled with sediments within the next century. While no site-specific sedimentation data exists for the project area, it is evident from aerial photographs that the site's wetlands are slowly filling.

In the future, suspended sediment loads may change, depending on the implementation of soil conservation practices in the Mississippi River System Basin. However, suspended sediment deposition is anticipated to remain a problem in the project area. Additional filling, due to sediment deposition during each minor flood event, would cause further degradation of the Pharrs Island wetlands complex.

Water stages at Pharrs Island are controlled by the operation of Lock and Dam 24. The pool stage is 448-449 NGVD under normal conditions, and exceeds 449 NGVD only during flows approaching bankfull or greater. Stages are less than 450 NGVD more than 90 percent of the time on an annual basis. Minimum stages occur during floods when the pool goes "on tilt" and proceeds to an open river condition. Minimum regulated stage is 444.5 NGVD at the dam, and about 446.5 NGVD at the downstream end of Pharrs Island. At this point, all gates at Lock and Dam No. 24 are out of the water. As flood flows continue to increase, the minimum, regulated stage increases as well, with the only effect of the locks and dam being a small local swellhead just upstream of the dam. Exterior water surface elevations at the downstream end of Pharrs Island less than 446.5 could only occur during a loss of pool, a situation which has not happened since the early 1950's. As the FIGURE 2 stage-hydrograph shows (1985 selected as a "typical" year for Pool 24), pool elevations in the Pharrs Island area can fluctuate by a number of feet above and below normal pool stage, and for extended periods of time (see also Plate 7 stage hydrographs for the past 16 years). Pharrs Island has no existing habitat improvement structures to help moderate these water level fluctuations.

Flood-frequency relationships at the downstream end of Pharrs Island are shown in TABLE 1. To determine the corresponding stage-frequency at the upstream end of the island (R.M. 277.5), one foot of elevation must be added to the TABLE 1 values. The flood-of-record occurred in 1973 and reached an elevation of about 461.5 NGVD.

Four old navigation dikes exist in the vicinity of the upstream end of Pharrs Island. These are located on the left bank at River Miles 276.9, 277.6, 277.9 and 278.1. The structures are about 10 feet under water.

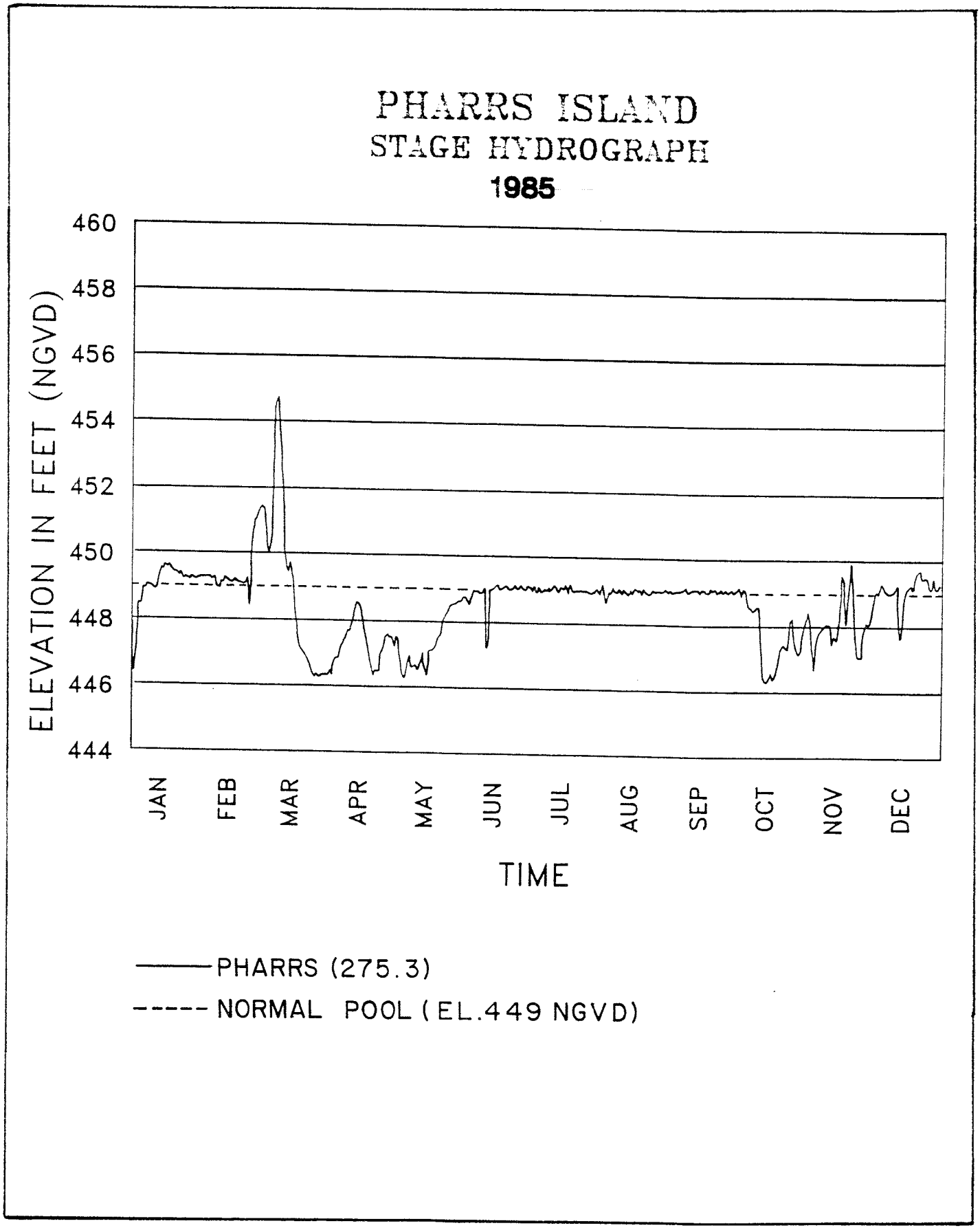

PHARRS ISLAND
STAGE HYDROGRAPH
1985
ELEVATION IN FEET (NGVD)
460
458
456
454
452
450
448
446
444
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
TIME
PHARRS (275.3)
NORMAL POOL (EL.449 NGVD)

Figure 2

TABLE 1

STAGE-FREQUENCY AT RIVER MILE 275.5
DOWNSTREAM END OF PHARRS ISLAND

FREQUENCY (Years)	ELEVATION (NGVD)
2	451.3
5	453.0
10	454.5
25	456.5
50	458.0
100	459.5

A Clean Water Act Section 404 (b)(1) evaluation has been prepared for this project and is included as an attachment to the DPR/EA. Before construction, a public notice for Section 404 (b)(1) and Section 401 of the Clean Water Act will be circulated for public review and comment.

d. Air Quality. Except for Hercules Chemical Company and Dundee Cement Company within lower Pool 24, there are no major sources of pollutant emissions in the vicinity of the project area. Because of its low pollution potential, this area is not actively monitored, and it is classified as in "attainment" (MDNR 1989). Most of the air pollutants in the area consist of suspended particles from agricultural activities and navigation operations. The existing air quality conditions are expected to continue into the future if the project is not implemented.

e. Noise. The major sources of ambient noise in the project area result from the diesel power plants of tows passing in the main channel of the Mississippi River, occasional motorboats navigating in the vicinity of the project area, and vehicle traffic along Highway 79. No change in noise level is expected in a future without a project.

f. Prime Farmland. Pharrs Island is a wetland and experiences frequent flooding. As such, the project area would not qualify as prime farmland. Development of the island in the future as farmland is not anticipated.

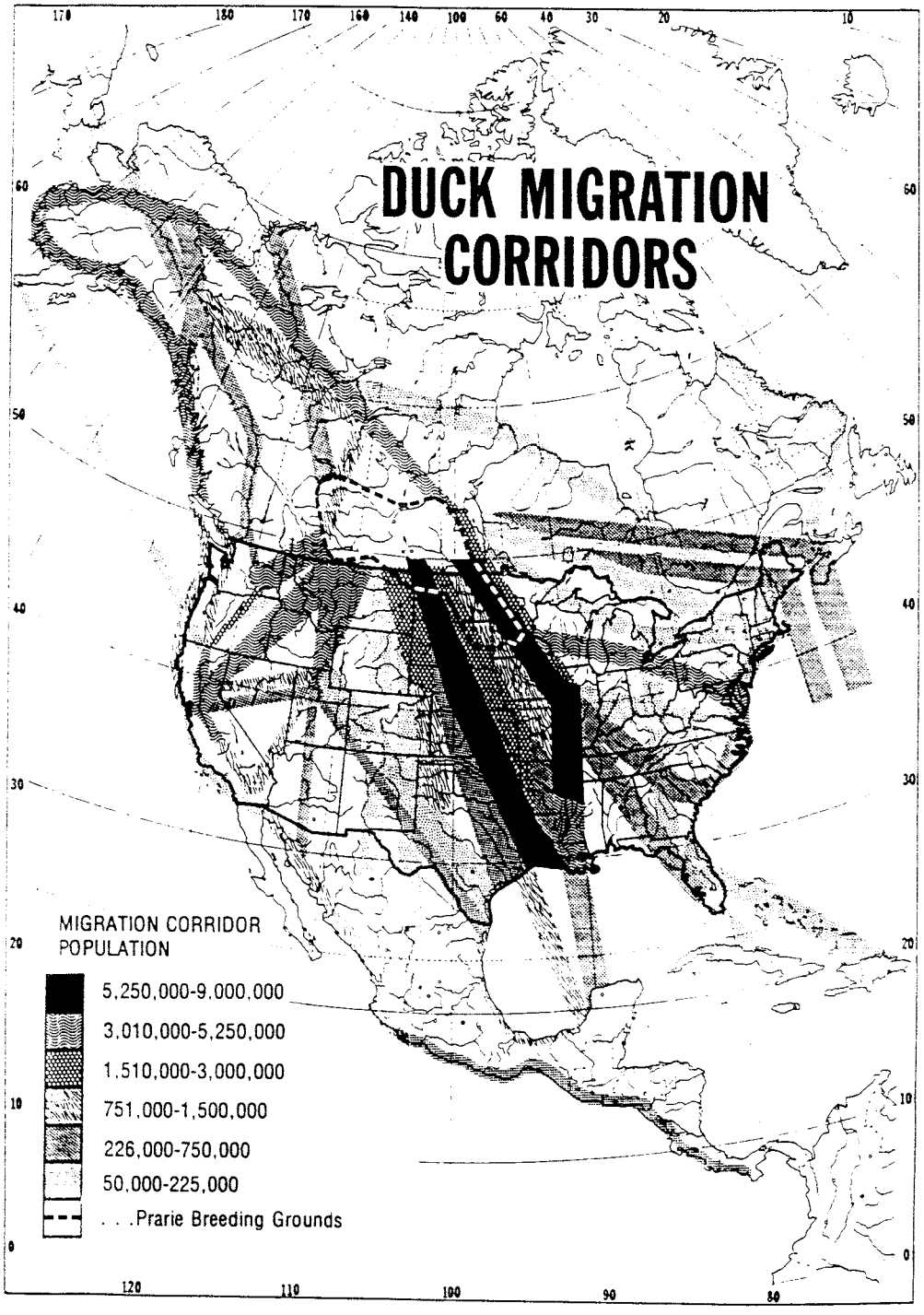
g. Habitats. Habitat provides the life requirements (food, cover, a place to reproduce) for the fish and wildlife living in an area. The wetland habitat types within the project area have been created by coincident physical, chemical and botanical characteristics. River position, depth, water surface area, stage and discharge, vegetation, river bottom types, water quality, and superimposed structural elements within the river define the various habitats.

(1) Wildlife Habitat.

Pool 24 is located within a major flight corridor for millions of migrating waterfowl (FIGURE 3). The most abundant duck in the Mississippi flyway is the mallard (FIGURE 4), and within the Upper Mississippi River, Pool 24 is one of the most important areas for this species. The importance of this area is highlighted by the North American Waterfowl Management Plan's (NAWMP) designation of the Upper Mississippi River as one of the waterfowl habitat areas of major concern in the U.S. (FIGURE 5). Since 1970, trend analysis data shows a decreasing trend nationwide for duck populations in general, and also specifically for mallards (FIGURE 6). The major factor attributed to this decline is deterioration of northern breeding grounds. However, habitat loss has also been noted to be of concern in areas used by waterfowl for rest stops during migration and for wintering. Waterfowl concentrate more during these periods, and the effects of habitat loss and degradation or disease outbreaks in such areas can be important. These areas have been lost to agriculture, and other uses and the quality of much of the remaining habitat has decreased substantially. The aim of the NAWMP is to ensure the preservation of enough high quality waterfowl habitat to sustain waterfowl populations at levels for a fall flight of more than 100 million ducks (i.e., the 1970 level.) For the mallard, the goal is to return to 1970-1979 population levels (or approximately 15 million birds in the fall flight).

The Pharrs Island complex illustrates well the ongoing conversion process in Pool 24 of water-to-land habitat. As the lower (growing) end of Pharrs Island achieves a more stable configuration, it is anticipated that all of its interior wetlands will eventually disappear. During the 15-year period

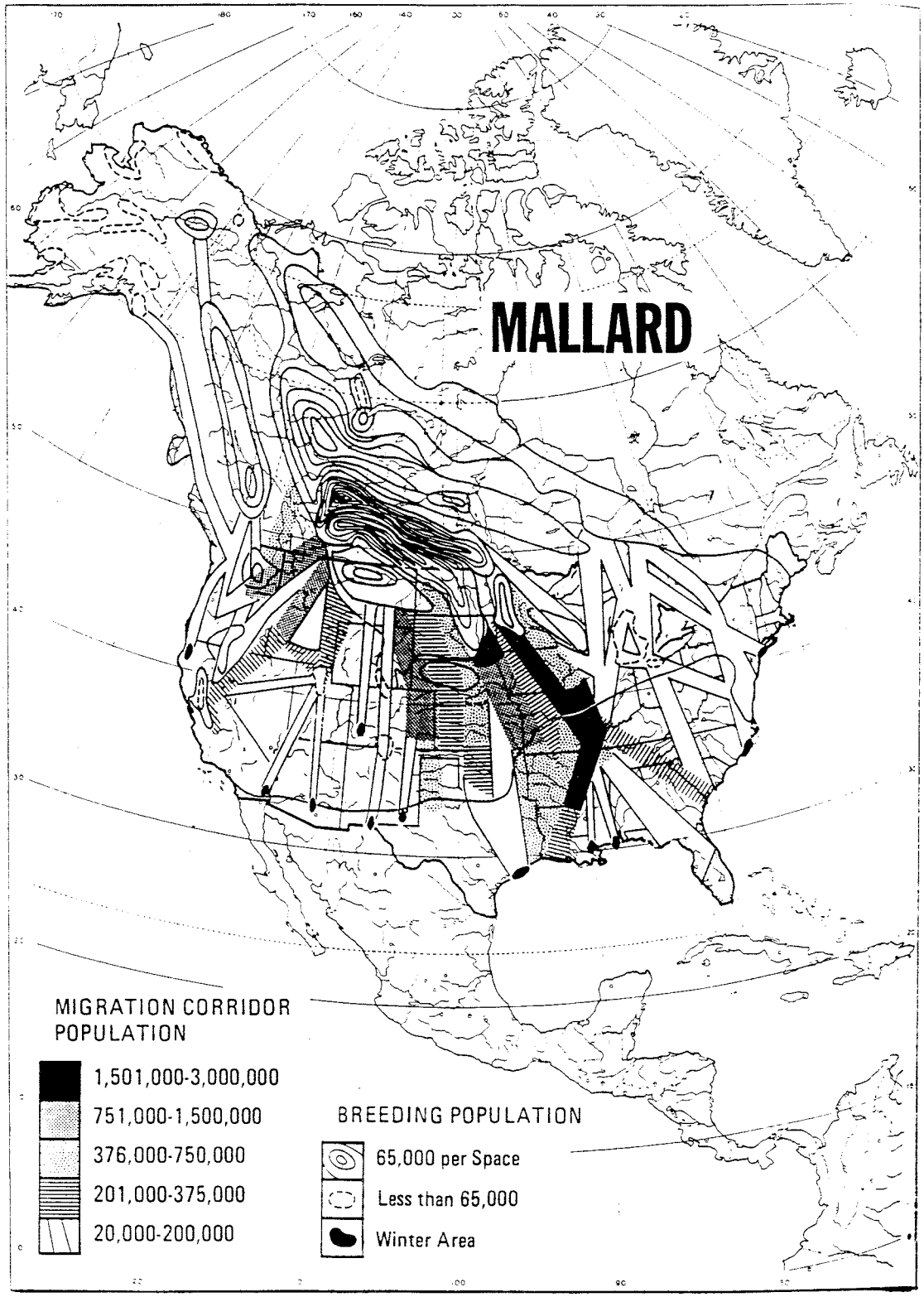
DUCK MIGRATION CORRIDORS



FROM: BELLROSE, 1976

Figure 3

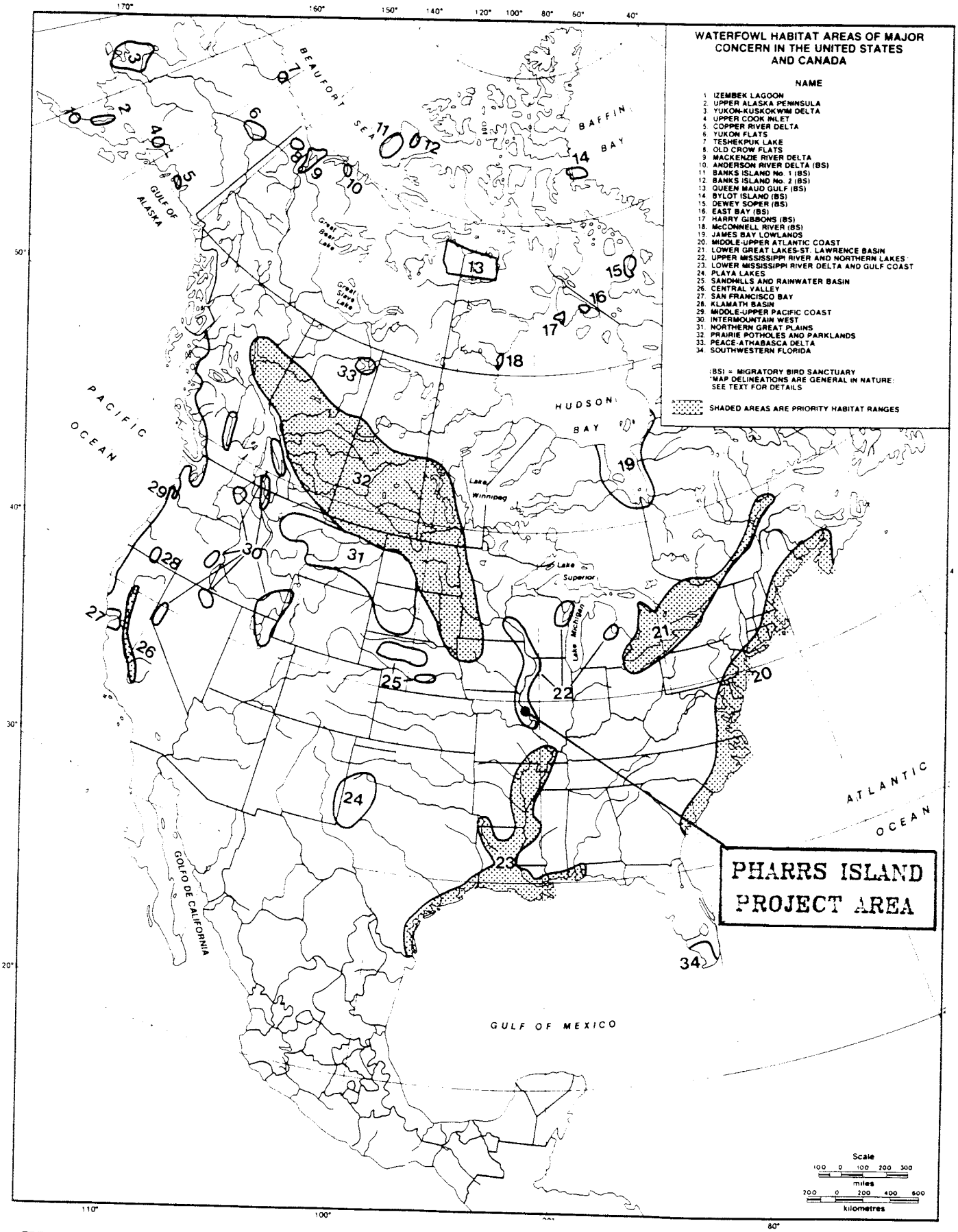
MALLARD MIGRATION CORRIDORS



FROM: BELLROSE, 1976

Figure 4

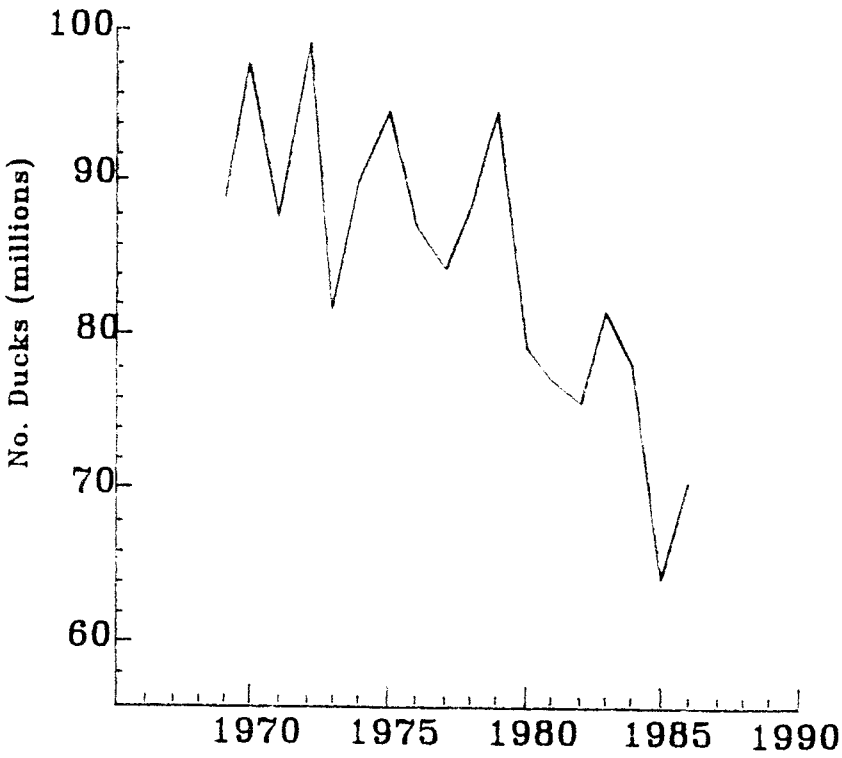
Waterfowl habitat areas of major concern in Canada and in U.S. (1985)



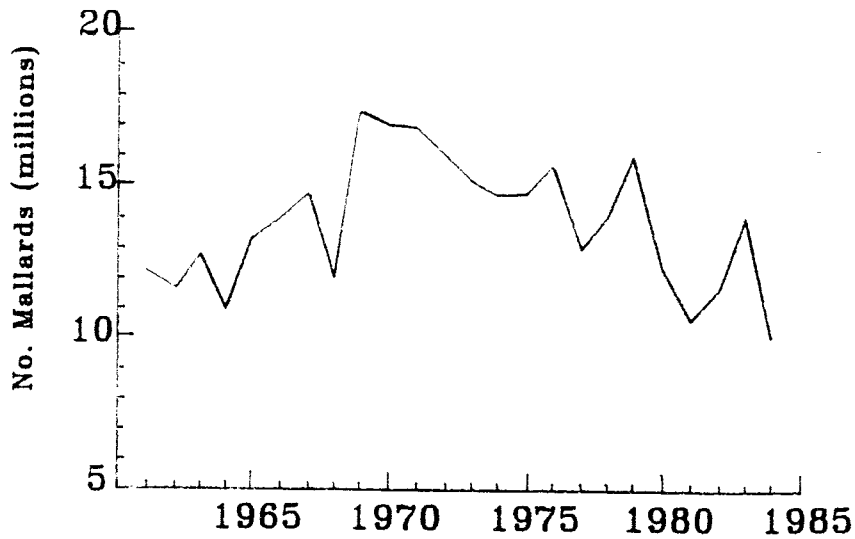
FROM: USFWS/CWS, 1986

Figure 5

NORTH AMERICAN FALL FLIGHT ESTIMATES



DUCKS, 1969–1986 (From USFWS/CWS, 1987).



MALLARDS, 1961–1984 (From INHS, 1985).

Figure 6

between 1972 and 1987, the conversion of water to land within the complex proceeded at a rate of 3 acres per year (see FIGURE 7 depiction). At this rate, all interior non-forested wetland habitat would be expected to disappear from the project area during the next 50 years. For waterfowl, this conversion translates to a quantitative loss of habitat. This problem is exacerbated by the fact that compared to most other Upper Mississippi River System (UMRS) pools (TABLE 2), Pool 24 has proportionately much less off-channel water habitat.

Moist soil plants currently constitute the majority of natural waterfowl foods within Pool 24. They seed (artificially or naturally) on exposed mud flats during the summer, but must become subsequently inundated by 0.5 to 1.5 feet of water in the fall to enable waterfowl to feed upon the seeds produced. Moist soil plants are especially sensitive to pool levels during early growth, when inundation can drown then. When water levels are dropped in the fall as a result of pool operations, the moist soil plants may be left stranded on mud flats. This makes these plants inaccessible to waterfowl. To circumvent this problem, some private and public organizations have built low levees adjacent to the pools in which water levels can be artificially controlled. These areas are not affected by changes in river stage unless they are over topped.

A description of project area habitat is provided below. This description includes a cross-reference to the U.S. Fish and Wildlife Service's wetlands classification system (Cowardin et al. 1979). Under the Service's system, the project's habitat falls into two major wetland systems, the riverine system and the palustrine system. TABLE 3 provides a breakdown of the projects wildlife associated habitat acreages.

(a) Forested Wetland. Currently, about 265 acres of the project area consists of bottomland forest. This habitat is classified by the Service as belonging to the Palustrine System, forested wetland class and broad-leaved deciduous subclass.

Willow communities dominate along the developing ends of Pharrs Island and the Island 461 group. Such areas have a more sandy soil and are subject to more frequent, prolonged periods of flooding. Willow species present are black willow (Salix nigra) and sandbar willow (S. interior, and S. rigida). Sandbar willow is successionally the first to colonize, followed by black willow. This pattern gives a banded appearance to the project's forests.

The most extensive forest community in the project area is the silver maple-cottonwood community, which occurs interior to the willow bands. This community flourishes on a variety of soils and can withstand limited annual flooding.

This community is dominated by silver maple, whose cover often exceeds 75 percent, with cottonwood usually contributing another 25 percent. The most common species associated with this community are American elm (Ulmus americana), willow (Salix spp.), swamp privet (Forestiera acuminata), red mulberry (Morus rubra), box elder (Acer negundo), and ash (Fraxinus spp.). The cover of one of these species is rarely greater than 25 percent. No pin oak trees (Quercus palustris) have been observed on the island.

Vines are typically present, but their cover is low. Wild grape (Vitis spp.), poison ivy (Rhus radicans), trumpet creeper (Campsis radicans), and catbriar (Smilax spp.) are likely.

PHARRS ISLAND
WATER TO LAND CONVERSION
1972 VERUS 1987

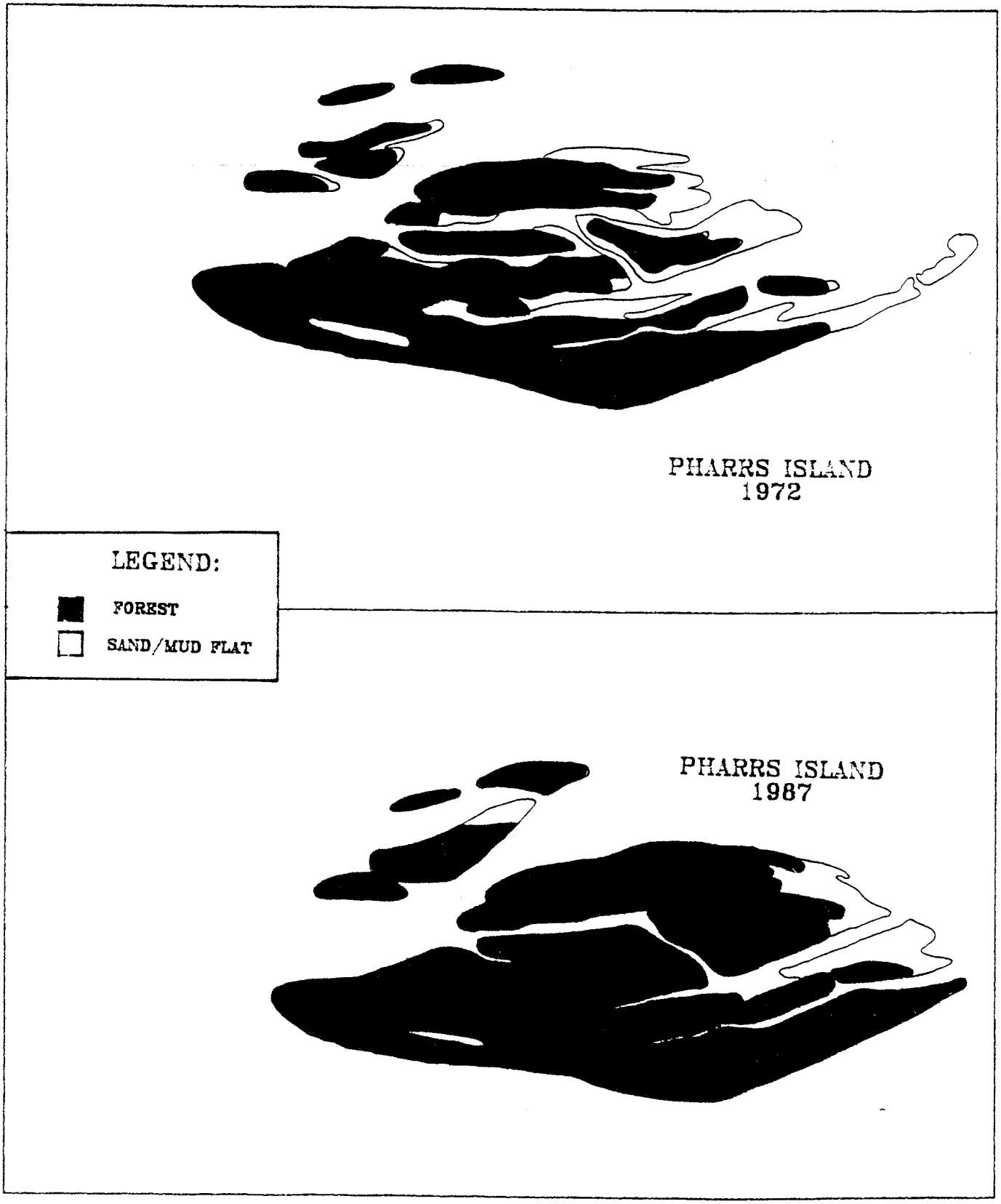


Figure 7

TABLE 2

EXTENT OF UMRS OFF-CHANNEL WATER HABITAT BY RIVER REACH

Mississippi River Reach	Off-Channel Water Habitat 1/		
	Acres 2/	Acres Per River Mile	Acres As Percentage Of Total Reach Aquatic Acres 3/
Pools 1-10	105,737	454	77
11-13	40,389	439	74
14-19	43,538	274	62
20-25	16,558	136	35
26	5,098	128	30

1/ Off-channel water is here defined as including side channel, river lakes and ponds, and sloughs.

2/ Data Sources = CE (1977) and CE (1988).

3/ Total aquatic habitat is here defined as including all off-channel water habitat plus main channel and main channel border habitat.

TABLE 3

PHARRS ISLAND HREP -
WILDLIFE HABITAT ACREAGES

Habitat Type (DPR Designation)	Wetlands and Deepwater Habitats Classification (USFWS) System	Class	Notes	Acreages (Average Annual) Existing Unprotected	Existing Protected a/	Existing Total	No Action Unprotected	No Action Protected	No Action Total	Selected Plan Unprotected	Selected Plan Protected	Selected Plan Total
Forested Wetland	Palustrine	Forested Wetland	2,3	265(265)	0	265(265)	333(333)	0	333(333)	207(207)	0	207(207)
Non-Forested Interior Wetland	Palustrine	Aquatic Bed	2,3	25(25)	0	25(25)	11(11)	0	11(11)	0	20(20)	20(20)
		Unconsolidated Bottom	2,3	41	0	41	17	0	17	1	35	36
		Emergent Wetland	2,3	35(35)	0	35(35)	4(4)	0	4(4)	1(1)	102(102)	103(103)
			Total	101(60)	0	101(60)	33(15)	0	33(15)	2(1)	157(122)	159(123)
River	Riverine	Unconsolidated Bottom	1	153	0	153	153	0	153	0	153	153
		Unconsolidated	2	7	0	7	7	0	7	0	7	7
			Total	160	0	160	160	0	160	0	160	160
			Grand Total	526(325)	0	526(325)	526(348)	0	526(348)	209(208)	317(122)	526(330)

FOOTNOTES:
1 Represents deepwater habitat under USFWS Classification System.
2 Represents Wetlands habitat under USFWS Classification System.
3 Wetland class meets the regulatory definition for administering the Section 404 permit program (Reference: "Federal Manual for Identifying and Delineating Jurisdictional Wetlands).

a/ Protected by either sediment and flow deflection or by water level regulation.

The ground cover is typically sparse, covering less than 25 percent of the area. The most common herbs are lizard's tail (Saururus cernuus), tall white aster (Aster simplex), stinging nettle (Laportea canadensis), smartweed (Polygonum spp.), and arrowhead (Sagittaria latifolia).

Forested habitat adjacent to the river is used by eagles as resting habitat. Forest also provides habitat for wood ducks, raccoon, white-tailed deer, cottontail rabbit, foxes, tree squirrels, songbirds, salamanders, frogs, snakes, and turtles.

Sedimentation accelerates the plant succession process by providing progressively higher and drier conditions suitable for the establishment of a forest community. FIGURE 7 gives an indication of what this conversion process has meant for the Pharrs Island complex in recent times.

(b) Non-Forested Interior Wetland. About 101 acres of the Pharrs Island and Island 461 subcomplexes is made up of open interior wetlands. These areas consist of mixed open water surrounded with emergent, floating-leafed and submergent aquatic plants. The majority of these habitats can be classified within the Palustrine System classes of unconsolidated bottom, aquatic bed, and emergent wetland.

The typical successional pattern for interior wetlands along Pool 24 is from a lotus community to an arrowhead community to a graminoid dominated community. The Missouri Botanical Garden (1975) provided the following account of community development on Pharrs Island:

> "... a transect was run from the edge of a forest through a marsh until the vegetation ceased to change in open water (a distance of about 35 meters). The first 23 meters of the transect were quite muddy. Tall white aster (Aster simplex) was the dominant herb. The most notable vegetation change through the transect was the gradually increasing abundance of arrowhead from the shore to the end of the transect. In the first 10 meters of the transect, arrowhead had a mean cover of only one percent (70% frequent, i.e., occurred in 70 percent of the quadrants). In the following 10 meters, its cover increased slightly to five percent (90%). In the third 10 meter segment, its cover averaged seven percent (10% frequent). In the final five meters, the cover of arrowhead averaged 43 percent (100% frequent).
>
> The last 11 meters of the transect had 15 centimeters of standing water. Lesser duckweed (Lemna minor) was a codominant in these quadrants. Its mean cover was 43 percent. It should be noted that duckweed is a floating vascular plant and thus subject to movement by wind. Its abundance increased markedly in the last few meters of the transect. Smartweed (Polygonum pensylvanicum) was rare in the quadrants, though a large patch was found just to the side of the transect. Tree seedlings of three species (willow, Salix nigra; silver maple, Acer saccharinum; and cottonwood, Populus deltoides) were present, though rare, in the transects, suggesting tree invasion. There were no seedlings found in the last 15 meters (the wettest) of the transect. In fact, only three species were found in these last 15 meters, arrowhead, duckweed, and smartweed (Polygonum punctatum). The latter occurred in only one of these quadrants with a cover of five percent. At the end of the transect lay an open water community dominated by American lotus. There was approximately 1.3 meters of standing water in this community at the time of study. The total estimated cover was 40 percent."

Species utilizing non-forested interior wetland habitat include ducks, coots, rails, bitterns, herons, egrets, numerous songbird species, hawks, wintering eagles and osprey. Many species of insects, amphibians, reptiles, and furbearers (including muskrat, mink, fox, raccoon, opossum, and beaver) are found in these wetlands.

In the absence of a rehabilitation project, the non-forested interior wetlands habitat, and the values it provides, would eventually be displaced by forested habitat.

(a) River. The riverine system includes all wetlands and deepwater habitat contained within the river. Within the project area (FIGURE 9) this includes all waters between and surrounding the Pharrs Island and Island 461 subcomplexes (160 acres), TABLE 3). The project area riverine habitat includes approximately 7 acres of unconsolidated shore and 153 acres of unconsolidated bottom. The predominant subclass type is sand, but some mud areas also occur. The project area's unconsolidated bottom habitat has little aquatic vegetation, little rock habitat, and a moderate to fast current, and some debris present. Furbearers may use this area to some extent for feeding; waterfowl use of this habitat during migration is expected to be minimal. In the future, the project area's riverine habitat may become more shallow as a result of future sedimentation.

(2) Fisheries Habitat.

Commercial and sport fishing are important activities on the UMRS, including the Pool 24 area. Both commercial and sport fish have specific life requirements and extensive backwaters are needed for their optimum feeding and reproduction. Biologists are concerned that the continuing loss of Upper Mississippi River system (UMRS) backwater habitat could result in a future reduction in the numbers and diversity of such slackwater fishes.

Sedimentation in Pool 24 (including the Pharrs Island area) has had implications for fish populations. Off-channel water habitat is vital to the spawning and rearing of many commercial and sport fishes (e.g., smallmouth and big mouth buffalo, channel and flathead catfish, white bass, largemouth bass, white and black crappie, rock bass, and longear sunfish). Based on a quarter century of commercial fish harvest data for the Upper Mississippi River, there appears to be a strong relationship between fish production and the total acres of available off-channel habitat (FIGURE 8). The total amount of off-channel habitat available in Pool 24 is low, and so too has been the commercial harvest from that pool. While an equivalent data base for sport fish does not exist, it is likely that with the known heavy dependence of this group on off-channel habitat, that a very similar relationship also exists.

The fisheries at Pharrs Island is also affected by shifting water levels. In the spring during high water, when the pool goes "on tilt" much of the island's shallow interior waters may be drawn out (FIGURE 2). This drawdown action can result in young fish and eggs being removed from the wetlands, and thus limits the value of this habitat for fish spawning and rearing.

From a fisheries perspective, the 160 acres of river habitat can be better described as consisting of main channel border habitat and side channel habitat. These two habitats are described in detail below. Much of the island's wetland habitat serves a fisheries function at least part of the time. Forested wetlands can become inundated during periods of high water, they provide spawning habitat for channel catfish, carp, and buffalo, plus marginal feeding habitat for other fish. The same can also be said for the mud flat emergent wetland areas; however, for year round use, the permanent

RELATIONSHIP BETWEEN OFF-CHANNEL HABITAT AREA AND UPPER MISSISSIPPI RIVER COMMERCIAL FISH HARVEST (1953-1977)

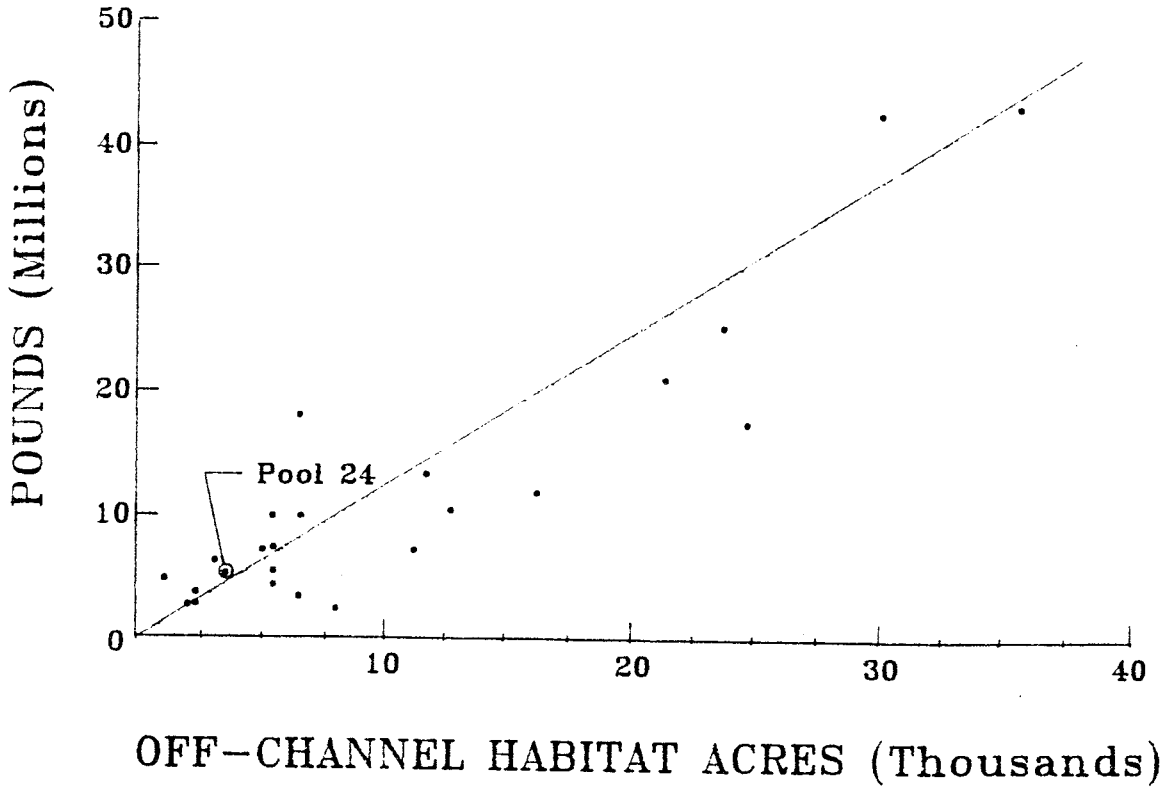


Figure 8

water component of the non-forested interior provides the most benefit to fish. Aquaticly this habitat is best described as slough and is also discussed in detail below. TABLE 4 provides a breakdown of the project associated fisheries habitat acreages.

(a) Main Channel Border. The project area has 104 acres of main channel border habitat. This habitat represents the zone between the 9-foot channel and the main river bank. Within the project area this habitat includes all existing river habitat minus the side channel habitat described below.

This habitat provides low to moderate conditions for spawning, rearing and adult life stage sport and commercial fishes. Physical conditions making this habitat less than ideal for slackwater fish include, a somewhat lower year-round water temperature, high turbidity, high water velocity in the spring, and low cover. Limited fishing for carp, catfish and drum is expected within this habitat type; there are no known mussel beds present.

This habitat will likely become more shallow as sedimentation continues, but the areal extent of this habitat is not anticipated to significantly change during the next 50 years. The same physical deficiencies described above will continue in the absence of a project.

(b) Side Channel. The project area has 56 existing acres of side channel habitat. Side channels include all departures from the main channel and main channel border, in which there is a current during normal river stage. The water zone between the Island 461 and Pharrs Island subcomplexes meets this description. The physical conditions making this habitat less than optimal for large slackwater fish are identical to those described for main channel border habitat. Limited commercial fishing for carp, channel catfish and freshwater drum is expected in this area. Sport fish using side channels for all life functions include largemouth bass, bluegill and crappie. There are no known mussel beds located within this project habitat.

Similar to the main channel border, habitat quality is not expected to improve over the next 50 years, but no loss in the areal extent of side channel habitat is expected.

(c) Slough. Sloughs are part of a broader category of habitat referred to as backwater habitat. Backwater habitat also includes river lakes and ponds. Sloughs may be former side channels that have been cut off, or that have only intermittent flows in them. They may also be relatively narrow branches or off shoots of other bodies of water. They are characterized by having no current at normal water stage, and muck bottoms. These sloughs are representative of the ecological succession taking place in the river bottoms, from aquatic to marsh habitat. Sloughs generally have an abundance of aquatic vegetation. The species diversity and density of aquatic macrophytes, phytoplankton, zooplankton, benthic fauna, and fish are usually higher in side channel and backwater areas than in main channel habitats. In a study of habitat effects on fish abundance in Pool 7 of the UMR, Sylvester and Broughton (1983) found 86 percent of its total fish captures to be coming from off-channel rather than main channel areas. Also, an electrofishing survey of the Illinois River (Sparks 1975a) showed that the largest numbers of game fish are taken in navigation pools that have the most connecting backwaters.

TABLE 4

PHARRS ISLAND HREP -
FISHERIES HABITAT ACREAGES

Habitat Type (DPR Designation)	Acreages (Average Annual)								
	Existing			No Action			Selected Plan		
	Unprotected	Protected	Total	Unprotected	Protected	Total	Unprotected	Protected	Total
Main Channel Border 1/	104	0	104	104	0	104	2	0	2
Side Channel 1/	56	0	56	56	0	56	1	0	1
Deep Slough 1/	0	0	0	0	0	0	0	157	157
Shallow Slough 2/	67	0	67	35	0	35	1	56	57
Total Aquatic	227	0	227	195	0	195	4	213	217

1/ Represents riverine unconsolidated bottom and unconsolidated shore under the USFWS habitat classification.

2/ Represents palustrine aquatic bed and unconsolidated bottom habitat.

Conditions lowering the value of slough habitat for slackwater fish within the project area include high water temperatures in summer, low dissolved oxygen levels in summer and winter, shallow water depth, and higher water velocities in the spring. Existing habitat limiting factors are expected to carry into the future, most serious of all will be a continuing shrinkage of habitat in response to unabated sedimentation.

h. Historic Properties. Maps from the first channel surveys document the island's existence as early as the 1820's, indicating the land mass is at least 165 years old. There are no known historic sites of significance on the island.

i. Recreation. Thirty years ago, Pharrs Island provided excellent waterfowl hunting opportunities with 51 blind sites annually available to the public. Some 24 duck blind sites remain active on the island, but many are little used due to declining waterfowl numbers, assumed to be the result of on-site wetland habitat loss. Other recreational activities in the project area include fishing and boating, as well as trapping and hunting. In the future without condition, both duck hunting and fishing in the area would be expected to further decline due to the continued loss of wetland habitat.

j. Aesthetics. The aesthetics of Pharrs Island is considered typical for a wetland area on the Mississippi River. From an aesthetic standpoint, it is expected that if a project is not built, then the area would remain similar to the existing condition, with the exception of progressively less open wetland - a result of continuing sediment deposition.

k. Socioeconomic Resources. There are no human residences or other permanent improvements on Pharrs Island. The only access to the island is by boat.

3. RESOURCE PROBLEMS AND OPPORTUNITIES.

Sedimentation, and water level fluctuation have hampered past habitat management efforts at the Pharrs Island site. Sedimentation is causing a rapid conversion of water to land with a resulting long-term quantitative loss of fish and waterfowl habitat. Fluctuating water levels at the site have impacted the productivity of the site via effects on fish spawning and rearing, and on the production of plants and their availability to waterfowl.

Opportunities do exist to provide sediment protection and water level control at the Pharrs Island wetland complex. The various alternatives explored for addressing the sedimentation and water control problems are described in Section 5 of this report.

The potential for the management of a waterfowl management unit (particularly for moist soil plant production) on Pharrs Island would allow for a more reliable production of waterfowl food during the summer months, and an increased availability of that food during migration. Creation of an off-channel water area would improve the aquatic habitat year round, providing enhanced conditions for fish reproduction, and a quiet deep water habitat for wintering fish.

4. PROJECT OBJECTIVES. The specific project goals and objectives of the project are included in TABLE 5.

5. ALTERNATIVES.

a. Formulation and Evaluation Criteria. Alternative plans were formulated and evaluated in consideration of the following four criteria:

(1) Completeness - The extent to which an alternative addresses all of the stated project objectives.

(2) Effectiveness - The extent to which an alternative alleviates the specified problems and achieves the specified opportunities.

(3) Efficiency - The extent to which an alternative is the most cost effective means of alleviating the specified problems and realizing the specified opportunities.

(4) Acceptability - The workability and viability of the alternative plan with respect to acceptance by state and others and compatibility with existing laws, regulations, and public policies.

b. Measures Available. An array of potential measures were identified during the project study to address one or more of the project objectives. These potential enhancement features are listed in TABLE 5 and are described below in paragraph c as components of the project alternative plans.

c. Alternatives.

(1) Alternative A - No Federal Action. No Federal action would consist of no Federal funds being provided to meet the project purposes.

(2) Alternative B - Wetlands Excavation. This alternative would entail large-scale excavations to deepen the project area wetlands, thus rehabilitating areas damaged by past siltation. To make the output of this plan more comparable, the extent of excavation was set to yield the same acres of non-forested wetland as that provided by the Alternative D described below.

(3) Alternative C - Modified Navigation Dikes. This alternative consists of the modification of existing upstream navigation dikes to reduce sedimentation within the wetlands complex.

(4) Alternative D - Wetlands Protection System. This alternative (see FIGURE 9) would entail the construction of structures to reduce the frequency with which silt-laden floodwaters enter the project area, and to provide features permitting the regulation of water levels on the interior of Pharrs Island. The array of potential features identified for a protective system are described below.

(a) Stone Revetment. This measure would entail the placement of stone material along the erosion-prone upper island shorelines at an elevation sufficient to deflect sediment laden river flows during higher river stages. Earthen plugs would be needed to fill any slough depressions.

(b) Dike. Consistent with established UMRS-EMP terminology, a dike is here defined as any structure used to control or influence water flows, such as for deflecting highly sediment-laden waters. As an alternative to stone revetment, a dike structure would be placed in open water at the head of the island in an alignment, and at a height, sufficient to deflect sediment

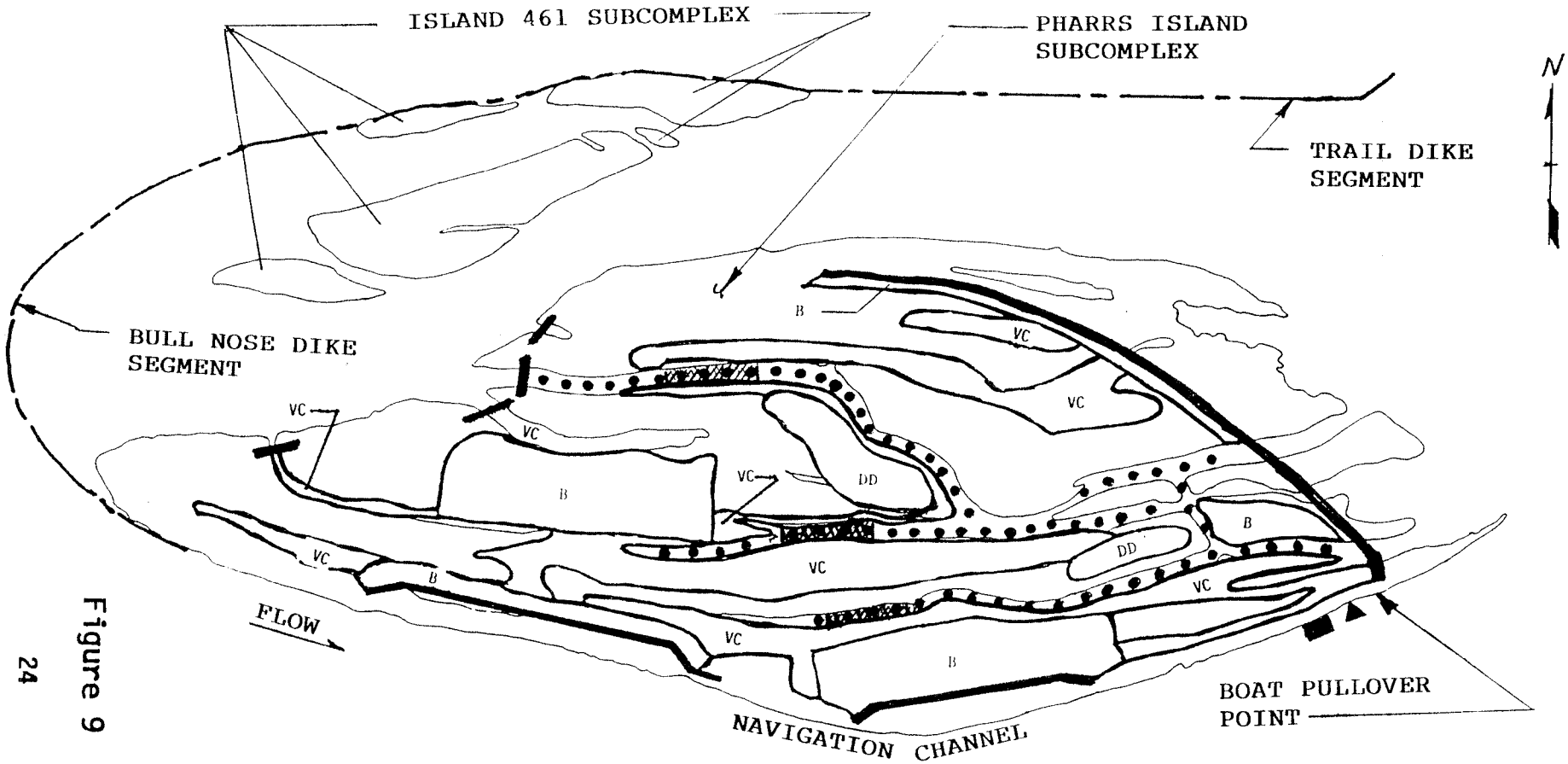


Figure 9

POTENTIAL GROUND DISTURBANCE
LEGEND:

- = Levee
- B = Levee borrow areas
- DD = Dredge disposal areas
- VC = Vegetation clearing
- = Slough dredging
- = Summer fish refuge
- = Rock dike
- = Gated Drain
- = Portable Pump

SCALE

0 1000 2000

FEET

SELECTED PLAN
PHARRS ISLAND

TABLE 5

PROJECT GOALS, OBJECTIVES, AND ALTERNATIVE ENHANCEMENT FEATURES

Goal	Objective	Potential Enhancement Feature
Enhance Wetland Habitat for Migratory Waterfowl	Decrease sedimentation into island wetlands	Excavation Sediment Barriers (Stone Revetment, Dike, Levee)
	Provide a means to control water levels on island independent of river stage	Gated Drain/ Levees/ Slough Dredging/ Pump Facilities
	Increase potential for reliable food production for waterfowl	Waterfowl Management Unit/ Cooperative Agreement
	Increase total wetland value for migratory waterfowl (mallard)	All
Enhance Aquatic Habitat for Slackwater Fishes	Increase quantity of river slackwater habitat (take into account D.O. related effects)	Dike
	Reduce potential for backwater sedimentation	Dike
	Increase photic zone	Dike
	Increase available cover along river	Cedar Trees
	Increase total value for large slackwater fishes	All

from the project area. At the same time, this structure could provide an important sheltered off-channel water habitat for use by slackwater fishes. Two potential types of material were identified for such a structure, dredged sand and rock fill. A sand structure with a wider crown could be planted to trees to provide a more aesthetically appealing structure.

(c) Levee. A levee, as defined by the UMRS-EMP, is any structure used to enclose an area for the purposes of controlling water levels. Two major levee configurations were identified for water level control on Pharrs Island. One configuration would entail the use of a water-based rock leveelocated on the downstream end of the island (this feature was included in the recommended plan of the Draft DPR). The other configuration would consist of a land-based earthen levee at the downstream end of the island, and along portions of the island facing the navigation channel. Levees would serve to complete the island, bringing the entire island perimeter to an above normal pool grade. In combination with a gated drain, a levee would permit the retention and release of water on the island in a manner beneficial to waterfowl management. A levee system would also help to reduce sediment input into the lower island. Because of this dual function, the structure could be referred to as a "levee/dike." However, due to its primary function of water control, and for the sake of simplicity, the term "levee" will be applied in this study report.

(d) Interior Dredging. This feature entails the deepening by dredging of the major sloughs within the island's interior, and additional dredging at selected locations to provide summer fish refuges. Ditch excavation would facilitate interior wetland water delivery and drainage, fish movement, and access for operations and maintenance personnel. Deepening for refuges would enhance the prospects for survival of fish residing in the island's interior during the summer drawdown period. Dredging would be accomplished by hydraulic or mechanical dredging methods.

(e) Bermed Disposal Areas. Material dredged from the interior sloughs during the initial construction would require disposal areas with a suitable method of containment.

(f) Drains. Various drains could be used in combination with other project structures to regulate water flow or water levels within the wetland complex.

1. Dike Flow Control Structure. This device would consist of multiple ungated culvert drains built into the rock dike structure. It would permit year round water flow into a dike created off-channel water area. The intent of the device would be to enhance dissolved oxygen levels to the off-channel area during potential summer and winter stress periods.

2. Levee Inlet/Outlet Drain. This feature would be built into any downstream levee segment implemented. Its function would be to deliver or drain interior wetland waters, when so desired for management purposes. It would contribute to the raising and long-term holding of water levels within the island's interior at levels above that of normal pool. This feature would be used in combination with levees, interior dredging, and a pump.

(g) Pump. A pump would be used to help ensure desired water level increases in the management unit at times when most critically needed. The pump could be a fixed unit at the site, or a portable unit intended for use at one or more river sites.

(h) Boat Pullover. This entails the construction of a roller/pulley operated device mounted on the downstream levee that would permit MDOC service boats (and at MDOC's discretion - recreational craft) to access the island's interior.

(i) Borrow Areas. Borrow areas would be needed as a source of material for any earthen levee segments constructed. The location, depth and other parameters would need to be determined on the basis of contributions to wetland habitat and to minimize impacts to existing tree vegetation.

(j) Vegetation Removal. Woody vegetation clearing would be necessary for the placement of land-based levee segments, levee borrow areas, and dredged material disposal areas. In addition, vegetation removal from selected lower elevation areas could be employed to further expand moist-soil plant production areas for waterfowl. This would help provide a better diversity or balance between the amount of flooded forest and flooded non-forest habitat. The emphasis on clearing would be in areas of less desirable woody vegetation (primarily willows, and younger-aged maples and cottonwoods).

(k) Mast Tree Plantings. The planting of mast bearing trees could take place in selected higher elevation areas of the project such as the dredged material disposal sites.

(l) Cedar Trees. To increase fish cover, this measure would entail the placement (by weighting and anchoring) of cedar trees in sections of project backwater habitat deficient in habitat structure.

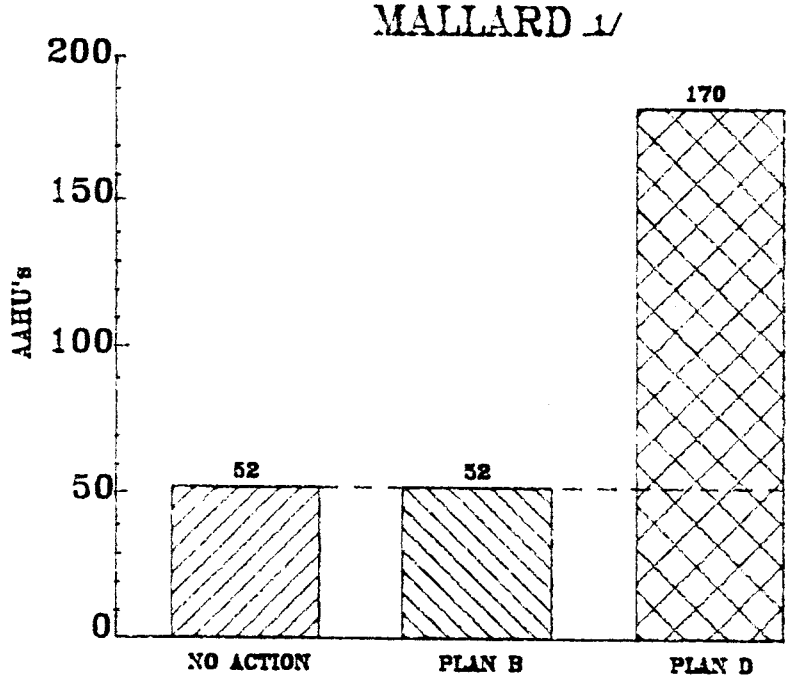
d. Evaluation of Alternatives.

(1) Alternative A - No Federal Action. This alternative would not meet any of the planning goals and objectives for migratory waterfowl or slackwater fish habitat enhancement. Wetlands would continue to deteriorate as aquatic habitat converts to terrestrial habitat, at Pharrs Island, and within Pool 24 at large. Food production for waterfowl at Pharrs Island would continue to be unreliable - strongly dependent upon the prevailing river stage conditions. Spawning/rearing and wintering habitats sheltered from the main river would continue to decline in a navigation pool already deficient in such habitat. The loss of such wetland areas is viewed as unacceptable from a fish and wildlife standpoint.

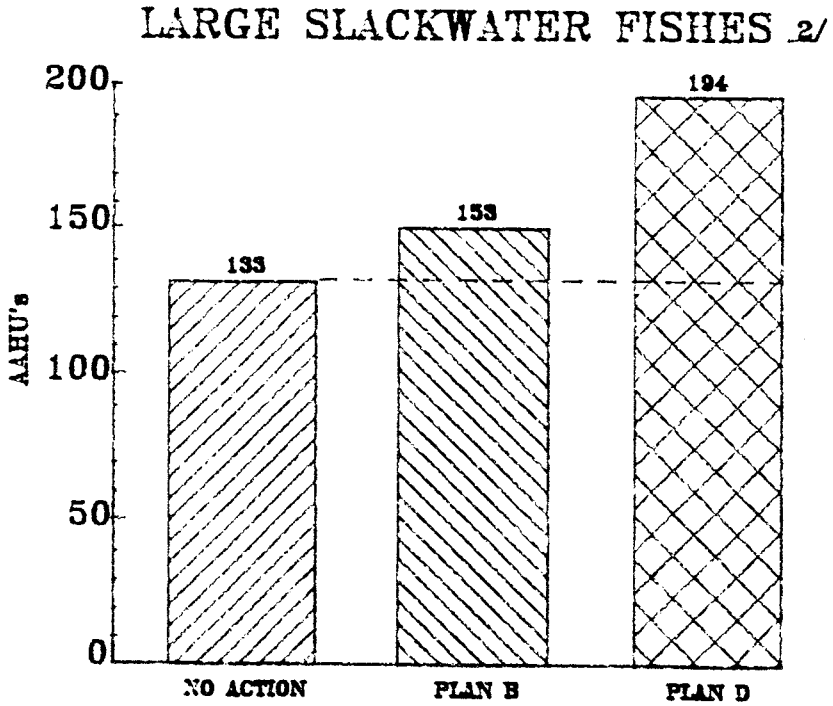
FIGURE 10 provides a summary comparison of the habitat conditions generated by each project alternative. This quantification was developed using the Wildlife and Aquatic Appraisal Guide (WHAG and AHAG) habitat evaluation methods (see APPENDIX J for details). The mallard was selected by an interagency evaluation team as the species best representing the project areas' requirements for migratory waterfowl, and the large slackwater fish guild (including most of the commercially and recreationally important fishes) was selected as the preferred group for fisheries management emphasis. As shown in the figures, the output of the no action plan for the mallard (52 AAHU's) and for slackwater fish (133 AAHU's) would be less than that for the other plan alternatives.

(2) Alternative B - Wetlands Excavation. This alternative was rejected, since it would only partially address the planning objectives. Unacceptable features include: a lack of control over future sedimentation; lack of control over the island's interior water levels; probable high costs

PHARRS ISLAND HREP
PLAN COMPARISIONS
FOR AVERAGE ANNUAL HABITAT UNITS (AAHU's)



1/ AAHU's For All Habitat Types Combined



2/ AAHU's For All Habitat Types Combined
Types, Seasons And Life Stages Combined

Figure 10

and difficulties with the disposal of excavated materials; little compatibility with current fish and wildlife practices, and no provisions for an off-channel fisheries habitat. The habitat benefits of this plan (FIGURE 10) were found to be no higher than the no action plan for the mallard, and only somewhat higher (+20 AAHU's) than the no action plan for slackwater fish.

(3) Alternative C - Navigation Dike Modifications. It was determined that the old upstream navigation project dikes, due to their depth (an average of 10 feet under water) have a negligible influence on the area's siltation process. Their shape and alignment relative to the island does not lend to their upgrading as an effective means of deflecting sediment. A more bullet-shaped structure is needed to effectively deflect sediment and to protect the head of the island from erosion.

(4) Alternative D - Wetlands Protection System. This alternative consists of the combination of acceptable plan features described below, and is summarized in TABLE 6. This plan addresses all of the planning goals and objectives and was determined to be the only viable project alternative. FIGURE 10 indicates a substantial increase in the total habitat improvement for both the mallard (+118 AAHU's) and for slackwater fish (+61 AAHU's).

(a) Stone Revetment. This feature was rejected. While the structure would address the need to reduce sedimentation on the island itself, it would not address the need for additional off-channel water habitat.

(b) Dike. This feature was accepted per the description provided below. As FIGURE 11 indicates, the selected dike configuration provides the majority (+57 AAHU's) of the Plan D gain in slackwater fish habitat units. The increment of cost per AAHU for this project feature is $1,946.

1. Material. The option of using locally dredged sand material rather than transported rock as a construction material for a dike structure was rejected. A dike structure made of sand would have a bottom width of 260 feet (assuming a crown width of 20 feet, a height of 12 feet, and 1 on 10 side slopes) versus that of a rock structure which would require a 40 foot bottom width (6-foot crown width, 12-foot height, and 1 on 2 side slopes). The cost of a sand dike, with a total required volume of material more than 5 times that required for a rock structure, would be more than double that of a rock structure. This does not consider the additional cost of stabilization work including log cribbing internal to the structure and stone rip-rap placed at strategic points along the exterior of the structure. O&M costs would also likely be higher for a sand rather than a stone structure. No significant environmental benefits were identified that would off-set this cost differential. Consequently, rock was considered to be the only cost-effective building material for a project dike structure.

2. Dike Alignment. During the development of the draft DPR, four closure dike alignment configurations were considered, as shown in FIGURES 12 and 13. The dike of Alignments A, B, and C consisted of two segments: a bull nose dike segment extending from the head of Pharrs Island to the Island 461 group, and a trail dike segment extending from the Island 461 group in a southeasterly direction to the downstream end of the project (for the purposes of the analysis, the end of the project was assumed to terminate with a water-based rock dike structure extending downstream to R.M. 275.3). Alignment D consisted of a bull nose segment only, reconnecting to the Pharrs Island shoreline to the southeast. The Alignment A bull nose extended the furthest upstream (to R.M. 277.5) and connected to the two outermost islands of the Island 461 group. The total length of the Alignment A dike (including the trail dike segment) was 12,640 feet. The Alignment B

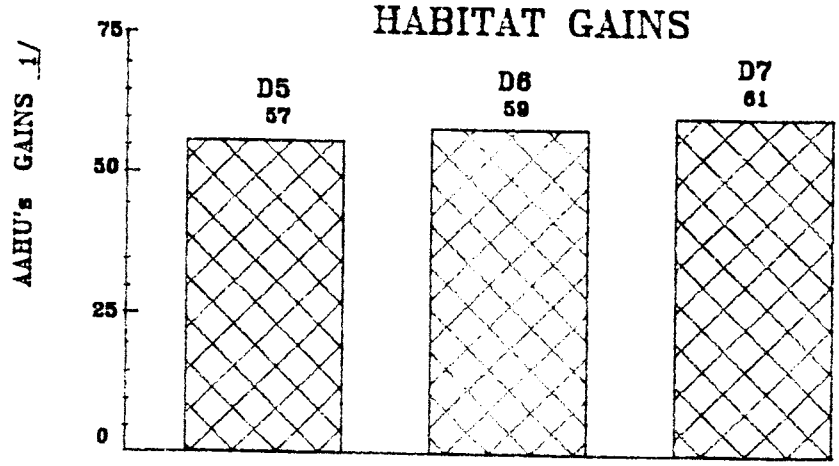
TABLE 6

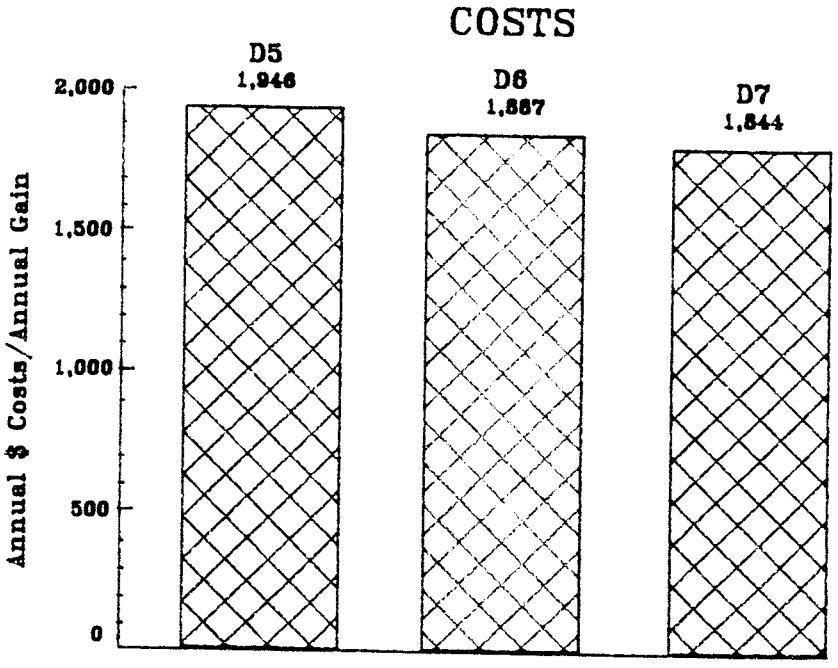
EVALUATION OF WETLANDS PROTECTION SYSTEM FEATURES

Feature	Objectives	Planning Decision/Remarks
Stone Revetment	N	(D) No off-channel habitat provided
Dike	T	(I) Alignment Option B, 453 NGVD Crown elev., full length trail dike with kicker. Dike represents an innovative tool for backwater creation.
Levee	T	(I) 452-453 NGVD elev., land-based, water regulation to 451 NGVD
Interior Dredging	T	(I) Sloughs cut 25-foot wide, fish refuges 50-foot wide and 500-feet long
Bermed Disposal Areas	T	(I) Two locations, 10 total combined areas
Drains		
Dike Flow Control Device	T	(D) Dissolved oxygen not likely to be a serious problem.
Levee Inlet/Outlet Drain	T	(I) Integral component of levee water reg. design
Pump	T	(I) Portable pump, 15,000 GPM
Boat Pullover	T	(I)
Borrow Areas	T	(I) Subsequently planted to moist soil species
Vegetation Removal	T	(I) Subsequently planted to moist soil species
Mast Tree Plantings	T	(I) Planted at elevations above 452 NGVD in selected locations
Cedar Trees	T	(I)

Key: T = Measure totally compatible
N = Measure not totally compatible
I = Measure incorporated into Selected Plan
D = Measure deleted; not further considered

PHARRS ISLAND HREP
LARGE SLACKWATER FISH
PLAN D ANNUAL HABITAT GAINS AND COSTS





1/ AAHU's For All Habitat Types, Seasons And Life Stages Combined.

PLAN D

D5: Dike Only Feature
D6: Dike And Refuge Features
D7: Dike, Refuge And Cedar Tree Features (Complete Plan)

Figure 11

DIKE ALIGNMENTS A AND B

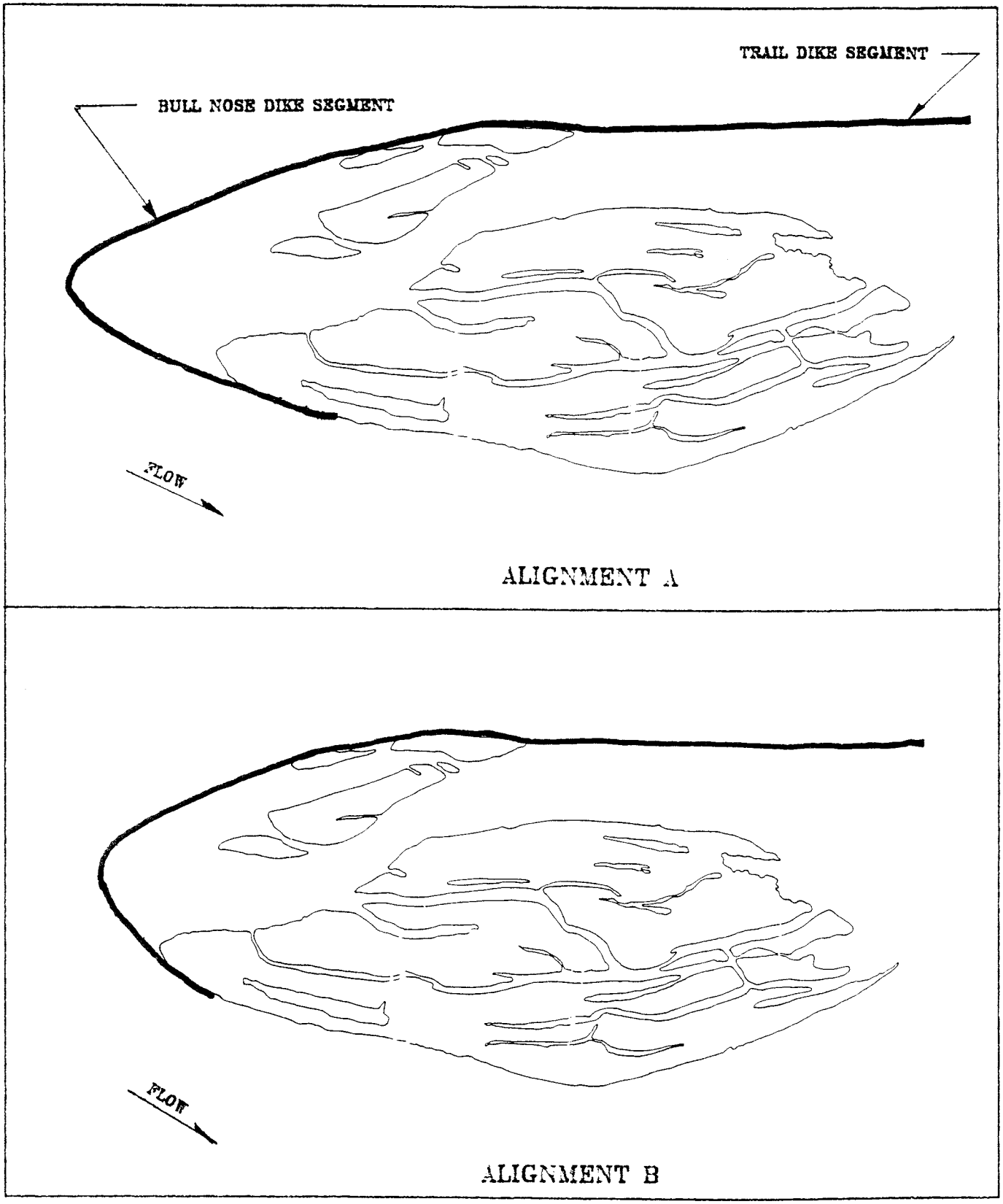
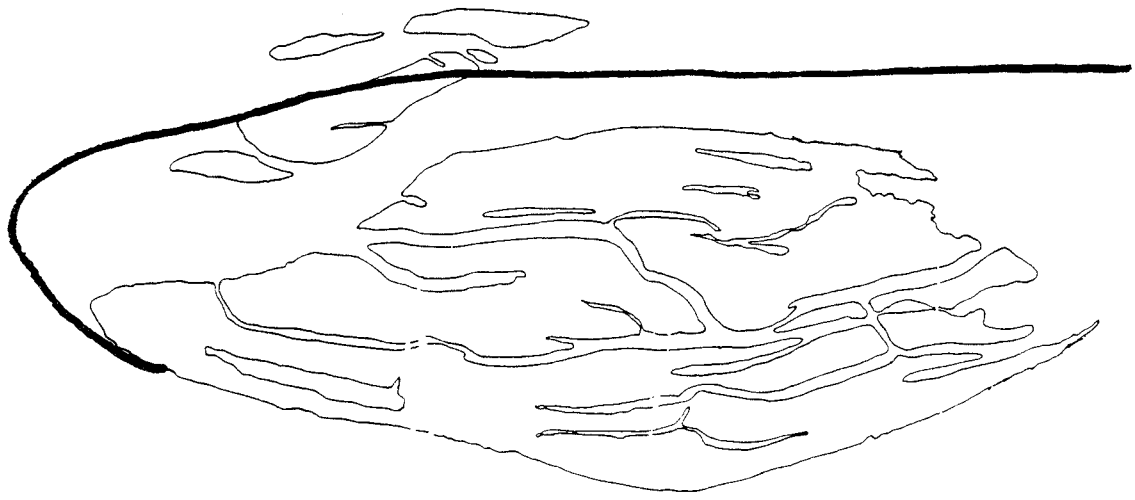
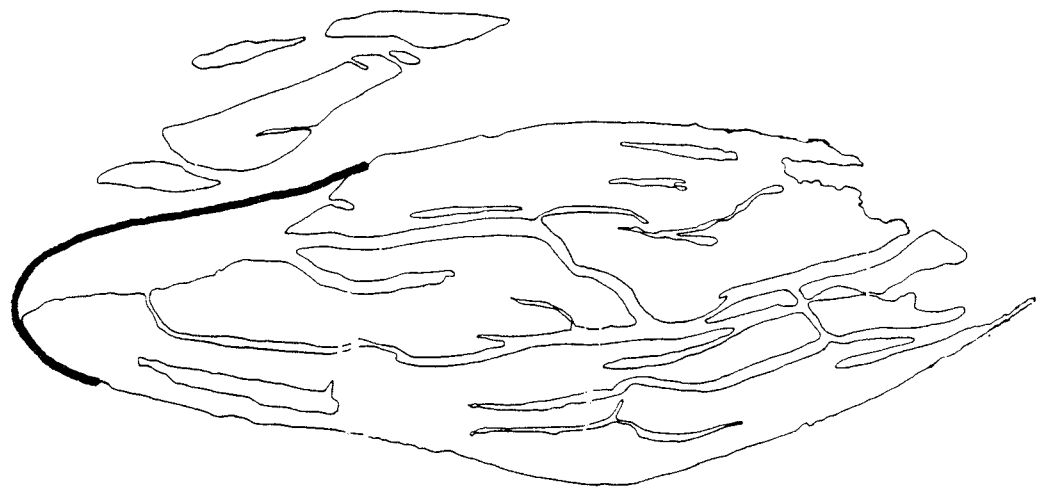


Figure 12

DIKE ALIGNMENTS C AND D



ALIGNMENT C



ALIGNMENT D

Figure 13

dike would be constructed similar to Alignment A, but would not extend as far up river (i.e., R.M. 277.3), and it would have a total length (10,930 feet) 1,710 feet shorter. Alignment C would include a 10,100 foot long structure, with a bull nose identical to Alignment B, except that it would connect to the middle island of the Island 461 group. In Alignment D, there would be a 3,960 foot long dike structure extending upstream to R.M. 277.2.

For the following reasons, the upstream dike configurations of Alignments C and D were dropped from serious consideration. Alignment D, while affording sediment protection to the island and (in combination with other features) some potential for water control, would not result in an important contribution to off-channel water habitat. Alignment C, like Alignments A and B, addressed all of the planning objectives, and at a lower cost (since portions of the structure would be constructed either on dry ground or in shallower open water areas). However, Alignment C was considered infeasible to construct due to the very shallow water conditions prevailing in the mid-Island 461 location. Unlike alignment B, Alignment C would be constructable only during high water periods which would cause logistical problems in carrying out contract work. Another drawback to Alignment C was that it would have considerably less off-channel water habitat (142 acres) compared to either Alignment A (239 acres) or Alignment B (204 acres).

Considerable savings in dike construction would be achieved with Alignment B over Alignment A (TABLE 7). This cost savings (at a dike height of 453 NGVD) would be on the magnitude of $728,000 (35 percent less). This saving results from the comparatively shallower water depths in the vicinity of Alignment B. Also, Alignment B compared to Alignment A would result in a substantially reduced dike cost per acre ($2,081 less). The acreage provided by Alignment B was only slightly less than that provided by Alignment A. Alignment B was also believed to be hydraulically superior to Alignment A, deflecting the maximum amount of sediment, and minimizing the development of new deposits immediately upstream and downstream of the dike. Consequently, Alignment B was selected.

3. Dike Height. Optional dike crown elevations of 451, 453, and 455 NGVD, were considered.

An upstream 451 NGVD elevation, although providing considerable sediment reduction potential (90 percent, TABLE 8), was not considered sufficiently effective on the upstream portion from a maintenance standpoint to withstand the effects of ice attack, wave wash, debris, and potentially strong flood currents. Based on years of District field experience with river regulation works, it was judged that a 453 NGVD structure for the bull nose dike segment was the lowest engineeringly stable structure. From TABLE 8 it is also clear that there is still a significant increase in sediment reduction (8 percent) to be achieved by raising the structure from 451 NGVD to 453 NGVD, while far less significant gains are made in raising the structure to 455 NGVD. The 453 NGVD dike elevation, at the upstream end of Pharrs Island, would be exceeded at an estimated frequency of 2.1 years. The local sponsor has concurred in the selection of a 453 NGVD elevation.

4. Other Dike Considerations.

a. Overbuild/Geogrid Fabric/Material Loss Reduction. Past experience with regulatory works structures has shown that most structure settlement occurs during, not after construction. For this reason, it appeared feasible to eliminate overbuild from the project's dike design. After additional evaluation of the site specific substrate conditions, it was also decided that geogrid foundations stabilization fabric would not be used.

TABLE 7

COMPARISON OF DIKE OPTIONS VS COST-EFFECTIVENESS

Alignment[1/]	Off-Channel Water Acres	Dike Stone Fill (Tons)	Total Dike Stone Cost ($)	Dike Stone Cost Per Acre ($ Per AC)
A	239	296,000	2,072,000	8,669
B	204	192,000	1,344,000	6,588

1/ The two alignments are comparable, that is, they are both built to a design elevation of 453 NGVD, and both include overbuild, geogrid fabric and a material loss reduction of 25 percent. The dike includes both the bull nose dike and the trail dike segments.

TABLE 8

SEDIMENT REDUCTION VS STRUCTURE ELEVATION 1/

Downstream end (RM 275.5)		Upstream end (RM 277.5)	
Crown Elev. (NGVD)	Sediment Reduction (%)	Crown Elev. (NGVD)	Sediment Reduction (%)
450	90	451	90
451	96.7	452	96.7
452	97.8	453	97.8
453	98.7	454	98.7
454	99.2	455	99.2

1/ The sediment reduction values are based on decreased time duration that the island will be exposed to sediment deposition. The depicted relationships take into account the water elevation differential between the upper and lower end of the island (approximately 0.5 - 0.7 foot drop in water level) during floods.

It was also determined that with additional monitoring of the contractor's placement of the dike material that material loss could be reduced from 25 percent to 20 percent. The net effect of eliminating overbuild and geogrid fabrid and of reducing material loss was considerable, reducing dike construction costs by 25 percent.

b. Dike Length. The lower end of the trail dike was initially established as the downstream most point of the water control levee (i.e., 10,930 feet for a water-based rock levee design and 10,200 feet for a land-based earthen levee design). To further streamline Alignment B, consideration was given to reducing the total length of the trail dike. Hydrologic analysis determined that it is feasible to limit the formation of a sediment plug at the entrance to the project's backwater by shortening the trail dike by as much as 1,500 feet. This could be done with or without a kicker device at the end of the trail dike; however, it was believed that a structure with a kicker would be more effective, and would be less likely to require future O&M dredging. On the other hand, it was also determined that while the cost of a longer trail dike was greater, the cost per acre of off-channel water habitat (FIGURE 14) was less for a longer dike. In recognition that environmental management is the main intent of the UMRS-EMP, the District opted for the larger trail dike (consistent with the selected levee design) which provides a larger scale, but more cost-effective management option.

c. Dike Stone Type. The dike structures would be susceptible to river currents, ice flows and floodborne debris. Accordingly, the dike would need to be shielded with large, heavy grade stone A. The bullnose portion of the dike would need to have a core constructed of finer grade stone (gravelly-red clay) to reduce the movement of sediment laden waters through the dike structure.

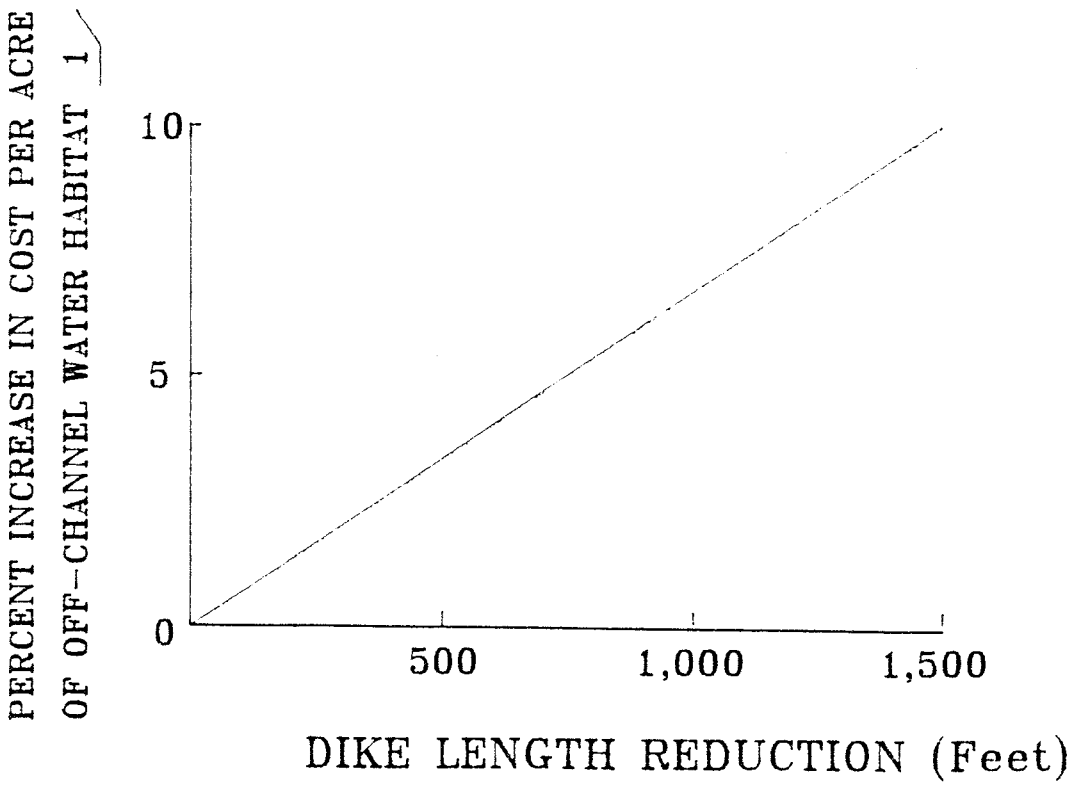
d. Dike Slope/Width. The dike would require standard 1 vertical on 2 horizontal side slopes. The crown width was established as 6 feet. This width was based on the District's prior experience with the structural effectiveness of regulatory structures. The base width of the structures would be variable depending on the river bottom elevation.

(c) Levee. The Draft DPR proposed a water control system for Pharrs Island that included a downstream rock levee extending from the island into the river (FIGURE 15). Corps internal review comments on the DPR prompted a computer model study to better assess the potential for water and sediment seepage problems relating to this structure. The model revealed that even with an essentially impervious levee core (gravelly-red clay), significant amounts of water movement (but not sediment) would still occur. This water would move into and out of the wetland area as underseepage thru a predominately sand river bottom. Thus, a rock levee sediment/water regulation concept was not viable.

As an alternative, a predominately land-based levee design (FIGURE 15) was formulated (consisting of earthen material in higher sections, and gravelly-red clay in slough depression areas). The design would consist of three major segments of low profile levee, and several smaller slough closure segments. These segments would link together existing areas of natural levee along the island's perimeter. One-half of the levee system would consist of natural levee, and one-half of new levee.

The alignment for the new segments was determined by taking into account the following locational criteria: The alignment should (1) take advantage of as much of the island's natural levee as possible, (2) capture as much of the island's interior wetlands habitat as possible, while maintaining at least a 500-foot silt/clay seepage barrier riverward of the downstream levee segment, (3) mimic the hydraulically more stable bullet-shaped configuration of the

ALIGNMENT B
DIKE LENGTH VERUS COST-EFFECTIVENESS



1/ The cost considered both the bull nose and trail segments of the dike structure. Costs excluded overbuild and geogrid fabric, and material loss was reduced to 20 percent.

Figure 14

LEVEE CONFIGURATIONS

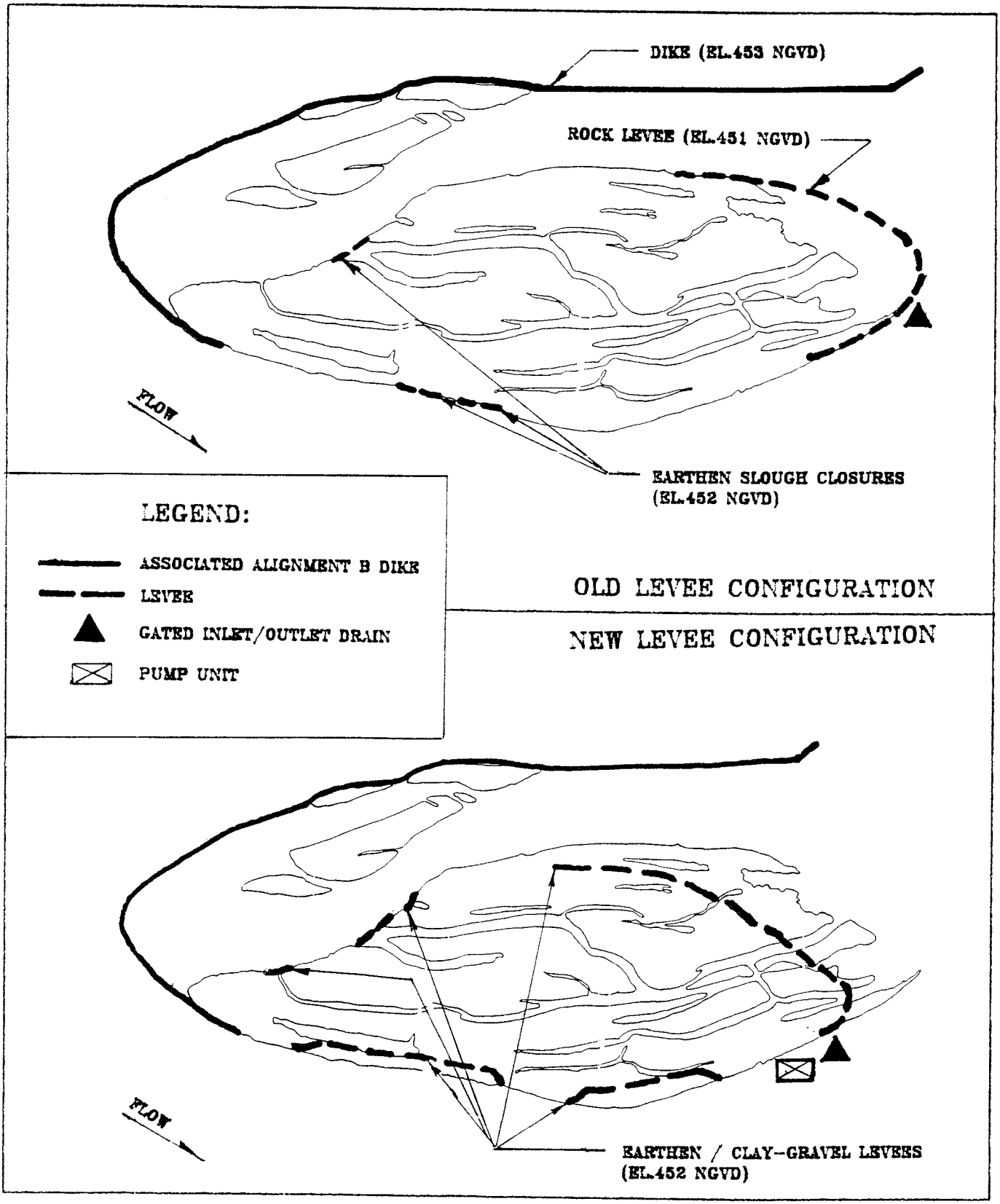


Figure 15

existing island, (4) be routed so as to take advantage of existing higher ground elevations, thereby minimizing levee costs, and (5) along the major levee segments, maintain at least a 150-foot tree buffer with the shoreline to avoid the potential for impacts to eagle perch sites.

A crown elevation of 453 NGVD was selected for upstream levee segments, and a 452 NGVD was selected for downstream levee segments. There are four reasons for the selection of these elevations, (1) during a flood, a 0.5 - 0.7 foot slope difference will occur between the upper and lower end of the island, thus a 453 elevation structure at the upper end has the same sediment reduction capability as a 452 elevation structure at the lower end of the island (TABLE 8), (2) the elevation of the natural levee is approximately 453 NGVD, (3) MDOC has recommended a 451 elevation water level for the island management unit, and the District has confirmed (TABLE 9) that a 451 elevation would maximize the island's total area with a waterfowl preferred water depth of less than 2 feet deep, and (4) at least one-foot of free board was deemed desirable from an engineering standpoint.

This revised levee system would necessitate the use of a pump in addition to the water control provided by a gated culvert structure. The gated culvert pipe will permit the uptake of water to the elevation of normal pool (449 NGVD), but additional water input to achieve a 451 NGVD elevation must be accomplished via a pump.

The project levee system will be exceeded by flood waters at an estimated frequency of 2 years.

The WHAG analysis (FIGURE 16) showed that the single major contributor to Plan D's waterfowl habitat improvement is from the water control and sediment protection system of which a levee is a key component. A levee structure would result in a net gain over the no action plan of +100 AAHU's, with an annual cost per AAHU of $520.

(d) Interior Dredging. It was judged that the minimum width and depth of a channel that would provide for adequate water delivery and drainage, fish movement, and O&M service was a ditch 25 feet wide and 3 feet deep at normal pool. At the urging of MDOC, several fish refuges were placed along the ditch system. Each segment would be 6 feet deep at normal pool (8 feet deep after a 451 NGVD interior pool raise), 50 feet wide and 500 feet long. They were placed near the center of the island to minimize the potential for water seepage to these areas from the river. Hydraulic dredging was considered preferable over that of mechanical dredging. The mechanical side casting of material would have problems in lacking containment, in being susceptible to bank slumping, and in its obstruction of wetland drainage. Hydraulic dredging, on the other hand, could be implemented in a manner that would avoid these problems.

(e) Bermed Disposal Area. Dredge materials would be contained by the construction of two 5-foot high earthen ring retention structures. Plates 2 and 3 show the location and configuration of the two selected disposal sites. Site location criteria used were (1) the areas must be within reach of typical hydraulic dredging equipment, (2) the areas should have a fair quantity of on-site borrow material for the construction of the berms, (3) the areas should be kept large to reduce the berm length to fill area ratio, (4) sites must collectively furnish 10 acres of fill storage area, and (5) older forested areas should be avoided, particularly near the shoreline, so as to safeguard eagle perch trees.

TABLE 9

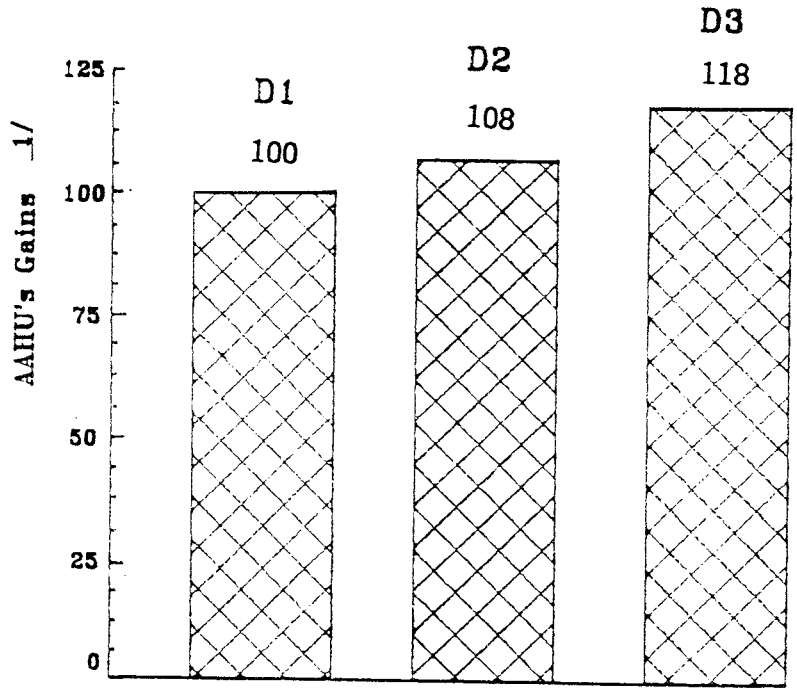
WATER DEPTHS VS WATER LEVEL HEIGHT

Top Elevation	Acres At Depth					Total Acres Flooded
	>1′	1′-2′	2′-3′	3′-4′	>4′	
449	4.2	4.2	4.2	12.7	0.0	25.3
450	88.7	4.2	4.2	4.2	12.7	114.0
*451	74.4	88.7	4.2	4.2	16.9	188.4
452	29.1	74.4	88.7	4.2	21.1	217.5
454	32.8	29.1	74.4	88.7	25.3	250.3
455	0.7	32.8	29.1	74.4	114.0	251.0

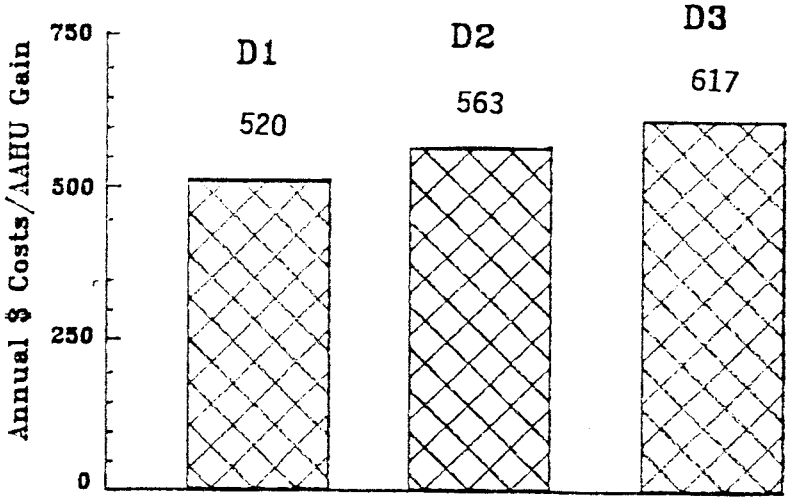
* Selected management elevation, this elevation maximizes the habitat area with water less than 2 feet deep.

PHARRS ISLAND HREP
MALLARD
PLAN D ANNUAL HABITAT GAINS AND COSTS

HABITAT GAINS



COSTS



1/ **AAHU's For All Habitat Types Combined; Assumes Available Moist Soil Seeded To Millet/Smartweed During O&M**

PLAN D

D1: Water Control Feature Only
D2: Water Control And Borrow Features
D3: Water Control, Borrow and Clearing Features (Complete Plan)

FIGURE 16

For the following reasons, it was decided that most trees at the disposal sites would be cleared: (1) most of the trees would have to be removed to provide the heavy equipment with enough room to build the retention berms, (2) the placement of dredged material could kill trees left standing, and (3) the higher elevation created by the disposal material affords an opportunity to incorporate some high food value wildlife plantings (e.g., mast bearing trees such as pin oaks and pecans). Some of the larger trees could be left as future snags, affording nesting cavities for a number of wildlife species. This feature would result in a minor reduction in the overall value of the site for waterfowl, but with mast-tree production, it would furnish improved habitat conditions for certain other species such as deer and turkey.

(f) Drains.

1. Dike Flow Control Structure. Several methods were investigated as a means of allowing a continuous flow of fresh water to enter the off-channel water area; these were dike notching, multiple culvert pipes, and pumps. However, based on the subsequent input of MDOC and St. Louis District fisheries biologists, a decision was made to drop this measure from further consideration. The rationale for this decision was as follows: (1) Dissolved oxygen (DO) is not generally a problem in waters greater than 7 feet average depth, the average depth of the off-channel water area would be 8-10 feet at normal pool; (2) a control structure may not provide a significant flow capability due to the flat slope of the area and pooled summer condition; (3) increasing water input with pumps or by using aeration devices, while engineeringly possible, would have high dollar costs (construction and O&M costs) relative to the biological benefits derived; (4) the dike would occasionally be overtopped and the off-channel water refreshed; (5) if DO did become a problem, a solid dike design would not preclude the placement of a flow control device at some future date; (6) the lower end of the off-channel area is open to the main river, thus permitting freshwater to back in at higher river stages.

2. Levee Inlet/Outlet Drain. In combination with a levee and interior dredging, this measure is an integral part of water regulation.

The selection and design of a sluice gate for the site was based upon such factors as maintenance and operating convenience, function, and extended service life. Since the sluice gate would be exposed to ice flows and floodborne debris, a gatewell was judged necessary to protect operating mechanisms and to facilitate maintenance.

When the navigation pool is "on tilt", the gated drain would be opened to release interior water and then reclosed as the river again rises. Thus, a progressively greater drawdown could be achieved as the opportunity arises. With the area drained, moist-soil areas could then be seeded. The subsequent flooding of a matured plant crop could be achieved by the reverse process. That is, the gate would be alternately opened and closed to take on sufficient river water to reach normal pool (449 NGVD). MDOC would then mobilize the portable pump to further raise the water to elevation 451 NGVD.

The culvert was sized to evacuate the ponded water in a reasonable time. Due to the potentially short time period the river could be at the minimum elevation, 24 hours was used as the evacuation period. A 36-inch pipe was found adequate for this criteria. For head differentials of 1 - 2.5 feet, pipe velocities will range from 5-8 feet per second. A riprap blanket of 300-pound top size stone for 10 feet upstream and downstream of the culvert would be needed to prevent erosion. The pipe invert was set at elevation 446.5 NGVD, approximately equal to the invert of the slough channel designed to

drain the interior waters. The culvert could also serve to help fill the interior area when the levee is forecasted to overtop. Assuming a one to two foot head differential, the culvert would be able to pass over 100 acre-feet per day to the interior. To ensure substrate stability, geogrid foundations stabilization fabric material would be needed beneath this drain structure.

Construction techniques were considered which would allow the drains to be placed without having to dewater the site completely. None of these would assure proper compaction of material around and under the pipes; therefore, these techniques were discarded in favor of conventional construction using cofferdams and sumping, avoiding potential future maintenance costs.

(g) Pump. In coordination with MDOC, a decision was made to adjust the maximum water level from the 449 NGVD recommended in the Draft DPR, to 451 NGVD. The main reason for this change was to offset the acreage reduction caused by shifting from a water-based to a land-based levee system. To raise water levels above normal pool stage would require a pump.

The size of a pump depends on the time necessary to fill the island interior to the desired elevation of 451 NGVD. Because of a number of EMP projects proposed or planned for construction in the Pools 24, 25 and 26 area, the sponsor desires a single large pump which could fill one EMP area, and then be floated to a different site to repeat the process. As most of the areas would require filling in the September-October time frame, the sponsor has suggested that an adequate pump size would be 25,000 GPM. MDOC is also interested in reducing pumping time so that it can reduce the time demands on its limited field management staff. MDOC has requested that the pump unit be trailer mounted. This would make possible the storage of the unit within a building during non-use periods, and would also facilitate the transport of the unit to the island via an MDOC provided barge. The barge (25' X 55') would be moved by a pushboat (the state may be able to obtain a pushboat being surplused by the District) or other motorized craft. Trailer mounting the pump, rather than permanent barge mounting the unit, has the advantage of freeing up the barge for other management tasks on the river.

District analysis shows that the Pharrs Island interior, from elevation 449 to 451 NGVD, could be filled in two days with a 28,000 GPM (63 CFS) pump. However, the District believes that it would be more prudent to use a smaller 15,000 gpm unit (4 days fill time). This is said in view of the fact that (1) it will be a number of years before all of the HREP projects in need of such pumps will be in place, (2) 15,000 GPM is the largest size trailer mounted pump commercially available, and (3) the purchase of an additional 15,000 GPM unit later on would approximate the 28,000 GPM capacity unit desired by MDOC, and would have the added advantage of providing some back-up potential in the event that one unit should breakdown. This above stated rationale has been explained to MDOC and the Department concurs with this phased approach to pump acquisition.

(h) Boat Pullover. This measure was accepted. It represents the only means identified for gaining access to the island's interior wetlands.

(i) Borrow Areas. It was decided that levee borrow areas should be located as close to the landside toe of the levee segments as possible to minimize haul costs. Due to variation in depth to the water table, the depth to which particular borrow sites could be excavated would vary from 0.5 to 1.5 feet in depth. These borrow sites were determined to be suitable for post-construction use as additional moist soil habitat areas. The addition of on-

site borrow pits (a necessity for a cost-effective project) adds a further +8 AAHU's to the project (FIGURE 16). The annual cost per AAHU for this feature is $1,102.

(j) Vegetation Removal. This measure would effectively increase the total amount of non-forested wetland at the project site. The increase in Plan D HU's resulting from this feature is +10 AAHU's (FIGURE 16) at an annual cost of $1,202 per AAHU. While the incremental cost per acre increases slightly, the measure was included, since it would contribute to a much better balance between the amount of flooded forest and flooded non-forested habitat (i.e., it would greatly improve habitat diversity).

(k) Cedar Trees. The habitat gains, including this feature, are not great (2 AAHU's) but the $/AAHU is also relatively low ($563). MDOC strongly supports the inclusion of this measure. For these reasons, this measure was accepted.

(l) Mast Tree Plantings. The placement of mast trees at the disposal sites, would provide some habitat improvement benefits (not quantified) for such wildlife species as deer and turkey.

(5) Summary Comparison. TABLE 10 provides a summary comparison of the enhancement potential of each project alternative plan and its component enhancement features. Plan D (the Selected Plan) clearly provides the greatest overall enhancement contributions.

6. SELECTED PLAN WITH DETAILED DESCRIPTION.

a. Plan Components. The following is a general description of the Selected Plan. Specific features of the plan are listed in TABLE 11 and are depicted in FIGURE 9 and Plates 2 and 3.

To retard the deposition of sediment into the project area, and to provide additional backwater habitat, a rock dike would be constructed. The upstream end of the dike would be bull-nose shaped, and would then trail in a southeasterly direction to the downstream end of the project.

To provide a means for controlling water levels on the island, a levee would be constructed. This levee would supplement existing segments of natural levee along the island's perimeter. This construction would bring the entire island perimeter up to a similar grade. In addition to water control, the levee system would also help provide sediment protection to the island, and would shield the head of the island from erosional forces. The new levee would consist of a long downstream segment, two intermediate length segments located along the navigation side of the island, and a number of small slough closure segments at the head of the island. A vegetative buffer would be included between the levee segments and the island's shoreline, to safeguard eagle perch trees. Borrow areas would be required just landward of the levee construction zones; but after project construction they would serve as non-forest waterfowl management sites. Younger-aged forest vegetation would be cleared from certain lower elevation areas to further expand non-forested wetland habitat.

In addition to the levee, a culvert drain with a gatewell protected sluice gate, and a portable pump would be needed for water control on the island. Installation of the gated drain would be accomplished using a cofferdam; this structure would be used primarily for the discharge of interior waters and for

TABLE 10

COMPARISON OF ALTERNATIVES - ENHANCEMENT POTENTIAL

Goal	Objective	Project Alternative Enhancement Feature	Unit of Measure	Potential (Annualized)			
				Existing	Without Project (Plan A)	With Enhancement 2/ Project Plan B	With Enhancement 2/ Project Plan D
Enhance Wetland Habitat for Migratory Waterfowl	Decrease sedimentation into island wetlands	Large-Scale Excavation	Inches/Year of Sedimentation	1-2 (Great II, 1980)	1-2	.5-1	-
		Sediment Barrier Levee)		1-2	1-2	-	0.1
	Provide a means to control water levels on island independent of river stage	Gated Drain/ Levees/ Slough Dredging/ Pump Facilities	Graphed comparison between river stage and actual interior water levels achieved	No Difference (Interior wetland both at approx. 448.5 NGVD)	No Difference	No Difference	Difference (Interior wetland down to normal pool or below and up to 451.0 NGVD)
	Increase potential for reliable food production for waterfowl	Waterfowl Management Unit	Acres	101	33	33	153
	Increase total wetland value for migratory waterfowl (mallard)	All	Average Annual Habitat Units (AAHU's)	51	52	52	170
Enhance Aquatic Habitat for Slackwater Fishes	Increase quantity of river slackwater habitat (take into) account D.O. related effects)	Dike	Acres 1/	0	0	0	177
			D.O. (mg/)	>5	>5	>5	>5
	Reduce potential for backwater sedimentation	Dike	Inches per year	1-2	1-2	1-2	0.1
	Increase photic zone	Dike	Percent change from present	0	0	0	50
	Increase available cover along river	Cedar Trees	Percent surface area with cover	<10	<10	<10	25-50
	Increase total value for large slackwater fishes	All	AAHU's	162	133	153	194

1/ Includes Island 461 Slough habitat.
2/ Plan C not depicted, determined infeasible to implement.

TABLE 11

COMPONENTS OF THE SELECTED PLAN 1/

1. Dike - Consists of 2 segments of rock structure totaling 10,200 feet long. Structure would have a 6-foot crown width, an approximate 46-foot wide base, and 1 on 2 side slopes. Function is to deflect river sediments from project the wetlands complex. Structure also reduces water flow in backwater area.

   a. Bull nose dike segment - 6,750 feet long, crown elevation (453 NGVD) 4 feet above normal pool (elevation 453 NGVD), average height 10 feet above river bottom. Structure has an A-stone exterior protection with a gravelly-red clay interior for sediment thru seepage control.

   b. Trail dike segment - 3,450 feet long including a 300-foot kicker device at downstream end of dike, tapers from 453 NGVD to 449.4 NGVD, average height 12 feet high above river bottom. This segment of dike does not require special design for sediment seepage control.

2. Levee - A low profile structure (average height 2-4 feet) built to 452-453 NGVD with a 10-foot crown width and 1 on 5 side slopes. Low lying segments would consist of gravelly-red clay material, higher sections would be constructed of earthen material. Combined length of all levee segments is 8,255 feet. About five acres of forest would be cleared for the levee. Levee serves to supplement the island's natural levee system to bring entire island perimeter to a similar above pool grade, facilitating subsequent water control management on the island. The newly constructed levee would consist of the following segments:

   a. Lower Island levee segment - 3,950 feet long, structure is set-back more than 500 feet from the island's downstream shoreline to enhance water seepage control.

   b. Mid-Island segments - Includes an upstream segment, 1,760 feet long, and a 1,495-foot segment on the downstream end. Both segments tie into the island's natural levee at the shoreline, but otherwise extend 150 feet back from the shoreline to safeguard potential eagle perch trees.

   c. Upper Island slough closure segments - Includes four slough depression closures along the upper shore of the island totaling 1,050 feet.

3. Interior Dredging - 12,000 feet of shallow interior sloughs would be dredged up to 25 feet wide, and to a bottom elevation of 446 NGVD, to provide O&M access within island interior, and to facilitate drainage of the management unit to the river. Three 500-foot segments along this ditch system would be opened to a bottom width of 50 feet, with depth to 443 NGVD to serve as summer fish refuges.

4. Bermed Disposal Areas - Approximately 10 acres of trees would be cleared to provide for a bermed disposal area to receive and contain material dredged from the interior sloughs.

1/ See also FIGURE 9 and Plates 2 and 3.

TABLE 11 (CONTINUED)

5. Water Control Structure -

a. Gated Drain - A lower levee-based 36-inch culvert drain with a pneumatically operated sluice gate for the control of interior water levels.

b. Gatewell - A 60-inch diameter unit with an 18-inch concrete base to protect the sluice gate structure.

c. Cofferdam - A cofferdam would be used for placing the gravity drain; the cofferdam would subsequently be removed.

6. Pump - A trailer mounted 15,000 GPM portable pump for filling the interior island with water from 449 to 451 NGVD. The unit would be transported to the island via an MDOC provided barge.

Boat Pullover - A roller/pulley operated device mounted on the downstream levee to permit service boats to access the island's interior.

7. Borrow Areas - Forty-three acres of island to be excavated as a source of levee borrow material.

8. Vegetation Removal - Forty-six acres of woody vegetation to be removed from lower elevation areas (449-450 NGVD) to further expand non-forested wetland habitat.

9. Mast Tree Plantings - Ten acres of levee and disposal area habitat to be enhanced by the planting of mast trees such as pin oaks and pecans.

10. Cedar Trees - Cedar trees would be scattered over a 40-acre area of backwater to increase the amount of fish cover from an existing < 10 percent to > 25 percent.

the input of water up to the elevation of normal pool. A pump would be provided to enable the raising of water levels to an above normal pool elevation.

To facilitate the input and output of water, interior island sloughs would be deepened by dredging. In addition, three segments along this ditch system would be further widened and deepened to serve as summer fish refuges. Two areas would be cleared of forest, and its perimeter used to contain the material dredged from the slough.

To improve aquatic habitat cover within the new backwater area, cedar trees would be placed within the backwater and appropriately anchored. To permit the access of MDOC service boats (and at MDOC's discretion recreational craft) to the island's interior, a boat pullover device (i.e., a roller/pulley operated device mounted on the levee) would be provided.

b. Design Considerations.

(1) Subsurface Exploration Data. Fourteen reconnaissance overwater grab samples were obtained at the locations of the upstream bull nose dike, the downstream rockfill dike (previously proposed in the draft DPR), and the main interior slough. The deepest borings taken with the sampler were 10 feet. The foundation soils under the upstream bull nose dike are mostly medium to coarse sandy material. Foundations soils under the downstream rockfill dike consist of silts and some sandy materials. All field logs were recorded; however, soil classifications shown on the logs are from field identification only, and not from laboratory testing.

Thirty exploratory borings were taken on Pharrs Island itself, of these, ten borings were taken in response to modification of the original plan proposed for the island. The modified plan eliminated the downstream rockfill dike, and replaced it with an earthen and red clay/rock levee located along the downstream edge of the island. All borings were obtained using a hand auger, with the deepest boring taken to a depth of 10 feet. Field logs were taken and soil classifications were made from field identification only. Clay soils (CL, CH) were found in a majority of the borings taken. Occasional sand (SP) lenses (less than 12 inches thick) were encountered at various depths in several borings along the levee's centerline.

(2) Retention Embankment. The design for the dredged material retention embankment has been evaluated for suitability, settlement, and seepage. All earth embankment sections for the retention area will require at least 1 on 3 side slopes. All borrow material to be used for the construction of the retention levee will be obtained by excavating immediately adjacent to the retention area itself. Based on the site borings, the proposed borrow material, clay (CL or CH), has been determined to be suitable for embankment construction. All excavation for borrow material shall be a minimum of 10 feet from the interior toe of the embankment. An additional one foot of overbuild will be added to the height of the structure to account for any settlement during the life of the project. The retention embankment will be protected against overtopping by the development of a good grass cover, and by the stable side slopes of the embankment.

(3) Rockfill Dike. The proposed design of the upstream rockfill bull nose and trail dikes will meet stability and settlement needs (as shown in the geotechnical appendix of the report), as well as certain specific project requirements. These requirements include seepage control to reduce sedimentation, maintaining a fluctuating water level at various times of the year, and withstanding overtopping, ice action and water velocities. In order

to meet these requirements, the rockfill bull nose section of the dike will be composed of a gravelly-red clay material for seepage control, capped with a layer of graded stone "A" to minimize damage from overtopping wave action and river water velocities. Limited sediment seepage is considered to be acceptable, and it will not affect the performance of the project. Siltation over time will tend to further reduce seepage losses through the rockfill dike. Even with the above, it is still possible that a segment of the dike will experience seepage unacceptable for project operational requirements. If such a condition does occur, it may be necessary to cap the riverside slope of the rockfill dike with an impervious blanket. Such a blanket could be constructed on an as needed basis anytime during the life of the project. The construction of the rockfill levee will probably be done with a combination of earth moving equipment and a dragline. Some control of rock placement will be accomplished, or required, to avoid large areas of rockfill being placed with little or no fines.

(4) Earthen and Red Clay/Rock Levee and Slough Closure System. The proposed design of the downstream earthen and red clay rock levee meets both the stability and settlement needs, as well as project requirements. These requirements include maintaining a pool behind the downstream levee of the Pharrs Island system for several months at a time, reducing sedimentation on the island's interior, and withstanding overtopping. The earthen portion of the levee will be constructed of the semi-compacted clay soils obtained from adjacent borrow areas. An additional one foot of overbuild will be added to the height of the levee to account for any settlement during the life of the project. As protection against overtopping, the levee side slopes will be 1 vertical (V) on 5 horizontal (H) with grass cover over the crown and side slopes. At the slough closures, a riprap overflow section will be constructed to minimize damage over the entire levee system. Based on hand auger borings, the borrow material for earthen levee sections will be clays (CL and/or CH). Off-site borrow from a nearby quarry will be used to construct the red clay rock portion of the earthen levee system.

Stability analyses of the levee configuration described above indicate a stable levee section with a factor of safety (FS) greater than 2.0 for the after construction condition.

(5) Seepage Analysis and Recharge Conclusions. The seepage investigation began with interpreting the soils data collected from several soil exploration investigations. These investigations indicated the existence of impervious clays on the upper portion of the soil profile (top 3-5 feet) underlain by pervious soils (sand) (6-12 inches) underlain by more soft clays. Groundwater was usually 18 to 24 inches below the ground surface. Based on these findings, a typical soil profile was developed for the seepage analysis. The analysis determined both underseepage and through seepage for the levee configuration. It is estimated that the overall seepage for the downstream levee, approximately 3,900 feet in length, would be approximately 4,500 gallons per minute (GPM) for maximum (2 ft.) head conditions. Seepage elsewhere on the island was assumed to be negligible for the analysis.

In addition, water loss due to evaporation during the fall innundation period would be offset by the average rainfall for that time of year, and therefore it was not included in the analysis.

Based on the findings, recharge pumping to maintain the island's interior water elevation above normal pool would be necessary. It is estimated that the island would need to be recharged approximately 4 times during the fall season, for a total of 320 hours of pumping time using a 15,000 GPM pump.

c. Construction Considerations.

(1) Wintering Bald Eagles. For the most part, construction activities would be scheduled to take place outside of the winter months in order to avoid potential conflicts with wintering bald eagles. In addition, consideration will be given during the preparation of Plans and Specifications to sequencing construction activities in a manner that minimizes impacts to eagles. Specific restrictions relative to any sequencing will be included as part of the contract specifications. The contracting officer will ensure appropriate compliance.

(2) Historic Properties. Due to the island's dense woody vegetation, and the presence of recent alluvial sediment on the island's ground surface, a decision was made to instate archaeological investigations coincident with construction related earthmoving activities. A professional archaeologist would monitor all earthmoving activities for the presence of archaeological remains. If such remains are observed during this inspection, all earthmoving activities in the vicinity of the remains would be postponed until an archaeological investigation can be conducted. The written results of this evaluation would be forwarded to various state and Federal review entities.

(3) Permits. Appendix DPR-F provides a Clean Water Act Section 404(b)(1) Evaluation Report for the Pharrs Island project. This documentation is also being forwarded to the Missouri Department of Natural Resources along with a request for the state's Section 401 Water Quality Certification. A request for a permit to open air burn trees at the site will be submitted to the Missouri Department of Natural Resources prior to construction.

d. Operation, Maintenance and Rehabilitation.

The local sponsor will maintain and operate the project after completion. Maintenance is defined as the repair and replacement associated with hydrologic events (including minor storm and flood events) that do not exceed the level of design for the project. For Pharrs Island, this level of design has been designated as the top elevation of the rock dike and earthen levee structures (elevation 452 NGVD). (In the project reach of river, river stages would remain at or below this level more than 95 percent of the time.) Consequently, such operation and maintenance responsibilities shall include, but are not limited to, the following:

(1) The sponsor shall prepare annually a Management Plan which incorporates Operational Activities including water control and manipulation, plantings, day-to-day project observation, inspection, record keeping, visitor monitoring, vegetation control and planned maintenance activities. (This Plan shall be mutually agreed upon between the sponsor and the U.S. Army District Engineer in charge of the administration of the project and may be amended as necessary.) A tentative site regulation plan for water control is provided by FIGURE 17. This plan may undergo further coordination and refinement.

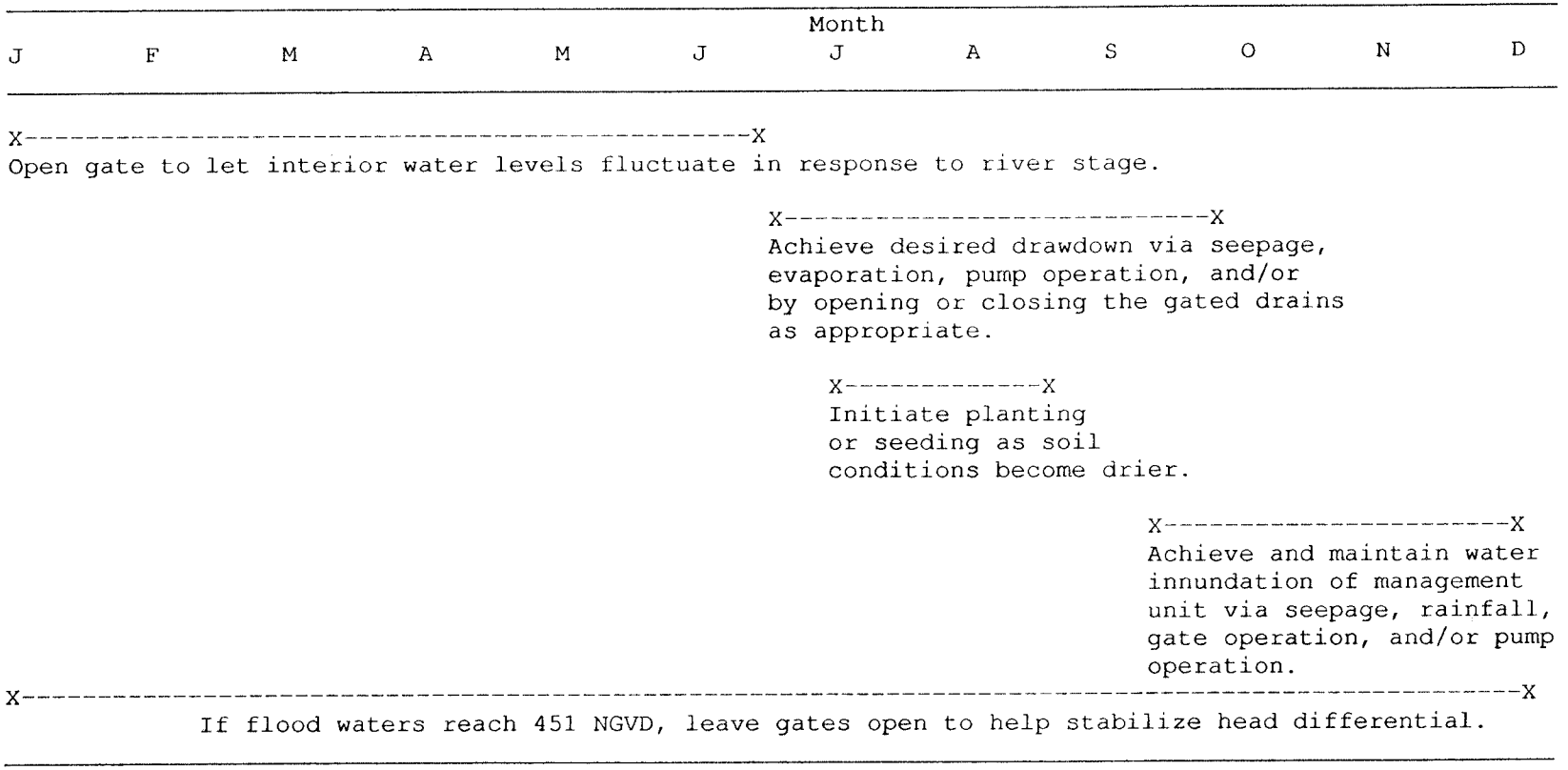
(2) The sponsor shall operate project features (such as the gate and pump) to insure accomplishment of the Management Plan.

(3) The sponsor shall not collect any fees for public use of these lands for hunting or fishing.

(4) The sponsor may use the project for the production of crops exclusively to provide food for wildlife, as permitted by current agreements regarding General Plan Lands.

FIGURE 17

SITE REGULATION PLAN



NOTE: Summer drawdown is somewhat delayed so fish spawning & rearing benefits on the interior of the island can be maximized.

(5) The sponsor shall provide all operation and maintenance of project features in accordance with manufacturer data and Corps of Engineers recommendations. (The Corps of Engineers will provide manufacturer O&M requirements of all manufactured components of the project, as well as "As Built" drawings and shop drawings for all facilities constructed, as soon as possible after construction is complete.)

(6) The sponsor will perform routine levee maintenance, which includes mowing the levee and 10 feet beyond the toe two times per year; removal and/or control of all vegetation from the levees; removal of all debris, regardless of source, from the levees, reshaping of the surface of the existing levee slopes to eliminate gullies, and/or shallow depressions resulting from the normal "peeling action" that occurs from overtopping and/or wave action; rodent control; inspection; and litter removal.

(7) The sponsor shall provide routine structural maintenance, which includes painting of metal items; removal of vegetation from expansion, contracting, and monolith joints; day-to-day inspection; sealing and caulking of various joints; vandalism obliteration; and road grading.

(8) The sponsor shall provide routine mechanical/electrical maintenance, which includes lubrication, oil changes, inspections of equipment, touch-up painting, testing of equipment, record-keeping, and vandalism repairs.

The Corps of Engineers will inspect the project at least annually to determine the status of operation and maintenance being performed by the sponsor. Representatives of the sponsor will be invited to attend. The inspection will follow procedures outlined in the latest issue of DIVR 1130-2-304 entitled "Project Operations - Maintenance by Local Interests." The report following this inspection will serve as a basis for the sponsor and/or Corps of Engineers (in the case of rehabilitation) to make required repairs and/or changes to the Operation and Maintenance procedures. In addition, the Corps of Engineers may also make periodic inspections at various intervals for the purpose of determining compliance with the approved Annual Management Plan by the sponsor.

The Corps of Engineers will provide for all rehabilitation of this project. Rehabilitation shall be considered any reconstructive work needed in excess of estimated annual O&M as a result of specific storm or flood events which exceed the design event. For the Pharrs Island project, rehabilitation features consist of the following:

(1) Interior ditch dredging consisting of subsurface excavation of sediment deposited as a result of a hydrologic event exceeding the design event and necessary to allow for wildlife habitat and other environmental features of the original project design;

(2) Rock dike repair of damaged areas within the zone of riprap protection which requires the purchase of new riprap and/or bedding material, and;

(3) Earthen embankment repair consisting of repair of damaged areas that extend into the compacted impervious portion of the levee and including the obtaining, placement and compaction of suitable impervious material in the

damaged areas. (Damaged areas extending less than four inches below the "as-design" surface of the earthen embankment are considered routine levee maintenance.)

The proposed project is located on lands managed as a National Wildlife Refuge by MDOC under a Cooperative Agreement with the USFWS. The USFWS Regional Director and the District Commander will sign a Memorandum of Agreement for Enhancing Fish and Wildlife Resources addressing the relationships, arrangements, and general procedures under which the USFWS and the Department of the Army will operate in constructing, operating, maintaining, repairing, and rehabilitating the project.

Upon completion of construction, an Operation and Maintenance Supplement to the Memorandum of Agreement will be prepared and signed by both the USFWS and the District Commander. This Supplement will provide specific requirements for operation, maintenance, repair, and rehabilitation of the project; as-built drawings; shop drawings; manufacturer's operation and maintenance manuals; and, specific procedures for project review and inspection, rehabilitation, abandonment, improvements or alteration.

e. Project Performance Evaluation Monitoring Plan.

The purpose of this section is to summarize the monitoring aspects of the project. The principal types, purposes, and responsibilities of project monitoring are presented in TABLE 12. The plan for post-construction qualitative field observations and quantitative measurements are presented in TABLES 13 and 14, respectively. To the extent possible, methods will be standardized with the methods used for other Habitat Rehabilitation and Enhancement Projects, and with the Upper Mississippi River System - Long-Term Resource Management program, in general.

f. Real Estate Requirements.

(1) General. Project features are to be located on public lands originally acquired through the Corps of Engineers in fee for the 9-foot navigation project, and later designated as General Plan lands. These lands are managed by MDOC in accordance with the General Plan, dated 8 March 1961, approved jointly by the Assistant Secretary of the Army, the Secretary of the Interior and the Director, MDOC; and as prescribed in a Cooperative Agreement dated 14 February 1963, between the Department of the Army and the Department of the Interior. The principal objective of this General Plan and Cooperative Agreement is to provide optimum habitat for wildlife species. Secondarily, the General Plan lands also provide water-related recreation opportunities, such as sport fishing, waterfowl hunting, and trapping.

Construction access will be made available to the contractor using a road right-of-way, which is presently incorporated in a Corps commercial concession lease. Requirements for construction access will be coordinated with the lessee prior to contract award.

(2) Operation, Maintenance and Rehabilitation Agreement. Since the proposed project is located on lands managed as a National Wildlife Refuge, it qualifies under Section 906 (e) of the 1986 WRDA, 100 percent Federal implementation funding. The USFWS and MDOC will assure that operation and maintenance (including repair and replacement) will be accomplished in accordance with Section 906 (e). Annual operation and maintenance costs are estimated at $19,563. A Supplement to the Operation, Maintenance and

TABLE 12

MONITORING AND PERFORMANCE EVALUATION MATRIX

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions.	USFWS	USFWS (EMTC)	LTRM	Leads into pre-project monitoring; defines desired conditions for plan formulation.
Pre-project Monitoring	Identifies and defines problems at HREP site. Establish need for proposed project features.	Sponsor	Sponsor	Sponsor	Attempts to begin defining baseline. See DPR Sections 2 and 3.
Baseline Monitoring	Establishes baselines for performance evaluation.	Corps	Field station or sponsor thru Cooperative Agreements or Corps.	LTRM	Appendix DPR-C shows the locations of and sites for physical/chemical data collection. Actual data collection will be accomplished during P&S phase. For biological baseline information, see Appendix DPR J.
Data Collection for Design	Includes identification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	Comes after the fact sheet. This data aids in defining the baseline. See DPR Sections 4-7 and 13.
Construction Monitoring	Assesses construction impacts; assures permit conditions are met.	Corps	Corps	HREP	Environmental protection specifications to be included in construction contract documents. Inter-agency field inspections will be accomplished during project construction phase.
Performance Evaluation Monitoring	Determines success of project as related to objectives.	Corps (quantitative) sponsor (field observations).	Field station or sponsor thru Cooperative Agreement, sponsor thru O&M, or Corps.	LTRM	Comes after construction phase of project. See DPR Section 13.
Analysis of Biological Responses to Projects	Evaluates predictions and assumptions of habitat unit analysis. Studies beyond scope of performance evaluation, or if projects do not have desired biological results.	USFWS	USFWS (EMTC)	LTRM	This item and first monitoring activity item are the linkage between LTRM and the HREP.

TABLE 13

ANNUAL POST-CONSTRUCTION FIELD OBSERVATIONS 1/
(Sponsor Contributions to Performance Evaluations)

Goals	Objectives	Unit of Measure	Enhancement Feature	Field Observation
Enhance Wetland Habitat for Migratory Waterfowl	Decrease sedimentation into island wetlands	Inches/Year	Levee	Evidence of recent sediment deposition
	Provide a means to control water levels on island independent of river stage	Graphed comparison between river stage and actual interior water levels achieved	Levee, Gated Drain, Ditching, Pump	Evidence of a water stage differential based on recorded stage data at the site
	Increase reliable food production for waterfowl	Acres	Waterfowl Management Unit, Cooperative Agreement	Presence of waterfowl, survival of plantings
	Increase total wetland values for migratory waterfowl	Habitat Units (HU)	All	Annual presence of waterfowl
Enhance Aquatic Habitat for Slackwater Fishes	Increase quantity of river slackwater habitat (take D.O. into account)	Acres, D.O. (mg/l)	Dike	Condition of dike, evidence of fish kills
	Reduce potential for backwater sedimentation	Inches/Year	Dike	Evidence of recent sediment deposition
	Increase photic zone	Percent change from present	Dike	Observed visual clarity of backwater as compared to adjacent river water
	Increase available cover	Percent surface area with cover	Cedar Trees Structures	Condition of structures
	Increase total habitat values for slackwater fishes	HU	All	Evidence of fishing success

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

TABLE 14

POST-CONSTRUCTION QUANTITATIVE MEASUREMENTS

Goals	Objectives	Unit of Measure	Enhancement Feature	Monitoring Plan	Monitoring Intervals (Years) 1/
Enhance Wetland Habitat for Migratory Waterfowl	Decrease sedimentation into island wetlands	Inches/Year	Levee	Perform survey cross-sections for sedimentation	5
	Provide a means to control water levels on island independent of river stage	Graphed comparison between river stage and actual interior water levels achieved	Levee, Gated Drain, Ditching, Pump	Corps river stage data to be plotted against sponsor provided interior water stage data, and against project expected interior stage data	5
	Increase reliable food production for waterfowl	Acres	Waterfowl Management Unit, Cooperative Agreement	Perform vegetation survey	5
	Increase total wetland values for migratory waterfowl	Habitat Units (HU)	All	With assistance from MDOC, Corps will perform a habitat analysis using the Missouri WHAG methodology	1, 5, 15, 50

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

TABLE 14 (CONTINUED)

Goals	Objectives	Unit of Measure	Enhancement Feature	Monitoring Plan	Monitoring Intervals (Years) 1/
Enhance Aquatic Habitat for Slackwater Fishes	Increase quantity of river slackwater habitat (take D.O. into account)	Acres, D.O. (mg/l)	Dike	Corps to determine functional acres achieved. Periodic D.O. testing	5
	Reduce potential for backwater sedimentation	Inches/Year	Dike	Perform survey cross-sections for sedimentation (soundings)	5
	Increase photic zone	Percent change from present	Dike	Perform visibility readings with Secchi disk	5
	Increase available cover	Percent surface area with cover	Cedar Trees	Perform cover type survey	5
	Increase total habitat values for slackwater fishes	HU	All	With assistance from MDOC, the Corps will perform a habitat analysis using the Corps developed AHAG	1, 5, 15, 50

Rehabilitation Agreement will be developed during the construction phase of the project which will more specifically define the operation and maintenance requirements.

The final DPR (APPENDIX DPR-A) provides the following:

(1) a letter from the USFWS which expresses support for the project, and assures that O&M will be accomplished;

(2) a letter from the MDOC indicating support for the project, and a statement that the agency will cooperate with the USFWS to assure the O&M is accomplished as described in the DPR; and

(3) a draft OM&R Agreement between the District Commander, St. Louis District and the Regional Director, USFWS.

g. Cost Estimates.

(1) Construction.

(a) General. A detailed estimate of the initial construction costs is presented in TABLE 15. Project costs were optimized through careful consideration of construction costs versus the environmental benefits of each potential project feature. This process included consideration of dike and levee alignment, dike and levee height, water control method and drain placement. The total project construction cost differs from that indicated in the Fourth Annual Addendum. The reason for this difference is that the costs presented in the addendum were based on preliminary design information. The present estimate was developed using previous cost estimates, current designs and quantity take-offs, recent bid abstracts for projects in the area, detailed cost estimates and estimator judgement. A PC spreadsheet program was used to prepare the baseline cost estimate with an appropriate contingency that was applied to each line item cost. The Price Level for this estimate is October 1989.

(b) Discussion.

1. Bottomline Cost Differential. Planning, Engineering and Design and Construction Management have been more clearly defined and separated. In the estimate that was enclosed with the draft Definite Project Report, these items were simply percentages of the total construction cost. In addition, contingencies have been developed for each baseline cost item, rather than using an across the board percentage. Many new items have been added and for some other items quantities have been changed.

2. Reliability of Designs, Quantities, and Unit Prices. For the most part, the channels and canals work has been adequately quantified. However, some aspects are inherently difficult to quantify, and for that reason they have been assigned a higher contingency value. Items falling into this category include dewatering, sluice gate, boat pullover and embankment. Since the time of year for construction is not yet known, there is uncertainty as to the amount of dewatering that will be required. Sluice gates and embankments are features typically subject to many changes during project development. The haul distances for embnakment material are not yet well defined, and the wetness and difficulty of moving the material could affect cost. At the present time, only minimal design parameters have been established for the boat pullover device.

TABLE 15

PHARRS ISLAND INITIAL CONSTRUCTION DETAILED ESTIMATE OF COST
(OCTOBER 1989 PRICE LEVELS)

Cost Acct. No.	Description	Quantity	Unit	Unit Price	Estimated Cost w/o Contingencies	% Cont	Contingency	Total Estimated Cost
09.-.-.-	Channels and Canals							($1,920,000)
09.0.A.-	Mobilization, Demobilization and Preparatory Work	SUM	JOB	----	35,000	25	8,750	43,750
09.0.4.-	Bank Stabilization, Dikes and Jetties:							
09.0.4.B	Site Work							
	Clearing and Grubbing	105	Acre	2,500.00	262,500	15	39,375	301,875
	Embankment							
	Slough Closure Plugs (Gravelly/Red Clay Emb)	2,400	CY	6.00	14,400	30	4,320	18,720
	Earth Levees	11,500	CY	3.00	34,500	20	6,900	41,400
	Gravelly/Red Clay	25,100	CY	6.00	150,600	30	45,180	195,780
	"A" Stone	120,800	TON	7.00	845,600	20	169,120	1,014,720
	Slope Treatment							
	Riprap	1,300	TON	15.00	19,500	20	3,900	23,400
	Bedding Material	410	TON	15.00	6,150	20	1,230	7,380
	Drainage							
	Tensar Geogrid (under culvert)	50	SY	2.00	100	25	25	125
	Plastic Liner	400	SY	13.50	5,400	25	1,350	6,750
	Dewatering	SUM	JOB	-----	30,000	30	9,000	39,000
	Cofferdam-Graded							
	Stone C	3,050	TON	8.00	24,400	20	4,880	29,280
	36" Dia. Culvert Pipe	30	LF	50.00	1,500	15	225	1,725
	60" Dia. Gatewell w/Base	1	EACH	5,000.00	5,000	15	750	5,750
	Sluice Gate	1	EACH	12,000.00	12,000	30	3,600	15,600
	End Sections	2	EACH	500.00	1,000	15	150	1,150
	Hand Compacted Crushed Stone	220	TON	15.00	3,300	15	495	3,795
	Water Level Gages	SUM	JOB	-----	5,000	25	1,250	6,250
09.0.R.-	Associated General Items:							
09.0.R.B	Site Work							
	Boat Pullover	SUM	JOB	-----	5,000	50	2,500	7,500
	Deadmen (For Pump Docking Area)	2	EACH	5,000.00	10,000	25	2,500	12,500
	Cedar Trees and Weights	SUM	JOB	-----	10,000	25	2,500	12,500
09.0.R.Q	Mechanical							
	Power Unit	SUM	JOB	-----	100,000	25	25,000	125,000
	T-Connection	2	Each	2,000.00	4,000	25	1,000	5,000
	Misc. Materials	2	Each	1,000.00	2,000	25	500	2,500
	SUBTOTAL				1,586,950			
09.0.Z.-	CONTINGENCIES:						334,500	
	TOTAL							1,921,450
	CHANNELS AND CANALS ROUNDED TOTAL							1,920,000

TABLE 15 (CONTINUED)

Cost Acct. No.	Description	Quantity	Unit	Unit Price	Estimated Cost w/o Contingencies	% Cont	Contingency	Total Estimated Cost
12.-.-.-	DREDGING							($133,000)
12.0.A.-	Mobilization, Demobilization and Preparatory Work	SUM	JOB	-----	15,000	25	3,750	18,750
12.0.1.-	Disposal Areas:							
12.0.1.B	Site work							
	Retention Dike (20,900 CY)	SUM	JOB	-----	31,350	25	7,838	39,188
	Effluent Control Structure	SUM	JOB	-----	10,000	25	2,500	12,500
	Tree Planting	SUM	JOB	-----	5,000	25	1,250	6,250
12.0.4.-	Mechanical Dredging							
12.0.4.B	Site Work							
	Excavation and Disposal	12,800	CY	3.50	44,800	25	11,200	56,000
	SUBTOTAL				106,150			
12.0.Z.-	CONTINGENCIES						26,538	
	TOTAL							132,688
	DREDGING ROUNDED TOTAL							133,000
30.-.-.-	PLANNING, ENGINEERING AND DESIGN							($489,250)
30.A.-.-	PLANNING				67,000	0	0	67,000
30.B.-.-	ENGINEERING AND DESIGN PRIORTO APRIL				166,000	0	0	166,000
30.C.-.-	LOCAL COOPERATIVE AGREEMENTS				1,000	25	250	1,250
30.D.-.-	ENVIRONMENTAL AND REGULATORY ACTIVITIES				4,000	25	1,000	5,000
30.H.-.-	PLANS AND SPECIFICATIONS				150,000	25	37,500	187,500
30.J.-.-	ENGINEERING DURING CONSTRUCTION				10,000	25	2,500	12,500
30.M.-.-	COST ENGINEERING				11,000	25	2,750	13,750
30.N.-.-	CONSTRUCTION AND SUPPLY CONTRACT AWARD ACTIVITIES				10,000	25	2,500	12,500
30.P.-.-	PROJECT MANAGEMENT				15,000	25	3,750	18,750
30.Z.-.-	MISCELLANEOUS ACTIVITIES				4,000	25	1,000	5,000
31.-.-.-	CONSTRUCTION MANAGEMENT (S & I)							($241,000)
31.B.-.-	CONTRACT ADMINISTRATION				29,000	31	9,000	38,000
31.D.-.-	REVIEW OF SHOP DRAWINGS				14,500	24	3,500	18,000
31.E.-.-	INSPECTION AND QUALITY ASSURANCE				18,500	19	3,500	22,000
31.F.-.-	PROJECT OFFICE OPERATION				140,000	7	10,000	150,000
31.H.-.-	CONTRACTOR INITIATED CLAIMS AND LITIGATIONS				0	100	7,000	7,000
31.J.-.-	GOVERNMENT INITIATED CLAIMS AND LITIGATIONS				0	100	2,000	2,000
31.P.-.-	PROJECT MANAGEMENT				3,000	33	1,000	4,000
	TOTAL CONTINGENCY COST						448,288	
	TOTAL PROJECT COST							2,783,250

DATE: 12 MAR 1990
PREPARED BY: C. MUELLER
REVIEWED BY: J. DIERKER

3. Variable Contingencies. The cost estimate on this project includes contingencies ranging in value from 15 percent to 50 percent. Assigned contingencies are based on the inherent difficulties in visualizingand quantifying certain types of work such as dewatering, boat pullover, embankment, etc. Generally a contingency of about 25 percent was utilized for this project, which was felt to be reasonable at this stage of development.

(2) Operation, Maintenance and Rehabilitation. A detailed estimate of operation, maintenance, and rehabilitation costs is presented in TABLE 16. These quantities and costs may change during final design. Maintenance costs are here defined as those costs of repair and replacement associated with hydrologic events that do not exceed the level of design for the project. On this basis, the principal maintenance features of the project consist of dike and levee inspection, gatewell care, backwater dredging, a portion of the dike and levee repairs, and pump repair and replacement. Rehabilitation is here defined as reconstructive work needed in excess of estimated annual O&M as a result of specific storm or flood events. For the Pharrs Island project, rehabilitation features consist of interior ditch dredging, and a portion of the rock dike and levee repairs.

Dredging is expected to be minimal, consisting of occasional redredging of both the interior sloughs, and the entrance to the off-channel water area at the downstream end of the trail dike. The interior sloughs would require redredging perhaps once every 10 years, and then possibly only at limited locations. The off-channel water area entrance is expected to need redredging about once every 25 years. No significant deposition is expected within the channel along the trail dike as velocities during overtopping events will be sufficient to maintain the sediment in suspension.

Since this project is located on general plan lands where the USFWS has entered into a cooperative management agreement with the state of Missouri, the state will continue to be responsible for operation and maintenance in accordance with the cooperative agreement.

(3) Performance Evaluation Monitoring Plan. TABLE 17 provides an estimate of costs related to the project's performance evaluation monitoring.

h. Construction Schedule. TABLE 18 presents a schedule of project completion steps.

7. **ENVIRONMENTAL EFFECTS OF THE SELECTED PLAN.** The following section presents a discussion of the environmental impacts of the Selected Plan. TABLE 19 is an environmental assessment matrix which summarizes the analysis.

a. Natural Resource Effects.

(1) Physiography-Topography. With the construction of the project, the topography of the island and river bottom will be altered. The construction of dike and levee structures, and the creation of borrow and disposal areas represent permanent changes to the topography of the area.

(2) Hydrology/Hydraulics. A downstream inlet/outlet drain would permit the control of island interior water levels. When interior drainage is needed, it would be accomplished during the typical 2-3 day period that the pool is "on-tilt." Water would be taken on at times when river stages are at levels above that of the interior wetland. The total input or output of water

TABLE 16

PHARRS ISLAND
ESTIMATE OF ANNUAL OPERATION, MAINTENANCE, AND REHABILITATION COSTS
(OCTOBER 1989 PRICE LEVELS) 1/, 2/

Item	Interval			Unit Price ($)	Total Price ($)	Average Annual Price ($)	
	Years	Quantity	Unit			Operation	Maintenance
Gate Operation	Annual	75	Hr	30	2,250	2,250	
Pump Operation 3/	Annual	320	Hr	20	12,800	6,400	
Pump Repair 4/	Annual	Sum Job			50		50
Pump Replacement 4/	1 in 25	1	Pump	25,000	25,000		269
Dike/Levee Inspection & Reporting	Annual	20	Hr	20	400		400
Gatewell Maintenance (debris and sediment removal, paint, lube)	Annual	20	Hr	20	400		400
Backwater Maint.	1 in 25	3	Days	27,667	83,000		891
Rock Dike Maint.	1 in 5	3,600	Tons	7	25,200		4,190
Levee Repair/ Maint.	Annual	40	Hrs	20	800		800
			Total			8,650	7,000
			Total Contingencies (25%)			2,163	1,750
			Total + Contingencies			$10,813	$8,750

1/ Maintenance costs are defined as those costs of repair and replacement associated with hydrologic events (including minor storm and flood events) that do not exceed the level of design for the project. For Pharrs Island this level of design has been designated as the top elevation of the rock dike and earthen levee structures. In the project reach of river, river stages would remain at or below the top of these structures more than 95 percent of the time. On this basis, the formation of a plug at the entrance to the backwater, by heavy sands low in the water column, will occur predominately during this lower water elevation period. At least some rock material and earthen levee material is expected to be lost during minor flood events due to undermining during floods with the pool on tilt, and from ice damages.

2/ Rehabilitation is defined as reconstructive work needed in excess of estimated annual O&M as a result of specific storm or flood events. For the Pharrs Island project, water elevations above 452 NGVD occur less than 5 percent of the time. Any interior ditch filling is expected to occur during this time period. Also during this period, most rock dike and earthen levee damages are expected from currents overtopping the structures.

TABLE 16 (CONTINUED)

Consistent with other UMRS-EMP projects, no estimates of rehabilitation costs are provided in this table. Any costs presented would be based on so little historical data as to be highly unreliable and misleading.

3/ This portable trailer mounted pump would be moved to the site using an MDOC provided barge. The unit would also service other EMP management areas.

4/ Values represent 25 percent of the actual total estimated pump repair and replacement costs for the unit, since this unit will be used on perhaps three other EMP areas of equivalent size.

TABLE 17

PHARRS ISLAND ESTIMATE OF PERFORMANCE EVALUATION MONITORING COSTS (OCTOBER 1989 PRICE LEVELS) 1/

Item	Interval			Unit Price ($)	Total Price ($)	Average Annual Price ($)
	Years	Quantity	Unit			
Sediment Survey	1 in 5	7	X-Sections 4,000' ea.	3,571	25,000	4,200
Water Control Analysis	1 in 5	2	Days	240	240	240
Habitat Analysis						
WHAG/AHAG	1 in 5	4	Days	240	480	144
Cover Type Survey	1 in 5	1	Day	240	240	72
Water Quality Readings	Annual (i.e., Quarterly)	4	Days	240	960	960
				TOTAL		$5,616
				Total Contingencies (+1-25%)		1,404
				GRAND TOTAL		$7,020
						(Say $6,000)

1/ Per current guidance, the cost of performance evaluation monitoring will be charged to the UMRS-EMP LTRM account.

TABLE 18

PROJECT IMPLEMENTATION SCHEDULE

Requirements	Scheduled Date
Submission of Draft Definite Project Report (DPR) to Corps of Engineers, Lower Mississippi Valley Division, North Central Division, agencies, and public for review	Aug 89
Submit final DPR to North Central Division	Jun 90
North Central Division submission of final report to Chief of Engineers	Jul 90
Receive plans and specifications funds	Dec 90
Obtain construction approval by Assistant Secretary of the Army (Civil Works)	Dec 90
Submit final plans and specifications to Lower Mississippi Valley Division for review and approval, and to participating agencies for review	Apr 91
Obtain approval of the plans and specifications	May 91
Advertise contract	Jun 91
Complete construction	Jul 92

TABLE 19

ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

Parameter	Magnitude of Probable Impact						
	Increasing Beneficial Impact			No Appreciable Impact	Increasing Adverse Impact		
	Significant	Substantial	Minor		Minor	Substantial	Significant
A. Social Effects							
1. Noise Levels					X		
2. Aesthetic Values					X		
3. Recreational Opportunities			X				
4. Public Health and Safety				X			
5. Transportation				X			
6. Community Cohesion				X			
7. Community Growth/Development			X				
8. Business/Relocations				X			
9. Controversy			X				
B. Economic Effects							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities/Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Energy Needs and Resources				X			
10. Flooding Effects				X			
C. Natural Resource Effects							
1. Air Quality					X		
2. Terrestrial Habitat				X			
3. Wetlands	X						
4. Aquatic Habitat		X					
5. Habitat Diversity and Interspersion	X						
6. Biological Productivity	X						
7. Surface Water Quality				X			
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
D. Historic Properties				X			

would require about one day. Section 6 of the DPR provides a water regulation plan for the site. The project is not expected to change profiles in the adjacent Mississippi River nor in the adjacent flood plains.

The project dike would prevent sediment-carrying waters from entering the project area for more than 96 per cent of the time. Even when the dike overtops, only the top few feet of flood flow would enter the proposed area. This water would carry relatively low quantities of sediment (mainly silts and clays) compared to the entire water column. Little sand contribution to the island is expected, since most of the sand load will be carried near the bottom as bed material load and would be prevented from entering the project area by the dike and also the levee.

Structure overtopping will average about once every two years. Floods and overtopping would normally occur in the late winter-early spring of the year, due to upstream snowmelt and normal spring rains. No significant damage to the wetland protection structures is expected when overtopping occurs. The dike is protected due to the stone size used, and the small differences in water surface elevation that would occur across the dike at the time of overtopping (i.e., water could still back-in at the lower end of the dike as river stages increase). The levee is protected during floods due to its gated culvert and overflow structures. The overflow structures allow for the safe overtopping of water into the interior before the main levee structure can be attacked. In addition, the culvert gate can be left open to further hasten the backfilling of the interior with water.

The effects of the project on upstream river elevations during floods was evaluated using the HEC-2, Water Surface Profiles Program. The maximum effect was less than 0.1 foot during the 2-year recurrence interval event, insignificant for all practical purposes. No differences were apparent for rarer events.

When the navigation pool is "on tilt", the project will cause river channel water velocities to increase slightly, mainly on the Illinois side. This could be a concern, since on the left river bank, the SNY D&L District levee is close to the shoreline. During and after construction of the project, the Illinois bankline will be monitored for erosion during pool tilt. Revetment will be applied to any reaches of bank erosion resulting from the Pharrs Island project. This revetment is expected to be minimal.

(3) Air Quality. Regional development will continue in the future, and consequently, air quality may decline somewhat. Project construction would result in a temporary increase in exhaust fumes from equipment. Additional short-term impacts to air quality are expected from the mining, hauling, and placement of crushed stone for the rock dike. No long-term impacts are expected.

(4) Noise. During construction activities, there will be periodic increases in noise levels in the general vicinity of the project area. Factors affecting noise levels will include the operation of heavy equipment, the placement of stone, and the use of chain saws.

(5) Prime Farmland. The area currently does not qualify as prime farmland. As such, there would be no impacts to prime farmland associated with the project.

(6) Habitats

(a) Wildlife Habitat

1 Forested Wetland. The project (with 207 total forested acres, see FIGURE 18) will result in a net average annualized loss of 125 forested acres compared to that of the no action plan (332 total acres). Levee construction, dredged disposal and borrow area development and vegetation clearing for non-forested wetland expansion will result in a permanent loss of 83 acres of forested habitat, and a temporary loss of 13 acres. The 13 acres are a temporary loss since they will subsequently be planted to mast trees. A remaining 29 acres of loss represents a conversion of water to forested wetland habitat. About one-half of the trees that would be lost to construction activities are young to old aged willows with some younger silver maples present, and the other half consists of medium-aged silver maples along with younger elm and hackberry trees.

Without reliable water control, the habitat value of the island's existing forested habitat for waterfowl is very low (HSI 0.1). With a project, waterfowl habitat quality will significantly increase (to an HSI of 0.6) on about one-third of the project's 207 average annualized acres of forested habitat. For the mallard, the project's forested habitat would yield a net gain of +23 AAHU's over that of the no action plan (33 AAHU's). Certain species, such as the beaver and parula would be somewhat negatively impacted by the selected project plan. However, minor loss of habitat to certain wide-ranging species is considered to be an acceptable trade-off for significant gains in waterfowl habitat in a region critical to waterfowl migration.

It is the District's opinion that the 13 acres of reforestation and increased habitat quality of the remaining forest, would adequately mitigate any construction-related losses of bottomland forest. Thus, the project complies with the Water Resources Development Act of 1986 (P.L. 99-662) and EC 1165-2-146.

2 Non-Forested Wetland. The project (with 159 total non-forested acres) will result in a significant net increase in average annualized acres (+126) over that of the no action plan (with a total of 33 acres). In all, a total of 107 acres of non-forested habitat would be influenced by the water regulation effects of the new levee system, its gated drain, and a portable pump. Due to the levee's sediment reduction effects, the life span of these interior wetlands would be greatly extended. To further improve the quality of these wetlands, waterfowl preferred plant species would be seeded each year following a summer drawdown of interior water levels. The plantings would then be flooded prior to the fall migration. The life span of non-forested wetlands outside the Pharrs Island project area is not expected to change.

Without water control and other features, the habitat value of the island's existing non-forested habitat for waterfowl is very low (HSI 0.1). With a project, waterfowl habitat quality will significantly increase (to an HSI of 0.8). For the mallard, this habitat would provide a net gain of +89 AAHU's over that of the no action plan (3 AAHU's). Other species showing important gains in response to increased non-forest wetland include the Canada goose, muskrat and heron.

3 River. The large off-channel water area provided by the project would provide a resting area for waterfowl during migration, but in the absence of water level management, the potential habitat value of this area would be low. For the mallard, the project with 22 AAHU's gives a net

PHARRS ISLAND HREP
ANNUALIZED HABITAT ACRES

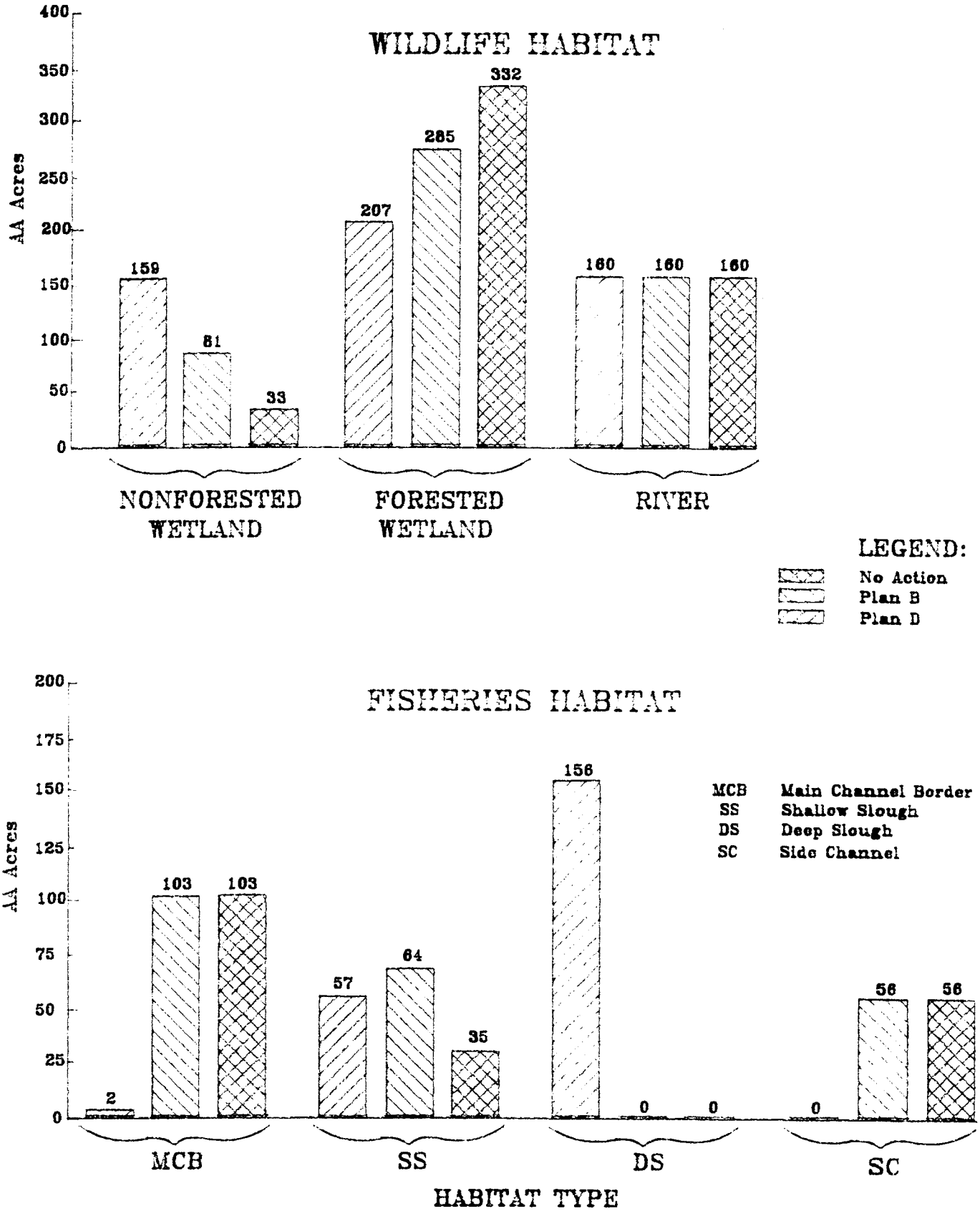


Figure 18

gain of +6 AAHU's over that of the no action plan (16 AAHU's). For other wildlife species, no impact, or a slight improvement in habitat conditions is anticipated.

(b) Fisheries Habitat

1 Backwater (Shallow and Deep Slough). The project dike would reduce future sand deposition within the newly created backwater (consisting now of protected shallow slough and deep slough). Little loss of water depth is anticipated over the life of the project. The substrate composition would shift to include a greater silt and detritus component. Water level fluctuations would remain unchanged as a result of the dike. Water velocity would be reduced, particularly during the spring spawning season. Water temperatures would increase somewhat during all periods of the year. Dissolved oxygen levels would not be expected to change significantly from existing conditions. Turbidity would be reduced, thus contributing to improved light passage and increased food production. Available cover would be increased in response to new aquatic plant production, and by the placement of cedar trees.

The levee would provide increased water depth within the island sloughs due to fall-winter-spring inundation and the creation of deepwater fish refuges. Water temperature during the summer would be reduced as a result of the deepwater fish refuges. Dissolved oxygen would be less of a problem due to the increased water depth. Water velocity in the Pharrs Island shallow slough habitat would become reduced during the spring spawning period. Decaying moist soil plants would contribute to an increased amount of detritus. Water level fluctuations in the island's sloughs would become much reduced. The conversion of slough to land would be reduced by about 90 percent.

The project would result in an overall 47 percent increase in habitat value for large slackwater fishes. The shift would be from 133 AAHU's under the no action plan to 194 AAHU's under the Selected Plan. Substantial habitat gains would occur to rearing (+42 percent) and adult (+33 percent) stage fishes, with significant gains (+67 percent) predicted for the spawning of large slackwater fish. Most (94 percent) of this habitat gain results from the current and sediment protection afforded by the dike structure, with lesser gains resulting from the inclusion of summer fish refuges and the placement of cedar trees. The project would result in 213 average annualized acres of protected shallow and deep slough habitat.

(7) Historic Properties. Archaeological investigations coincident with construction related earthmoving activities will ensure that any significant site will be located, evaluated, and recovered. The District, therefore, concludes that the effect of undertaking the project would not be adverse.

(8) Recreation. Area sport fishing and duck hunting are expected to improve as a result of sediment control, water level control and improved management of the wetland complex.

(9) Aesthetics. The clearing of trees for the disposal site would have essentially no impact on the aesthetics, since it would be hidden from view in its central location on the island. These disturbed areas would eventually be revegetated. The dike construction would have a slight, but long-term, negative impact on the area's aesthetics.

b. Economic and Social Impacts. There are no socioeconomic resources in the immediate vicinity of the project that would be impacted by the project.

c. Relationship of the Proposed Project to Land-Use Plans. The present land use of the entire project area is the management of fish and wildlife resources. This project is compatible with this land use and is designated to enhance and promote these land-use plans. The USFWS also has determined that the proposed project is compatible with existing refuge goals and objectives (see Appendix DPR-H).

d. Adverse Effects Which Cannot be Avoided. The clearing of approximately 96 acres of bottomland hardwoods during construction is unavoidable. Approximately 5 acres of aquatic habitat will be lost as a result of the placement of the rock dike.

e. Short-Term Use Versus Long-Term Productivity. The proposed project would improve both the short- and long-term productivity of fish and waterfowl habitat. The project would provide reliable long-term feeding habitat for waterfowl, and long-term spawning and rearing habitat for fish.

f. Irreversible or Irretrievable Resource Commitments. Aside from the commitment of funds, labor and construction materials, there would be no permanent loss of natural resources except for the loss of habitat necessary for the installation of project features.

g. Compliance with Environmental Quality Statutes. The proposed project complies with all applicable laws and regulations listed in TABLE 20.

8. FEDERALLY ENDANGERED SPECIES: BIOLOGICAL ASSESSMENT.

a. Introduction. In compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, the St. Louis District requested that the U.S. Fish and Wildlife Service (USFWS) provide a listing of Federally threatened or endangered species, currently classified or proposed for classification, that could be present in the project area. The USFWS, in a letter dated January 3, 1989, provided the following list:

Common Name	Scientific Name	Classification
Bald eagle	Haliaeetus leucocephalus	Endangered
Fat Pocketbook Pearly Mussel	Potamilus capax	Endangered
Indiana Bat	Myotis sodalis	Endangered
Gray Bat	Myotis grisescens	Endangered

This Biological Assessment evaluates the environmental effects of the Pharrs Island wetland rehabilitation project on those Federally endangered species.

b. Bald Eagle. The bald eagle (Haliaeetus leucocephalus) is a common winter inhabitant of the Mississippi River and it is often seen in the vicinity of Pharrs Island. As winter arrives on the breeding grounds of northern Alaska and Canada, deep snows and sub-freezing temperatures cause waterways in the area to become icelocked. This reduces the availability of

TABLE 20

COMPLIANCE OF THE SELECTED PLAN WITH WRC-DESIGNATED ENVIRONMENTAL STATUTES

Federal Policies	Compliance
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Full compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full compliance
Clean Water Act (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.	Full compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Estuary Protection Act, 16 U.S.C. 1221, et seq.	Not applicable
Federal Water Protection Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 1401, et seq.	Full compliance
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 42 U.S.C. 4321, et seq.	Full compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full compliance
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Not applicable
National Farmland Protection Policy Act, 7 U.S.C. 4201, et seq.	Full compliance

fish, the preferred food of the bald eagle. Eagles respond to this annual paucity of food by migrating south to milder climates and more accessible food sources. Eagles winter as far north as open water and food permit.

The construction of numerous dams and reservoirs in this century has altered the distribution of wintering eagles in the United States. Mankind's alteration of habitat has unintentionally increased potential wintering areas, attracting wintering populations to areas where eagles were previously only casual visitors. Concentrations of wintering bald eagles below locks and dams on the Mississippi River are a recent phenomena (Musselman, 1949). These man-made structures create areas of relatively warm, open water which provides feeding areas throughout the winter.

Ice cover on the river influences bald eagle distribution. During a relatively mild winter with little ice cover, eagles are generally scattered (Harper 1983). With increased ice cover on the river, eagles become more and more concentrated - foraging in and around the remaining open water areas (i.e., primarily below Locks and Dams). Pharrs Island, being located upriver of Lock and Dam 24, probably receives greater use during warmer winters. However, because of its close proximity to L&D 24 (which typically has one of the highest concentrations of winter eagles on the Mississippi River), Pharrs Island probably always receives some use by eagles.

Stalmaster and Newman (1978) reported that high human activity, such as that occurring frequently in the sight of eagles, cause the birds to use less suitable habitat. They report that feeding behavior was the most sensitive activity observed. Activities directly on the channel of the river, such as boating and fishing, were most disturbing to eagles if the activities did not regularly occur there. Harper (1983) reported disruptions of daily activities of eagles in the Lock and Dam 24 area by hunters, fishermen in watercraft, and aircraft. f eagles are disturbed while on a feeding ground, they usually fly to nearby perch sites and do not resume feeding for long periods (Stalmaster, 1976).

c. Fat Pocketbook Pearly Mussel. The historical distribution of Potamilus capax included the Niagara River and nearby Wilson Creek in western New York (Great Lakes-St. Lawrence Drainage); the Ohio, Green, and Wabash rivers in Illinois, Indiana, and Kentucky (Ohio River Drainage); the Illinois River in Illinois; the Mississippi River in Illinois, Iowa, and Minnesota; and the White and St. Francis river systems (Clarke 1984). The ecological requirements of P. capax in the Mississippi River are not fully known because of its uncommon occurrence in early surveys and absence in recent studies. Parmalee (1967) described P. capax as a large river species found on sand and mud bottom, in flowing water, and at depths from a few inches to 8 feet or more. In the St. Francis River, Arkansas, where it is fairly common, it has been collected in depositional habitats consisting of mud and sand substrate (Clarke 1984). The host fish for this mussel is unknown (Clarke 1984).

Although shells of this species have been found in the Upper Mississippi River, no live specimens have been collected in nearly half a century (Wisconsin Department of Natural Resources 1985). With respect to the Illinois River, Starrett (1971) noted that the species probably disappeared from the upper river by 1900 and from the middle and lower river before 1920. Conservations with local mussel experts (Cohen 1986; Cummings 1986; Fritz 1986; Havlik 1986; Latendresse 1986; Miller, unpublished data, 1986; Peach 1986) indicate that the species has not recently been taken in the UMRS. More recently MDOC, in coordination with the Memphis Corps District, has transplanted a number of P. capax specimens from the St. Francis River to Pool 24 (Ted Sharks area) and other riverine locations for reestablishment. In

addition, there are no known mussel beds within the project area boundary. It is the St. Louis District's perspective that P. capax would not be impacted by the project.

d. Indiana Bat. This bat is known primarily from the caves in which it hibernates. Two mines and 11 caves have been designated as critical habitats by the U.S. Fish and Wildlife Service. However, none of these are near the Mississippi River.

Little is known about Indiana bat summer habitat (Brady et al. 1983). Recent studies indicate that maternity colonies are formed mostly in riparian and flood plain areas of small to medium-sized streams (Humphrey et al. 1977, Cope et al. 1978, Sparling et al. 1979, Gardner and Gardner 1980). Optimum foraging habitat appears to consist of streams lined on both sides with mature trees that overhand the water by more than 3 meters.

No Indiana bat caves would be impacted by the Pharrs Island project. The loss of riparian habitat from the project would be small (a permanent loss of 83 acres). This loss of trees would not be of great significance, particularly in view of the species preference for vegetation adjacent to smaller riverine systems.

e. Gray Bat. The gray bat occupies a limited geographic range in limestone karst areas of the southeastern United States. The gray bat is known from southern and southwestern Illinois and Missouri (Barbour and Davis 1969, Brady et al. 1982). This bat is restricted to caves or cave-like habitats throughout the year. In spring and early summer, colonies of gray bats disband and leave their winter hibernacula. They can be found in large transient colonies for several days as they prepare to migrate to summer caves. Female gray bats usually select caves with high humidity where they give birth to a single young. Only a few adult males are found scattered among the females, or near the perimeter of the nursery. These bats have also been found in a storm sewer (Hayes and Bingham 1964, Jones et al. 1967) where there was running water, although no sewage.

Summer caves, especially those used by maternity colonies, are nearly always located within 1 kilometer of rivers or reservoirs (rarely more than 4 kilometers) over which the bats feed (Tuttle 1976). LeVal et al. (1977) studied a gray bat maternity colony in Missouri and found colony members foraging up to 20 or more kilometers from their roost. Detailed observations over an east Tennessee reservoir indicated that most foraging was restricted to within 5 meters of the water surface near shore, but gray bats in Missouri have also been seen foraging in forest conopy along river edges (Tuttle et al. and LaVal, R.K., unpublished data In: Brady et al. 1983).

No caves would be impacted by the construction of a project at Pharrs Island. Therefore, no winter hibernacula, summer caves, or nursery caves would be lost or disturbed. The project would result in a permanent loss of 83 acres of riparian habitat; however, this would not greatly reduce the overall summer foraging habitat available to this species.

f. Efforts to Eliminate Adverse Impacts on Species and Habitats.

(1) Bald Eagle. Eagles are expected to occasionally use the Pharrs Island area for feeding and resting during the winter. To avoid impacts to bald eagles, the St. Louis District would place special conditions on the contracted clearing work as follows:

(a) For the most part, construction activities would be scheduled to take place outside of the winter months in order to avoid potential conflicts with wintering bald eagles. In addition, consideration will be given during the preparation of Plans and Specifications to sequencing construction activities in a manner that minimizes impacts to eagles. The project may potentially decrease eagle use at the Pharrs Island site during construction; however, the impact would be short-term and not significant. Specific restrictions relative to any sequencing will be included as part of the contract specifications. The contracting officer will ensure appropriate compliance.

(b) Large trees, especially eastern cottonwoods close to water, are the preferred perches used by eagles. Most tree clearing will be a considerable distance back from the river's edge. The larger sections of levee would be constructed at least 150 feet back from the shoreline.

g. Conclusions. It is the St. Louis District's conclusion that the wetland rehabilitation of Pharrs Island, in conjunction with the described measures to avoid conflicts with bald eagles, would have no significant effects on Federally endangered species or their critical habitat. The Service, in its August 21, 1989 letter (APPENDIX B) to the District commenting on the draft DPR, concurred with this conclusion.

9. IMPLEMENTATION RESPONSIBILITIES AND VIEWS.

a. Corps of Engineers. The St. Louis Corps District, is responsible for the Pharrs Island project's overall management, and its coordination with other agencies. The St. Louis District prepares and submits the DPR; programs funds; finalizes the Plans and Specifications; completes all National Environmental Policy Act requirements; advertises and awards a construction contract; performs construction contract supervision and administration. The District is also responsible for the gathering of quantitative measurements for the project's performance evaluation monitoring.

b. U.S. Fish and Wildlife Service. The USFWS has determined that the project is compatible with the purposes for which the Mark Twain National Wildlife Refuge was established (see APPENDIX A refuge compatibility statement). In the future, the USFWS will ensure that all O&M activities are conducted in a manner compatible with refuge objectives and management strategies and will ensure that the O&M is performed in accordance with Section 906(e) of the Water Resources Development Act of 1986 and the Operation, Maintenance and Rehabilitation Agreement. The views of the USFWS on implementation responsibilities, as understood by the North Central Division, are contained in the Fourth Annual Addendum, III.A.1 page 9. The Service also has responsibilities for the HREP in terms of problem identification, the evaluation of planning assumptions, and the analysis of biological responses to the projects.

c. Missouri Department of Conservation. MDOC, the project's sponsor, has been responsible for the identification and definition of the problems at the HREP site, and for establishing the need for the proposed project features. MDOC will also provide field observations (via the annual management report for Cooperative Agreement Lands) for the project's performance evaluation monitoring. The sponsor is also responsible for the non-Federal share of operation and maintenance, as estimated in this report.

10. COORDINATION, PUBLIC VIEWS, AND COMMENTS.

The Federal, state and local agencies receiving the Definite Project Report and Environmental Assessment are listed in APPENDIX DPR-D.

Numerous joint field reconnaissance trips and study meetings have been conducted by representatives of the St. Louis District, U.S. Fish and Wildlife Service, and the Missouri Department of Conservation. Additional coordination was carried out as a result of public and agency review of the Environmental Assessment/Draft Finding of No Significant Impact. The St. Louis District's responses to the draft DPR review comments are provided as APPENDIX B to this report. The U.S. Fish and Wildlife Service provided comments in a letter (dated 13 June 1989, and supplemented by a 7 March 1990 letter, see APPENDIX H) which constitutes its Fish and Wildlife Coordination Act Report.

11. CONCLUSIONS.

Sedimentation, and water level fluctuation has hampered past habitat management efforts at the Pharrs Island site. Sedimentation is causing a rapid conversion of aquatic habitat to terrestrial habitat with a resulting long-term quantitative loss of fish and waterfowl habitat. Fluctuating water levels at the site have impacted the productivity of the site via effects on fish spawning and rearing, and on production of plants and availability to waterfowl.

Pharrs Island has been recommended to the Corps of Engineers, St. Louis District, by MDOC and the Fish and Wildlife Service for priority inclusion in the UMRS-EMP. The project would significantly reduce sedimentation into the Pharrs Island wetland complex, and would thus greatly increase the island's longevity as a wetland. The project will also enhance migratory waterfowl habitat by providing an increased food source within a reliable water-control unit, and will also improve the fisheries resource by providing a large new protected off-channel water habitat. Only Alternative D, a wetlands protection system, was found to meet all of the planning objectives and is also compatible the with refuge management objectives.

12. **RECOMMENDATIONS.**

I have weighed the accomplishments to be obtained by implementing this habitat rehabilitation project versus the costs, and have also considered the scope and the special locational factors associated with the project. In my judgment, implementing the proposed project would entail a justified expenditure of Federal funds.

I recommend that the Secretary of the Army, under the provisions of Public Law 99-662, approve this project for habitat rehabilitation at Pharrs Island in Pike County, Missouri. A Letter of Intent has been furnished by the Missouri Department of Conservation. I further recommend that an Operations, Maintenance, and Rehabilitation Agreement be approved for execution. The total estimated cost of this project is $2,783,250, which would be entirely a Federal cost according to the provisions of Public Law 99-662. Of this amount, I ask that $187,500 be allocated so that Plans and Specifications work can be initiated as soon as possible.

James E. Corbin
Colonel, U.S. Army
District Engineer

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14. LIST OF PREPARERS.

The people primarily responsible for preparing this document are listed in TABLE 21.

TABLE 21

**DEFINITE PROJECT REPORT/
ENVIRONMENTAL ASSESSMENT PREPARERS**

Name	Expertise/Discipline	Experience
John Dierker	Cost Engineering	17-yrs Cost Engineering
Gary Dyhouse	Hydrologic Engineering	21-yrs, Hydrology/Hydraulics
David Gates	Wildlife Biologist/Study Manager	10-yrs Wildlife Biologist, 1-yr Natural Resource Planner (Study Management), SLD
Mike Hamm	Civil Engineering/Design	18-yrs Civil Engineering Design, SLD
Suzanne Harris	Archaeology/Historic Sites	15-yrs, Historic Properties Management, 5-years Archaeologist, SLD
Ben Hawickhorst	EMP Program Manager	22-yrs Civil Engineer Planning, SLD
Tom Hewlett	Real Estate	10-years Natural Resource Planning (Study Manager), 7-yrs Supervisory Realty Specialist, SLD
Clyde Hopple	Geotechnical	8-yrs Geotechnical Design, SLD
Michael Kruckeberg	Civil Engineering/Design	9-yrs Civil Engineering Design, SLD
David Leake	EMP Program Manager	1-yr Structural Design 2-yrs Construction Contract Mgmt 16-yrs Planning - Study Mgmt SLD
Ted Moore	Civil Engineering/Project Manager	7-yrs Project Mgt.
Kathy Mueller	Cost Engineering	5-yrs Civil Engineering Design, 1-yr Cost Engineering
F. Terry Norris	Archaeology/Historic Sites	12-yrs Archaeologist, SLD

TABLE 21 (CONTINUED)

Name	Expertise/Discipline	Experience
Riley Pope	Civil Engineering Technology/Civil Engineering Technician	19 yrs Engineering Division; Design Branch, Civil & Structural Sections, SLD 4 yrs Planning Division; Plan Formulation Branch
George Postol	Geotechnical	28-yrs Geotechnical Design, SLD
John Poullain	Civil Engineering/Design	28-yrs Civil Engineering Design, SLD
Stephen Redington	Potomology	15-yrs in River Engr/Reg Works Design
Claude Strauser	Potomology/River Engineering	21-yrs in River Stabilization

15. DRAFT FINDING OF NO SIGNIFICANT IMPACT

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

PHARRS ISLAND WETLAND HABITAT REHABILITATION
POOL 24, MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

(1) I have reviewed and evaluated the documents concerning the proposed rehabilitation of Pharrs Island.

The purpose of the project is to enhance wetland habitat at the Pharrs Island wetland complex for both migratory waterfowl and slackwater fishes. This is to be done primarily by reducing sediment deposition during frequent flooding, by controlling interior water levels, and by providing a new off-channel water area. The project would be funded under the 1985 Supplemental Appropriations Bill (PL 99-88).

(2) Prior to my decision, I evaluated other pertinent data and information which addresses the various practicable alternatives. As part of that evaluation, I considered:

a. The "No Action" alternative,

b. a "Wetlands Excavation" alternative,

c. the proposed or recommended plan, referred to as the "Wetlands Protection" alternative, and

d. various alternative component features leading to the recommended plan (e.g., various dike and levee heights and alignments).

(3) These alternatives have been studied, and major findings of this investigation include the following:

a. The "No Action" alternative was evaluated and it was concluded that in the absence of a rehabilitation project, continuing sedimentation in the wetlands complex would lessen the area's value as a wetland. The loss of this wetland is considered to be unacceptable from a fish and wildlife resource standpoint.

b. The "Wetlands Excavation" alternative was also found to be unacceptable. Large-scale excavation would not alter future sedimentation, it would not permit any means of regulating water levels, it would not increase off-channel water habitat, and the potential for applying habitat management practices would be severely limited.

c. The "Wetlands Protection" alternative represents an innovative approach to wetlands management and was found to be fully responsive to the project objectives, and was designated as the Selected Plan. Most importantly, it would significantly reduce the sedimentation rate, it would provide a reliable means of water control, it would increase the pool's off-channel water acreage, and it would provide conditions compatible with traditional habitat management practices. Specific options considered in detail included: dikes, levees, clearing, fish refuges and cedar tree fish habitat structures.

(4) The possible consequences of the recommended plan have been studied for physical, environmental, cultural, social and economic effects. Major conclusions of this study are as follows:

a. The construction of the project represents a permanent change in the topography of the Pharrs Island area. These changes will present no adverse impacts and are necessary for interior water control and sediment deflection.

b. The project is in compliance with the requirements of the Clean Water Act Section 404(b)(1) guidelines. An application will be submitted for state water quality certification under Section 401. The proposed project would have minimal adverse impacts on water quality.

c. The effects of the project on upstream river elevations during floods would be insignificant. Any project induced bank erosion is expected to be minimal.

d. The project would result in a net gain of +118 average annual habitat units (AAHU's) for waterfowl and +61 AAHU's for slackwater fish. A total of 96 acres of forested wetland would be cleared as part of project construction, 10 of these acres would later be reforested. The area covered by the rock dike would be about 5 acres, and would represent a permanent loss of river habitat.

e. A professional archaeologist would monitor construction activities for the presence of archaeological remains. If such remains are found, construction will be postponed until an archaeological investigation is conducted.

f. Fishing and hunting is expected to improve as a result of the project.

g. It is anticipated that the proposed action will have minimal or no adverse impact on air quality, noise, prime farmland, socioeconomic resources and aesthetics.

h. No Federally listed endangered species will be adversely affected by the proposed action.

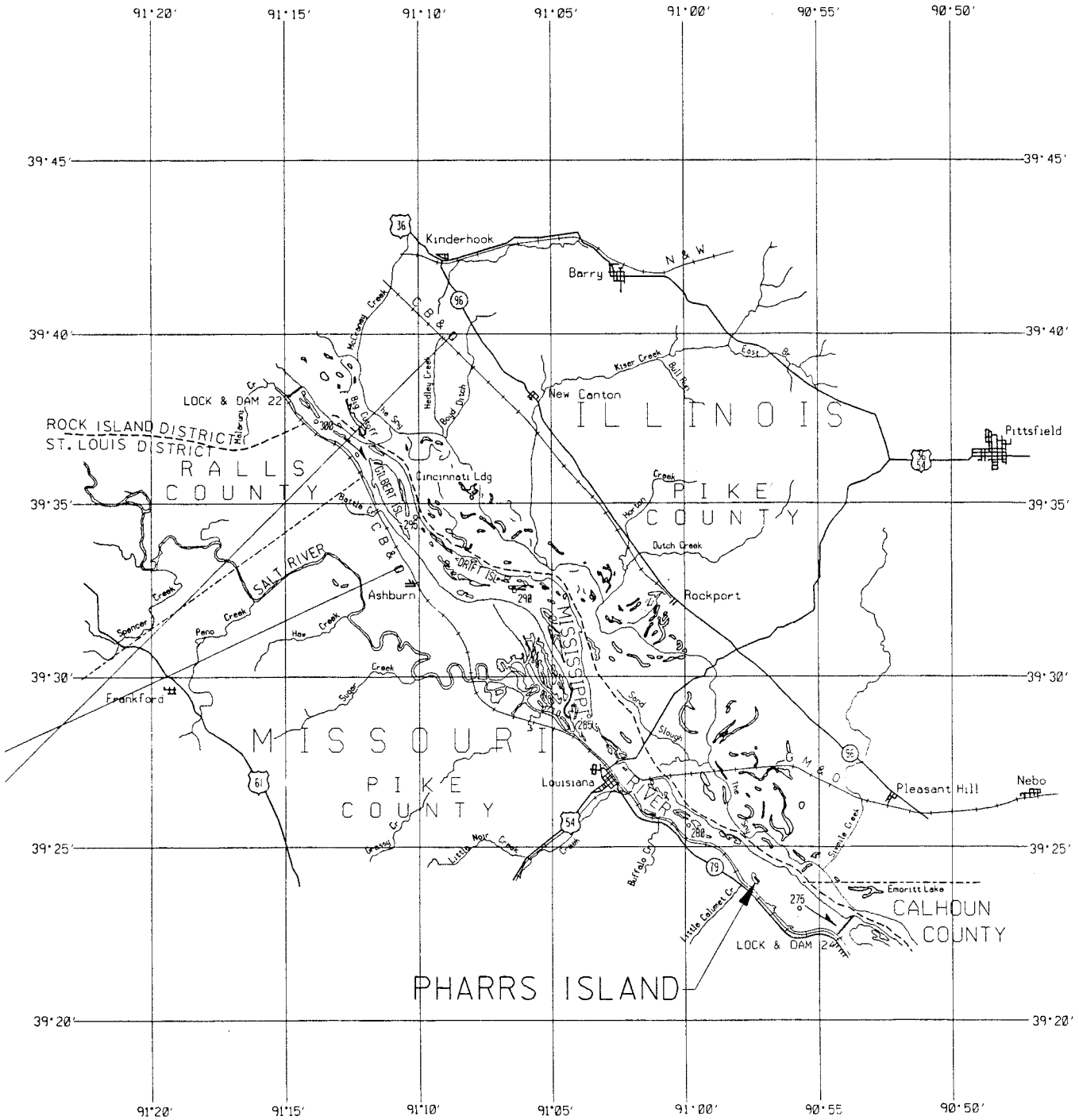
(5) Based on my analysis and evaluation of the alternative courses of action presented in the Environmental Assessment, I have determined that the rehabilitation of Pharrs Island will not have significant effects on the quality of the environment. Therefore, No Environmental Impact Statement will be prepared prior to proceeding with this action.

26 June 1990
Date

James E. Corbin
Colonel, U.S. Army
District Engineer

ATTACHMENT 1

PLATES



PROJECT LOCATION

APPROX. SCALE IN MILES
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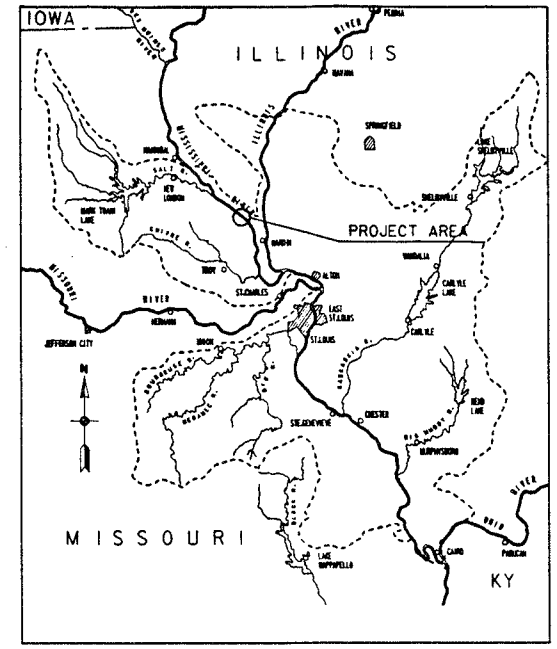

VICINITY MAP

APPROX. SCALE IN MILES
35 0 35 70

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ST. LOUIS, MISSOURI

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PROJECT LOCATION AND VICINITY MAP

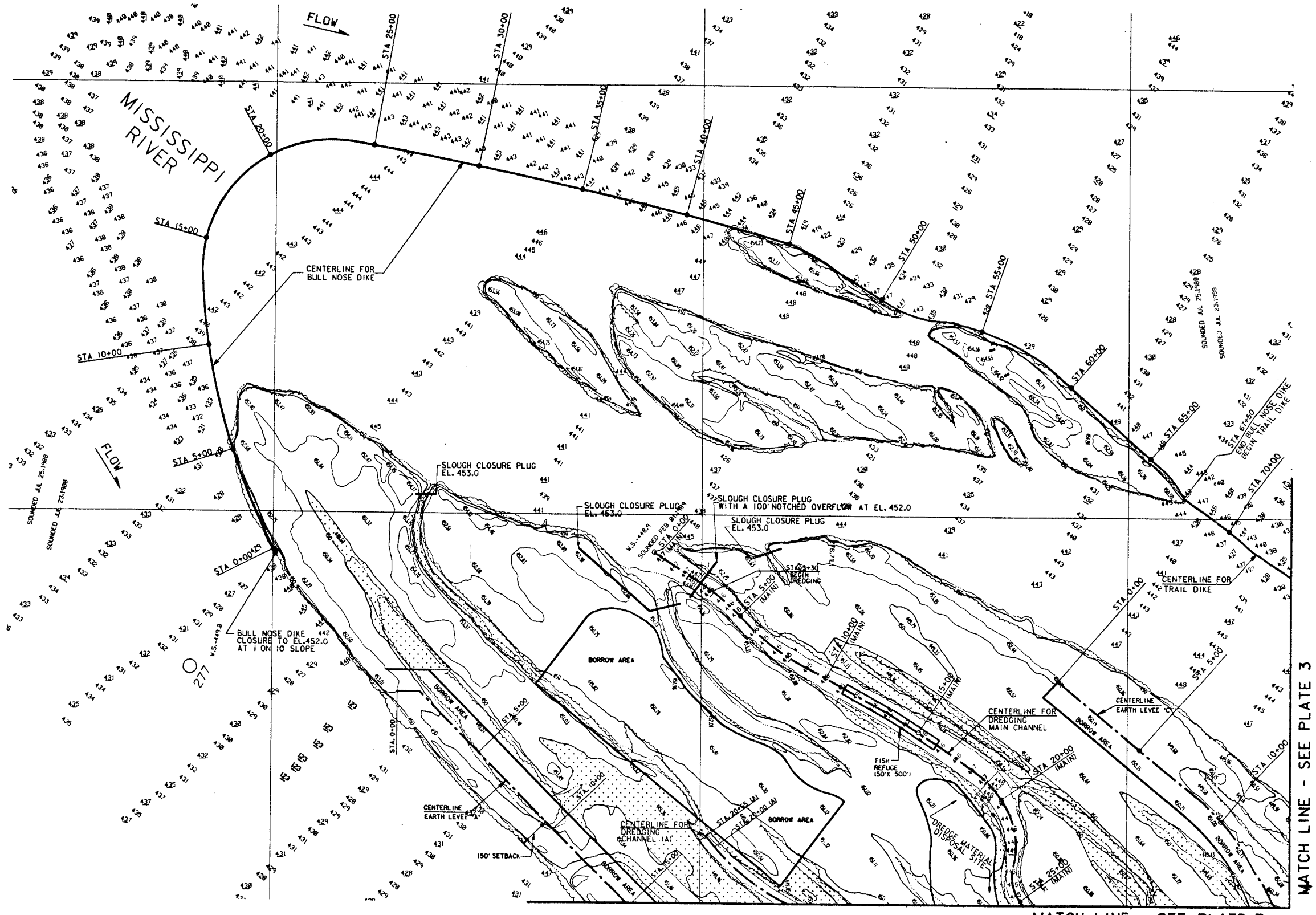
COMPUTER AIDED DESIGN & DRAFTING

SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

CHECKED BY: M. G. KRUCKEBERG | DESIGN FILE: PHARLOC
DATE: JUL 89 | PLOT SCALE: .083' | SHEET NO. 1 OF 9

PLATE 1

10727 ●●●●DATE&TIME●●●● BSC&B



LEGEND:
AREAS FOR VEGETATION REMOVAL

PLAN

SCALE: 1" = 200'

200' 0 200'

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT

PLAN

COMPUTER AIDED DESIGN & DRAFTING

SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

CHECKED BY: M.E. HAHN | DESIGN FILE: PHARPL1
DATE: JUL 89 | PLOT SCALE: 200 | SHEET NO. 2 OF 9

PLATE 2

10727 89069 $$$$DATETIME$$$$

MATCH LINE - SEE PLATE 2

MATCH LINE - SEE PLATE 2

STA 75+00

STA 80+00

STA 85+00

STA 90+00

STA 95+00

STA 100+00

END STA. 102+00

45°

CENTERLINE FOR TRAIL DIKE

FLOW

MISSISSIPPI RIVER

N

STA. 15+00

STA. 17+61.03

FISH REFUGE 50' X 500'

CENTERLINE FOR DREDGING CHANNEL A

FISH REFUGE 50' X 500'

DREDGED MATERIAL DISPOSAL SITE

BORROW AREA

STA. 20+00

STA. 30+00 (MAIN)

CENTERLINE FOR DREDGING CHANNEL B

STA. 40+00 (MAIN)

CENTERLINE FOR DREDGING CHANNEL D

STA. 25+00

CENTERLINE EARTH LEVEE "C"

STA. 37+10

150' NOTCHED OVERFLOW SECTION

STA. 28+60

STA. 30+00

SLOUGH CLOSURE PLUG EL. 452.0

STA. 0+00

150' SETBACK

CENTERLINE FOR DREDGING CHANNEL C

STA. 10+00

BORROW AREA

STA. 45+00 (MAIN)

BEAVER DAM

DREDGE MATERIAL DISPOSAL SITE

STA. 50+00 (MAIN)

BORROW AREA

CENTERLINE FOR DREDGING MAIN CHANNEL

STA. 35+00

STA. 35+40

100' NOTCHED OVERFLOW SECTION

STA. 14+95

FLOW

STA. 45+00 (MAIN)

STA. 46+00

TRANSITION INVERT EL. FROM EL. 445.5 TO EL. 446.0

END EARTH LEVEE "C" STA 391+47.83 EL. 452.0

PORTABLE PUMP DOCKING AREA W/ 2 DEADMEN

BOAT PULLOVER

℄ 36" DIA. CULVERT WITH SLUICE GATE STA. 39+15 INV. EL. 445.5

W.S. 449.0

276

379800 E

LEGEND:

AREA FOR VEGETATION REMOVAL

PLAN

SCALE: 1" = 200'

200 0 200'

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
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PLAN

COMPUTER AIDED DESIGN & DRAFTING

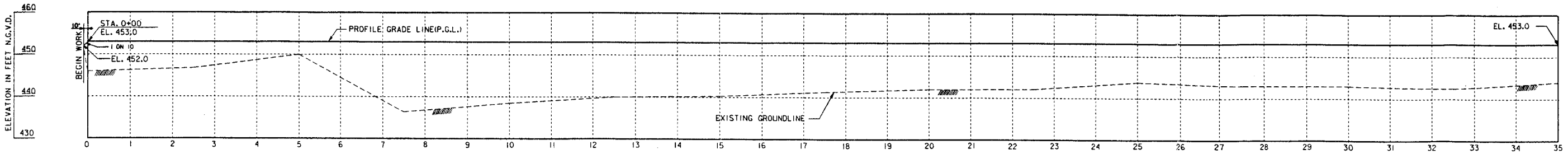
SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

CHECKED BY: M. E. HAMM | DESIGN FILE: PHARPL2
DATE: JUL 89 | PLOT SCALE: 200 | SHEET NO. 3 OF 9

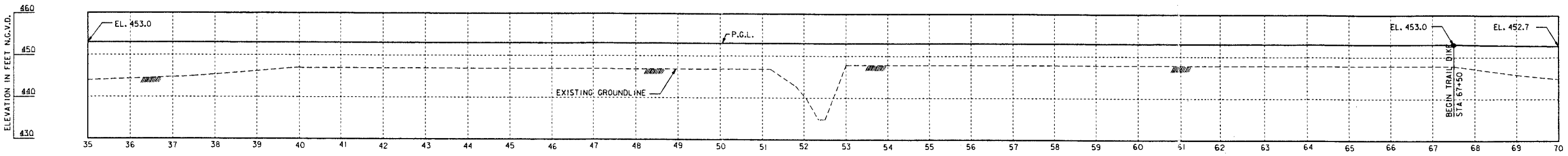
PLATE 3

10727
89C70

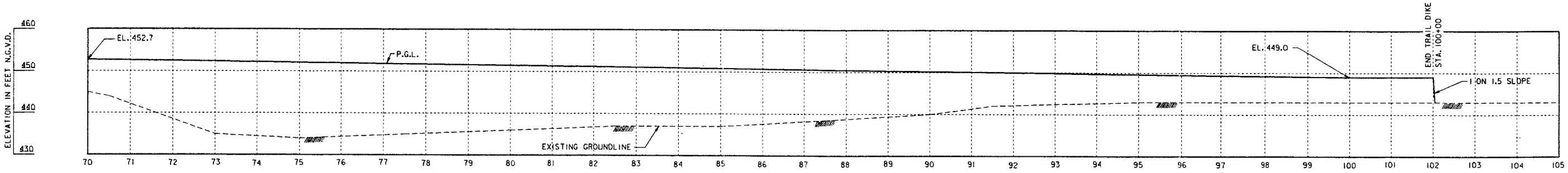
@@@@DATETIME@@@@



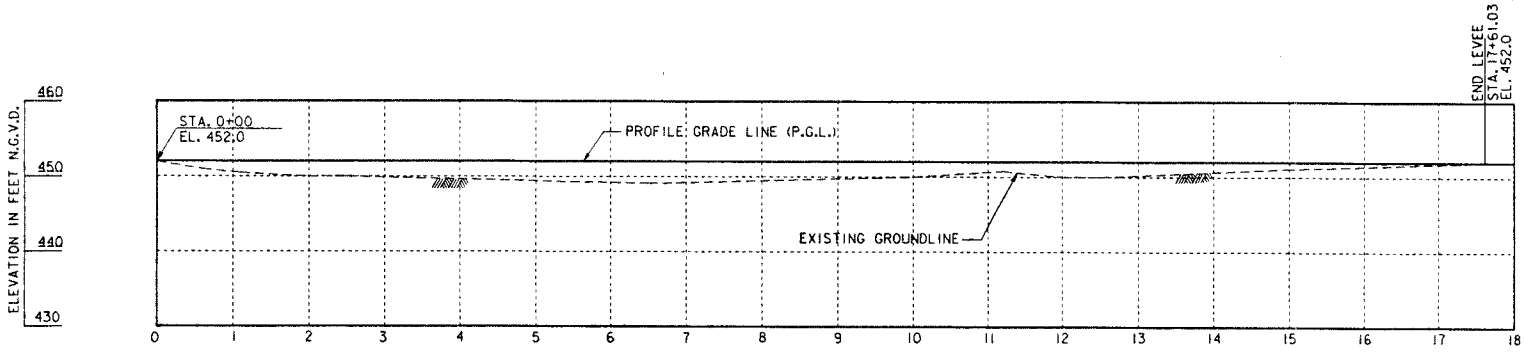
BULL NOSE DIKE PROFILE



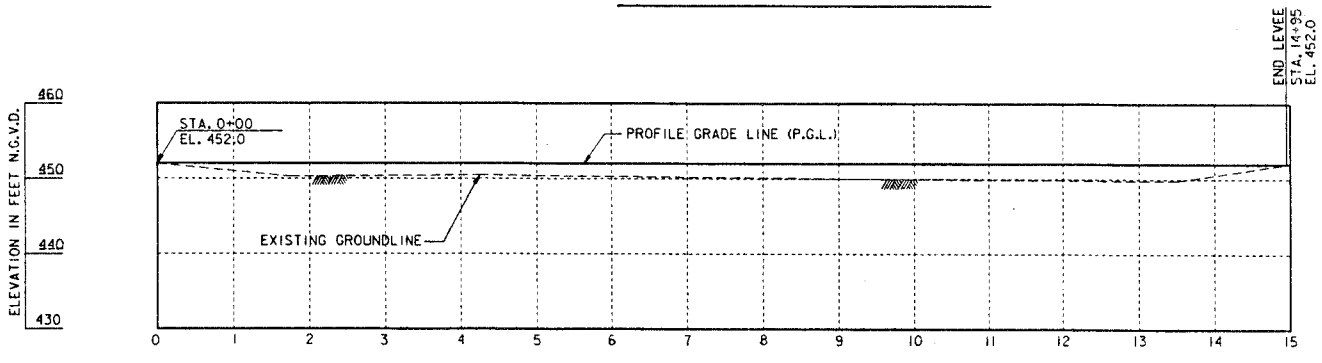
BULL NOSE/TRAIL DIKE PROFILE



TRAIL DIKE PROFILE



EARTH LEVEE "A" PROFILE



EARTH LEVEE "B" PROFILE

SCALE: 1"=10'
10' 0 10'
VERTICAL

SCALE: 1"=100'
100' 0 100'
HORIZONTAL

10727 88CT ●●●●DATE&TIME●●●●

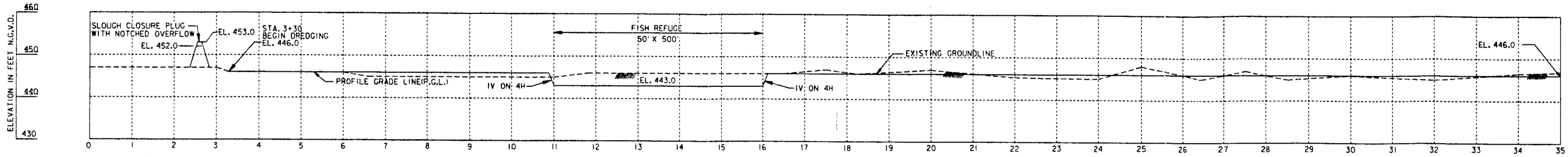
COMPUTER AIDED DESIGN & DRAFTING

SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

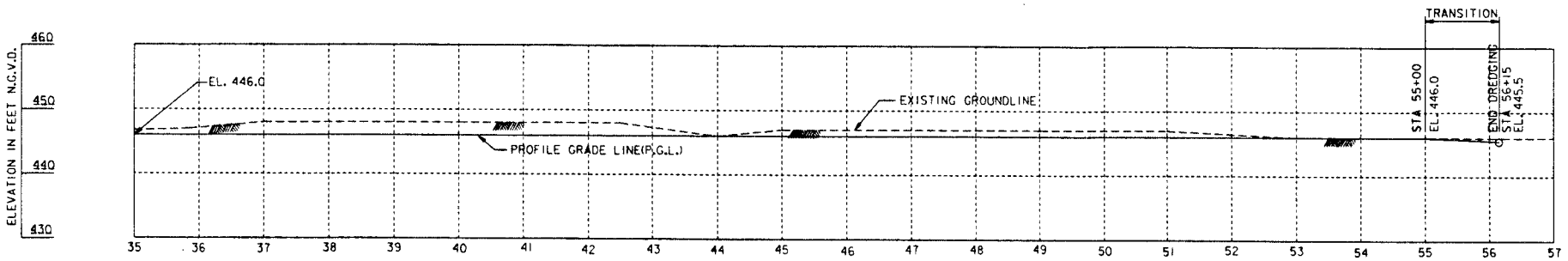
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT
PROFILES
BULL NOSE & TRAIL DIKES
EARTH LEVEES "A" & "B"

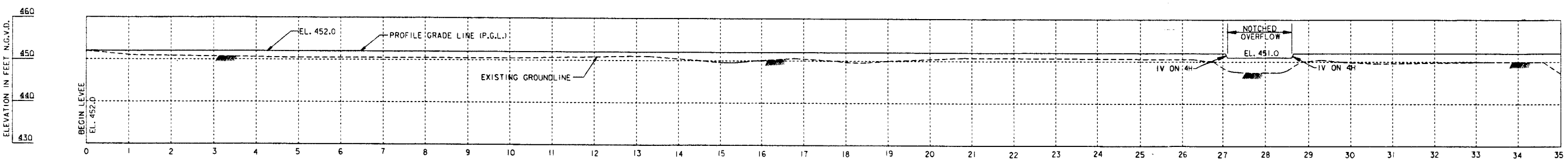
CHECKED BY: M. E. HAMM	DESIGN FILE: PHARPRO1	PLATE 4
DATE: JUL 89	PLOT SCALE: 10	SHEET NO. 4 OF 9



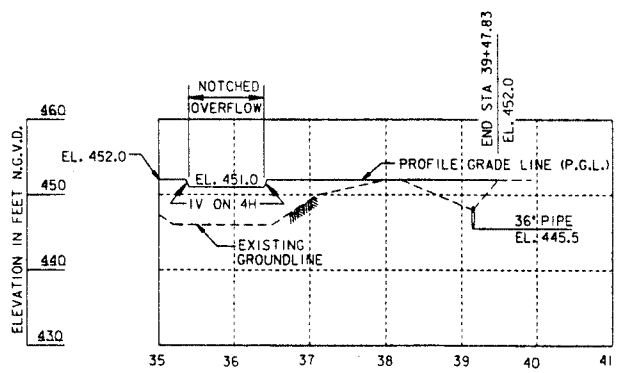
DREDGING PROFILE
MAIN CHANNEL



DREDGING PROFILE
MAIN CHANNEL



EARTH LEVEE "C" PROFILE



EARTH LEVEE "C" PROFILE

SCALE: 1"=10'
10' 0 10'
VERTICAL

SCALE: 1"=100'
100' 0 100'
HORIZONTAL

COMPUTER AIDED DESIGN & DRAFTING

SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

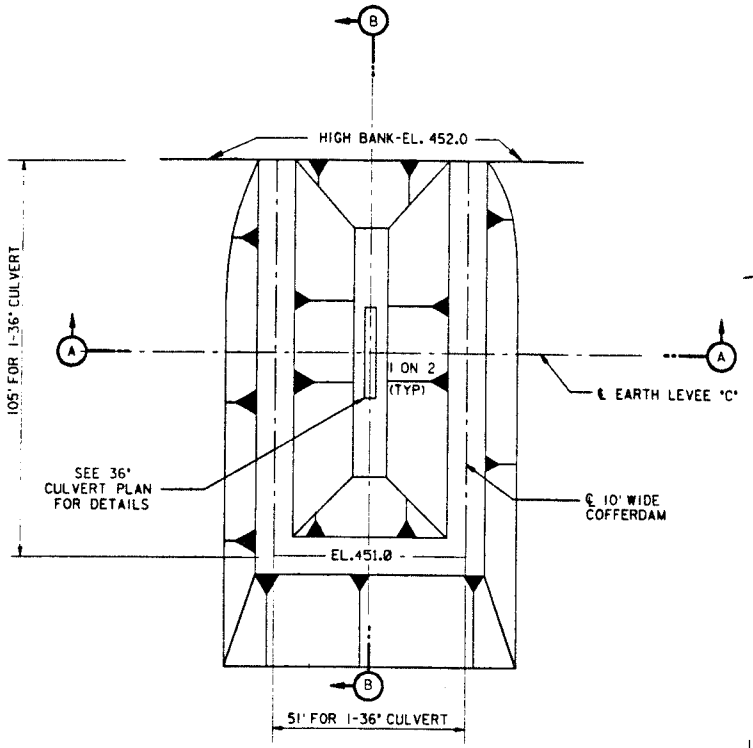
UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT

PROFILES
DREDGING & EARTH LEVEE "C"

CHECKED BY: M. E. HAMM	DESIGN FILE: PHARPR02	
DATE: JUL 89	PLOT SCALE: 10	SHEET NO. 5 OF 9

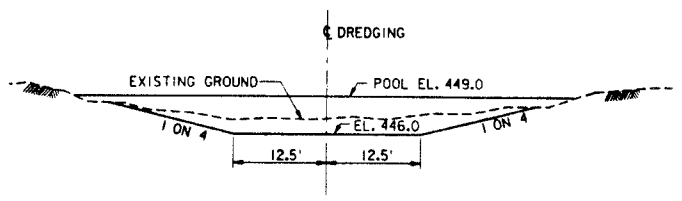
PLATE 5

10727 89C72 $$$$DATE$TIME$$$$



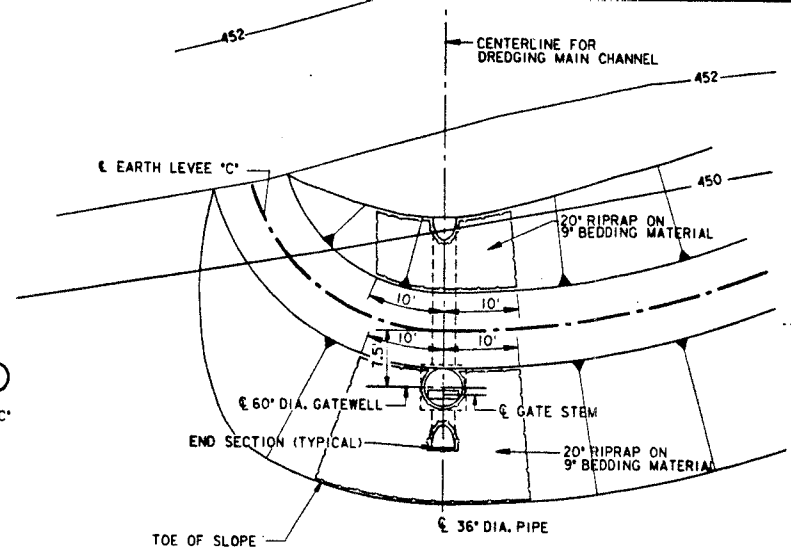
COFFERDAM PLAN (TYPICAL)

SCALE: 1" = 20'



DREDGING TYPICAL SECTION

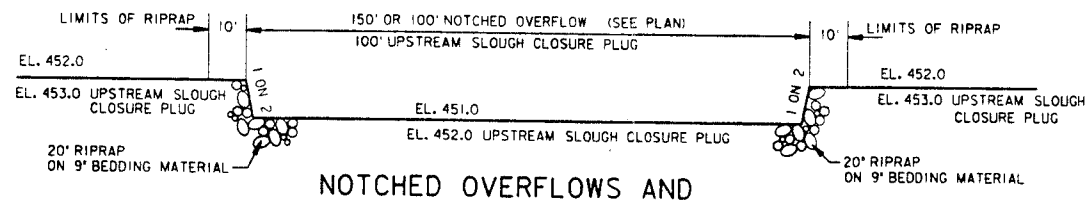
NO SCALE



NOTE: GATEWELL COVER NOT SHOWN.

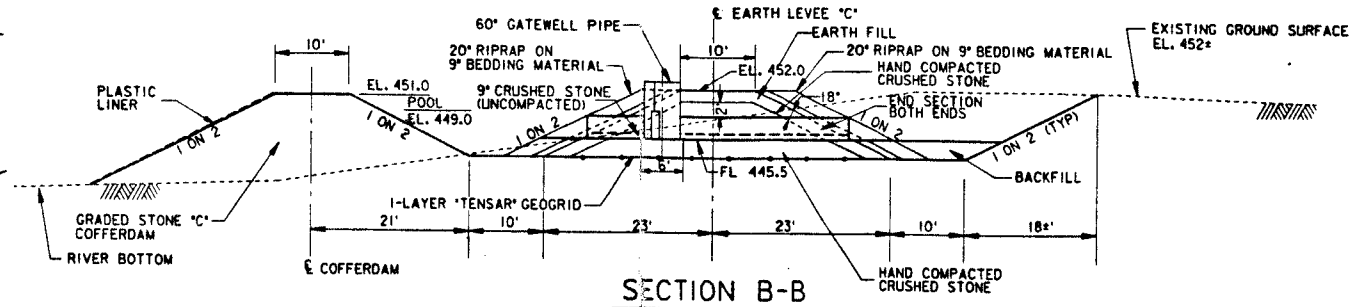
36" DIA. CULVERT PLAN (TYPICAL)

SCALE: 1" = 10'



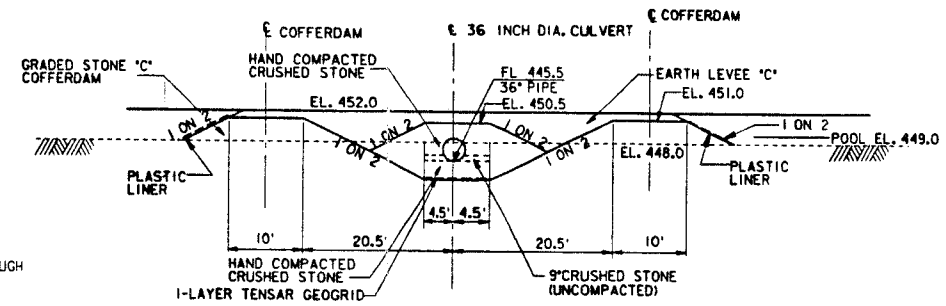
NOTCHED OVERFLOWS AND UPSTREAM SLOUGH CLOSURE PLUG ON MAIN CHANNEL PROFILE

NO SCALE



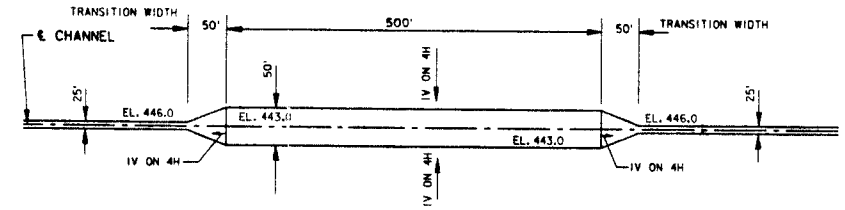
SECTION B-B

SCALE: 1" = 10'



SECTION A-A

SCALE: 1" = 10'

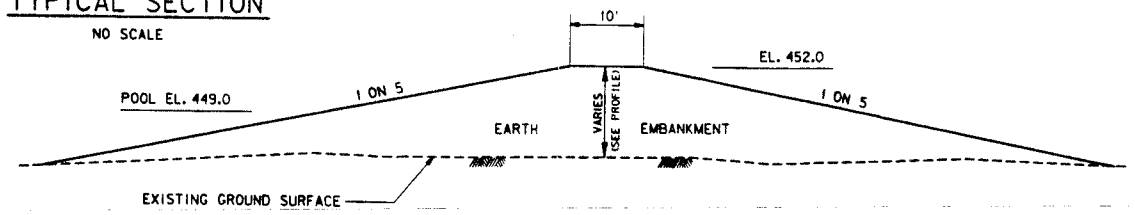


FISH REFUGE-PLAN

NO SCALE

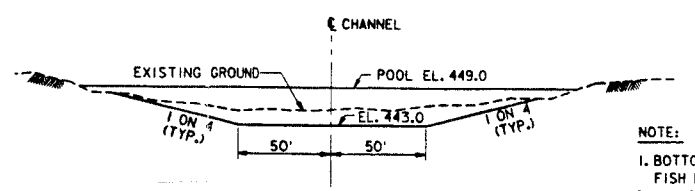
SLOUGH CLOSURE PLUGS TYPICAL SECTION

NO SCALE



EARTH LEVEES "A","B" & "C" TYPICAL SECTION

SCALE: 1" = 10'

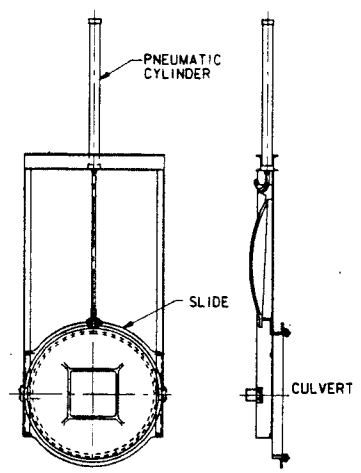


NOTE:

1. BOTTOM DIMENSIONS OF ALL OF THE FISH REFUGES ARE 50' X 500'.
2. ALL SIDE AND END SLOPES FOR THE FISH REFUGES ARE 1V ON 4H.

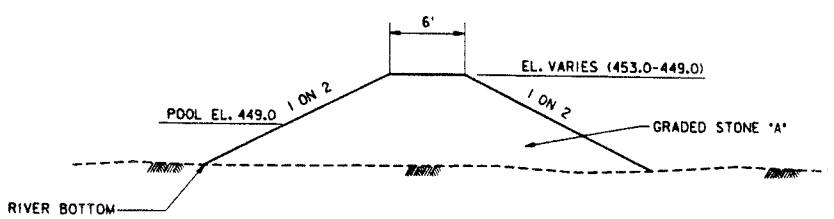
FISH REFUGE-TYPICAL SECTION

NO SCALE



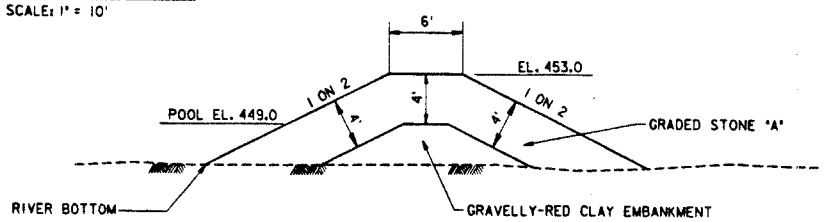
SLUICE GATE

NO SCALE



TRAIL DIKE TYPICAL SECTION

NO SCALE



BULL NOSE DIKE TYPICAL SECTION

NO SCALE

COMPUTER AIDED DESIGN + DRAFTING

SVERDRUP CORPORATION
ENGINEERS-ARCHITECTS-PLANNERS
ST. LOUIS, MISSOURI
DESIGNED BY: E.C. STRAUSS

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

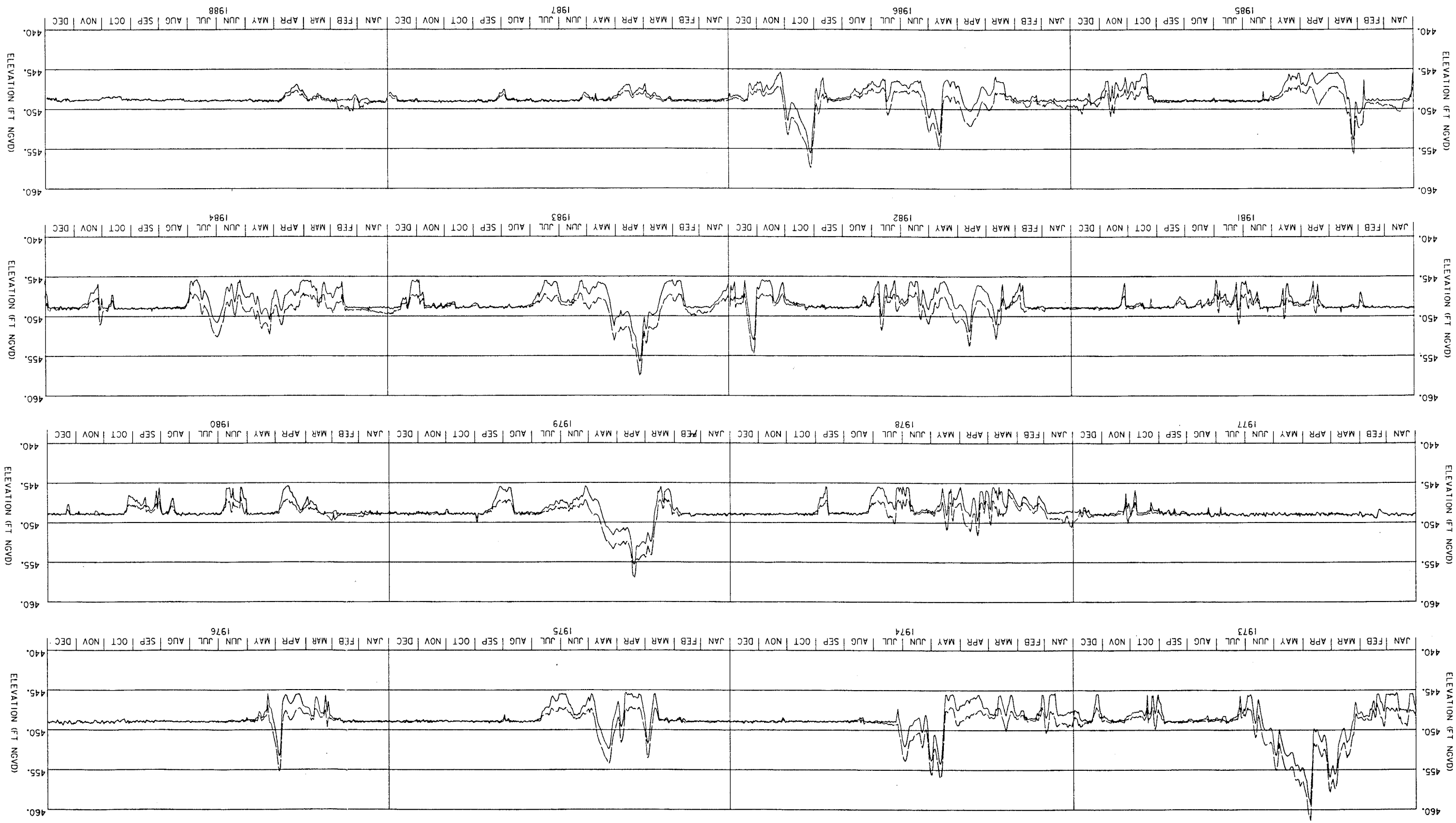
UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT

PLAN AND SECTIONS

CHECKED BY: M. E. HAMM | DESIGN FILE: PHARTYP
DATE: JUL 89 | PLOT SCALE: 20 | SHEET NO. 6 OF 9

PLATE 6

10727 89673 @@@@DATE\TIME@@@@



LEGEND

L&D24 POOL

PHARRS ISLAND

NOTE:
FREQUENCY CURVE / PROFILE INFORMATION IS AVAILABLE BY PUBLICATION "UPPER MISSISSIPPI RIVER, WATER SURFACE PROFILE, RIVER MILE 0.0 TO RIVER MILE 847.5", THROUGH THE U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT.

U.S.ARMY ENGINEER DISTRICT,ST.LOUIS
CORPS OF ENGINEERS
ST.LOUIS,MISSOURI

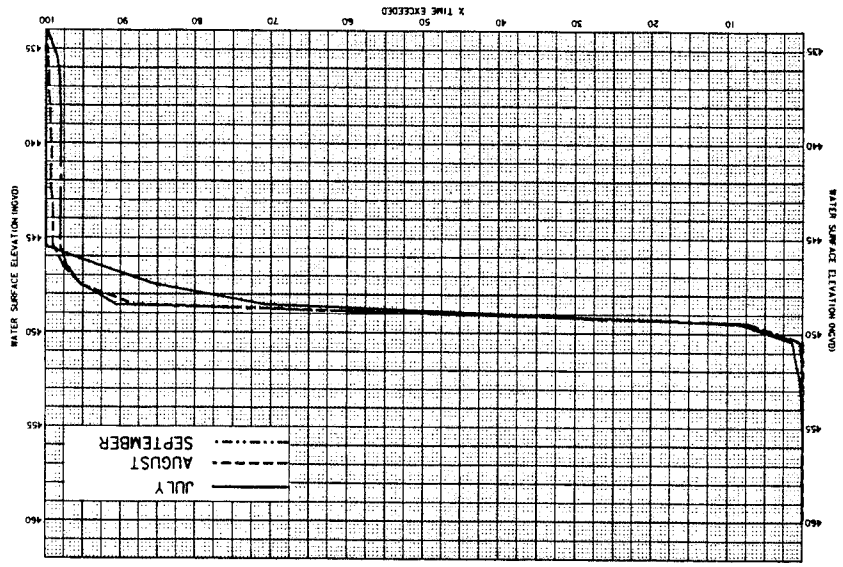
UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI

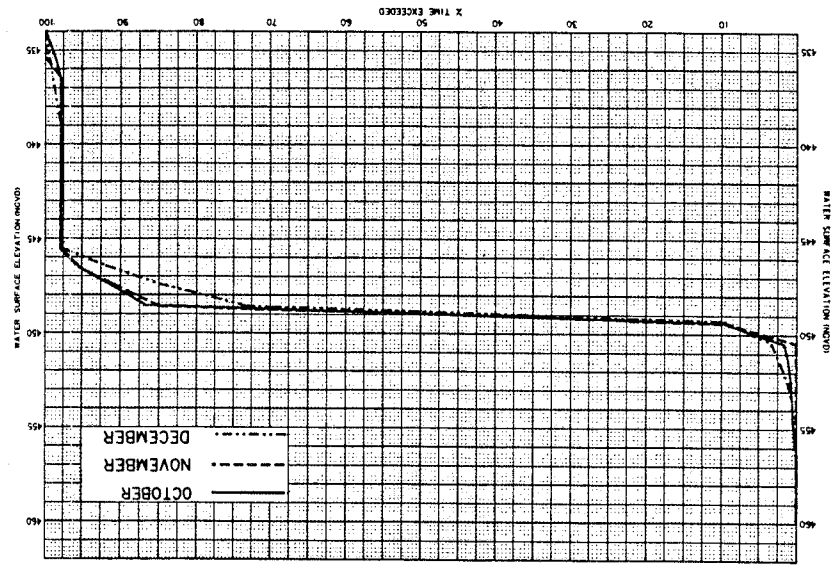
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT

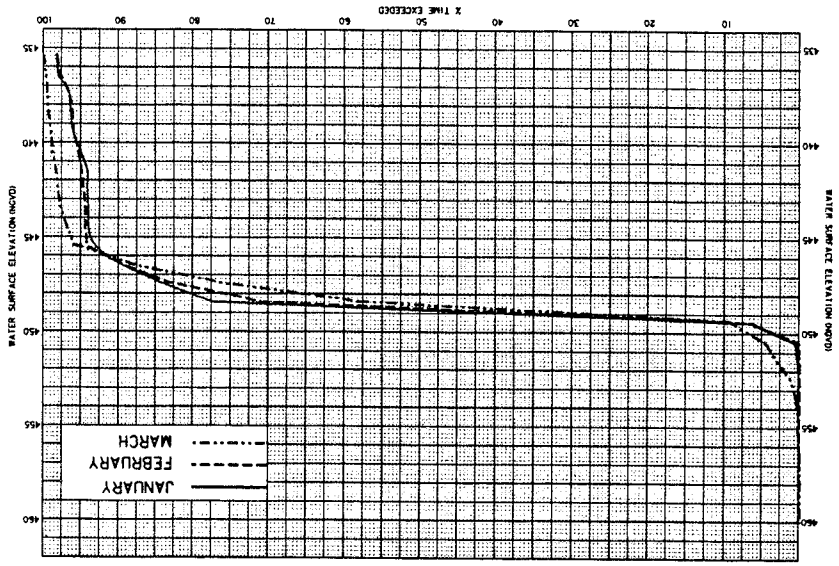
LOCK & DAM NO.24 (POOL)
CLARKSVILLE, MO.
STAGE - HYDROGRAPH

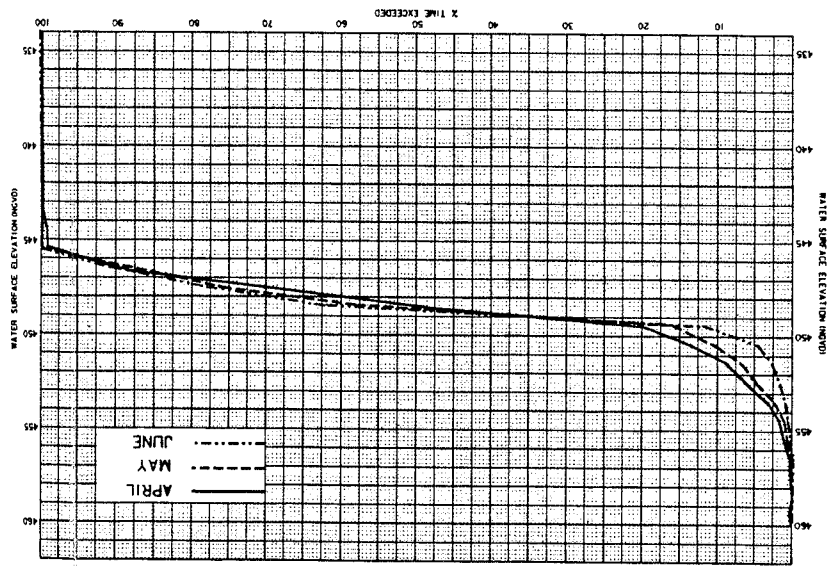
DESIGNED BY: PHILLIP S. EYDMANN	DATE: JUL 89	PLATE 7
DESIGN FILE: 203(140,3,PHARS.DGN	PLOT SCALE: 1'	SHEET 7 OF 9

COMPUTER AIDED DESIGN & DRAFTING









PERIOD, 1939-1987

U.S.ARMY ENGINEER DISTRICT,ST.LOUIS
CORPS OF ENGINEERS
ST.LOUIS,MISSOURI

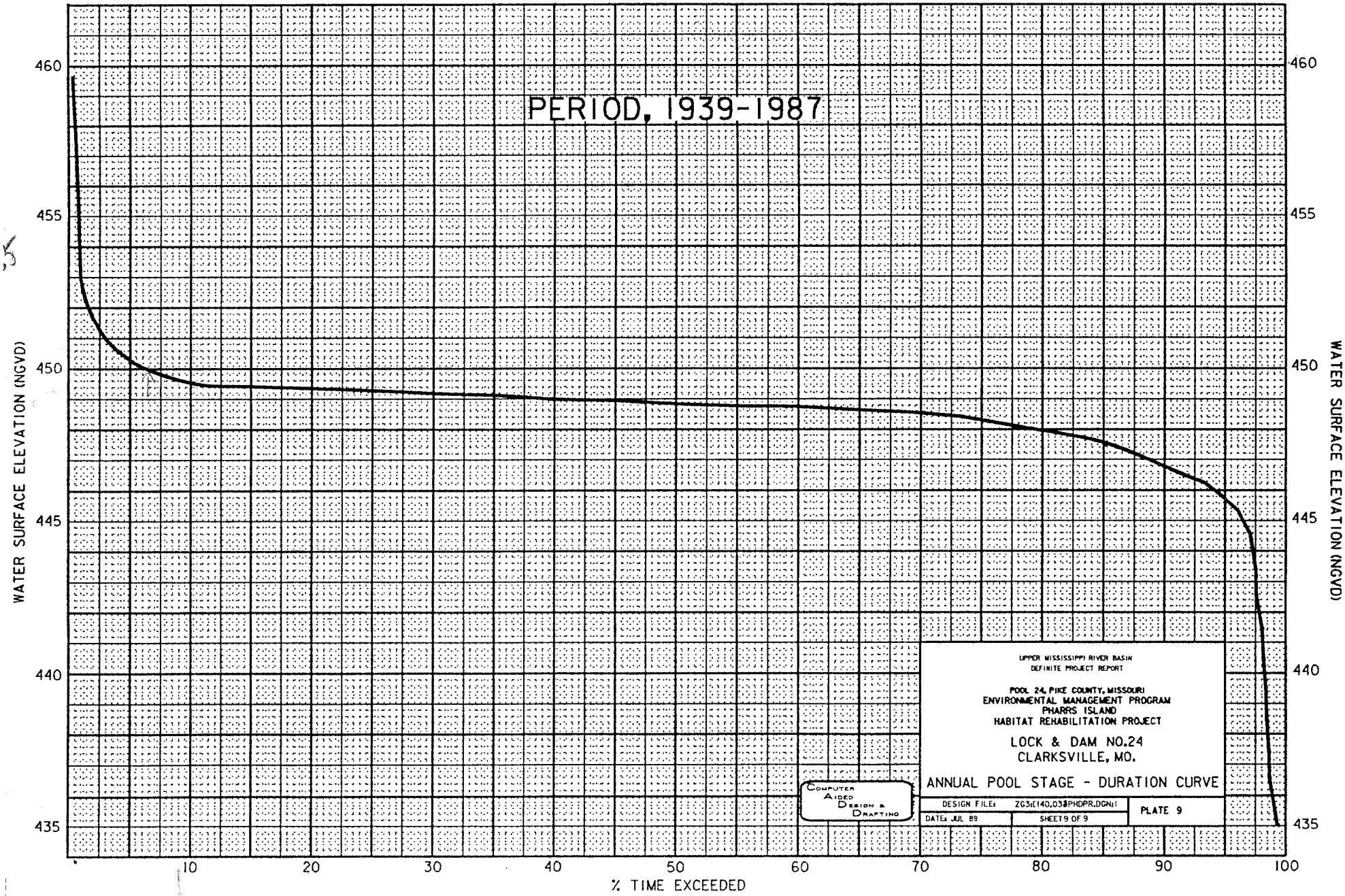
UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI

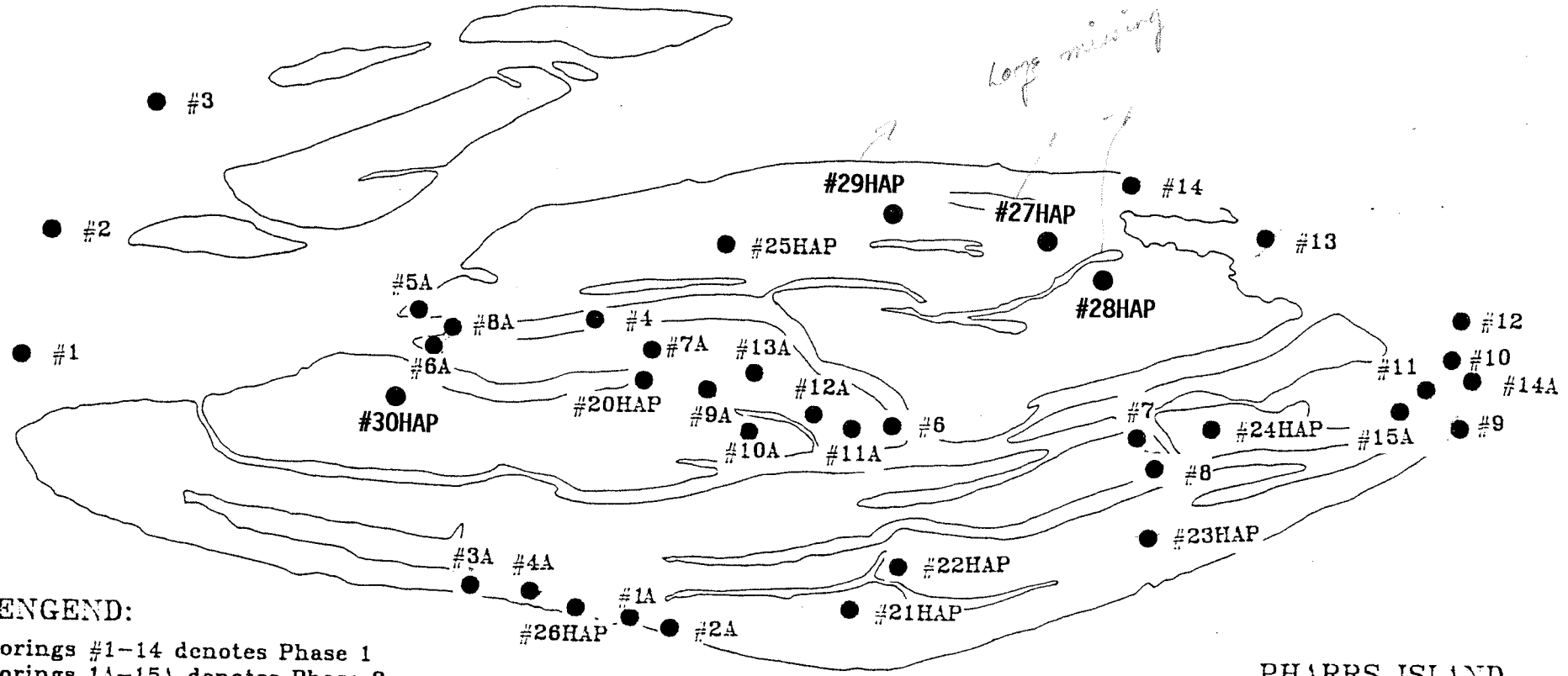
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT

LOCK & DAM NO.24 (POOL)
CLARKSVILLE, MO.
MONTHLY POOL STAGE - DURATION CURVE

DESIGNED BY: PHILLIP S. EYOUANN	DESIGN FILE: ZGSd140.03.PHDPR.DGN1	PLATE 8
DATE: JUL 89	PLOT SCALE: 1"	SHEET 8 OF 9

COMPUTER AIDED DESIGN & DRAFTING


PERIOD, 1939-1987
WATER SURFACE ELEVATION (NGVD)
460
455
450
445
440
435
10
20
30
40
50
60
70
80
90
100
% TIME EXCEEDED
UPPER MISSISSIPPI RIVER BASIN
DEFINITE PROJECT REPORT
POOL 24, PIKE COUNTY, MISSOURI
ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND
HABITAT REHABILITATION PROJECT
LOCK & DAM NO.24
CLARKSVILLE, MO.
ANNUAL POOL STAGE - DURATION CURVE
COMPUTER AIDED DESIGN & DRAFTING
DESIGN FILE: ZG3:[140,038]PHDPR.DGN;1
DATE: JUL 89
SHEET 9 OF 9
PLATE 9



LENGEND:

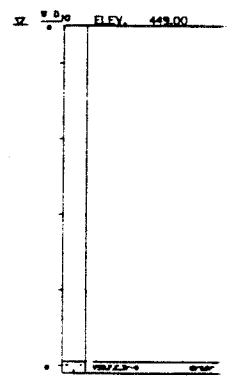
Borings #1–14 denotes Phase 1
Borings 1A–15A denotes Phase 2
Borings 20HAP–26HAP denotes Phase 3
No Borings were surveyed into an established baseline.

PHARRS ISLAND
BORING LOGS
LOCATION MAP

PLATE 10

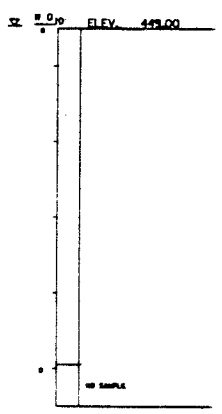
BORING NO. PI-1

Upper Bullnose
Rockfill Dike
(Grab Samples)
06/12/87



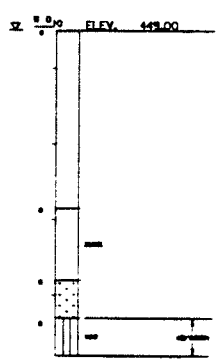
BORING NO. PI-2

Upper Bullnose
Rockfill Dike
(Grab Samples)
06/12/87



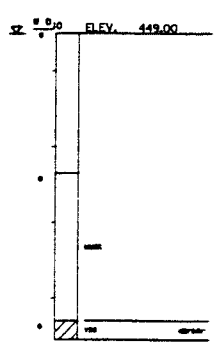
BORING NO. PI-3

Upper Bullnose
Rockfill Dike
(Grab Samples)
06/12/87



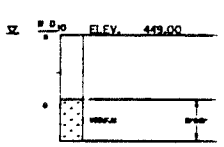
BORING NO. PI-4

Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



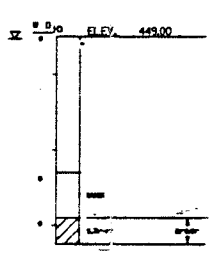
BORING NO. PI-5

Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



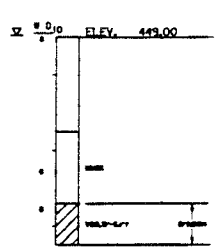
BORING NO. PI-6

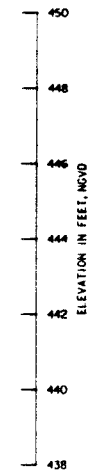
Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



BORING NO. PI-7

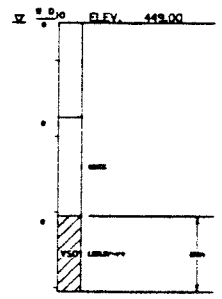
Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87





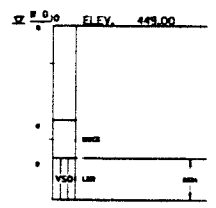
BORING NO. PI-8

Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



BORING NO. PI-9

Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



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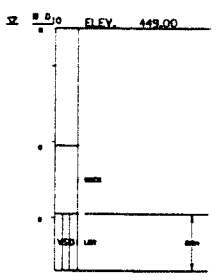
Slough Area Through
Pharrs Island
(Grab Samples)
06/12/87



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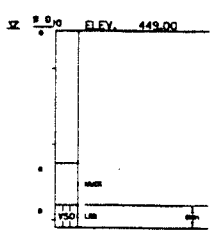
Lower End
Trail Dike
(Grab Samples)
06/12/87



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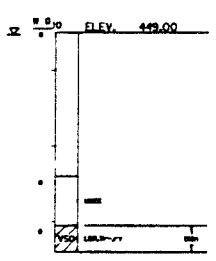
(Grab Samples)
06/12/87



BORING NO. PI-13

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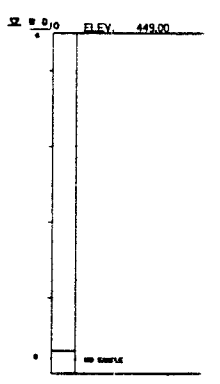
(Grab Samples)
06/12/87



BORING NO. PI-14

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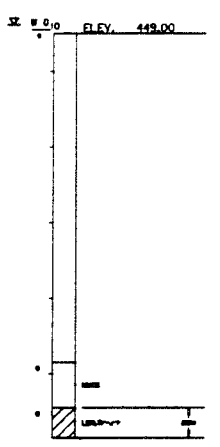
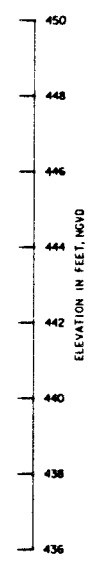
Trail Dike
(Grab Samples)
06/12/87





SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

DESIGNED BY: C. F. HOPPLE
DRAWN BY: L. M. PADILLA
CHECKED BY: C. F. HOPPLE
DATE: MAR 90

CLYDE F. HOPPLE
DESIGN ENGINEER

CHIEF, E SECTION

GEORGE J. POSTOL
CHIEF, GEOTECHNICAL BRANCH

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

PHARRS ISLAND
PHASE I
BORING LOGS

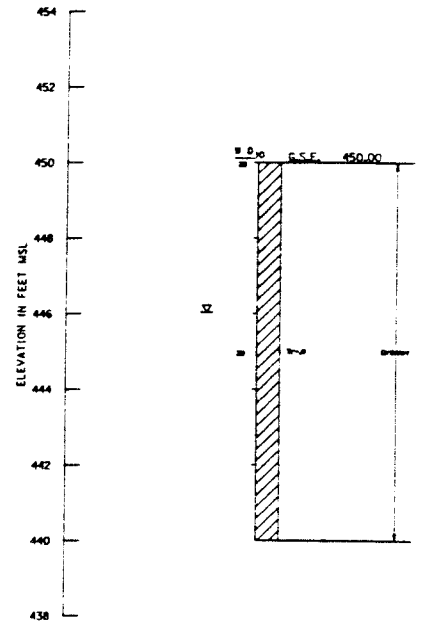
CORPS CONTR. NO. DACW 43
DESIGN FILE: PI1.DGN
PLOT SCALE:
DRAWING NO. PLATE 11
SHEET X OF X

COMPUTER AIDED DESIGN & DRAFTING

BORING NO. 1A

(Hand Auger)

07/25/89



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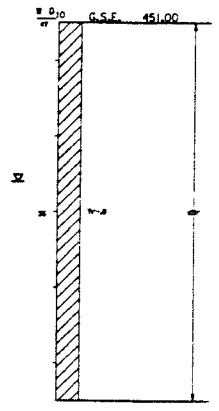
(Hand Auger)

07/25/89



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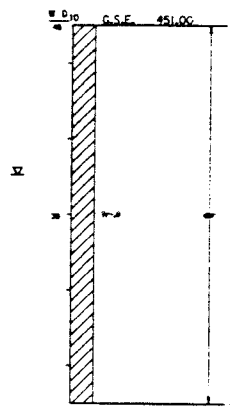
07/26/89



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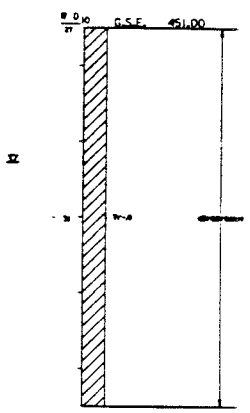

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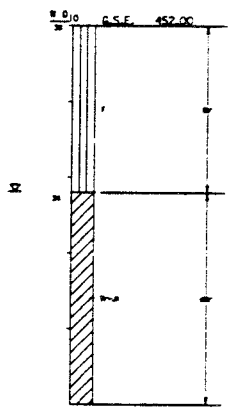

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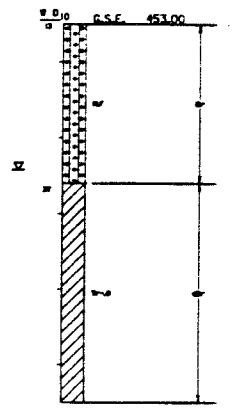
07/26/89



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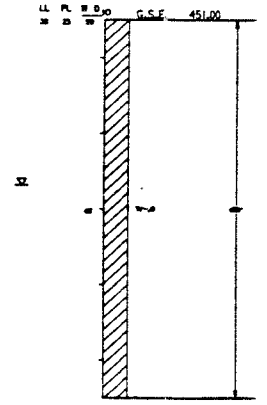
07/27/89



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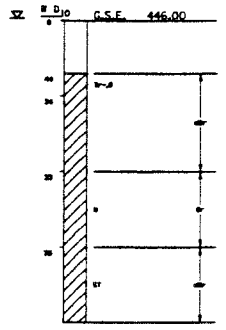

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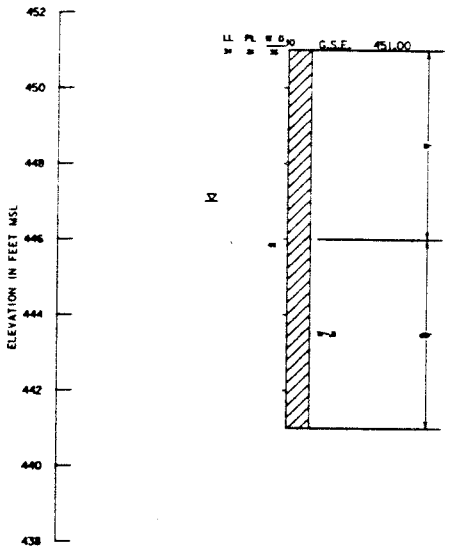

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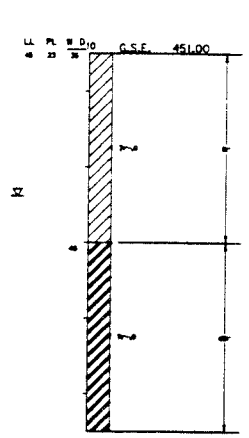

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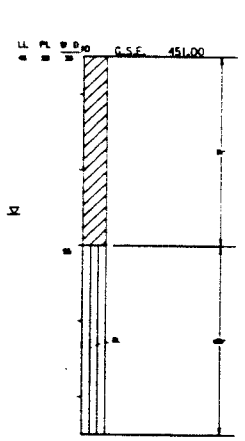

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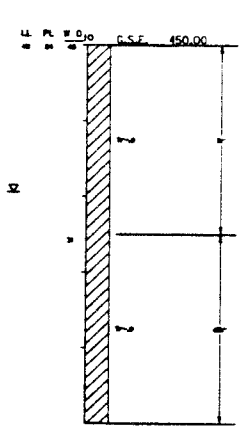

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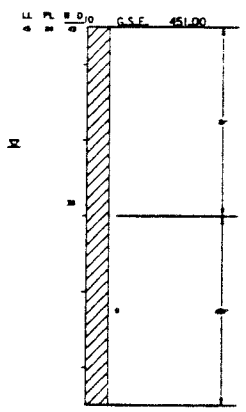

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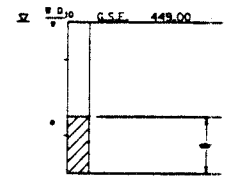

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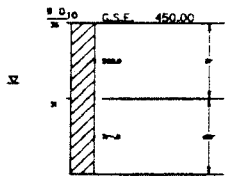
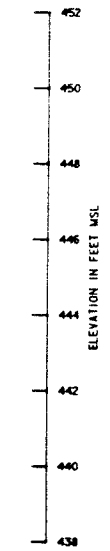




SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

DESIGNED BY: C. F. HOPPLE
DRAWN BY: L. M. BROHLAN
CHECKED BY: C. F. HOPPLE
DATE: MAR 90

SUBMITTED: CLYDE F. HOPPLE, DESIGN ENGINEER

SUBMITTED: X, CHIEF, E SECTION

APPROVED: GEORGE J. POSTOL, CHIEF, GEOTECHNICAL BRANCH

U.S.ARMY ENGINEER DISTRICT,ST.LOUIS
CORPS OF ENGINEERS
ST.LOUIS,MISSOURI

PHARRS ISLAND
PHASE 2
BORING LOGS

CONTR. CONST. NO. DACW 43

DRAWING NO. PLATE 12

DRAWING FILE: PI2 3.DGN

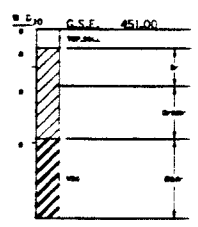
PLOT SCALE: X

SHEET X OF X

COMPUTER AIDED DESIGN & DRAFTING

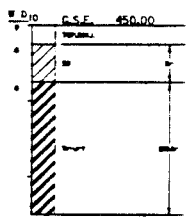
BORING NO. 20HAP

Approx. 200' S
of Old Slough
(Near Boring 7A)
01/19/90



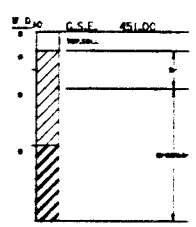
BORING NO. 21HAP

Approx. 400' E
of High Bank of Island
(1200' S of Boring 1A)
01/19/90



BORING NO. 22HAP

Approx. 600' E
of High Bank
(600' S of Boring 21HAP)
01/19/90



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of High Bank
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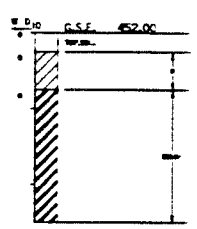
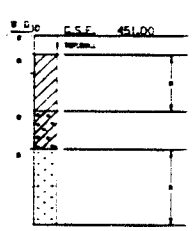
01/19/90



BORING NO. 24HAP

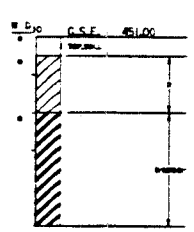
Approx. 300' S
of Old Slough Fork

01/19/90



BORING NO. 25HAP

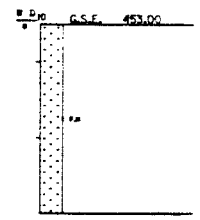
Approx. Half-way between
Old Slough & High Bank
of Island
01/19/90

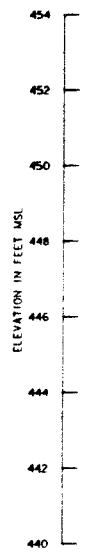


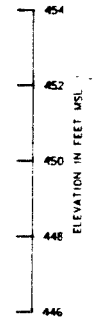
BORING NO. 26HAP

Approx. 400-500' N
of Boring 1A on High Bank

01/19/90







SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

DESIGNED BY: C. F. HOPPLE
DRAWN BY: L. M. WICKLAM
CHECKED BY: C. F. HOPPLE
DATE: MAR 90

SUBMITTED: CLYDE F. HOPPLE
(CESWD-ED-MCP)

SUBMITTED: X
(CHIEF, X SECTION)

APPROVED: GEORGE J. POSTO
(CHIEF, GEOTECHNICAL BRANCH)

U.S.ARMY ENGINEER DISTRICT,ST.LOUIS
CORPS OF ENGINEERS
ST.LOUIS,MISSOURI

PHARRS ISLAND
PHASE 3
BORING LOGS

CONTR. IDENT. NO. DACW 43
DESIGN FILE P12 3.DGN
DRAWING NO. PLATE 13
PLOT SCALE: X INS. = X UNITS
SHEET X OF X

COMPUTER AIDED DESIGN & DRAFTING

ATTACHMENT 2

APPENDICES

FINAL DEFINITE PROJECT REPORT (SL-E)

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND WETLAND HABITAT REHABILITATION
POOL 24, MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

APPENDICES

APPENDIX	DESCRIPTION
DPR-A	Letter of Intent and Draft Memorandum of Agreement for OM&R
DPR-B	Correspondence Pertaining to Draft DPR
DPR-C	Clean Water Act, Section 404(b)(1) Evaluation
DPR-D	Distribution List
DPR-E	Hydrology and Hydraulics
DPR-F	Geotechnical Considerations
DPR-G	Cultural Resources Documentation
DPR-H	Fish and Wildlife Coordination Act Documentation
DPR-I	Endangered Species Act Documentation
DPR-J	Project Habitat Quantification
DPR-K	Biological Data
DPR-L	Performance Evaluation Monitoring - Physical, Chemical Sampling Locations

APPENDIX DPR-A

LETTERS OF INTENT AND DRAFT MEMORANDUM OF AGREEMENT FOR OM&R

FOREWORD

APPENDIX DPR-A provides a draft Memorandum of Agreement (MOA) between the St. Louis District and the U.S. Fish and Wildlife Service. The appendix also includes signed letters from both the Missouri Department of Conservation and the Fish and Wildlife Service indicating intent to accomplish the project's O&M activities in accordance with the provisions of the 1986 Water Resources Development Act.

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 PHARRS ISLAND, MISSOURI

I. PURPOSE

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

II. BACKGROUND

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

III. GENERAL SCOPE

The (Project) to be accomplished pursuant to this MOA shall consist of enhancing fish and wildlife habitat, by reducing sedimentation, by providing a means of water level control, and by implementing a variety of habitat management practices.

IV. RESPONSIBILITIES

a. DOA is responsible for:

(1) Construction: Construction of the Project which consists of enhancing fish and wildlife habitat, by reducing sedimentation and by providing a means of water control.

(2) Major Rehabilitation: Any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the Definite Project Report and that is needed as a result of specific storm or flood events.

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

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

b. FWS is responsible for:

(1) Operation, Maintenance, and Repair: Upon completion of construction as determined by the District Engineer, St. Louis, the FWS shall accept the Project and shall operate, maintain and repair the Project as defined in the Definite Project Report entitled "Pharrs Island Wetland Habitat Rehabilitation," dated July 1989, in accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662.

(2) Non-Federal Responsibilities: In accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662, the FWS shall obtain 25 percent of all costs associated with the operation, maintenance, and repair of the Project from the Missouri Department of Conservation.

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, St. Louis
210 Tucker Blvd., North
St. Louis, Missouri 63101-1986

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:

(Signature)
JAMES E. CORBIN
Colonel
U.S. Army Engineer District
St. Louis
Corps of Engineers

Date _____

THE U.S. FISH AND WILDLIFE SERVICE

By:

(Signature)
JAMES C. GRITMAN
Regional Director
U.S. Fish and Wildlife Service

Date _____

MISSOURI DEPARTMENT OF CONSERVATION

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

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

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

February 21, 1990

Colonel James E. Corbin
District Engineer
St. Louis District, Corps of Engineers
210 Tucker Blvd., North
St. Louis, Missouri 63101

Dear Colonel Corbin:

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

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

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

Sincerely,

JERRY J. PRESLEY
DIRECTOR

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

Fe 1-2-1

United States Department of the Interior

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

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

FWS/ARW-SS

MAY 8 1990

Colonel James E. Corbin
District Engineer
U.S. Army Engineer District, St. Louis
210 Tucker Boulevard North
St. Louis, Missouri 63101

MAY 90 9:51

RECEIVED STL

Dear Colonel Corbin:

The U.S. Fish and Wildlife Service (Service) has reviewed the Definite Project Report (April 1990) for the Pharrs Island Habitat Rehabilitation Project. This project, located north of St. Louis in Pool 24, is proposed under the Water Resources Development Act of 1986 (Public Law 99-662) as part of the Upper Mississippi River System Environmental Management Program.

The Pharrs Island 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 action described in the Environmental Assessment. A copy of the refuge compatibility statement as required by the National Wildlife Refuge Administration Act of 1966 has been provided.

The Service will assure that operation and maintenance requirements of the project as defined in the Definite Project Report will be accomplished in accordance with Section 906 (e) of the Water Resources Development Act of 1986.

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

Sincerely,

James C. Gritman

James C. Gritman
Regional Director

APPENDIX DPR-B

CORRESPONDENCE PERTAINING TO DRAFT DPR

FOREWORD

APPENDIX DPR-B provides the letters of comment received on the Draft DPR, and as appropriate, St. Louis District responses to those comments.

MISSOURI CHAPTER
AMERICAN FISHERIES SOCIETY

323 South Main
Palmyra, MO 63461
August 17, 1989

U.S. Army Corps of Engineers
St. Louis District
Plan Formulation Branch, CELMS-PD-F
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

Dear Sir:

The Missouri Chapter of the American Fisheries Society has reviewed the Draft PDR (SL-3) for the Pharrs Island Wetland Habitat Rehabilitation Pool 24, Mississippi River, Pike County, Missouri project and provide the following comments:

P.9 c. Air Quality The presence of two large industries within lower Pool 24 should be mentioned ie., Hercules Chemical Company and Dundee Cement Company.

P. 13 (3) Interior Wetlands Discussion is needed concerning the value of the interior wetlands to the river's overall fishery. Mention spawning, nursery and permanent fish habitat available in these off channel areas. Enclosed is a list of fish species collected from project interior waters.

P. 19 Boat Pullover Will those individuals wanting to use interior wetlands for recreational purposes be allowed to do so? This paragraph implies that only MDOC personnel will access interior wetlands.

P. 33 2nd Paragraph Recommend dredging to 446 or 447 NVGD at selected locations, this practice would create deeper holes providing thermal refuges for fish during summer months.

P.42 Mention should be made of the recent attempts by MDOC personnel to relocate and establish P. capax within Pool 24.

Our organization appreciates the opportunity to make comment.

Sincerely,

Gordon B. Farabee

Gordon B. Farabee

cc: Steve Weithman

Listing of fish species seined from Pharrs Island wetland complex Pool 24, field seasons 1987 and 1988. Collection made by Gordon B. Farabee, Fisheries Biologist, Missouri Department of Conservation.

Species	Number Collected	Percent of Harvest
Emerald shiner Notropis atherinoides	75	4
Bluegill Lepomis macrochirus	901	48
River shiner Notropis blennius	26	1
Gizzard shad Dorosoma cepedianum	125	7
Bullhead minnow Pimephales vigilax	171	9
Quillback carpsucker Carpiodes cyprinus	4	
Spottail shiner Notropis hudsonius	115	6
Drum Aplodinotus grunniens	11	
Smallmouth buffalo Ictiobus bubalus	65	3
Silver chub Hybopsis storeriana	94	5
Spotfin shiner Notropis spilopterus	51	2
White bass Morone chrysops	7	
Sand shiner Notropis stramineus	2	
Johnny darter Etheostoma nigrum	9	
Brook silverside Labidesthes sicculus	33	1
Common carp Cyprinus carpio	1	
Bluntnose minnow Pimephales notatus	2	
Largemouth bass Micropterus salmoides	8	
Walleye Stizostedion vitreum	1	
Mosquitofish Gambusia affinis	70	3
Orangespotted sunfish Lepomis humilis	64	3
Red shiner Notropis lutrensis	1	
Logperch Percina caprodes	4	
Central stoneroller Campostoma anomalum	4	
Longnose gar Lepisosteus osseus	2	
Green sunfish Lepomis cyanellus	1	
Black crappie Pomoxis nigromaculatus	3	
Slenderhead darter Percina phoxocephala	5	

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
MISSOURI CHAPTER AMERICAN FISHERIES SOCIETY
AUGUST 17, 1989

ST. LOUIS DISTRICT RESPONSES:

P.9c. Air Quality. The text has been modified per your comment.

P.13(3) Interior Wetlands. The text description has been expanded and the list of fish species included as part of the biological data appendix to the DPR.

P.19 Boat Pullover. The text has been revised to indicate the use of the boat pullover for recreational purposes will be left to the discretion of the local sponsor, i.e., the Missouri Department of Conservation.

P.33 2nd Paragraph. The revised project plan includes three 50' wide X 500' long sections of interior slough deepened to 443 NGVD as summer fish refuges.

P.42. The endangered species discussion has been expanded per your comment.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MARION SUBOFFICE (ES)
Rural Route 3, Box 328
Marion, Illinois 62959

IN REPLY REFER TO:

TAKE PRIDE IN AMERICA

August 21, 1989

Colonel James E. Corbin
U.S. Corps of Engineers
St. Louis District
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

ATTN: Plan Formulation Branch (CELMS-PD-F)

Dear Colonel Corbin:

We have reviewed the Pharrs Island Draft Definite Project Report and Draft Finding of No Significant Impact accompanying your letter of August 7, 1989.

The document is well written and adequately reflects the effects of the proposed project on fish and wildlife resources. We are confident that the combination of this Environment Management Program (EMP) project and Clarksville Refuge EMP project, located immediately across the Mississippi River on the Missouri side, will be of great benefit to migratory birds using the Mississippi River Flyway. We are especially pleased that the Pharrs Island Wetland Rehabilitation project includes improved habitat for river fishes.

We agree with your conclusions that the rehabilitation of Pharrs Island will not have significant effects on the quality of the environment and will not affect federally listed endangered species.

Sincerely,

Thomas M. Groutage

Thomas M. Groutage
Assistant Field Supervisor

cc: IDOC (Atwood, Donels)
MDOC (Stucky)

United States
Department of
Agriculture

Soil
Conservation
Service

555 Vandiver Drive
Columbia, Missouri
65202

August 22, 1989

Mr. Jack F. Rasmussen, P.E.
Chief, Planning Division
Department of the Army
St. Louis District, Corps of Engineers
210 Tucker Boulevard, North
St. Louis, Missouri 63101-1986

Dear Mr. Rasmussen:

Our office has reviewed a copy of the Pharrs Island Project Report dated July 1989 and do not have any comments.

We appreciate the opportunity to comment.

Sincerely,

ACTING
Russell C. Mills
State Conservationist

John Ashcroft
Governor

James R. Moody
Commissioner

State of Missouri
OFFICE OF ADMINISTRATION
Post Office Box 809
Jefferson City
65102

Stan Perovich
Director
Division of General Services

August 30, 1989

District Engineer
St. Louis District, Corps of Engineers
ATTN: Plan Formulation Branch (CELMS-PD-F)
210 Tucker Boulevard, North
St. Louis, Missouri 63101-1986

Dear Sir:

Subject: 89080030 - Pharrs Island Habitat Rehabilitation Project

The Missouri Federal Assistance Clearinghouse, in cooperation with state and local agencies interested or possibly affected, has completed the review on the above project application.

None of the agencies involved in the review had comments or recommendations to offer at this time. This concludes the Clearinghouse's review.

A copy of this letter is to be attached to the application as evidence of compliance with the State Clearinghouse requirements.

Sincerely,

Lois Pohl, Coordinator
Missouri Clearinghouse

LP:cm

United States Department of the Interior

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

TAKE PRIDE IN AMERICA

August 31, 1989

Colonel James Corbin
U.S. Army Corps of Engineers
210 Tucker Boulevard
St. Louis, MO 63101-1986

Dear Colonel Corbin:

The draft definite project report for Pharrs Island has been reviewed by appropriate staff and we offer the following comments.

The Pharrs Island habitat rehabilitation and enhancement project is complex and expensive. It will be subjected to highly critical review within the Corps. With that in mind, we think it would be a matter of some urgency to lay out the benefits of the project in one place in a succinct and comprehensive manner as you do the consequences of no project . Currently you have to winnow the text, compare a number of tables and understand the somewhat enigmatic presentation of data in the WHAG, Appendix DPR-E. There is no assurance that other reviewers at other levels have the familiarity with the process used at the District level to fully comprehend the projected benefits of the project.

Is the control of encroaching willows and cottonwood (page 37, paragraph 5) a project feature? If it is not, why is it addressed? This would appear to be a discretionary management step for the land manager.

The Fish and Wildlife Service has determined that the project is compatible with the purposes for which the Mark Twain National Wildlife Refuge was established. The District Engineer has been notified of that determination and acknowledgement of this fact would be more appropriate then the statement following "The USFWS should ensure that. . ." on page 55.

The Regional Director will sign the agreement contained in Appendix DPR-H at the appropriate time. We would suggest that the section entitled Implementation Responsibilities and Views, page 55, really contain our views. These views, as understood by the North Central Division, are captured in the Fourth Annual Addendum, III.A.1 page 9. Please cite that reference in addition to Section 906(e).

The discussion on historic properties (pages 37-39) is a matter of concern. By waiting until construction starts to institute archeological monitoring, the Corps has foreclosed opportunities

for the Advisory Council on Historic Preservation to comment and consider alternatives to adverse effects. If this approach is not changed our Historic Preservation Officer is apt to recommend to the Regional Director that he not sign the project Memorandum of Agreement until he has determined that the Corps of Engineers is in compliance, 36 CFR Part 800. The fix appears to be an elementary change so that monitoring is conducted in accordance with a memorandum of agreement with the council that includes the Fish and Wildlife Service and the Missouri Historic Preservation Officer. We believe that this would be an acceptable approach, where as, the unilateral approach proposed in the DPR is not.

The WHAG evaluates Alternative 1 while the DPR alternatives are labelled A, B, C and D. This ambiguity needs to be cleared up.

Thank you for the opportunity to comment on this draft.

Sincerely,

Robert H. Stratton, Jr.
Project Leader

cc: Matt Kerschbaum, WAM-2
LeRoy W. Sowl, EMP Coordinator

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
U.S. FISH AND WILDLIFE SERVICE
MARK TWAIN NATIONAL WILDLIFE REFUGE
AUGUST 31, 1989

ST. LOUIS DISTRICT RESPONSES:

Project Benefits Depiction. An attempt has been made to condense and better highlight the benefits of the project, particularly with regard to the executive summary section of the report. The WHAG analysis has been greatly expanded upon and an AHAG (Aquatic Habitat Appraisal Guide) procedure has been applied to the project.

Vegetation Control. Per the desires of MDOC, vegetation removal in certain areas will initially be included as part of the project construction. Subsequent control of vegetation encroachment will be the responsibility of the MDOC.

Refuge Compatibility Wording. The DPR text has been revised per your comment.

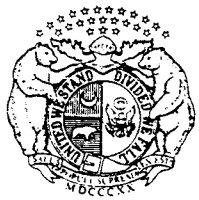
Annual Addendum Citation. The requested citation is now included in the DPR text.

Cultural Resources Compliance. At the suggestion of the U.S. Fish and Wildlife Service, concurrence with this procedure and the determination of no adverse effect to historic properties is being sought from the Advisory Council on Historic Preservation; the document submitted to the Council is included in Appendix I of the final DPR. Prior communication with the Council indicated that concurrence with this approach will be forth coming once the necessary documentation has been received (telephone conversation of 26 January 1990 between Suzanne Harris, St. Louis District and Thomas McCulloch, Advisory Council on Historic Preservation).

WHAG Versus Alternatives. The WHAG and AHAG, as contained in the revised DPR, addresses all alternatives (see APPENDIX E).

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director



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

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE DIRECTOR
P.O. Box 176
Jefferson City, MO 65102
314-751-4422

September 7, 1989

Colonel James Corbin
District Engineer
St. Louis District
Corps of Engineers
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

Dear Colonel Corbin:

The Missouri Department of Natural Resources has reviewed the Definite Project Report/Environmental Assessment and draft Finding of No Significant Impact for the proposed Pharrs Island Wetland Habitat Rehabilitation Project.

Our review causes us to have no objection to the determination that an Environmental Impact Statement will not be required prior to proceeding with the proposed action and we concur with the Finding of No Significant Impact.

Thank you for the opportunity to review and comment on this proposed project.

Very truly yours,

DEPARTMENT OF NATURAL RESOURCES

G. Tracy Mehan, III
Director

GTM:tlk

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

September 8, 1989

Colonel James E. Corbin, USA
U.S. Army Engineer District-St. Louis
ATTN: Planning Division
210 Tucker Boulevard, North
St. Louis, Missouri 63101-1986

Dear Colonel Corbin:

RE: Pharrs Island Habitat Rehabilitation Project

In accordance with our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act, we have reviewed the Definite Project Report with integrated Environmental Assessment, Finding of No Significant Impact (FNSI) and Clean Water Act Section 404 (b)(1) Evaluation report for the project referenced above. Although we are generally in favor of the proposed project, we do not believe that wetlands are adequately addressed. Therefore, we cannot concur with your intent to issue a FNSI for this project without further clarification.

Our detailed comments are enclosed. Any questions on the comments should be directed to Mr. Bob Barber of the Wetlands Protection Section at 913/236-2823.

Thank you for the opportunity to comment.

Sincerely yours,

Michael J. Bronoski

for Lawrence M. Cavin
Chief, Environmental Review
and Coordination Section

Enclosure

Comments

1. Since the project will involve discharge of dredged or fill material, and is therefore subject to regulation under Section 404 of the Clean Water Act, wetlands should be defined in accordance with the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands."

2. If the Cowardin Classification is used, wetlands and deepwater habitats should not be combined as one unit. The section titled Wetland Habitat on page 11 refers to the riverine system as a wetland when it is actually a complex of both wetland and deepwater habitats. In order to address EPA's overall "no net loss" goal, wetland acreages and functions need to be compatible with the Federal wetlands definition.

3. There is an apparent conflict of information in the DPR between figure 3 (page 14) and the description of Forested Wetland on page 37. Figure 3 indicates that the dredged material disposal site is old growth forest (silver maple-cottonwood). Page 37 states that the material will be discharge into "younger aged trees of low habitat value." Clarification is needed.

4. The documents need to describe the effect of the discharge of dredged material on the wetland disposal site, i.e. will dredged material disposal result in conversion of wetland to upland?

5. The 404 (b)(1) Evaluation "Description of Proposed Discharge Sites" (page F-8) does not indicate whether the forested dredged material disposal site is wetland.

6. The number of acres and functions of jurisdictional wetlands which are existing, are lost as a result of the project or are gained as a result of the project should be described.

7. The 404 (b)(1) Evaluation should describe the dredged material disposal sites mentioned in paragraph "C. Alternatives" on page F-5. The alternatives analysis must demonstrate that there are no practicable alternatives.

8. The 404 (b)(1) Evaluation should include practicable alternatives analyses for disposal of dredged material from maintenance dredging.

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VII, KANSAS CITY
SEPTEMBER 8, 1989

ST. LOUIS DISTRICT RESPONSES:

Comment 1. The revised Section 404(b)(1) evaluation now includes the referenced definition of wetlands. The acreages of project wetlands meeting this definition has been tabulated.

Comment 2. The Cowardin classification will be used in the report, but a new tabulation has been included to indicate those wetlands under this classification that fall under Section 404 jurisdictional authority.

Comment 3. The subject sections have been revised.

Comment 4. The text of the 404 evaluation has been clarified per your comment. The disposal site does represent a conversion from wetland to upland.

Comment 5. The revised Section 404 Evaluation includes a map showing the areas of forested habitat not included under 404 jurisdiction. The two disposal areas lie in areas outside of this zone and therefore represent wetland.

Comment 6. Average annualized acres and species related habitat unit changes resulting from the project are now described in the revised 404 evaluation.

Comment 7. The site selection criteria used to arrive at the two designated disposal sites is provided in paragraph II.e.(3) and that paragraph is now referenced in the paragraph C - Alternatives. Applying the criteria it was felt that no other viable site alternatives exist for the disposal of the dredged material.

Comment 8. Paragraph C - Alternatives, now includes reference to paragraph II.G. for a description of mechanical dredging as an alternative to hydraulic dredging.

PD-F

MISSOURI DEPARTMENT OF CONSERVATION

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

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

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

September 18, 1989

Mr. Jack F. Rasmussen, P.E.
Chief, Planning Division
St. Louis Division, Corps of Engineers
210 Tucker Blvd., North
St. Louis, Missouri 63101

Re: Pharrs Island
Habitat Rehabilitation Project

Dear Mr. Rasmussen:

We have reviewed the Pharrs Island Draft Definite Project Report. St. Louis District, Corps of Engineers staff is to be commended for its effort in preparing this report. It is well written and clearly presents project objectives, alternatives considered, and the recommended plan to achieve these objectives.

Attached are several minor comments or points which should be clarified in the final report.

A major concern relates to the estimated annual operation and maintenance costs. Though critically important wetland habitat would be restored or rehabilitated by this project, we cannot commit to assuming responsibility for 100 percent of the operation and maintenance costs projected to be $56,000 per year on a 600 acre area.

Our staff would appreciate the opportunity to meet with you to discuss details of the breakdown of projected operation and maintenance costs presented in Table 13.

Please continue to direct future coordination on the Environmental Management Program to Mr. Norman P. Stucky at the above address.

Sincerely,

Dan F. Dickneite

DAN F. DICKNEITE
ENVIRONMENTAL ADMINISTRATOR

Attachment

Upper Mississippi River System

Environmental Management Program Definite Project Report (SL-3)

Pharrs Island

Habitat Rehabilitation Project

Specific Comments

Page 9. c. Air Quality. Mention should be made of two large industries, i.e. Hercules Chemical Company and Dundee Cement Company in lower Pool 24.

Page 13. (3) Interior Wetlands. The value of the interior wetlands to the river's fishery should be discussed. Included should be the important spawning, nursery and permanent fishery habitat provided by these off-channel areas. Enclosed is a list of fish species seined from the Pharrs Island wetland complex by our biologists in 1987 and 1988.

Page 19. 9. Boat Pullover. Will those individuals wanting to use interior wetlands for recreational purposes be allowed to do so? This paragraph implies that only Missouri Department of Conservation (MDOC) personnel will access interior wetlands.

Page 25. 3rd paragraph. It is stated that 453 NGVD dike elevation would be exceeded at an estimated frequency of 2.1 years. Table 2, page 10 indicates that an elevation of 453.0 NGVD would provide protection from a 1 in 5 year flood event.

Page 33, 2nd paragraph. It would be prudent at several selected locations in the slough to dredge deeper holes (up to 8 ft. deep) to assure that fishes are provided a refuge from potential summer and winter kill conditions.

Page 42, 1st paragraph. Mention should be made of the recent attempts by MDOC personnel to relocate and establish P. capax within Pool 24.

Page 53. It is our understanding that key HREP projects will be selected for performance evaluation monitoring using funds from the Long Term Resource Monitoring account. It may be presumptuous to state that monitoring will be charged to this account.

Listing of fish species seined from Pharrs Island wetland complex Pool 24, field seasons 1987 and 1988. Collection made by Gordon B. Farabee, Fisheries Biologist, Missouri Department of Conservation.

Species	Number Collected	Percent of Harvest
Emerald shiner Notropis atherinoides	75	4
Bluegill Lepomis macrochirus	901	48
River shiner Notropis blennius	26	1
Gizzard shad Dorosoma cepedianum	125	7
Bullhead minnow Pimephales vigilax	171	9
Quillback carpsucker Carpiodes cyprinus	4	
Spottail shiner Notropis hudsonius	115	6
Drum Aplodinotus grunniens	11	
Smallmouth buffalo Ictiobus bubalus	65	3
Silver chub Hybopsis storeriana	94	5
Spotfin shiner Notropis spilopterus	51	2
White bass Morone chrysops	7	
Sand shiner Notropis stramineus	2	
Johnny darter Etheostoma nigrum	9	
Brook silverside Labidesthes sicculus	33	1
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Bluntnose minnow Pimephales notatus	2	
Largemouth bass Micropterus salmoides	8	
Walleye Stizostedion vitreum	1	
Mosquitofish Gambusia affinis	70	3
Orangespotted sunfish Lepomis humilis	64	3
Red shiner Notropis lutrensis	1	
Logperch Percina caprodes	4	
Central stoneroller Campostoma anomalum	4	
Longnose gar Lepisosteus osseus	2	
Green sunfish Lepomis cyanellus	1	
Black crappie Pomoxis nigromaculatus	3	
Slenderhead darter Percina phoxocephala	5	

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
MISSOURI DEPARTMENT OF CONSERVATION
SEPTEMBER 18, 1989

ST. LOUIS DISTRICT RESPONSES:

O&M Costs. The District has revised the breakdown of these costs in response to the revised project plan (which deletes the downstream dike and about 2,000 feet of the upstream dike, and adds segments of earthen levee to tie into a natural levee along the island's perimeter), and in response to a need to more clearly distinguish between maintenance costs and rehabilitation costs. The revised cost estimate is now $15,528 annually. In its February 21, 1990 letter to the St. Louis District, MDOC indicated that the Department is prepared to serve as the non-Federal sponsor and will cooperate with the U.S. Fish and Wildlife Service to assure that the O&M activities will be accomplished.

Specific Comments.

P.9c. Air Quality. The text has been modified per your comment.

P.13(3) Interior Wetlands. The text description has been expanded and the list of fish species included as part of the biological data appendix to the DPR.

P.19 Boat Pullover. The text has been revised to indicate the use of the boat pullover for recreational purposes will be left to the discretion of the local sponsor, i.e., the Missouri Department of Conservation.

P.25. 3rd Paragraph. The discrepancy results from a one foot stage difference that will occur between the upstream and downstream ends of the island during floods. The table has been relabeled to indicate that the depicted values are for the downstream end of the island (not the upstream end where the 453 NGVD elevation dike would be located).

P.33 2nd Paragraph. The revised project plan includes three 50' wide X 500' long sections of interior slough deepened to 443 NGVD as summer fish refuges.

P.42. The endangered species discussion has been expanded per your comment.

P.53. It is the District's understanding that all HREP performance evaluation monitoring will be charged to the Long Term Resource Monitoring account.

PD-F

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
230 S. DEARBORN, SUITE 3422
CHICAGO, ILLINOIS 60604

TAKE PRIDE IN AMERICA

ER-89/674

September 22, 1989

Colonel James E. Corbin
District Engineer
U.S. Army Engineer District
St. Louis
210 Tucker Boulevard North
St. Louis, Missouri 63101-1986

Dear Colonel Corbin:

The Department of the Interior (Department) has reviewed the Draft Definite Project Report with Integrated Environmental Assessment for the Pharrs Island Habitat Rehabilitation Project, Pool 24, Upper Mississippi River, Pike County, Missouri. The Department does not object to this project. We do, however, have the following comments.

Mineral Resources

Although the report does not mention mineral resources, construction of rock closures, levees, dredging and disposal, drains, gates, and pumps would not significantly impact mineral resources in the area. Therefore, we suggest a statement to that effect be incorporated in subsequent versions of the document. Such an inclusion would provide users of the document with knowledge that mineral resources were considered during project planning.

The opportunity to comment on this document is appreciated.

Sincerely,

Sheila Minor Huff

Sheila Minor Huff
Regional Environmental Officer

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
U.S. DEPARTMENT OF THE INTERIOR
OFFICE OF ENVIRONMENTAL PROJECT REVIEW
SEPTEMBER 22, 1989

ST. LOUIS DISTRICT RESPONSES:

The St. Louis District agrees with your assessment relative to the impacts of the project on mineral resources. The users of the DPR are here informed of this assessment via the inclusion of your letter and the District's comment in this Appendix to the report.

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

May 3, 1990

David R. Gates, Study Manager
U.S. Army Engineer District, St. Louis
Attn: CELMS-PD-F
210 Tucker Boulevard, North
St. Louis, Missouri 63101-1986

Dear Mr. Gates:

Re: Pharrs Island Habitat Rehabilitation Project, Upper Mississippi River Pool 24, Pike County, Missouri

This letter is in reference to your updated revised Section 404(b)(1) Guidelines (Guidelines) evaluation transmitted to EPA on April 17, 1990, for review and comment. The St. Louis District, Corps of Engineers, proposes to place fill material below ordinary high water and in adjacent wetlands, in conjunction with construction for wetland habitat rehabilitation on Pharrs Island.

We have reviewed the proposal as outlined and addressed in the revised Guidelines evaluation and provide the following general and specific comments and recommendations for your consideration.

General Comments/Recommendations

In general, we agree with the findings of the Guidelines evaluation except for the documentation of wetland functions and values (EPA comment No. 6). You adequately addressed EPA's other comments made in review of the draft Guidelines evaluation dated September 8, 1989. In order to more fully document Pharrs Island's wetlands functions and values (non-wildlife/fishery functions and values), we request that A Wetland Evaluation Technique (WET) Volume II: Methodology by Paul R. Adamus, E.J. Clairain Jr., R.D. Smith and R.E. Young, October 1987, Operational Draft Technical Report Y-87-____, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, be applied and results reported in the Guidelines evaluation.

A baseline analysis (preproject) must be performed, prior to any construction taking place. Subsequent to project completion, a WET analysis must be performed at 3-year intervals, or at intervals corresponding to the updating of the baseline Missouri Wildlife Habitat Appraisal Assessment, to assist in

documenting wetland functional performance. Your continued sedimentation survey results on the Mississippi River will assist in documenting the occurrence/nonoccurrence of the lowered sediment trapping function in the rehabilitated wetlands.

Through proper documentation, we can ensure that the Corps/EPA Memorandum of Agreement (MOA), concerning the determination of mitigation under the Clean Water Act Guidelines, will be achieved. Thusly, we will be striving to achieve the MOA "no overall net loss of values and functions" wetland goal.

Specific Comments/Recommendations

1. Page C-1, Section II.b., 3rd paragraph - we suggest that the entirity of Pharrs Island be considered and classified as wetlands, not just areas below elevation 452 NGVD. The entire land mass of the project area meets the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" criteria for hydrophytic vegetation, probably contains hydric soils (survey data not available), and receives flood events (hydrological events which maintain moist soil conditions) which would meet wetland hydrology criteria above 452 NGVD. This designation will necessitate other changes throughout the text.

2. Page C-3, Section II.b., 4th paragraph, 5th sentence - we suggest that non-forested wetlands will not disappear but rather be converted to forested wetlands. The text should be revised to reflect this fact.

3. Page C-5, Figure C-2 - see comment number 1. Revise Figure C-2 as appropriate.

4. Page C-10, Table C-3 - see comment number 1. Revise Table C-3 as appropriate.

5. Page C-11, Tables C-4 and C-5 - the Future Without Project Condition (FWO) for all plans should be the same (921 HU's and 550 HU's respectively). Appropriate changes to these tables should be made.

6. Page C-12, Section II.e., paragraph 1.a.-c. - the frequency of overtopping of structures by flows in the Mississippi River should be identified (e.g., 2-year flood event).

7. Page C-14, Section II.f., paragraph 4 - see comment number 1. The 10 acre disposal site may still be classified as wetland habitat, not upland. Appropriate changes to the text should be made.

8. Page C-20, Section III.e., paragraph 5.b. - although the project may enhance wetland quality, it will reduce overall wetland acreage and this loss should be stated (Table C-3).

9. Page C-22, Section IV, paragraph 3 - mention of the WET analysis documentation should be made either here or elsewhere in the text. Also, it should be pointed out that the project strives to achieve the wetland goal of the MOA: "no overall net loss of wetland values and functions."

These comments have been prepared in accordance with our authority under Section 404 of the Clean Water Act as amended by the Water Quality Act of 1987. If you desire to further discuss the contents of this letter, please contact me at (913) 551-7573 or Richard Raines, of my staff, at (913) 551-7566. We would appreciate receiving copies of your WET analysis and revised Guidelines evaluation when available. Please keep us informed as to the disposition of this project.

Sincerely,

for Kathleen A. Mulder
Diane R. Hershberger, Chief
Wetlands Protection Section

cc: US Army Engineer District, St. Louis
(Attn: CELMSOD-F, Ron Messerli)
U.S. Fish and Wildlife Service, Columbia, MO
U.S. Fish and Wildlife Service, Marion, IL
Missouri Department of Conservation, Jefferson City, MO
(Attn: Norm Stucky, Bill Dieffenbach)
Missouri Department of Natural Resources, Jefferson City, MO
(Attn: Dan Mazur)

SLD RESPONSE TO DRAFT DPR
COMMENTS FROM
U.S. ENVIRONMENTAL PROTECTION AGENCY
MAY 3, 1990

ST. LOUIS DISTRICT RESPONSES:

EPA General Comments/Recommendations. The District concurs in the application of the Wetlands Evaluation Technique (WET) to the project, and the Guidelines text has been revised to so indicate this intent. The WET will be applied at the same intervals as the Wildlife Habitat Appraisal Guide (WHAG).

EPA Specific Comments/Recommendations.

1. to 5. The District agrees with these comments and the text has been so revised.

6. The frequency of overtopping for the subject structures is now noted in the text, but has been entered under Section II.f., paragraph (1).(a)-(c).

7. The statement in question has been deleted from the newly revised text.

8. and 9. The District agrees with these comments and the text has been so revised.

Copies of the WET analysis and revised Guidelines evaluation will be furnished to EPA upon completion of the baseline work.

APPENDIX DPR-C

CLEAN WATER ACT, SECTION 404(B)(1) EVALUATION

FOREWORD

APPENDIX DPR-C provides the Clean Water Act Section 404(b)(1) Evaluation Report for the Pharrs Island project. This documentation will also be forwarded to the Missouri Department of Natural Resources along with a request for the state's Section 401 Water Quality Certification.

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM
PHARRS ISLAND HABITAT REHABILITATION PROJECT
POOL 24, UPPER MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

SECTION 404(B)(1) EVALUATION REPORT ON THE EFFECTS OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES

I. PURPOSE OF THIS EVALUATION

The proposed habitat rehabilitation project at Pharrs Island in Mississippi River Pool 24, Pike County, Missouri, would involve placement of dredged and fill materials into waters of the United States. Section 404 of the Clean Water Act established a permit program for the purpose of regulating discharges of dredged or fill material into such waters. Under Section 404(b) of the Act, proposed discharges of dredged or fill material must conform to guidelines which are to be developed by the Administrator, Environmental Protection Agency. On 5 September 1975, in accordance with Section 404(b)(1), the Environmental Protection Agency published regulations, 40 CFR 230, which outline criteria and procedures for evaluating activities subject to Section 404. On 24 December 1980, revised Section 404(b)(1) guidelines were published which became effective 30 March 1981. It is mandatory that the guidance be applied to all proposed discharges of dredged or fill material subject to approval under Section 404. This evaluation will address proposed discharges of dredged and fill material required for the habitat rehabilitation of Pharrs Island.

II. PROJECT DESCRIPTION

a. Location. The Pharrs Island project area is located in mid-river, Mississippi River Pool 24, near river mile 276, Pike County, Missouri (FIGURE C-1). The project area includes Corps-owned lands and waters that are presently managed for fish and wildlife purposes by the Missouri Department of Conservation. Lock and Dam 24 at Clarksville, Missouri, is located 2.6 miles downstream of the Island. Access to the Missouri shore across from Pharrs Island is provided by Highway 79.

b. General Description. The Pharrs Island project area consists of approximately 526 acres of Federal land and water. The complex includes the lands and waters contained within and between Pharrs Island and an area referred to in preimpoundment days as Island No. 461. Today, Island 461 is fragmented into four islands separated by small sloughs. Originally acquired for the navigation project, the Pharrs Island area is now managed for fish and wildlife purposes by the Missouri Department of Conservation (MDOC) under Cooperative Agreements between the Department of Interior and the Corps of Engineers.

Historically, the island complex included a prime wetlands area used extensively by migratory waterfowl, wintering bald eagles and other wetland wildlife species. The wetlands also provided important spawning and nursery areas for river fishes.

All of the project area consists of Section 404 jurisdictional wetlands. Wetlands, as defined by the U.S. Environmental Protection Agency and the Corps of Engineers (for regulatory purposes), consist of "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil

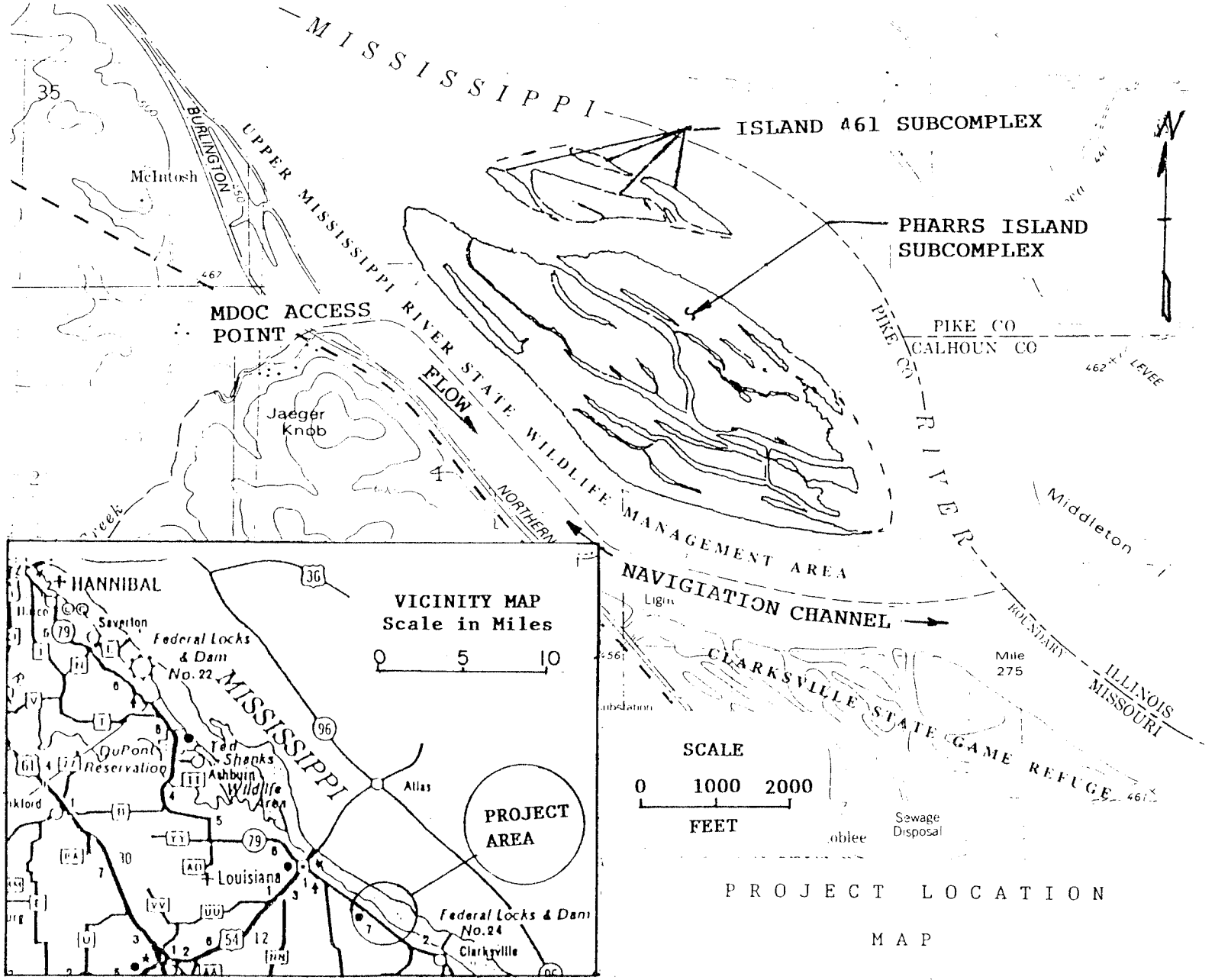

FIGURE C-1

PROJECT LOCATION MAP

conditions." The "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" indicates that all three criteria, hydrophytic vegetation, hydric soils, and wetland hydrology must be met for an area to be identified as wetland. The entire land mass of the project area meets the criteria for hydrophytic vegetation, with more than 50 percent of the dominant plant species in each community type (forest, aquatic bed, emergent wetland) being obligate, faculative wetland or faculative (TABLE C-1). The island is believed to also meet the hydric soil and wetland hydrology criteria. Based on available river hydrology data, it is known that the island soils are frequently flooded (at least every other year) for long durations (at least 7 days) during the growing season (April to October). Survey data is not available for the islands, but the soils probably consist of Carlow and belknap hydric soils.

Sedimentation has been identified as the most significant resource problem affecting the Upper Mississippi River System (UMRS). Compared to other UMRS pools, Pool 24 has little off-channel water habitat for fish spawning and rearing, and its continuing loss will further impact waterfowl populations. The Pharrs Island complex illustrates well the on-going conversion process in Pool 24 from water-to-land habitat. During the 15-year period between 1972 and 1987, the conversion of water-to-land within the complex has been proceeding at the rate of 3 acres per year. At this rate, all interior non-forested wetlands are expected to be converted to forested wetlands during the next 50 years. The complex is also affected by fluctuations in pool stage that lowers the value of shallow areas for spawning and rearing, and can also impact the production of aquatic plants and their availability as a food source to migratory waterfowl.

The following is a general description of the Selected Plan. Specific features of the project are presented in TABLE C-2 with those components of the project which are subject to Section 404 jurisdiction so indicated. The Selected Plan is depicted in FIGURE C-2.

To retard the deposition of sediment into the project area, and to provide additional backwater habitat, a rock dike would be constructed. The upstream end of the dike would be bull-nose shaped, and would then trail in a southeasterly direction to the downstream end of the project.

To provide a means for controlling water levels on the island, a levee would be constructed. This levee would supplement existing segments of natural levee along the island's perimeter. This construction would bring the entire island perimeter to the same above pool grade. In addition to water control, the levee system would also help provide sediment protection to the island and would shield the head of the island from erosional forces. The new levee would consist of a long lower island segment, two intermediate length segments located on the navigation side of the island's mid-section, and a number of smaller slough closure segments along the upstream shore of the island. A vegetative buffer would be included between the levee segments, and the island's shoreline, to safeguard eagle perch sites. Borrow areas would be required just landward of the levee construction zones. These areas would serve as future non-forested wetland management sites. Some young forest vegetation would be cleared from lower elevation areas to further expand non-forested wetland habitat.

In addition to the levee, a culvert drain with a gatewell protected sluice gate, and a portable pump would be used for water control on the island. Installation of the gated drain would be accomplished using a cofferdam; this structure would be used primarily for the discharge of

TABLE C-1

PHARRS ISLAND - WETLAND PLANT INDICATORS

Wetland Community	Dominant Species	Indicator Status
Forest	Ulmus americana	FACW
	Salix spp.	OBL
	Forestiera acuminata	OBL
	Acer negundo	FACW
	Acer saccharium	FACW
	Fraxinus spp.	FACW
	Vitis spp.	FACW
	Smilax spp.	FAC
	Saururus cernuus	OBL
	Aster simplex	FACW
	Laportea canadonsis	FACW
Aquatic Bed	Nelumbo lutea	OBL
	Lemna minor	OBL
Emergent	Polygonum pensylvanicum	FACW
	Sagittaria latifolia	OBL

OBL = Obligate - A plant species that is nearly always found in wetlands; its frequency of occurrence in wetlands is 99 percent or more.

FAC = Faculative Plants - Species that are equally likely to occur in wetlands or nonwetlands (estimated probability 34-66 percent).

FACW = Faculative Wetland Plants - Species that usually occur in wetlands (estimated probability 67-99 percent), but occasionally are found in nonwetlands.

TABLE C-2

Components of the Selected Plan Subject to 404 Jurisdiction

Feature	404 Jurisdiction
1. Dike - Consists of 2 segments of rocks structure totaling 10,200 feet long. Structure would have a 6-foot crown width, an approximate 46-foot wide base, and 1 on 2 side slopes. Function is to deflect river sediments from the wetlands complex. Structure also reduces water flow in backwater area.	
(1) Bull nose dike segment - 6,750 feet long, crown elevation (453 NGVD) 4 feet above normal pool, average height 10 feet above river bottom. Structure has an A-stone exterior protection with a gravelly-red clay interior for sediment thru seepage control.	Yes
(2) Trail dike segment - 3,460 feet long with a 300-foot kicker at downstream end of dike, tapers from 453 NGVD to 449.4 NGVD, average height 12 feet above river bottom. This segment does not require a special design for sediment seepage control.	Yes
2. Levee - A low profile structure (average height 2-4 feet) built to 452 NGVD with a 10-foot crown width and 1 on 5 side slopes. Low lying segments would consist of gravelly-red clay material, higher sections would be constructed of earthen material. Combined length of all levee segments is 8,255 feet. Five acres of forest would be cleared for the levee. Levee serves to supplement the islands natural levee system to bring entire island perimeter to a similar above pool grade, facilitating subsequent water control management on the island. The newly constructed levee would consist of the following segments:	
(1) Lower island levee segment - 3,950 feet long, structure is set-back more than 500 feet from the island's down-stream shoreline to enhance water seepage control.	Yes
(2) Mid-island levee segments - Includes an upstream segment, 1,760 feet long, and a 1,495-foot segment on the downstream end. Both segments tie into the island's natural levee at the shoreline, but otherwise extend 150 feet back from the shoreline to safeguard potential eagle perch trees.	Yes
(3) Upper island slough closure segments - Includes five slough depression closures along the upper shore of the island totaling 1,050 feet.	Yes
3. Interior Dredging - 12,000 feet of shallow interior slough would be dredged up 25 feet wide, and to a bottom elevation of 446 NGVD, to provide O&M access within island interior, and to facilitate drainage of the management unit to the river. Three 500-foot segments along this ditch system would be opened to a bottom width of 50 feet, with depth to 443 NGVD to serve as fish refuges.	No

TABLE C-2 (CONTINUED)

Feature	404 Jurisdiction
4. Bermed Disposal Areas - Approximately 10 acres of trees would be cleared to receive and contain material excavated from the interior ditch work.	Yes
5. Water Control Structure -	
(1) Gated Drain - A lower levee based 36-inch culvert drain with pneumatically operated sluice gate for the control of interior water levels.	Yes
(2) Gatewell - A 60-inch diameter unit with 18-inch concrete base to protect sluice gate structure.	Yes
(3) Cofferdam - A cofferdam would be used for placing the gravity drain; the cofferdam would subsequently be removed.	Yes
6. Pump - A trailer mounted 15,000 GPM portable pump for filling the interior island from 449 to 451 NGVD. The unit would be transported to the island via an MDOC provided barge.	No
Boat Pullover - A roller/pulley operated device mounted on the downstream levee to permit service boats to access the island's interior.	No
7. Borrow Areas - Forty-three acres of island to be excavated as a source of levee borrow material.	No
8. Selective Vegetation Removal - Forty-six acres of woody vegetation removed from lower elevation areas (449-450 NGVD) to further expand non-forested wetland habitat.	No
9. Mast Tree Plantings - Ten acres of levee and disposal habitat to be enhanced by the planting of mast trees such as pin oaks and pecans.	No
10. Cedar Trees - Cedar trees would be scattered over a 40-acre area of backwater to increase cover from an existing < 10 percent to +25 percent.	No
11. Project Operation and Management - After construction, MDOC would be responsible for the project's operations and maintenance. It appears that the discharge of maintenance dredged material may require a permit. It would be MDOC's responsibility to secure Section 10 and Section 404 permits as required during the life of the project.	Yes

* See also FIGURE C-2 and Plates 2 and 3.

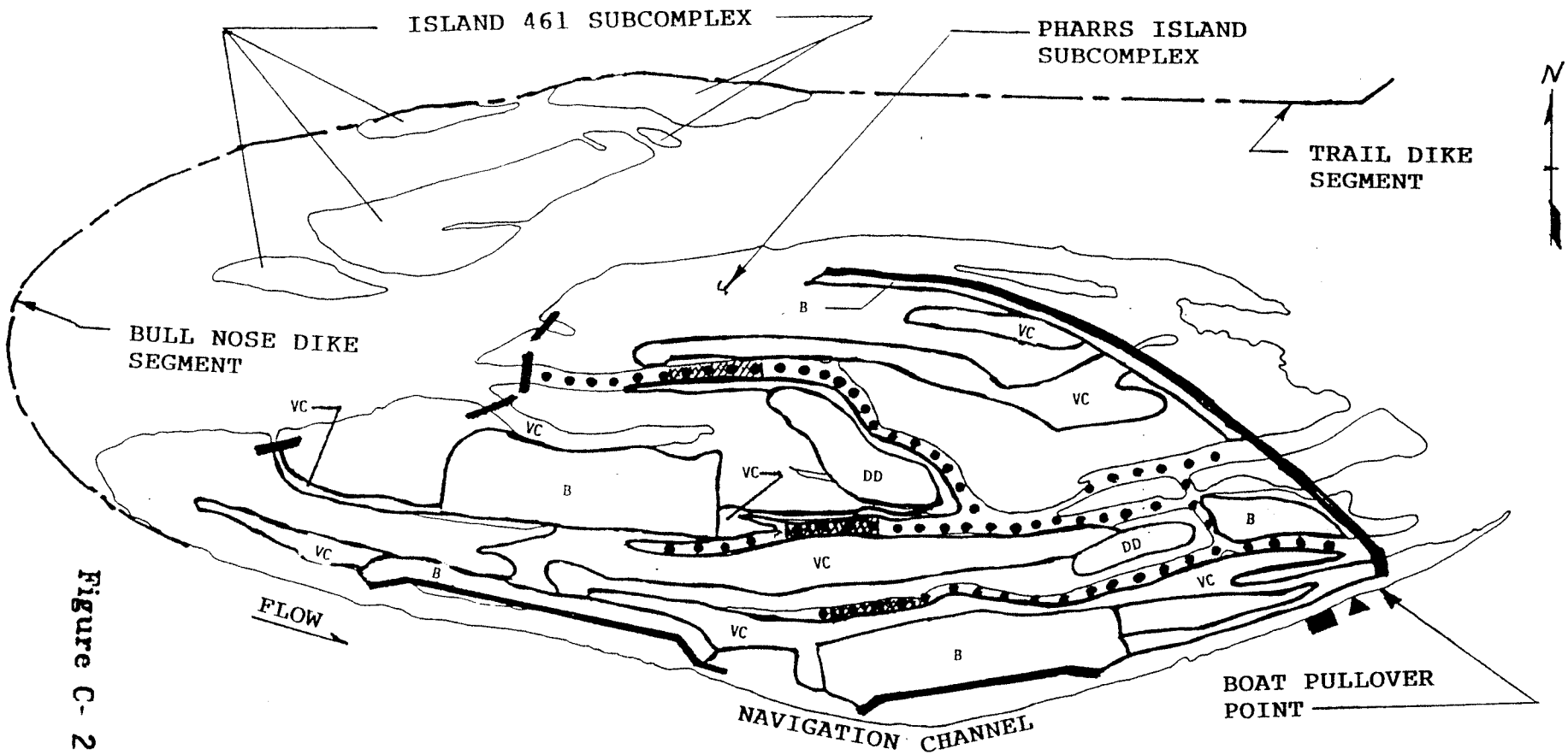

Figure C-2

POTENTIAL GROUND DISTURBANCE
LEGEND:

- = Levee
- B = Levee borrow areas
- DD = Dredge disposal areas
- VC = Vegetation clearing
- = Slough dredging
- = Summer fish refuge
- = Rock dike
- = Gated Drain
- = Portable Pump

SCALE

0 1000 2000

FEET

SELECTED PLAN
PHARRS ISLAND

interior waters and for the input of water up to the elevation of normal pool. The pump would enable the raising of water levels above normal pool to a required elevation for management.

To facilitate the impact and output of water, interior island sloughs would be deepened by dredging. In addition, three segments along this ditch system would be further widened and deepened to serve as summer fish refuges. Two areas would be cleared of forest, and its perimeter bermed. These areas would be used to contain the material dredged from the slough.

To improve aquatic habitat cover within the new backwater area, cedar trees would be placed along the shoreline and appropriately anchored. To permit the access of MDOC service boats (and at MDOC's discretion, recreational craft) to the island's interior, a boat pullover device (i.e., a roller/pulley operated device mounted on the levee) would be provided.

c. Alternatives. Four project alternatives were considered: Alternative A, No Federal Action; Alternative B, Wetland Excavation; Alternative C, Navigation Dike Modification; and Alternative D, Wetland Protection System. Alternative A was rejected, since it would do nothing to alter the sedimentation, water level, and off-channel water problems that must be addressed if habitat is to be improved. Large-scale excavation (Alternative B) was considered unacceptable; it would not alter future sedimentation, it would not permit any means of regulating water levels within the complex, it would not increase off-channel water habitat, and the potential for applying habitat management practices would be severely limited. Dike modification (Alternative C) would not be feasible due to the depth of the existing structures, and would not provide the stable bullet-shaped nose needed to protect the head of the island from erosion. Alternative D was found to be fully responsive to the project objectives, and was designated as the Selected Plan. It would significantly reduce the sedimentation rate, it would provide a reliable means of water control, it would increase the pool's off-channel water acreage, and it would provide conditions compatible with traditional habitat management practices. Specific Alternative D options considered in detail included: dikes, levees, borrow areas, dredging and disposal areas, drains, gates, pumps, vegetation clearing, fish refuges and tree cover. The site selection criteria that led to the two designated disposal area locations is provided in paragraph II.e.(3). No viable alternatives to these locations were identified. Hydraulic dredging was the only viable placement method for dredged material as described in paragraph II.g. TABLES C-3, C-4, and C-5 provide a comparison of the various habitat outputs of each alternative in terms of habitat acreages and habitat units.

d. Authority and Purpose. Public Law (PL) 95-502 authorized the construction of a new dam and 1,200-foot lock at Alton, Illinois, and directed the Upper Mississippi River Basin Commission to prepare a Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Basin Commission completed the Master Plan report and submitted it to Congress on 1 January 1982. The report recommended an environmental management program that included construction of habitat rehabilitation and enhancement projects.

The 1985 Supplemental Appropriations Bill (PL 99-88), signed into law by President Reagan on 15 August 1985, provided initial authorization and appropriations for an environmental management program for the Upper Mississippi River System. A more comprehensive authorization was later provided by the Water Resources Development Act of 1986 (PL 99-662).

TABLE C-3

AVERAGE ANNUALIZED HABITAT ACREAGES

Habitat Type			Plan A	Plan B	Plan D
System	Class	Existing	(No Action)	(Wetlands Excavation)	(Wetlands Protection)
Palustrine	Forested Wetland	265 (265)	333 (333)	285 (285)	207 (207)
	Aquatic Bed	25 (25)	11 (11)	20 (20)	20 (20)
	Unconsolidated Bottom	41	17	33	36
	Emergent Wetland	35 (35)	4 (4)	28 (28)	103 (103)
Riverine	Unconsolidated Bottom	153	153	153	153
	Unconsolidated Shore	7	7	7	7
		526 (325)	526 (348)	526 (333)	526 (330)

(#) = Acres of project habitat that qualify as wetland under the regulatory definition for administering the Section 404 permit program (Reference: "Federal Manual for Identifying and Delineating Jurisdictional Wetlands").

PHARRS ISLAND HREP

TABLE C-4

ANNUALIZED WILDLIFE HABITAT UNITS - SUMMARY FOR ALL HABITATS

Species	Plan A			Plan B			Plan D		
	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Mallard	52	52	0	52	52	0	170	52	118
Goose	19	19	0	24	19	5	83	19	64
Muskrat	70	70	0	75	70	5	89	70	19
Heron	148	148	0	172	148	24	336	148	188
Wood Duck	186	186	0	160	186	-26	144	186	-42
Beaver	210	210	0	180	210	-30	119	210	-91
Parula	156	156	0	134	156	-22	123	156	-33
Warbler	80	80	0	69	80	-11	78	80	-2
Totals	921	921	0	866	921	-55	1142	921	221

TABLE C-5

ANNUALIZED FISHERIES HABITAT UNITS - SUMMARY FOR ALL HABITATS AND LIFE STAGES

Fish Group	Plan A			Plan B			Plan D		
	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Large Swiftwater	144	144	0	161	144	17	157	144	13
Small Swiftwater	150	150	0	169	150	19	168	150	18
Large Slackwater	133	133	0	153	133	20	194	133	61
Small Slackwater	123	123	0	143	123	20	187	123	64
Totals	550	550	0	626	550	76	706	550	156

The two goals of the project are to enhance migratory waterfowl habitat and to enhance habitat for slackwater fishes. Specific objectives for attaining the waterfowl goal are (1) decreasing sedimentation into island wetlands, (2) providing a means to control water levels on the island independent of river stage, (3) increasing reliable food production for waterfowl (particularly moist soil plant species), and (4) increasing total wetland values for migratory waterfowl.

Objectives for the fisheries goal are (1) increasing the quantity of river slackwater habitat, (2) reducing the potential for backwater sedimentation, (3) increasing the photic zone, (4) increasing the available cover, and (5) increasing the total habitat values for slackwater fishes.

e. General Description of Dredged or Fill Material

(1) General characteristics of Material (grain size, soil type).

(a) Dike. The bull nose dike segment would consist of a core of relatively impervious material capped with heavy stone material to resist Mississippi River currents, ice scour and wavewash. The core would be made of gravelly-red clay from a local quarry, and the cap would be made of graded stone "A" consisting of a 5,000 pound maximum size material which includes fines. The trail dike would consist entirely of graded stone "A".

(b) Levee. The levee embankments will be constructed of earthen material in higher locations and gravelly-red clay in lower sections with 9 inches of bedding stone and 20 inches of riprap in overflow zones.

(c) Bermed Disposal Areas. The proposed plan calls for the creation of two 4-7 foot high berms consisting of alluvial material (primarily silt) to surround a total of 10 acres of dredged material disposal sites. Material for the berms would be pushed from the center of the disposal area and/or brought in from a nearby borrow area. Hydraulicly dredged material from the Pharrs Island interior sloughs will be placed within the containment berm. Some of this dredged material will be sand, but most of it will consist of silt.

(d) Water Control Structure. The proposed plan calls for the installation of a single 36" diameter gravity drain. The drain would consist of a culvert pipe with a sluice gate. The drain would be installed within the lower island segment of levee. The gravity drain would be backfilled with hand-compacted crushed stone underlain by a 9-inch layer of uncompacted crushed stone and one layer of "Tensar" Geotextile. Grade "C" limestone, 1,200-pound maximum size material which includes fines, would be placed on top of the crushed stone to bring the dike up to the top elevation of the dike. A

U-shaped cofferdam would be constructed in order to install the gravity drains "in-the-dry." The cofferdam would consist of rock (Grade "C" limestone) with plastic liners to control thru seepage.

(2) Quantity of Material (cubic yards). The following quantities of fill materials will be required to construct the project:

Levee Embankment (Gravelly-Red Clay):	27,500 Cubic Yards
Levee Embankment (Earth)	11,500 Cubic Yards
Dike Rock Fill ("A" stone):	120,800 Tons
Slope Treatment (Riprap)	1,300 Tons
Slope Treatment (Bedding Material)	410 Tons
Cofferdam ("C" stone):	3,050 Tons

Sluice Gate/Gatewell/Culvert Pipe	1 Each
Culvert Backfill (Crushed Stone)	220 Tons
Deadmen (Concrete)	2 Each
Retention Dike (Earth)	20,900 Cubic Yards
Dredged Sediment Fill	12,800 Cubic Yards

(a) Rock Dike. The proposed plan calls for the permanent placement of 120,800 tons of rock material for construction of the dike. Most of this rock would be placed below the plane of ordinary high water (OHW, elevation 451 NGVD) for Pool 24.

(b) Levee. Approximately 11,500 cubic yards of earthen material, 410 tons of bedding material, and 1,300 tons of riprap.

(c) Bermed Disposal Area. Approximately 20,900 cubic yards of alluvial material would be placed at the perimeter of the disposal area to build the retention dike. Only a portion of this amount would lie below OHW. Of the 12,800 cubic yards of dredged material deposited within this area, about 8,320 cubic yards would lie below OHW.

(d) Water Control Structure. The gravity drain, sluice gate and gatewell would be below OHW. The construction of the drain would require the placement of 220 tons of crushed stone nearly all be below OHW. The cofferdam used for installation "in-the-dry" of the gravity drain would require the temporary placement of 3,050 tons of rock fill most of which would be below OHW.

(3) Source of Material. Alluvial material used to build the retention berm would be obtained from within and adjacent to the designated disposal areas (FIGURE C-2). The criteria used for the selection of the disposal areas were (1) the areas must be within reach of typical hydraulic dredging equipment, (2) the areas must have a fair quantity of on-site borrow material for the construction of the containment berms, (3) the areas should be kept large to reduce the berm length to fill area ratio, (4) sites must collectively furnish approximately 10 acres of fill storage area, and (5) older forested areas should be avoided, particularly near the shoreline. The muck to be placed within the retention areas would be obtained from the island's interior sloughs (see FIGURE C-2). It was decided that levee borrow areas (FIGURE C-2) would be located close to the landside toe of the levee segments to minimize haul costs. Due to variation in the depth to the water table, the depth to which particular borrow sites could be excavated would vary from 0.5 to 1.5 feet in depth. It was also judged that the 43 acres of borrow pits so created would be environmentally compatible, since it would provide an additional 38 acres of non-forested habitat for moist soil management.

Rock and crushed stone used for the rock dike and culvert placement would be obtained from commercial stone quarries in the vicinity of Pike County.

f. Description of the Proposed Discharge Sites.

(1) Location.

(a) Dike. The upstream dike would rise to 4 feet above (i.e., to 453 NGVD) normal pool elevation (449 NGVD). Overtopping of the structure would occur with approximately the 2-year flood event. FIGURE C-2 shows the placement of the dike relative to the Pharrs Island Complex.

(b) Levee. The three larger levee segments would rise 3 feet (i.e., to 452 NGVD) above normal pool elevation. The smaller segments serving as slough closures at the head of the island would rise 4 feet (i.e., 453 NGVD) above normal pool. Structure overtopping would occur with approximately the 2-year flood event. FIGURE C-2 shows the location of the various segments of project levee.

(c) Bermed Disposal Area. FIGURE C-2 shows the location of the proposed retention dike and dredged material containment area. The area is presently covered by bottomland forest. Overtopping would occur with a 2-year flood event.

(d) Water Control Structure. The location of the water control structure is depicted in FIGURE C-2.

(2) Size (acres). A total of approximately 5.0 acres would be required for placement of the dike structure, and a total of 4.8 acres for the placement of the levee system. Approximately 10 acres would be needed for a containment area to place dredged material from the interior sloughs.

(3) Type of Site (confined, unconfined, open water).

(a) Permanent Deposits of Dredged and Fill Material. The area covered by the rock dike (approximately 5 acres) represents a permanent placement of fill material in open water. Although the dike would be categorized as unconfined, it has been designed to remain immobile after placement. The retention dike and the fill material contained within it represent a primary confinement site. The earthen levee embankment material is unconfined, but is designed to remain immobile after placement.

(b) Temporary Deposits of Fill Materials. The cofferdam constructed for placement of the gravity drain "in-the-day" represents a temporary placement of fill material. All cofferdam material will be removed from below OHW as soon as the gravity drain installation is complete.

(4) Types of Habitat. The area covered by the dike closure (5 acres) represents a permanent loss of open water habitat. The construction of the levee system and disposal areas would represent a short-term loss of 13 acres of bottomland forested habitat since this area would be subsequently planted to mast trees (pin oaks, pecans).

(5) Timing and Duration of Discharge. A construction start has been tentatively scheduled for Fiscal Year 1991. Depending on local weather and flooding conditions, the estimated period of construction for the entire project is 6 to 12 months.

g. Description of Disposal Method (hydraulic, drag line, etc.). Rock fill would be transported to the site and would be placed from barges. The retention dike and levee would be constructed using a bulldozer and dragline. Dredging and material disposal would be accomplished using hydraulic dredge equipment. Side casting dredged material using mechanical methods was discarded as an alternative, since it had problems in lacking containment, being susceptible to bank slumping, and its potential disruption of drainage. A cofferdam will be constructed in order to install the gravity drain and gate, material compaction would be accomplished by tamping rollers or approved alternative equipment.

III. FACTUAL DETERMINATIONS

a. Physical Substrate Determination.

(1) Substrate Elevations and Slope. The upstream dike includes 2 segments. The bull nose dike portion of the closure would average 10 feet in height with a maximum elevation of 453 NGVD. The trail dike portion of the upper dike would average 12 feet high and would tapper from a maximum elevation of 453 NGVD to 449.4 NGVD. The levee system would average 5 feet in height with a maximum of 452-453 NGVD. The dike would have a slope of 1 on 2 and the levee a slope of 1 on 5. The retention dike would be built to an elevation of about 455 NGVD (i.e., 5 feet above the average ground elevation at the disposal site of 450 NGVD), and would have side slopes of approximately 1 on 3. The temporary rock cofferdam would be built to approximately 10 feet high to an elevation of 452 NGVD, with side slopes of 1 on 2.

(2) Sediment Type. The existing bed of the project area aquatic habitats consists of a mixture of clay, sands, silts, and organics. The excavated material used to construct the retention dike and the slough closures would be alluvial in nature and consist of sands, silts and clays.

(3) Dredged/Fill Material Movement. By design, the rock fills used for the project should not move. The material dredged from the interior ditch will not move because of the retaining dike structure. If the retention berm system were to break down, the levee system would also serve to keep the material from moving off of the island.

(4) Physical Effects on Benthos (burial, changes in sediment type, etc.). Construction of the rock dike and cofferdams, and installation of the gravity drain, will most likely result in the loss and burial of some benthic organisms. However, most of these areas will be recolonized within 1 year or so, possibly with different assemblages of benthic organisms. The rock material of the dike will provide a different but favorable substrate for benthic recolonization. Reducing the sedimentation rate within the wetland complex (particularly the interior wetlands and the new large backwater created) should also benefit the benthic fauna. Based on the location of the dredged material disposal site and levees, little or no impacts to benthos will occur in those areas. Dredging in the interior ditch will result in a short-term loss of benthic organisms, but this area will quickly recolonize with organisms adapted to the same substrate type.

(5) Other Effects. After construction is completed, it is anticipated that a more controlled environment of the site's interior wetlands will increase the value of the wetland complex.

(6) Actions Taken to Minimize Impacts. Contractors will be required to submit an environmental protection plan to include protection methods and procedures for avoiding landscape defacement, providing for water and air pollution prevention, for disposal of solid and chemical waste and of cleared and grubbed material, and for protecting fish and wildlife resources. In addition, the contractor shall be required to conduct a training course emphasizing environmental protection. Government inspectors will oversee the construction project to ensure that personnel, equipment, and construction techniques meet all contract specifications, including environmental requirements.

The primary actions taken to avoid adverse impacts on the substrate includes use of self-containing rock materials, retention of dredged materials, stable structure slopes, a construction phase environmental protection plan, construction during dry weather periods and revegetation of levee embankments and dredge spoil sites.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Water

(a) Salinity. No applicable.

(b) Water Chemistry. The water chemistry is not expected to be impacted to any significant degree by this work. Excavation for the levee and retention berm will be performed during dry summer conditions. These areas will also be revegetated to minimize erosion. Muck dredged from the ditch would not affect water chemistry due to its containment within the retention dike. Water chemistry effects caused by any sediments stirred during dredging would be minimal and contained within the immediate area due to the levee system. Bottom sediments would also receive short-term disturbance due to the placement of rock for the dike structures.

(c) Clarity. Possible short-term increases in turbidity from the disposal area and the levees during flood events, but no significant difference compared to normal water clarity. Short-term increases in turbidity would occur as a result of the ditch dredging, and also during the placement of the rock fill for the dikes.

(d) Color. Same as c.

(e) Odor. The project is not expected to have a significant impact on water odors.

(f) Taste. The project is not expected to significantly impact water taste.

(g) Dissolved Gas Levels. Minor short-term decreases in dissolved oxygen levels may occur as a result of water disturbances during construction. After construction, it is expected that dissolved oxygen levels in the wetland complex will remain sufficiently high (i.e., > 5 mg/l) for fish.

(h) Nutrients. Some nutrients would be released to the water column during construction; however, this would represent a temporary increase and is not considered significant.

(i) Eutrophication. The project is not expected to have a significant impact on eutrophication of the water column.

(j) Water Temperature. The effects of temperature on water quality can be numerous; of particular importance, as water temperature increases, its capacity to hold oxygen decreases.

(2) Current Patterns and Circulation.

(a) Current Patterns and Flow. The project would alter circulation and flow patterns. The upstream dike would eliminate the existing water movement patterns between the Pharrs Island and the Island 461 group. This structure would prevent flow in this side channel during minor flood

events except by way of the open downstream end of this structure. The dike would be overtopped by flood events with recurrence intervals of once in 2 years, protecting the wetland area from sediment deposition during minor flood events. The levee system in combination with a gated drain will be utilized to create more stable water conditions for waterfowl plant food production. Thus, the water movement patterns on the island will be much less fluctuating than what presently exists.

(b) Velocity. Due to the upstream dike, water velocity will be significantly decreased during river stages up to the elevation of a once in 2 years frequency flood event, at which time the dike structure will be overtopped.

(c) Stratification. Stratification does not normally occur in the wetland complex or in the adjacent Mississippi River.

(d) Hydrologic Regime. Without the upstream dike, filling due to sediment deposition during each minor flood event would cause further degradation of the wetland complex. Major flooding will overtop the dike (and sediment will continue to be deposited during these events). However, no changes in profiles in the adjacent Mississippi River are believed likely.

The levee system with its gated drain and pump unit would permit flexibility in controlling water levels. Changes in profiles within the island complex are discussed below.

(3) Normal Water Level Fluctuations (tides, river stage, etc.). The function of the upstream dike (with its lower end open to the river) is intended to serve as a sediment barrier, not a water barrier. Thus, this structure will not alter normal water level fluctuations. On the other hand, the levee system in combination with the drainage ditch, gated drain and pump unit will alter the normal water level fluctuations. Water levels will be managed in the range of 447.5 to 451 NGVD. The project is not expected to change profiles in the adjacent Mississippi River nor in the adjacent flood plain. The following provides a general summary of plans to regulate water levels on the lower portion of Pharrs Island.

December 15 to June 15 - Allow interior pool to fluctuate either by seep or by gravity flow through the drainage ditch (gate would be left open).

June 15 to September 15 - Open gate when pool is on tilt, then close gate as pool again rises. Achieve greater drawdown as the opportunity arises, dropping water level down to 447.5 NGVD. Initiate planting or seeding between 15 July and 15 August as soil conditions become drier.

September 15 to December 15 - Taking advantage of a rise in river, open and close gate as needed, and allow seep and gravity flow through ditch to achieve a 449 NGVD elevation, the activate pump to bring water level up to 451 NGVD by November 1.

(4) Salinity Gradients. There are no salinity gradients in the project area.

(5) Actions That Will Be Taken to Minimize Impacts. Work involving earthen materials will be performed during dry summer conditions. Dredged material placed within the disposal area will be contained by a small earthen berm. Secondary containment from sediment disturbance would be afforded by the downstream closure dike structure.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Short-term increases in suspended particulates and turbidity will occur as a result of dredging activity and the placement of the dike structure in the river. Dredging impacts will be confined to the Pharrs Island interior. In the long-term, the project is expected to protect the wetland complex from much river borne particulates. The slackwater conditions of the off-channel area created should result in overall reduced suspended particulate matter and consequently a lowered turbidity level as well.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column. The project would have a minimal impact on the water column in the vicinity of the construction activities. The detention berm and levee system would be constructed during dry summer conditions. The dredged material would be contained by a retention berm structure. Chemical and physical changes induced by the placement of rock on the river bottom will be short-term.

(a) Light Penetration. Short-term localized increases in turbidity and thus light penetration can be expected. In the long-term, light penetration within the waters contained by the project will increase.

(b) Dissolved Oxygen. Short-term decreases in dissolved oxygen levels may occur due to the construction activities, particularly dredging. Although somewhat sheltered from the river, dissolved oxygen levels after project construction are anticipated to remain acceptable due to the depth of the large off-channel area, and the deepened slough on the interior of Pharrs Island.

(c) Toxic Metals and Organics. There has not been any analysis for toxic metals or organics. However, there is no reason to believe that high concentrations of organic chemicals or toxic metals occur in the material to be used for the construction of the retention berm or the levees, or the river bottom where the stone fill will be placed. Dredged material will be contained within the retention berm, and thus would not enter the water column.

(d) Pathogens. There is no reason to believe that any pathogens exist in any of the proposed work areas.

(e) Aesthetics. The construction site would not be highly visible to the public. The tree clearing and dredging operations would not be visible, except ty those individuals directly accessing the interior of the site. Construction of the rock dike structure would have at least some visual impact on motorists or boaters in the vicinity of the project.

(f) Water Temperature. Water temperature in the newly created off-channel water area will increase somewhat during all seasons of the year as compared to the ambient river conditions.

(3) Effects on Biota.

(a) Primary Production, Photosyntheses. Minor short-term impacts on primary production and photosynthesis would occur. These impacts would be more important in the wetlands of the complex than within the river itself. In the long-term, light penetration would improve within the wetland complex which would enhance primary production and photosyntheses.

(b) Suspension/Filter Feeders. Some short-term reduction in benthos production due to foodchain effects and food processing effects resulting from increased suspended sediments. In the long-term, turbidity effects should be reduced in the project wetlands leading to an overall increased benthic productivity.

(c) Sight Feeders. Short-term impacts to the foodchain will have minor impacts on sight feeders. Due to the mobility of fish, short-term impacts on sight feeding would not be expected to translate to a loss of fish numbers.

(4) Actions Taken to Minimize Impacts. Construction of retention berm and levee during drier low water conditions of the summer season. Containment of dredged material within retention berm structure. Back-up protection is provided by the levee system.

d. Containment Determinations. There has not been any analysis for contamination of the dredged material or the borrow material for the levees and the disposal material retention berm. However, there is no reason to believe that these materials are contaminated with anything harmful to the local biota or humans. The dredged material from the ditch work would be contained by the retention berm and secondarily by the levee system.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. The project is not expected to adversely impact plankton. Overall plankton is expected to benefit due to improved off-channel water conditions, particularly with respect to increased light penetration and reduced flow.

(2) Effects on Benthos. Some direct loss of benthos will occur due to the placement of the rock structure and due to the slough dredging. There is a nearby mussels bed along the Illinois shore, but this bed would not be impacted by project construction. In the long-term, the improved off-channel water conditions at the site should result in an overall increase in the biomass of benthic organisms. The rock fill of the dike structure should provide for different benthic assemblages and possibly increase the diversity of the local benthic fauna. Reduction of the sedimentation rate in the wetland complex should benefit organisms by providing for more stable habitats.

(3) Effects on Nekton. The term "nekton" refers basically to larger, free-swimming aquatic organisms, such as fishes. Some short-term impacts to the foodchain would result in minor impacts to fishes. In the long-term, fish populations would benefit from the improved spawning, rearing, feeding, and wintering conditions afforded by the project's enhanced off-channel water habitat.

(4) Effects on Aquatic Food Web. Some loss or disruption of the benthic community would result from construction of the dike, the placement of material for the levees and the dredging of the ditch. However, recovery following construction should occur rapidly. Placement of stone would benefit some benthic species important in the food chain. The off-channel water conditions created by the dike is likely to contribute increased benthic productivity. Overall, the long-term impacts are expected to be positive.

(5) Effects on Special Aquatic Sites.

(a) Sanctuaries and Refuges. No sanctuaries or refuges would be affected by the project.

(b) Wetlands. Approximately 5 acres of river habitat will be required for the placement of the rock dike, 4.8 acres for the placement of the levees, and 10 acres for the dredged material disposal site. The disposal site is currently covered with young to medium aged bottomland forest. Borrow material for the levees would be taken directly adjacent to the fill locations.

While the project is expected to reduce slightly overall wetland acreage (TABLE C-3), it is expected to enhance the overall habitat value and longevity of the wetland complex, by reducing sediment deposition and by regulating water levels more independent of river stage.

(c) Mud Flats. The project will not impact mud flats.

(d) Vegetated Shallows. The project is not expected to impact vegetated shallows.

(e) Coral Reefs. None in the project area.

(f) Riffle and Pool Complexes. The project will not impact riffle and pool complexes.

(6) Threatened and Endangered Species. No Federally threatened or endangered species or their critical habitat would be adversely affected by the proposed action.

(7) Other Wildlife. Construction activities would temporarily disturb wildlife in the immediate project area. The clearing of 10 acres of bottomland forest for the dredged material disposal area and 5 acres for the levee represents a temporary loss of wildlife habitat. However, the long-term impacts to this future higher/drier site could be substantially offset with the planting of hard mast-bearing trees (e.g., pin oaks, pecan). In the long-term, wildlife associated with the wetland (particularly waterfowl species) are expected to benefit due to the rehabilitation of the wetland complex and its increased lifespan.

(8) Actions to Minimize Impacts. The impacts of the project will be significantly offset by the control of water levels on the lower portion of Pharrs Island independent of river stage, the construction of an upstream dike to reduce sedimentation and to create a large new off-channel water area, and by constructing and utilizing a retention berm for dredged material disposal.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. A mixing zone is not needed because there will be no return water to the water column.

(2) Determination of Compliance With Applicable Water Quality Standards. The project would comply with applicable water quality standards.

(3) Potential Effects on Human Use Characteristic.

(a) Municipal and Private Water Supply. No municipal water supply will be adversely impacted by project construction.

(b) Recreational and Commercial Fisheries. Two commercial mussel beds nearby, but these areas would not be impacted by the project. Area sport and commercial fishing should improve as a result of the creation of the large new backwater area. The waterfowl management unit on Pharrs Island may be of less use to fishermen due to the drawdown conditions required during the summer months.

(c) Water Related Recreation. Two public (Pleasant Hill, Little Calumet Access) and two private (Silo Park, and Calumet Sales and Service) boat ramps with picnic and/or camping services in the general vicinity of Pharrs Island. These areas and water related recreation in general (i.e., boating, fishing, etc.) is not expected to be adversely impacted by the authorized project. With improved habitat conditions for fish and waterfowl at the project site, the possibility exists for sustained, if not expanded, future fishing and hunting opportunities.

(d) Aesthetics. The construction site would not be highly visible to the public. The tree clearing and dredging operations would not be visible, except by those individuals directly accessing the interior of the site. Construction of the rock dike structure would have at least some visual impact on motorists or boaters in the vicinity of the project.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. A public shooting area and wildlife sanctuary exists on the left river bank (R.M. 274.0-280.0) behind the levee. Between river miles 275.9 and 277.1 on the left bank is the Delair Refuge, representing a portion of the Mark Twain National Wildlife Refuge. This area is managed as a waterfowl sanctuary and is closed to all public use. The above identified sites would not be adversely impacted by the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The Environmental Management Program should have a positive impact on the Upper Mississippi River System.

h. Determination of Secondary Effects on the Aquatic Ecosystem. There are no known significant secondary impacts to the aquatic ecosystem that would be caused by the project.

IV. FINDINGS OF COMPLIANCE OF THE RESTRICTIONS ON DISCHARGE

In our evaluation of discharges proposed in connection with the Pharrs Island Habitat Rehabilitation Project, the Environmental Protection Agency's Section 404(b)(1) Guidelines of 24 December 1980 were applied without significant adaption. Testing procedures outlined in subpart G of the guidelines were not required since the proposed placement would consist of materials taken from within the flood plain, and our review of the work disclosed no "reason to believe" that contaminants would be released to the waterway. However, muck excavated from the ditch area would be placed and contained within a dredged material retention berm zone. The small quantities of material proposed as fill for the levees would be obtained from borrow areas directly adjacent to the sites to be filled. The placement activities would not violate the toxic effluent standards of Section 307 of the Clean Water Act.

The wetland rehabilitation project would not jeopardize the existence of Federally listed endangered or threatened species or their critical habitat.

The proposed construction of levees and installation of water control structures would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values would not occur.

It is expected that river fishes and other wetland species will benefit from the proposed activities. The fish spawning and nursery function of the large new off-channel water area would be improved and would significantly increase the overall productivity of this reach of river. The quality and quantity of habitat for migratory waterfowl and other wetland wildlife species is also expected to increase.

Mitigation was considered as required by the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines." This consideration included avoidance minimization and compensatory mitigation. Several engineeringly feasible project alternatives were explored, Plan A (No Action), Plan B (Wetland Excavation) and Plan D (Wetlands Protection). However, since the intent of the project is an environmental one, the primary goal was not to find an alternative causing the least environmental harm (avoidance), but rather to find one that best maximizes environmental enhancement. On this basis, Plan D was chosen as the Selected Plan for the project. However, realizing that even a net beneficial project (dike and levee) has certain construction related environmental impacts, appropriate and practicable steps were taken to further reduce impacts (minimization) via project modifications. Such features include the use of a bermed containment area for the placement of dredged disposal material, the reforestation of disposal and levee slope areas, and the inclusion of a 150-foot vegetative buffer between levee segments and the shoreline. Since the project is expected to result in net environmental enhancement, for fish and wildlife, and since all appropriate and practicable minimization of adverse impacts have been included, it is the District's determination that no compensatory mitigation is required for this project. To ensure that the Corps/EPA Memorandum of Agreement concerning the determination of mitigation under the Clear Water Act Guidelines will be achieved, the District will apply the Wetland Evaluation Technique (WET) (technique developed by the Waterways Experiment Station). A pre-project baseline analysis will be performed and included as a revision to these guidelines. Past-project analyses using WET will be performed at first year and then 5-year intervals, corresponding to the time intervals for the re-evaluation of the Missouri Wildlife Habitat Appriasal Agreement. Periodic sedimentation surveys will also be made.

On the basis of the guidelines, the proposed levee construction is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

26 June 1990
Date

James E. Corbin
Colonel, U.S. Army
District Engineer

APPENDIX DPR-D

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POOL 24, UPPER MISSISSIPPI RIVER
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APPENDIX DPR-E

HYDROLOGY AND HYDRAULICS

FOREWORD

APPENDIX DPR-E presents the hydrologic/hydraulic effort leading to the proposed project. The appendix provides a discussion of climate, existing hydraulics and project hydraulics.

UPPER MISSISSIPPI RIVER SYSTEM

ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT

PHARRS ISLAND

REHABILITATION AND ENHANCEMENT

POOL 24, RIVER MILES 275.5-277.5

APPENDIX E

HYDROLOGY AND HYDRAULICS

General. The Pharrs Island project, shown on Plate 1 of the main report, is located within Pool 24 on the Mississippi River, formed by Lock and Dam 24 at river mile 273.5. This appendix will present the hydrologic/hydraulic effort leading to the proposed improvements to Pharrs Island.

Climate. The climate of the Missouri-Illinois region in which Pharrs Island is located is typical midwestern, with warm, humid summers and cold, relatively-dry winters. Normal temperature extremes range from 100 degrees or more in mid-summer to below zero in mid-winter. The average annual temperature in the local area is 51 degrees.

Significant precipitation occurs in every month of the year, with the greatest amounts normally in April-May and the least in January-February. The area averages slightly over 37 inches precipitation per year, with about 24 inches of snowfall in a typical winter. Average annual evaporation is 35.2 inches. Table E-1 gives average monthly precipitation totals at Louisiana, Missouri, about seven miles upstream of Pharrs Island, and average monthly evaporation totals at the National Weather Service gage at St. Louis.

TABLE E-1

Average Monthly Precipitation and Evaporation

Month	Precip. (in.)	Evap. (in.)	Month	Precip. (in.)	Evap. (in.)
January	1.80	0.69	July	3.86	5.85
February	1.79	1.01	August	3.28	4.87
March	3.33	2.00	September	3.52	3.48
April	4.01	3.24	October	3.00	2.32
May	4.28	4.59	November	2.32	1.22
June	3.82	5.24	December	2.23	0.69

Existing Hydraulics. Stages at Pharrs Island are controlled by regulation at Lock and Dam 24. The pool stage is 448-449 NGVD under normal conditions, and exceeds 449 NGVD only during flows approaching bankfull or greater. As shown on Plates 8 and 9, which give monthly and annual stage-duration relationships at Dam 24 (three miles downstream) respectively, stages are less than 450 NGVD more than 90% of the time on an annual basis. Minimum stages occur during floods when the pool goes "on tilt" and proceeds to an open river condition.

Minimum regulated stage is 444.5 NGVD at the dam and about 446.5 NGVD at the downstream end of Pharrs Island. At this point all gates at Lock and Dam No. 24 are out of the water. As flood flows continue to increase, the minimum, regulated stage increases as well, with the only effect of the locks and dam being a small local swellhead just upstream of the dam. Exterior elevations at the downstream end of Pharrs Island less than 446.5 could only occur during a loss of pool, a situation which has not happened since the early 1950's.

a. Floods. Mississippi River discharge- and stage-frequency relationships for the reach have been well-established from previous analytical and physical model studies. Flood-frequency relationships at the downstream end of Pharrs Island are shown on Table E-2. Add one foot to determine the corresponding stage-frequency at the upstream end of Pharrs Island.

TABLE E-2

Stage-Frequency at Mile 275.5

Frequency (yrs)	Elevation (NGVD)
2	451.3
5	453.0
10	454.5
25	456.5
50	458.0
100	459.5

The flood-of-record occurred in 1973 and reached an elevation of about 461.5 NGVD.

b. Sedimentation. Sedimentation data on the Mississippi River in the reach are essentially non-existent. Because of the low velocities through the navigation pools at normal flows, the sediment load consists of silts and clays which settle very slowly. During floods, when open-river conditions exist, the sand load increases significantly. Consequently, so to does the upstream and downstream bar building along Pharrs Island. Deposition occurs at all times but is most severe during floods. No records of deposition in the reach have been kept, but sloughs and side-channels are known to be slowly filling, and this loss of wetlands has been recognized as a problem for some time. Pharrs Island is a case in point, having increased in size and area over the years. It has become less desirable as waterfowl habitat as the upstream and downstream point bars have grown and vegetation has established.

Project Hydraulics. To minimize continued sediment deposition and island growth, a number of alternatives were evaluated. The recommended alternative is shown on Plates 2 and 3 of the main report and consists of an upper stone-fill dike, with a trail dike extending down the Illinois side, and a low earthen levee ringing the island. This alternative will significantly decrease the amount of sediment currently being deposited on and near the island, and will allow greatly improved water level management to the interior of the island.

a. Shape. The dike is shaped to deflect the maximum amount of sediment, minimizing the development of new deposits immediately upstream of the dike. Previous Waterway Experiment Station studies for St. Louis Harbor alternatives evaluated a variety of shapes, including chevrons, with the bullet shape resulting in minimum channel maintenance for the St. Louis Harbor reach, which carries a much greater sediment load than the Pharrs Island reach. Therefore,

a bullet shape for the upper closure structure was selected, providing flow splits having a minimum of scour and deposition. Deposition will still occur downstream of the island, but should be somewhat less than prior to the project, due to the upstream deflector and trail dike. The island will retain significant interior wetlands, while minimizing deposition upstream and along the sides of the island.

b. Crown Elevation. A range of crown elevations for the upstream dike and levee were analyzed to determine appropriate elevations to exclude most of the sediment, while minimizing construction cost. Table E-3 shows the average annual duration associated with various dike/levee crown elevations. Due to an absence of sediment data, it was assumed that the percent reduction in sediment inflow to the island would be similar to the percent time reduction of island inundation. This assumption is admittedly qualitative, the actual reduction could be somewhat higher or lower. The levee will prevent sediment-carrying waters from entering Pharrs Island more than 95% of the time. Even when the levee overtops, the majority of the flood events will exceed the top of the levee by only 1-3 feet. This upper few feet of the water column carries relatively low quantities of sediment (mainly silts and clays) compared to the entire water column and these fine grain particles should largely stay in suspension and pass out of the leveed area without settling. Little sand contribution to the island is expected during the usual range of overtopping events, since much of the sand load will be carried near the bottom as bed material load, and will be directed around the island by the upstream dike. Deposited material within the levee, after the project is constructed, is expected to be minimal, with possible exceptions during a major, long duration event such as the 1973 flood. Therefore, even though much of the sediment is transported during floods, the assumption that sediment reduction to the project area is proportional to the time duration is judged reasonable and valid.

TABLE E-3
Average Annual Duration vs. Structure Elevation

Downstream end (RM 275.5)		Upstream end (RM 277.5)	
Crown Elev. (NGVD)	Sediment Reduction (%)	Crown Elev. (NGVD)	Sediment Reduction (%)
450	90	451	90
451	96.7	452	96.7
452	97.8	453	97.8
453	98.7	454	98.7
454	99.2	455	99.2

As seen, the sediment reduction decreases very slowly above 451 NGVD, with the cost of dike/levee construction increasing in far greater proportion than the incremental amount of sediment reduction. Missouri Department of Conservation management practices require an interior water level of 451 NGVD in the fall/winter of the year for wildlife habitat management. Consequently, minimum levee crown elevations of 452 NGVD at the downstream end of the island and 453 NGVD at the upstream end of the island were selected. The differential allows for the approximately 0.5-0.7 foot drop in water level during floods over the 1.2-1.4 mile levee reach.

c. Dike/Levee Overtopping. Overtopping of these structures will be a fairly frequent occurrence. The levee crown elevations (453 NGVD upstream and 452 NGVD downstream) represent a stage slightly less frequent than a 2-year recurrence interval. An evaluation of the past 16 years of record (1973-1988) on Plate 7 shows 12 events greater than 452 NGVD, a period which had an unusually large number of significant flood events. Floods and overtopping would normally occur in the late winter-early spring of the year, due to upstream snowmelt and normal spring rains. Since 1973, stages at Pharrs Island have initially exceeded 452 NGVD as follows: February (1), March (3), April (1), May (2), June (1), October (1), and December (1). Any levee damage during all but the last two of these events would be repairable prior to the fall season, when higher interior water levels are required.

(1) Dike overtopping. No significant damage to the stone dike is expected when overtopping occurs, due to both the stone size used and the small differences in water surface elevation across the dike at overtopping. As the river rises, water can back up the channel between the island and the trail dike and some amount of water will be able to seep through the dike itself. No more than one foot of differential is expected across the dike during overtopping. Assuming a one foot head differential and that critical depth occurs across the top of the dike, maximum velocities would be 5-6 fps for a relatively short time period. This range of velocities would not cause erosion of the stone fill.

(2) Levee overtopping. When the low earthen levees are overtopped, some local erosion could occur, but this should be very minimal, if any. To prevent any significant erosion upon levee overtopping, three overflow notches are included at the locations shown on Plates 2 and 3. The two downstream notches are set at elevation 451.0 NGVD and would allow water to enter the interior whenever this elevation is exceeded. Similarly, the upstream notch is set at 452.0 NGVD. Total length of the three weirs are 350 feet, more than sufficient to fill the entire interior area to the level of the river in less than 24 hours. Interior and exterior water levels are expected to be essentially the same when overtopping occurs. As floods recede, water may exit through the notches, with the culvert used to drain water when interior levels drop below 451.0 NGVD. Assuming a one foot head differential across the weirs and that critical depth occurs, Maximum velocities of 7-9 fps could occur for a relatively short time period. Using riprap design criteria found in EM 1110-2-1601 and the recent WES update (by Maynord), riprap of 300 pound top size was found adequate for these flow conditions. Plate 6 shows additional detail on the overflow weirs.

d. Loss of conveyance. The effects of the dike and levee on upstream river elevations during floods were evaluated using the HEC-2, Water Surface Profiles Program. The conveyance loss due to the dike closures is minimal since the island, both through its physical elevation (450-453 NGVD) and its dense growth of willows and underbrush, already affects conveyance. Peak discharges from the 2-year through 100-year recurrence interval events were used to operate an HEC-2 model for with and without project conditions. The maximum effect on upstream flooding was less than 0.1 foot during the 2-year recurrence interval event, insignificant for all practical purposes. No differences are apparent for rarer events. Velocity increases due to the project are insignificant.

e. Interior drainage. Control of interior water levels, generally between elevations 449-451 NGVD, is necessary for wildlife habitat management. The interior areas of the island would normally be at elevation 449 NGVD, the same as the pool. When the pool is on tilt, river elevations at the gravity drain could drop as low as 446.5 NGVD.

(1) Culvert. During a tilting pool, the drain could be opened and allow flushing of the ponded waters, if desired. During a return to a normal pool (449 NGVD), the interior could be refilled with fresh water or kept low, to initiate seed growth for later use by wildlife. The culvert was sized to evacuate the ponded water in a reasonable time. Due to the potentially short time period the river could be at the minimum elevation, 24 hours was used as the evacuation period. A 36-inch pipe was found adequate for this criteria. For head differentials of 1-2.5 feet, pipe velocities will range from 5-8 feet per second. A riprap blanket of 300-pound top size stone for 10 feet upstream and downstream of the culvert will be used to prevent erosion. Pipe invert was set at elevation 446.5 NGVD, approximately equal to the invert of a short reach of new channel constructed to allow draining of the interior waters, if desired. The culvert could also serve to help fill the interior area when the levee is forecast to be overtopped. Assuming a one to two foot head differential, the culvert can pass over 100 acre-feet per day into the interior area.

(2) Pumping. Ensuring a manageable interior water level will require pumping. The size of pump depends on the time necessary to fill the interior to the desired elevation of 451 NGVD. Because of several similar EMP projects constructed, or planned for construction in the area, the sponsor desires a single large pump which could fill one area and then be floated to a different site to repeat the process. As most of the areas require filling in the September-October time frame, a 4 day time was assumed to be the maximum allowable for filling the interior area. The Pharrs Island interior, from elevation 449 to 451 NGVD, could be filled in four days with a 15,000 gpm (33.5 cfs) pump. This pump would be barge mounted and used for several MDOC projects in the immediate area.

(3) Pumping Times. Although the interior area will be filled in the fall of each year, loss of water through evaporation and seepage will require periodic refilling. As seen from Table E-1, average rainfall exceeds average evaporation by a significant amount throughout the October through December time period. Thus, evaporation is not expected to greatly affect the need for refilling. Seepage through the levee, from an interior ponding elevation of 451 to the river elevation of 449 N.G.V.D. will occur continuously and is much greater than the difference between the rainfall and the evaporation. Estimates of seepage losses are 4,400 cfs for this head differential. This flow could be higher or lower, depending on the final placement and compaction of the material, but is believed to represent an appropriate average value. This seepage flow could result in a draining of the interior area in about three weeks, since the maximum flow will occur at the maximum head differential of two feet, and approach zero as the head differential approaches zero. Refilling the interior with the pump will thus be necessary every three weeks, depending on the rainfall occurring during the period and if refilling prior to reaching an interior water level of 449 N.G.V.D. is desired. During the fall waterfowl migration period, a total of four recharges of the interior would be expected. With the 15,000 gpm unit, the interior can be refilled in about 80 hours, indicating that average annual pumping time would be approximately 320 hours per year. This operation time is about one-third that of the average for all of the conservation areas in Pools 25 and 26 operated by the Illinois Department of conservation.

f. Maintenance Dredging. Maintenance dredging is expected to be minimal, consisting of occasionally re-dredging the entrance to the channel along the trail dike for small boat access. The use of a deflector dike, or "kicker", will reduce the frequency of this dredging. Previous experience with kickers shows that the sediment load is largely diverted away from the entrance and

what deposition that does occur is located along and downstream of the inside leg of the kicker, away from the channel portion. The kicker is conservatively expected to reduce the need for any re-dredging to once every 25 years, and then only at the entrance channel to the passage along the trail dike. No significant deposition is expected within the channel along the trail dike as velocities during overtopping events will be sufficient to maintain the sediment in suspension. In addition, depths in this reach now average 6-10 feet, giving sufficient depth for small boat navigation even if significant deposition occurs.

APPENDIX DPR-F

GEOTECHNICAL CONSIDERATIONS

FOREWORD

APPENDIX DPR-F provides preliminary typical cross-sections for the upstream and downstream closure dikes. These cross-sections will be given more detailed consideration during the Plans and Specifications Phase of the project.

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
PHARRS ISLAND
REHABILITATION AND ENHANCEMENT
POOL 24, RIVER MILES 275.5 - 277.5

APPENDIX DPR-F

GEOTECHNICAL CONSIDERATIONS

1. LOCATION

The Pharrs Island project area is located within Pool 24 on the Mississippi River, near Lock and Dam 24 at approximate river mile 275.5. This appendix presents the geotechnical considerations leading to the proposed project improvements.

2. PHYSIOGRAPHY - TOPOGRAPHY

The topography within the project site includes a series of sloughs (i.e., one main slough and two minor sloughs) and several shallow depressions. Site elevation varies from 449 to 453 NGVD. With the construction of the project, the topography of the island will be altered dramatically. The construction of a dike, levee, slough closures, summer fish refuges, a gated water control structure, and a dredged disposal area represents permanent changes in the topography of the project area.

3. FEATURE DESCRIPTIONS

a. Upstream Rockfill Bull Nose Dike. The proposed rockfill dike, as shown on PLATES 2 and 3 of the main report, is approximately 10-12 feet high, and approximately 6,750 feet long. The purpose of the dike is to reduce the amount of river sediments on the interior wetlands and the newly created off-channel water habitat. The crown of the dike is at least six feet wide. The side slopes of the dike will be 1 vertical (V) on 2 horizontal (H). The core of the dike will consist of a locally obtained gravelly-red clay material. The core of the levee will be capped with graded stone "A". A typical section of the proposed dike is shown on PLATE 6 of the main report.

b. Rockfill Trail Dike. The proposed rockfill trail dike, as shown on PLATES 2 and 3 of the main report, is approximately 12 feet high, and approximately 3,459 feet long. The purpose of the trail dike is to deflect the river away from the island, and its newly created off-channel water habitat. The crown of the trail dike is at least six feet wide, and the side slopes of the dike will be 1 vertical (V) on 2 horizontal (H). The dike will be constructed entirely of graded stone "A". A typical section of the proposed dike is shown on PLATE 6 of the main report.

c. Downstream Rockfill Dike. It should be noted that included in the originally proposed Pharrs Island project was a downstream rockfill dike approximately 4,000 feet long. However, after further review, this structure was eliminated and replaced with an earthen levee at the perimeter of the island. Details of the seepage analysis, used in eliminating the downstream rockfill dike, is discussed later on in this appendix.

d. Earthen and Gravelly-Red Clay Levee and Slough Closures. The proposed earthen and gravelly-red clay levee (in 3 separate segments), as shown on PLATES 2 and 3 of the main report, are approximately 2-4 feet high, and approximately 7,200 feet long. The purpose of the levee is to create a moist soil management unit with controlled water levels for wildlife habitat landside of the levee. The crown of the levee will be at least 10 feet wide; this will provide for ease of construction, and normal maintenance and operation. The side slopes of the levee will be 1 vertical (V) on 5 horizontal (H). Because the levee is low and flat, no riverside riprap protection was considered necessary. A typical cross section of the proposed levee is shown on PLATE 6 of the main report.

The proposed slough closure plugs, as shown on PLATES 2 and 3 of the main report, are approximately 6-8 feet high and vary in length depending on location. The crown of the plugs are 10 feet wide and the side slopes are 1 vertical (V) on 5 horizontal (H). The purpose of the plugs will be to help with water management on the island. In addition, the plugs will act as overflow sections in the perimeter earthen levee when it is overtopped by the river.

e. Slough Dredging. Three interior sloughs are proposed to be dredged, as shown on PLATES 2 and 3 in the main report. The site dictates removal of 2 or more feet of soils from the sloughs. The bottom width of these cuts will be 25 feet across, with side slopes of 1 vertical (V) on 4 horizontal (H). A typical cross section of the dredge cut is shown in PLATE 6 of the main report. Within the sloughs are proposed three summer fish refuges. These refuges will have a bottom elevation of 443, a bottom width of 50 feet, and a length of 400 feet. The side slopes will be 1 vertical (V) on 4 horizontal (H) up to where they meet natural ground.

f. Disposal Area Embankment for Dredged Material. The proposed disposal area embankment for the slough dredged material, as shown on PLATES 2 and 3 of the main report, is approximately 4-7 feet high, and covers approximately 10 acres of land. The purpose of the disposal area is to receive the material excavated from the interior slough work. The crown of the disposal area embankment is at least 6 feet wide and the side slopes are a minimum of 1 vertical (V) on 2 horizontal (H).

4. SUBSURFACE EXPLORATIONS

a. Overwater Explorations. Access to the project site is by boat only. During March 1989, fourteen reconnaissance overwater grab samples P.I. #1 thru #14 were obtained using a Wildco hand core 2-inch sampler. These grab samples were taken at the then proposed locations of an upstream bull nose dike, a downstream dike, and in an area designated for main slough dredging. The deepest borings taken with the sampler extended to a depth of 10 feet. See PLATE 10 - map for location of the borings.

The rockfill bull nose and trail dike portions of the upstream dike are shown on PLATE 2 of the main report. Borings P.I. 1, 2, 3 were taken to evaluate the subsurface physical conditions. Detailed descriptions of the soils encountered are shown on PLATE 11 of the appendix. The borings do show some soft material (muck) above the sandy material in the river.

Borings P.I.4, 5, 6, 7, 8, 9, and 10 taken in the main slough indicate about 2 feet of very soft silt (muck) underlain by very soft clay (CL-CH). At several locations, sand (SP) was encountered at or near the water surface across the slough channel width. A detailed description of the material is shown in PLATE 11 of the appendix.

During July 1989, fifteen exploratory borings were taken on the island itself. These were numbered 1A thru 15A. The purpose of these borings was to evaluate potential borrow sites on the interior of the island, as well as to evaluate the potential location of a retention area site. All borings were obtained using a hand auger. The deepest borings extended to a depth of 10 feet. See PLATE 10 for location of borings. The slough plugs proposed for this project at four locations were not investigated extensively. A cursory reconnaissance investigation (boring 8A) was made to ascertain the foundation conditions. Subsurface material found at this location was primarily silty clays with traces of sand. Refusal was encountered at approximately 7 feet below the water surface.

A cursory field investigation was made to ascertain the foundation conditions for the disposal area embankment. According to hand auger borings (7A, 9A, 10A, 11A, 12A, 13A), shown on PLATE 12 of the appendix, the top five feet of material is clay (CL) underlain by 5 feet of wet, very soft clay (CL-CH) material. No testing is available to back up the field classification.

During January 1990, six additional exploratory borings were taken. These were numbered 20HAP thru 26HAP. The purpose of these borings was to evaluate the foundation soils at the proposed location of the new downstream earthen red clay/rock levee. All borings were obtained using a hand auger. The deepest borings taken extended to a depth of 5 feet. See PLATE 10 for the location of the borings.

According to hand auger borings, shown on PLATE 11 of the appendix, the top stratum of a typical soil profile is 6 inches of topsoil underlain by 18 inches of clay (CL) underlain by 3 feet of wet, very soft clay (CL-CH) material. No testing is available to back up field classification. Occasional lenses of fine sand were found in several borings at a depth of 24 to 30 inches below the ground surface. No rock was encountered in any of the borings.

A water control structure at the lower end of the island will be built as a part of the proposed project. The location of the proposed structure is shown on PLATE 2 of the main report. Boring 23HAP was taken in the vicinity of the structure's location to evaluate the physical characteristics of the substratum. Detailed descriptions of the soils encountered are shown on PLATE 13 of the appendix. No testing is available for this boring. The boring shows clay (CL) soil underlain by soft clay (CH) material at 18 inches below the ground surface.

During May 1990, four additional exploratory borings were taken. These were numbered 27HAP thru 30HAP. The purpose of these borings was to evaluate the proposed borrow sites for the earthen levee. All borings were obtained using a hand auger, with the deepest borings taken to a depth of 8.5 feet. See PLATE 10 for the location of the borings.

5. DESIGN CONSIDERATIONS

a. Foundations. A determination was made that the areas of muck in the vicinity of the upstream rockfill dike will not be removed prior to the placement of rock.

The foundation beneath the proposed earthen levees and the disposal area embankment will be stripped of vegetation and other deleterious materials to a depth of 6 inches. All tap roots, lateral roots, and trees within the foundation area of the embankment will be removed to a depth of 18 inches below the natural ground surface. Where the earthen levee crosses old slough

areas along the downstream end of the island, gravelly-red clay material will be used to construct that portion of the earthen levee. The material will be end-dumped across the slough area until a completed section is built. Existing foundation materials will be displaced with the gravelly-red clay material.

b. Slope Stability. The proposed earthen levee was analyzed for the end of construction condition. The stability of the slopes was analyzed by the Circular Arc Failure Method: Ref.1,DM 7.1 -319 Attached Fig. 2). Conservative shear strengths (Q) were assumed for atypical configuration of the earthen levee and foundation, to estimate the stability of the levee. These values are shown on FIGURE F-1 and are based on charts, and tests from other projects with generally similar soils and construction. The computed minimum factor of safety (F.S.) = 2.25 for end of construction case exceeds the required F.S. - 1.3 in EM 1110-2-1913, "Design and Construction of Levees," dated March 31, 1978. Therefore, no slope stability problems are expected.

c. Groundwater. Water level observations were monitored during the substrate boring operations. These observations are noted on the boring log, as shown on PLATE 12 of the appendix. Based on these observations, the ground water levels encountered in the vicinity of the proposed earthen levee areas, and disposal area embankment, were found to be fairly constant from hole to hole. The depth at which water was located, ranged from 1.5 to 4.5 feet, or from elevation 446.5 to 449.2 NGVD. The water levels should be expected to fluctuate from changes in climatic conditions and river levels.

e. Seepage.

(1) Rockfill Dike Seepage Evaluation. The initial purpose of the seepage evaluation was to quantify as accurately as possible the thru seepage and/or under seepage for the originally proposed downstream rockfill dike. The finite element method package containing CORPS PROGRAMS X8202, X8200 AND X8201, developed by WES (Fred Tracy), was used in the analyses. The reason this evaluation was undertaken at this time was that the project sponsor wanted the project capable of not only reducing the amount of sediment being annually deposited onto the island, but also wanting the capability of ponding water behind the dike. A worst case scenario occurs at the downstream dike which is required to maintain a pool behind it for several months at a time. It is obvious that rockfill dikes will pass water through them, but to what extent was unknown. The original design of the downstream dike called for a quarry run stone (small top size, high amount of fines) to be used as a core in the dike to help reduce the amount of seepage.

(a) Assumptions. It was assumed that the rockfill material was more permeable than the underlying sands. Based on the extensive testing experience for permeability of river sands at the Melvin Price L&D 26 Replacement Project, the permeability used for the underlying sands in the Pharrs Island evaluation was judged to be about .26 cm/sec. The rockfill material for the dike was varied from 10 times more permeable to 50 times more permeable than the underlying sands. To simplify the analyses, both the rockfill material and the foundation sands were considered homogeneous.

(b) Conclusions. The analyses indicated that large quantities of flow (between 20,000 to 25,000 GPM) would pass through the rock structure along its entire length when the head differential between the inside pool and river elevation was 4 feet. Conversely, if the rock dike was constructed such that it was more impermeable than the underlying sands, the underseepage flows were estimated to be approximately 15,000 GPM.

A summary of this analysis is provided at the end of this appendix (see FIGURES F-3 to F-11).

(c) Recommendations. The seepage analysis indicated that the concept of a rockfill dike should be eliminated and replaced with an earthen and gravelly-red clay levee structure located along the downstream edge of the island's interior.

(2) Earthen/Gravelly-Red Clay Levee Evaluation. Underseepage and thru seepage analyses were run on the earthen gravelly-red clay levee cross section. The overall quantity of seepage for the earthen and gravelly-red clay levee was estimated to be 4,500 GPM along the entire length of levee at a maximum head of 2 feet. In addition, the upstream rockfill dike will now include a core of gravelly-red clay, which should make it more impervious.

f. Settlement. The proposed 4-6 foot high earthen levee was analyzed for settlement. Because of the lack of testing data in the vicinity of the levee, a settlement analysis utilizing natural water content and atterberg limits was used. The foundation consists of 5 feet of soft to very soft clay. A six foot high levee will impose a maximum load of 720 pounds per square foot on the 5 foot clay stratum. A settlement analysis conforming to Missouri State Highway Commission (1972) standards indicates total settlement to be on the order of 4 inches.

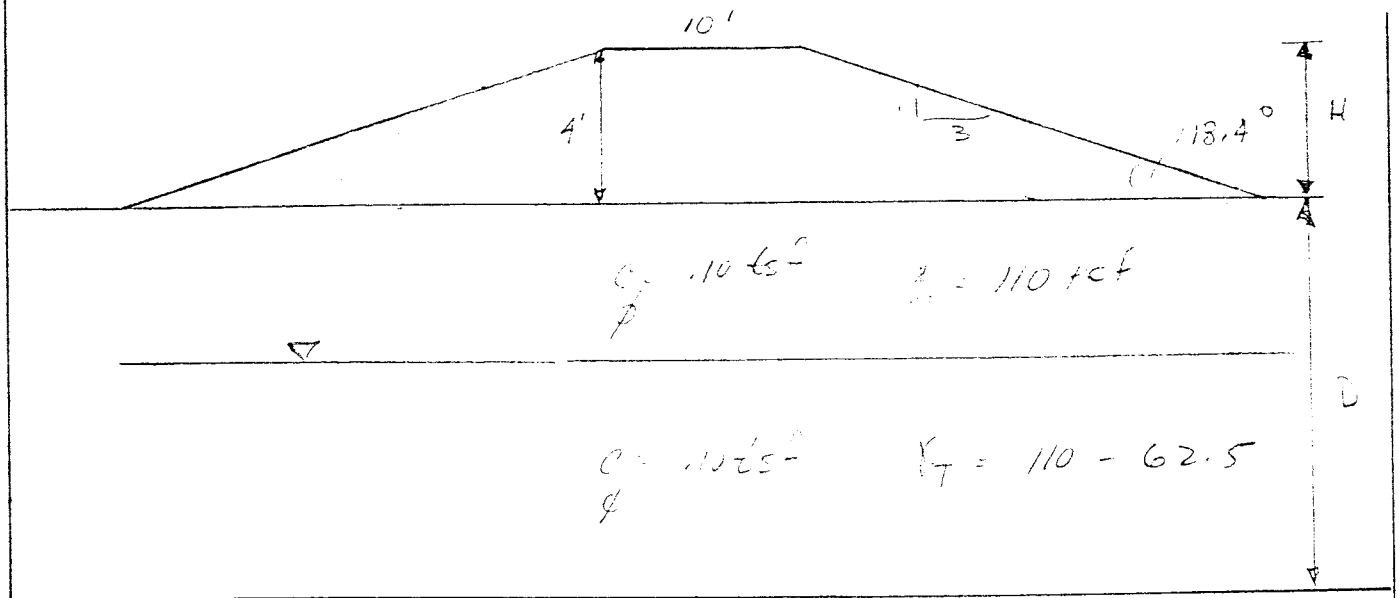
The proposed rockfill dike was analyzed for settlement for a height of 10 feet. The analyses used for the Dresser Island-EMP project was deemed appropriate for use at this project site. A settlement analysis conforming to EM 1110-2-1913 Design and Construction of Levees, indicates a total settlement to be on the order of 24 inches, as shown on FIGURE F-2. It is anticipated that similar settlement will occur at the Pharrs Island project.

It is recommended that 1 foot of overbuild be added to the height of the dike and levee design to offset any lack of testing of the foundation materials.

g. Borrow Material. The borrow material to be used for levee construction will be removed from areas, as shown on PLATES 2 and 3 of the main report. A 20-40 foot wide berm will be left in place between the toe of the levee and the near edge of the borrow site to ensure levee stability and facilitate construction. According to borings which are pertinent to borrow areas, the borrow material consists of wet soft clay. Because of a short or no haul distance, a dragline operation may be most cost effective. Excessive displacement of the excavated material should be expected due to very soft material of low strength and standing water. The excavated material will not be stockpiled higher than the height of the proposed levee and the levee should be constructed in multiple stages.

PROJECT PHARRS ISLAND- EMP	Page__ of__	COMPUTED BY CFH	DATE 3/1/90
SUBJECT SLOPE STABILITY		CHECKED BY	DATE

Ref: ERN 71-319 (Circular Arc Failure Method)



$d = D/H = 10/4 = 2.5$

(TRIAL #1) $F_S = N_o \frac{c}{\gamma_T H} = \frac{5.75\,(200)}{85(6)} = 2.25$ semi compacted

#2 $F_S = \frac{5.75\,(200)}{95(6)} = 2.02$

#3 $F_S = \frac{5.75\,(200)}{105(6)} = 1.83$ full compacted

Figure F—1

PROJECT PHARRS ISLAND - EMP	Page 1 of —	COMPUTED BY CFH	DATE 2/28/90
SUBJECT ESTIMATED SETTLEMENT		CHECKED BY	DATE

Assumptions:

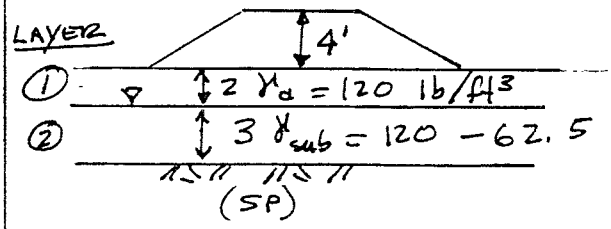
Nat. Water Content

$43.3 + 34.5 = 77.8/2 \Rightarrow 38.9$ (ave)

LL & PL $\Rightarrow 45$ & 22

DEPTH OF WATER TABLE — 4ft.

LAYER



$120 \times 2 + 57.5 \times 3 = 412.5$ lb/ft²

$e_o = \frac{2.67 \times WN}{S}$ $\frac{2.67 \times 38.9}{100} \Rightarrow 1.04$ (below water table)

$e_o = \frac{2.67 \times 38.9}{75} = 1.38$

P = weight of fill soil
P_o = weight of soil above mid pt.
ΔP = increase in pressure from fill

CALCULATION OF SETTLEMENT HT.

$$\Delta H = H[.007]\ LL-10\left[\left(\frac{1}{1+e_o}\right)\log\left(\frac{P_o+\Delta P}{P_o}\right)\right]$$

LAYER #1

$$\Delta H = 2[.007]\ 35\left[\left(\frac{1}{1+1.4}\right)\log\frac{120+480}{120}\right]$$

$$(.014)\ 35\ [(.417)\ (.699)]$$

$\Rightarrow \Delta H = .143$ ft. $\times 12 = 1.7$ inches say 2 inches

LAYER #2

$P_o = 120 \times 2 + 57.5 \times 1.5 = 326.25$

$$\Delta H = 3[.007]\ 35\left[\left(\frac{1}{1+1.04}\right)\log\frac{326.25+480}{326.25}\right]$$

$\Delta H = (.021)(35[(.490)(.393)] \Rightarrow .141$ ft say 2 inches

TOTAL SETTLEMENT $\Rightarrow$ 4 inches

PROJECT DHARRS ISLAND - EMP	Page 2 of	COMPUTED BY	DATE
SUBJECT ESTIMATED SETTLEMENT		CHECKED BY	DATE

Ref. NAVFAC DM-7.1 : SOIL MECHANICS

DM-7.2 : FOUNDATIONS OF STRUCTURES

Assume 6 ft high levee.

$$\Delta H = H\left[.007\right] LL - 10\left[\left(\frac{1}{1+e_o}\right)\log\left(\frac{P_o \Delta P}{P_o}\right)\right]$$

Layer #1

$$\Delta H = 2(.007)\,35\left[\left(\frac{1}{1+1.4}\right)\right]\log\left(\frac{120+720}{120}\right)$$

$$\Delta H = (.014)\,35\left[(.489)\quad(.845)\right]$$

$$\Delta H = .173 \times 12 = 2.1 \text{ inches}$$

LAYER #2

$$\Delta H = 3(.007)\,35\left[\left(\frac{1}{1+1.04}\right)\log\left(\frac{326.25+720}{326.25}\right)\right]$$

$$\Delta H = (.021)\,35\left[(.486)\ (.506)\right]$$

$$\Delta H = .182 \times 12 = 2.2 \text{ inches}$$

TOTAL Settlement 4.3 inches

Figure F-2 (Continued)

PHARRS ISLAND EMP	Page__ of__	OFH	5/14/90
SUBJECT Downstream Rockfill Dike		CHECKED BY	DATE

Assumptions:

$\Delta h = 4$ ft $\quad N_f/N_e = 4/10$ $\quad$ Use $Q = K \frac{N_f}{N_e} = 4/10$

Length of Rock Fill 4000 ft.

Sand = .5 ft/min

Quarry Run = 10 ft/min

"20 times more permeable"

1. $Q = 10\left(\frac{4}{10}\right) \times 4 \times 1 = 16\ ft^3/min \times \frac{1}{60 sec} = .26\overline{6}\ ft^3/sec$

$.26\overline{6} \times 448.8 = 119.7$ gpm $\times 4000 =$ **478,800 GPM**

"10 times more permeable"

2. Quarry Run = 5 ft/min

$Q = 5\left(\frac{3}{7}\right) \times 4 \times 1 = 8.57\ ft^3/min = .143\ ft^3/sec$

$.143 \times 448.8 = 64.11$ gpm $\times 4000 =$ **256,440 GPM**

3. Red Clay Core 8 ft/min

$Q = .05\left(\frac{8}{7}\right) \times 4 \times 1 = .8\ ft^3/min = .0133\ ft^3/sec$

$.0133 \times 448.8 = 5.984$ gpm $\times 4000 =$ **23,936 GPM**

LMV FORM 1 FEB 79 107e—R COMPUTATION SHEET **Figure F—3**

FILENAME (WORST CASE)

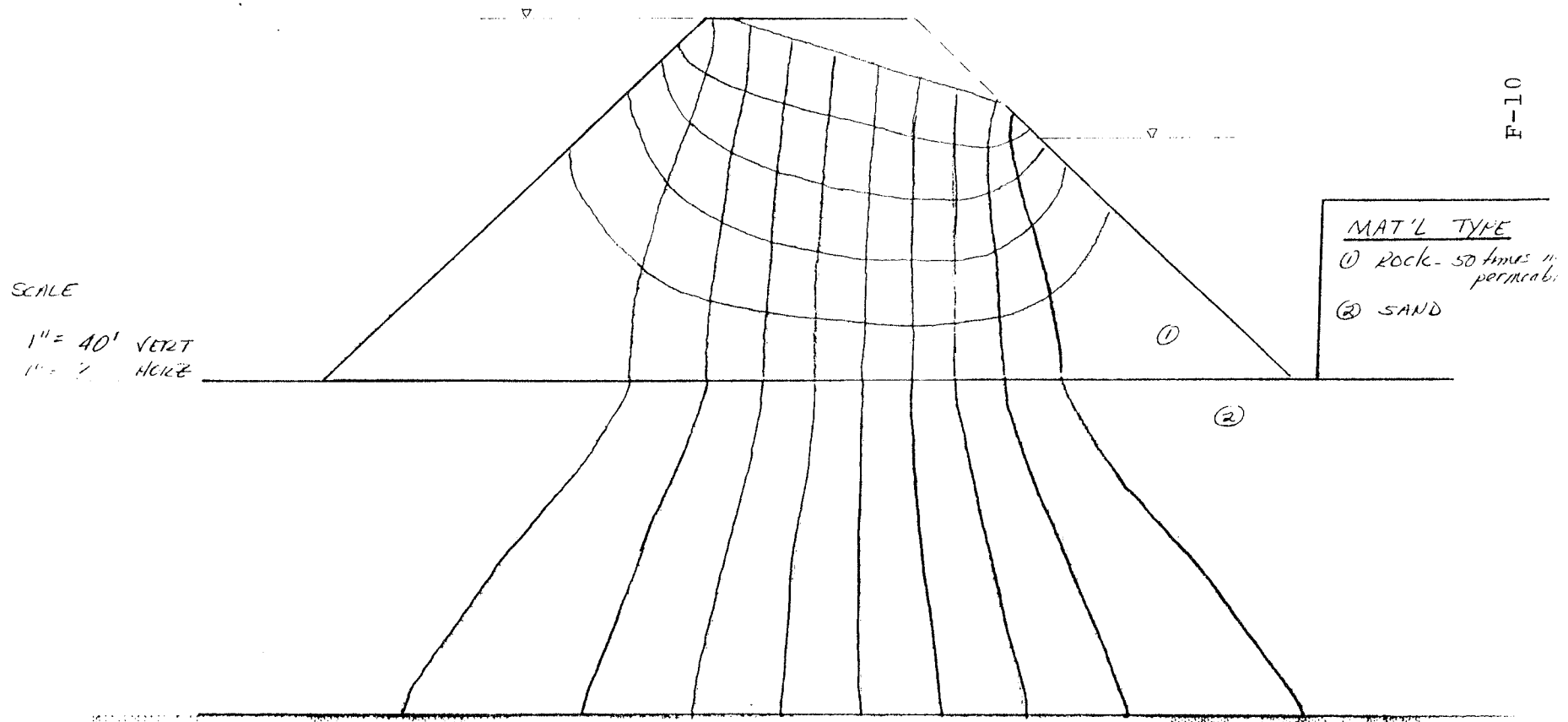
PHAP3

ASSUMPTIONS :

Rock dike is 50 times more permeable than sand foundation

Sand

5/13



F-10

Figure F-4

BEST CASE

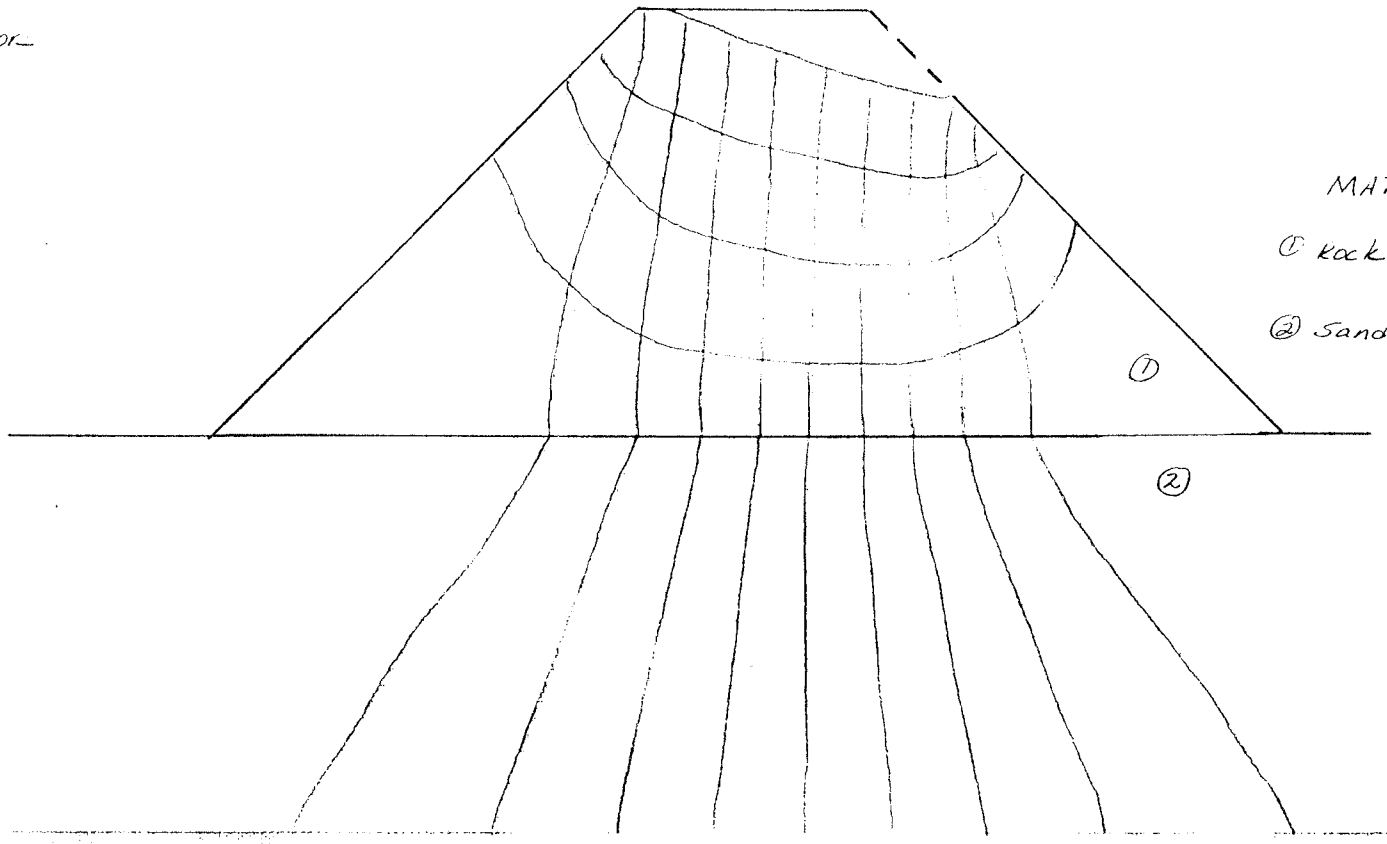
FILENAME
PHIP4

ASSUMPTIONS:

rock dike is 20 times more permeable than sand foundation
SAND = .51 fpm
C-STONE = 10 fpm

SHAPE FACTOR
4/10

SCALE
1" = 40' VERT
1" = ? HORZ



MAT'L TYPE
① Rock - 20 times permeable
② Sand

Figure F-5

FILE NAME
PHAP 5

ASSUMPTIONS :

Rock dike is 10 times more than sand

3/7

SCALE 1" = 40' VERT
1" = ? HORZ

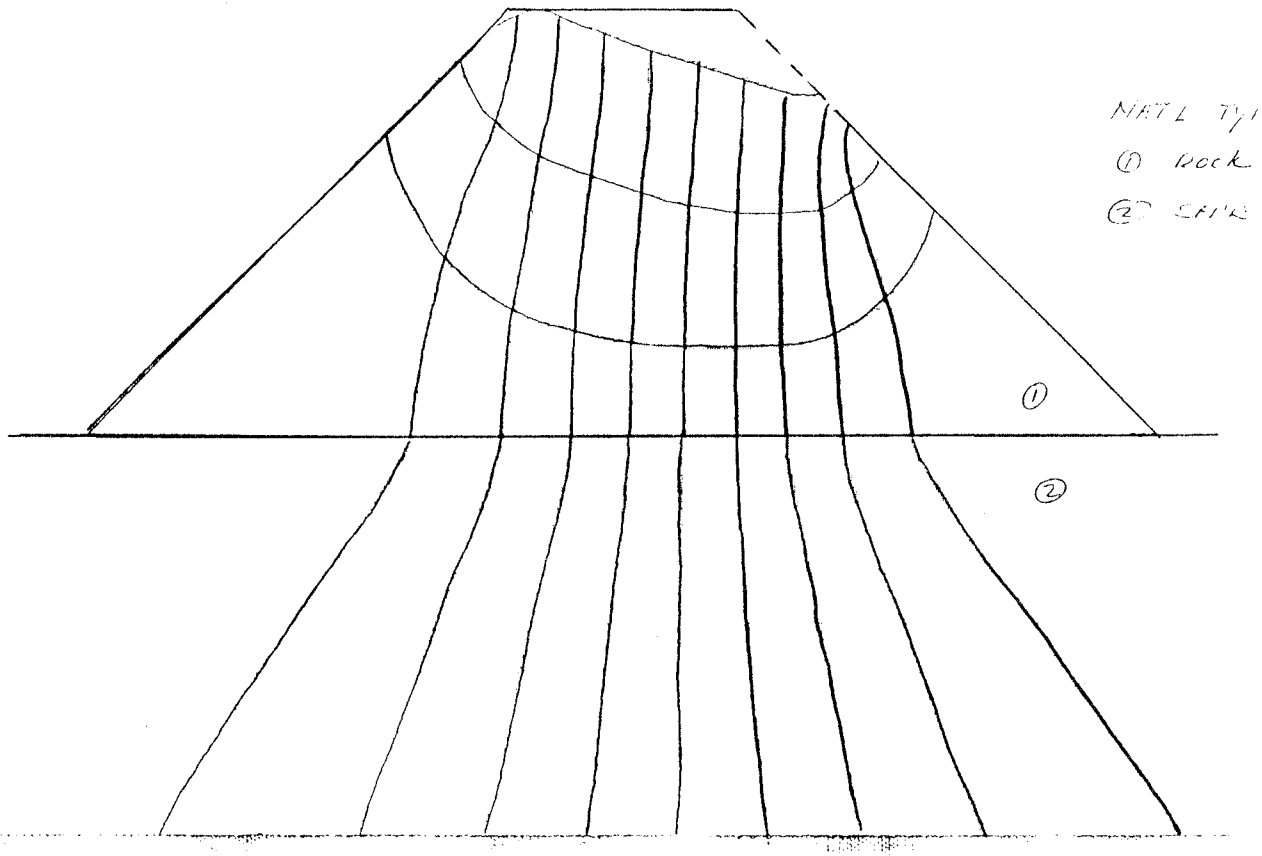


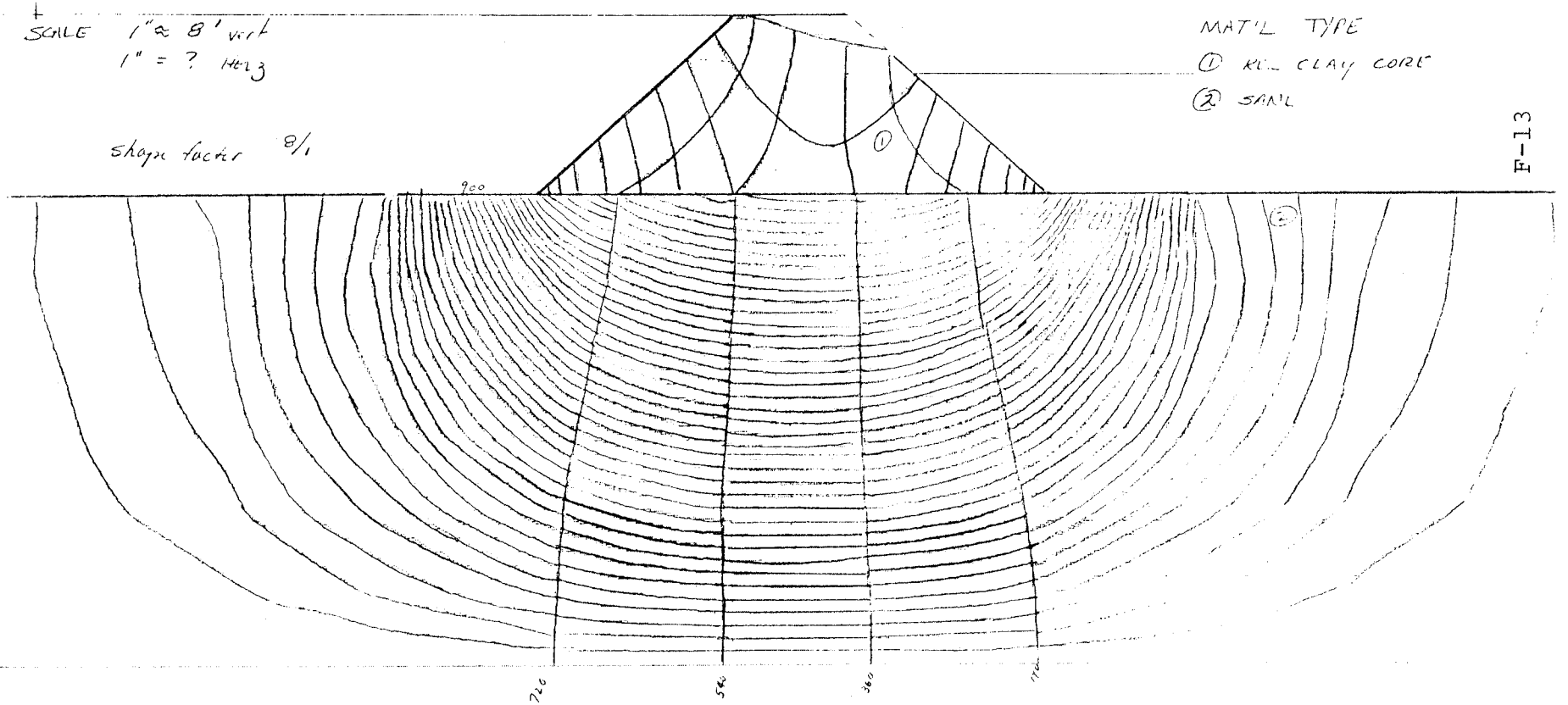
Figure F-6

F-12

FILENAME
PHAC 1

ASSUMPTIONS:

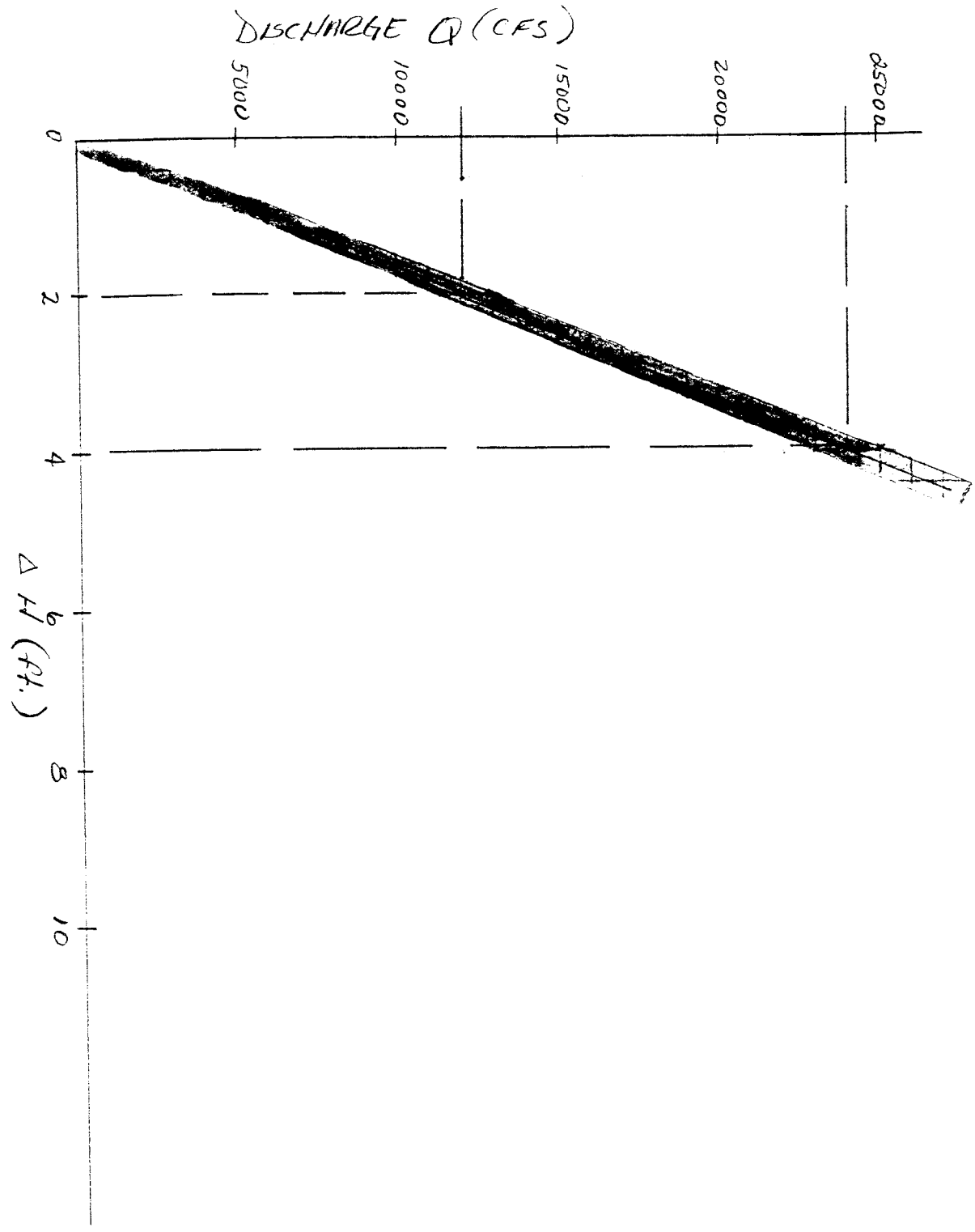
ROCK SIDE [illegible] IMPERMEABLE THAN
FOUNDATION SOILS



F-13

Figure F-7

PROJECT PHARRIS ISLAND	PAGE — OF —	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE



PLOT OF ANTICIPATED UNDERSEEPAGE FLOWS

PROJECT HARRIS ISLAND - TEMP

SUBJECT 2-D SEEPAGE ANALYSIS FOR ROCKFILL DIKES

COMPUTED BY CEL DATE 10/7/85

CHECKED BY DATE

SHEET NO. OF

LMV FORM 1079-R

COMPUTATION SHEET

Figure F-9

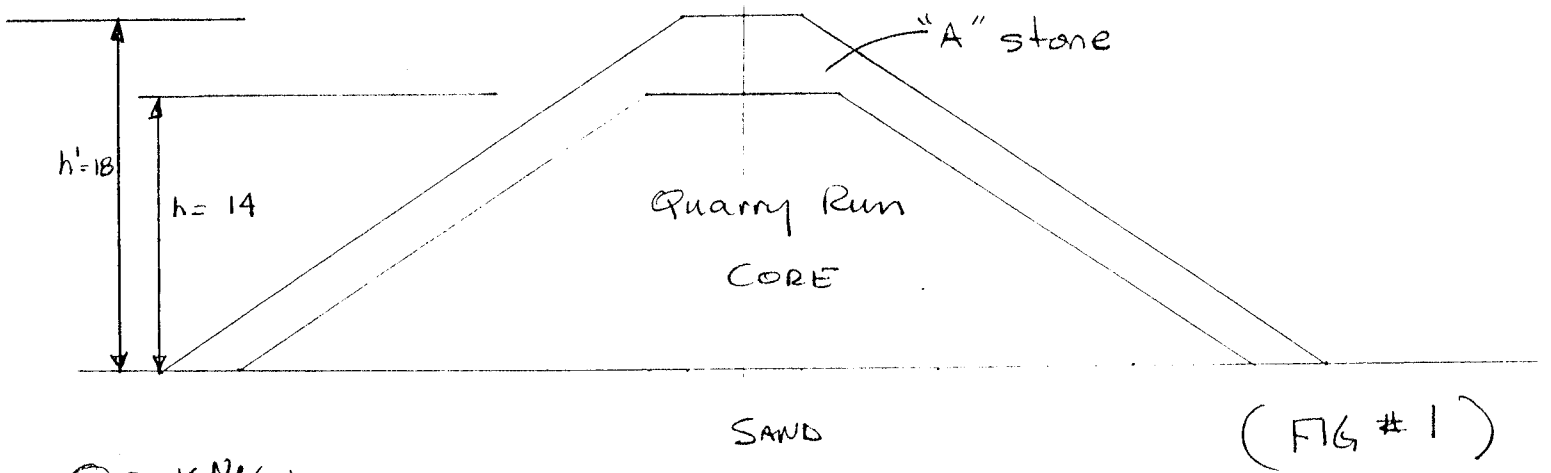
F-15

TYPICAL SECTION

STA. — 75+00

UPSTREAM BULL NOSE DIKE

SCALE : 1 sq = 2 ft



(FIG # 1)

$Q = K \frac{N_f}{N_e} h$

1. Assume Quarry Run Stone 20 times more permeable than foundation sands $L = 1'$

∴ $N_f/N_e = 4/10$ use sand = .5 ft/min

Quarry Run = 10 ft/min

$Q = 10(4/10)\,14 \times 1 = 56\ ft^3/min = 56/60$

$Q = .93\overline{3}\ ft^3/sec \times 448.8 = 419\ gal/min$

2. Assume Quarry Run Stone 10 times use .5 ft/min = sand
5 ft/min = Quarry

∴ $N_f/N_e = 3/7$ $Q = 5(3/7)\,14 \times 1 = 30\ ft^3/min = 30/60 = .5\ ft^3/sec$

$.5\ ft^3/sec \times 448.8 = 224.4\ gal/min$

PROJECT		Page ... of ...	COMPUTED BY	DATE
PHARRS ISLAND - EMP			CEH	10/18/89
SUBJECT			CHECKED BY	DATE
2-D FINITE ELEMENT SEEPAGE ANAL.				

Ref - ① 2D SEEP PROGRAMS; X8200, X8202, X8201

- ② M.I.T HARR'S MECHANICS OF PARTICULATE MEDIA

Obtainning a flow net usinng program X8201 allows for the calculation of flow through the rock fill dike.

Formula for calculations quanity of flow $Q = K \frac{N_f}{N_e} h$

Assumptions: REL Clay Core has K value = .025 ft/min

Foundation Sands K value = .5 ft/min

"C" stone K value = 10 ft/min

PROJECT: PHARRS ISLAND - EMP
SUBJECT: 2D SEEPAGE ANALYSES ROCKFILL DIKE
COMPUTED BY: CFH | DATE: 10/8/89
CHECKED BY: | DATE:
Page ___ of ___

NOTE: BECAUSE OF TIME LIMITATIONS I HAVE ASSUMED THE ANALYSES RUN ON THE "C" STONE DIKE TO BE THE SAME AS THE TYPICAL DIKE SECTION (FIG. 1) FOR THE UPSTREAM BULL NOSE DIKE

AGAIN: ASSUMING you get the SAME flow net for the "C" Stone ANALYSES AS you would for ANALYSING a "A" stone dike with a Quarry Run core you get the following values.

MAT'L TYPE	K, ft/min	Ne/Ne	RATIO of ROCK to SAND	DISCHARGE Q ft³/min	% ROCK % THRU SAND
Quarry Run (400 Top Size)	10ft/min	4/10	20 to 1	56 CF/mm	FROM FIG. 2
				42 CF/m ⇒ 314 gpm	75%
				14 CF/m ⇒ 105 gpm	25%
Quarry Run (400 Top Size)	5ft/min	3/7	10 to 1	30 CF/min	
				20 CF/m ⇒ 150 gpm	67%
				10 CF/m ⇒ 74 gpm	33%
RED Clay Core		8/1	1 to 20	.06 CF/min ⇒ .45 gpm	2.5%
				50 CF/min ⇒ 365 gpm	97.5%
				using 10 ft = h	
			*	40.6 C.F/min ⇒ 304 gpm	

LMV FORM 107e-R

COMPUTATION SHEET
F-17

Figure F-11

APPENDIX DPR-G

CULTURAL RESOURCES DOCUMENTATION

FOREWORD

Professional archaeologists would conduct monitoring during the initial construction phases to ascertain whether any significant historic properties are present. If so, all construction within the immediate vicinity of the remains would cease until these have been investigated and evaluated. Meanwhile, construction activities in other areas would procede as planned. These compliance activities would be coordinated with the appropirate Federal and state agencies.

This procedure would result in no adverse effect to any significant historic properties which may be located within the project area. The Missouri State Historic Preservation Officer, through the Missouri Department of Natural Resources, has accepted this procedure. At the suggestion of the U.S. Fish and Wildlife Service, concurrence with this procedure, and a determination of no adverse effect to significant historic properties, is being sought from the Advisory Council on Historic Preservation. A copy of the document submitted to the Advisory Council follows as Appendix G. Prior communication with the Advisory Council (telephone conversation of January 26, 1990 between Suzanne E. Harris, St. Louis District and Thomas M. McCulloch, Advisory Council on Historic Preservation) has indicated that concurrence with this approach will be forthcoming once the necessary documentation has been received.

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101-1986

REPLY TO
ATTENTION OF:

February 22, 1990

Environmental Analysis Branch
Planning Division

Advisory Council on Historic Preservation
ATTN: Thomas M. McCullouch
1100 Pennsylvania Avenue, Room 809
Washington, D. C. 20004

Dear Mr. McCullouch:

Pursuant to the National Historic Preservation Act, Section 106 (as amended) and its implementing regulation 36 CFR 800, the U.S. Army Corps of Engineers, St. Louis District requests the Advisory Council on Historic Preservation's concurrence with a determination that no adverse effect will occur to historic properties as a result of the Pharrs Island Wetland Habitat Rehabilitation Project, which is located in Pool 24, Upper Mississippi River, Pike County, Missouri (Enclosure 1). The Missouri Department of Natural Resources, which is headed by the Missouri State Historic Preservation Officer, has concurred with the St. Louis District's Finding of No Significant Impact (letter from Mr. G. Tracy Mehan, III to Col. James Corbin, dated September 7, 1989, Enclosure 2). This letter includes the documentation necessary to support the determination as discussed in the telephone conversation between Ms. Suzanne E. Harris, St. Louis District and Mr. Thomas McCullouch, Advisory Council on Historic Preservation, January 26, 1990.

Pharrs Island is managed for fish and wildlife purposes by the Missouri Department of Conservation under the cooperative agreements between the State and the Department of Interior, and between the Department of Interior and the Corps of Engineers. During the review of the draft Definite Project Report (SL-3), one respondent from the Department of the Interior, Fish and Wildlife Service expressed the concern that the Advisory Council be afforded the opportunity to comment on this project prior to construction (Enclosure 3). (Other repondents from that agency did not express this concern.)

The purpose of the Pharrs Island project is to enhance the island's wetland habitat value for fish and wildlife by: 1) decreasing sedimentation on the island, and 2) controlling the water level on the island independent of the pool stage. The project (Enclosure 4) will include: 1) constructing levees which will connect with natural levees around the island perimeter; 2) excavating levee borrow areas; 3) deepening the existing sloughs; 4) excavating interior of dredge disposal areas; 5) clearing vegetation using a brushhog; and 6) constructing a rock dike around the upstream end of Pharrs Island and a cluster of four relatively recent islands. None of these construction activities is expected to disturb the ground deeper than 2 feet below the existing surface, except in areas (levee, levee borrow, dredge disposal) of stump removal which may extend somewhat deeper.

Much of the island is covered by recent sediment deposited after the Lock and Dam 24 impoundment in 1940. A 1968 St. Louis District hydrographic map shows the southern half of the island as marsh which includes an area of waterlilies indicating standing water (Enclosure 5). By 1990, much of the former marsh had been built up by sedimentation 1 - 2 feet above the normal pool (449 feet MSL) and supports early successional trees (willow, silver maple). A narrow strip along the island's west side, facing the main channel, appears much less affected by sedimentation.

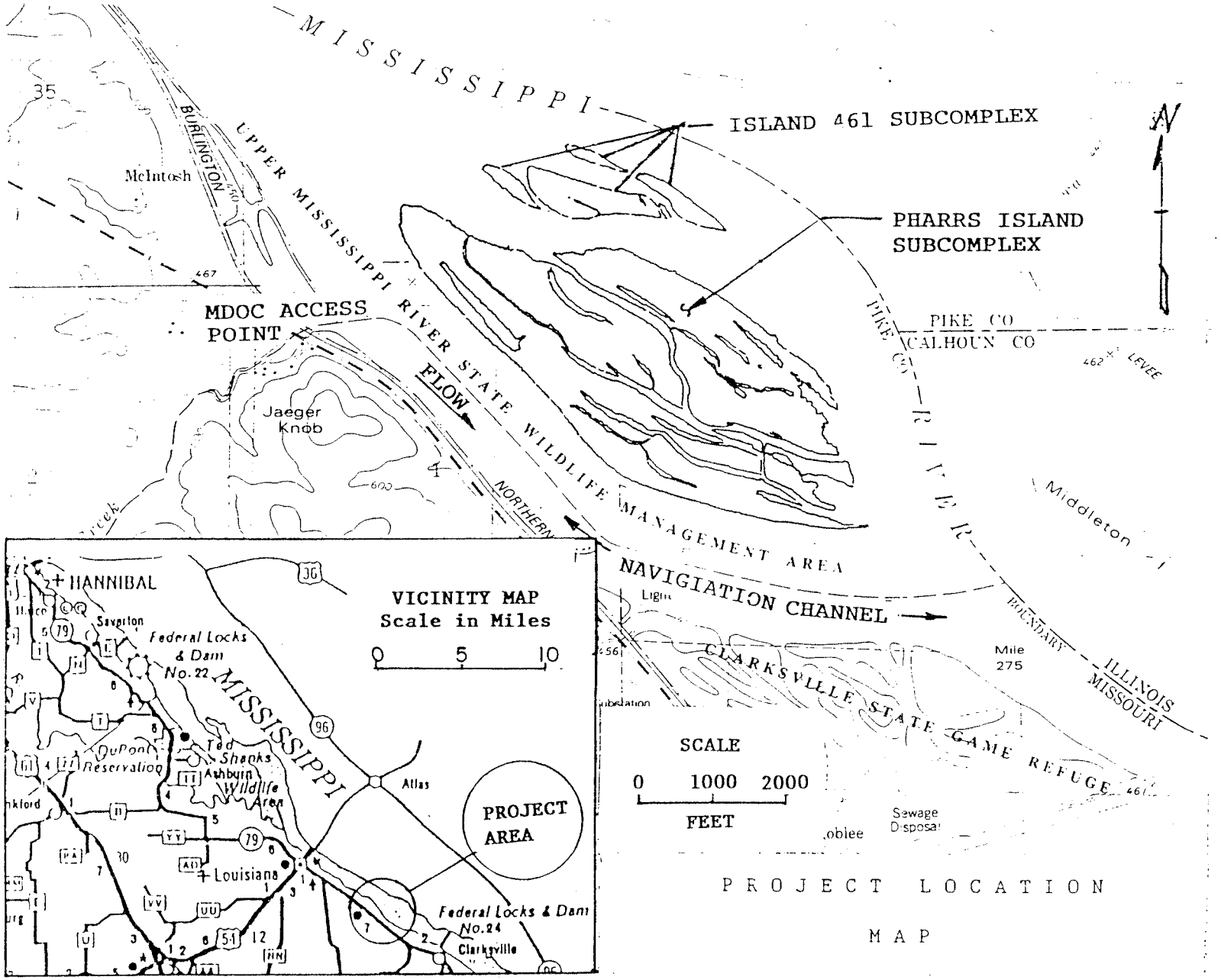
Due to sedimentation over much of the island surface (a situation which is compounded by impenetrable vines and thickets during the growing season, Enclosure 6), conducting a standard historic properties survey has not been attempted. A brief visual inspection of the higher ground on the western portion of the island by St. Louis District personnel located partial foundations from a twentieth century houseplace, but no earlier archaeological sites. It is anticipated that if any prehistoric and/or early historic (Historic Indian, French Colonial) sites are located on the island, they will lie buried under more recent sediments. Given the degree of sedimentation on the island and the relatively shallow ground disturbance proposed, the St. Louis District plans to conduct archaeological investigations in conjunction with construction related earth distrubing activities. A professional archaeologist will monitor all earth moving activities for the presence of archaeological remains. Should such remains be encountered, all earth-disturbing activities in the vicinity of the remains would cease until the archaeological investigations were completed. A report of this evaluation would be forwarded to the appropriate State and Federal agencies.

Data from any significant site will be located, evaluated, and recovered through the investigative approach outlined above. Therefore, the St. Louis District, Corps of Engineers, has concluded that the effect of the undertaking will not be adverse. The St. Louis District requests that Advisory Council on Historic Preservation concur with this determination of no adverse effect to historic properties by the Pharrs Island Wetlands Habitat Rehabilitation Project. If you have any questions, please contact Ms. Suzanne E. Harris or Mr. F. Terry Norris of my staff at (314) 263-5317.

Sincerely,

Jack F. Rasmussen, P.E.
Chief, Planning Division

6 Enclosures



PROJECT LOCATION MAP

ENCLOSURE 1

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

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

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE DIRECTOR
P.O. Box 176
Jefferson City, MO 65102
314-751-4422

September 7, 1989

Colonel James Corbin
District Engineer
St. Louis District
Corps of Engineers
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

Dear Colonel Corbin:

The Missouri Department of Natural Resources has reviewed the Definite Project Report/Environmental Assessment and draft Finding of No Significant Impact for the proposed Pharrs Island Wetland Habitat Rehabilitation Project.

Our review causes us to have no objection to the determination that an Environmental Impact Statement will not be required prior to proceeding with the proposed action and we concur with the Finding of No Significant Impact.

Thank you for the opportunity to review and comment on this proposed project.

Very truly yours,

DEPARTMENT OF NATURAL RESOURCES

G. Tracy Mehan, III
Director

GTM:tlk

ENCLOSURE 2

United States Department of the Interior

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

August 31, 1989

Colonel James Corbin
U.S. Army Corps of Engineers
210 Tucker Boulevard
St. Louis, MO 63101-1986

Dear Colonel Corbin:

The draft definite project report for Pharrs Island has been reviewed by appropriate staff and we offer the following comments.

The Pharrs Island habitat rehabilitation and enhancement project is complex and expensive. It will be subjected to highly critical review within the Corps. With that in mind, we think it would be a matter of some urgency to lay out the benefits of the project in one place in a succinct and comprehensive manner as you do the consequences of no project . Currently you have to winnow the text, compare a number of tables and understand the somewhat enigmatic presentation of data in the WHAG, Appendix DPR-E. There is no assurance that other reviewers at other levels have the familiarity with the process used at the District level to fully comprehend the projected benefits of the project.

Is the control of encroaching willows and cottonwood (page 37, paragraph 5) a project feature? If it is not, why is it addressed? This would appear to be a discretionary management step for the land manager.

The Fish and Wildlife Service has determined that the project is compatible with the purposes for which the Mark Twain National Wildlife Refuge was established. The District Engineer has been notified of that determination and acknowledgement of this fact would be more appropriate then the statement following "The USFWS should ensure that. . ." on page 55.

The Regional Director will sign the agreement contained in Appendix DPR-H at the appropriate time. We would suggest that the section entitled Implementation Responsibilities and Views, page 55, really contain our views. These views, as understood by the North Central Division, are captured in the Fourth Annual Addendum, III.A.1 page 9. Please cite that reference in addition to Section 906(e).

The discussion on historic properties (pages 37-39) is a matter of concern. By waiting until construction starts to institute archeological monitoring, the Corps has foreclosed opportunities

for the Advisory Council on Historic Preservation to comment and consider alternatives to adverse effects. If this approach is not changed our Historic Preservation Officer is apt to recommend to the Regional Director that he not sign the project Memorandum of Agreement until he has determined that the Corps of Engineers is in compliance, 36 CFR Part 800. The fix appears to be an elementary change so that monitoring is conducted in accordance with a memorandum of agreement with the council that includes the Fish and Wildlife Service and the Missouri Historic Preservation Officer. We believe that this would be an acceptable approach, where as, the unilateral approach proposed in the DPR is not.

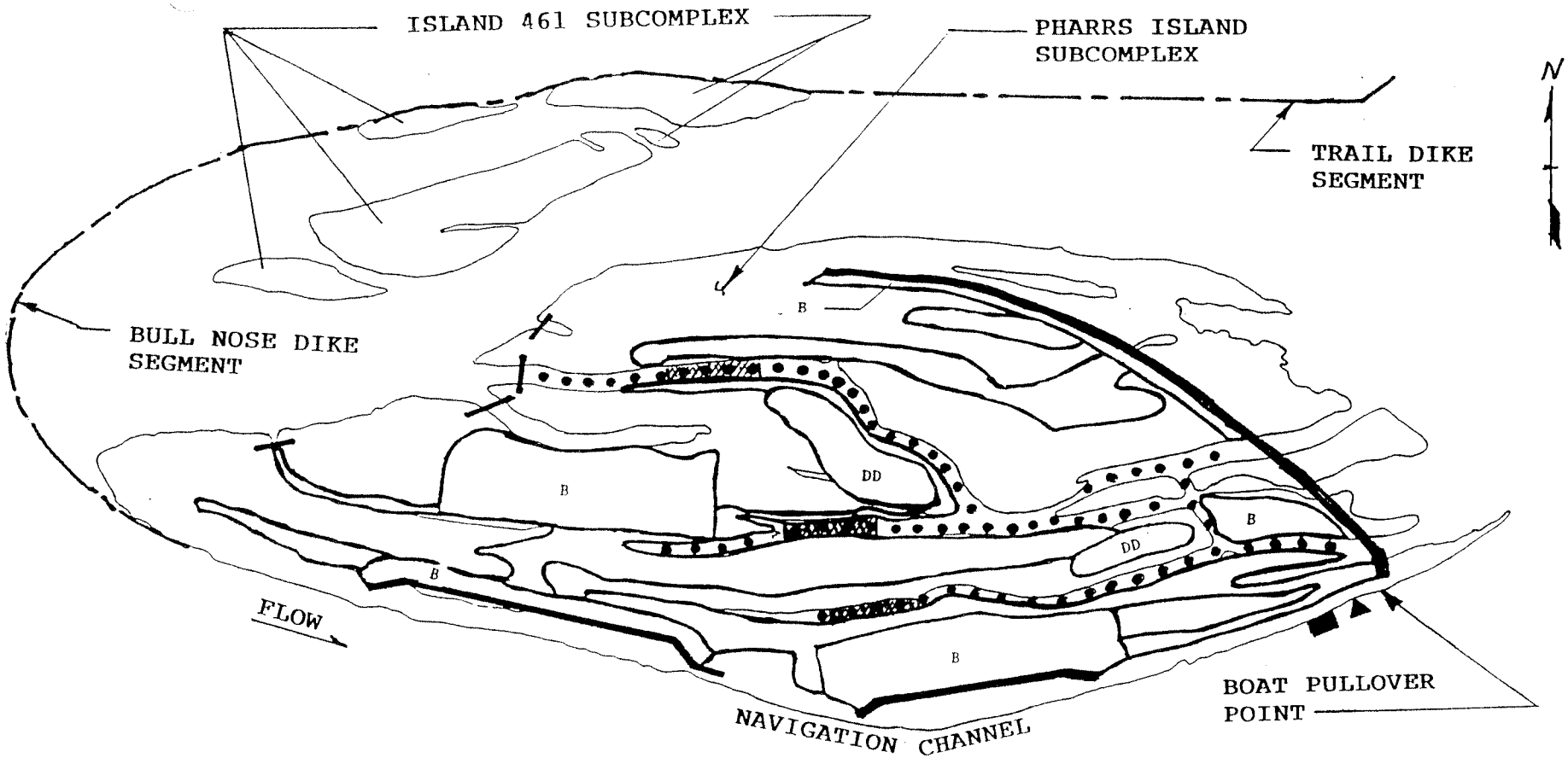
The WHAG evaluates Alternative 1 while the DPR alternatives are labelled A, B, C and D. This ambiguity needs to be cleared up.

Thank you for the opportunity to comment on this draft.

Sincerely,

Robert H. Stratton, Jr.
Project Leader

cc: Matt Kerschbaum, WAM-2
LeRoy W. Sowl, EMP Coordinator



POTENTIAL GROUND DISTURBANCE
LEGEND:

- = Levee (30 ft. wide, general disturbance to 2 ft. deep, stump removal to 3 ft. deep).
- B = Levee borrow (0.5 - 1.0 ft. deep, stump removal to 3 ft. deep).
- DD = Dredge disposal areas (1-2 ft. deep, stump removal to 3 ft. deep).
- VC = Vegetation clearing (0.5 ft. deep).
- = Slough dredging (25 ft. wide and 2 ft. deep).
- = Summer fish refuge (50 ft. wide and 4 ft. deep).
- = Rock dike (no ground disturbance).
- = Gated drain
- = Portable Pump

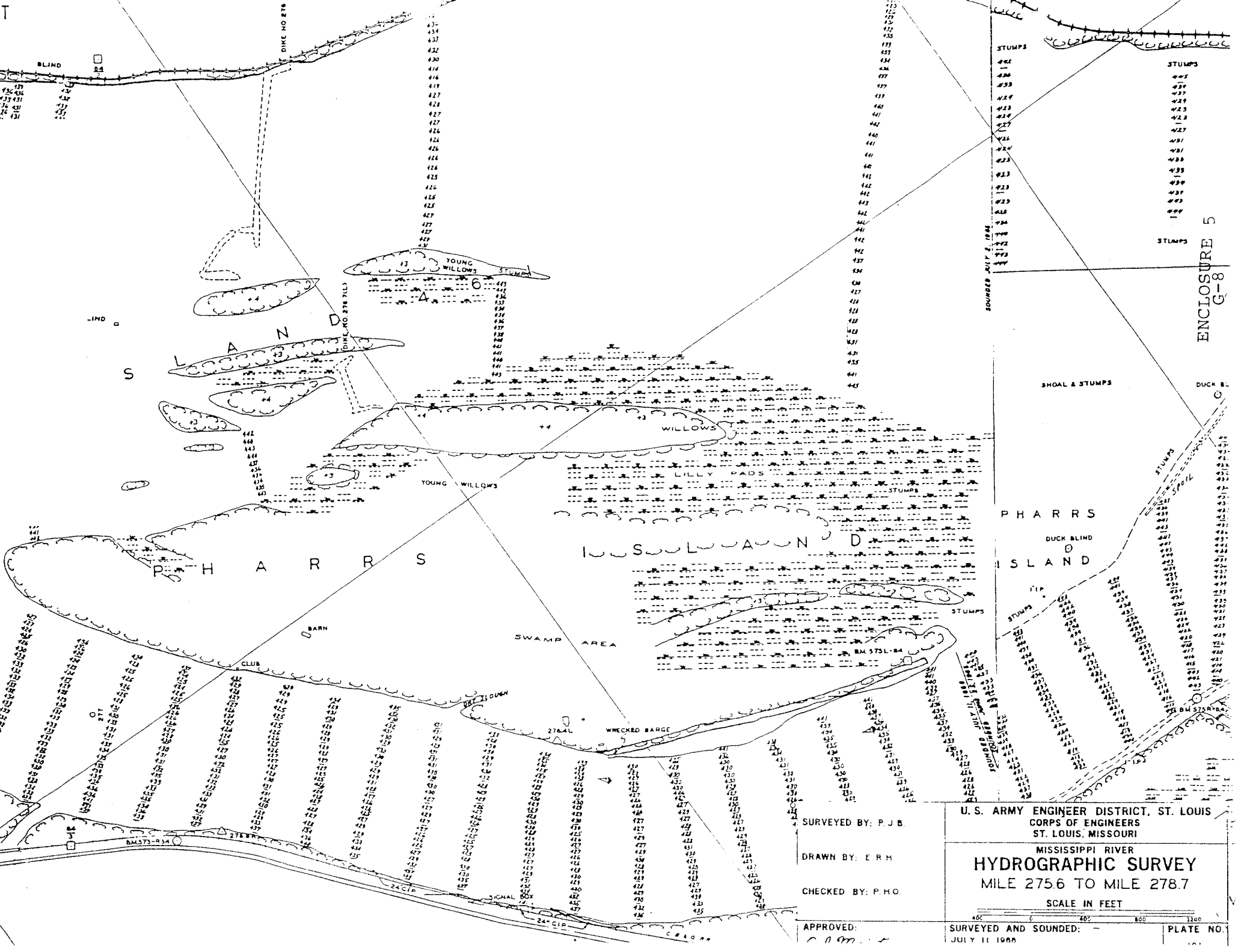
SCALE

0 1000 2000

FEET

PROJECT MAP

ENCLOSURE 4


DIKE NO 278
BLIND
DIKE NO 278 (L)
YOUNG WILLOWS
STUMPS
SOUNDED JULY 6, 1988
ENCLOSURE 5
G-8
SHOAL & STUMPS
DUCK BL
WILLOWS
LILLY PADS
YOUNG WILLOWS
PHARRS
ISLAND
DUCK BLIND
SPOIL
BARN
SWAMP AREA
CLUB
BM 575 L-84
WRECKED BARGE
BM 573-R 84
24" CIP
SIGNAL BOX
SURVEYED BY: P.J.B.
DRAWN BY: E.R.H.
CHECKED BY: P.H.O.
APPROVED:
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
MISSISSIPPI RIVER
HYDROGRAPHIC SURVEY
MILE 275.6 TO MILE 278.7
SCALE IN FEET
400 0 400 800 1200
SURVEYED AND SOUNDED:
JULY 11 1988
PLATE NO.

HOUSE PLACE

Pharrs Island Wetland
Habitat Rehabilitation
Project, Pike County, MO
U.S. Army corps of Engir
St. Louis District

ENCLOSURE 6

VEGETATION, NORTHWEST SIDE OF ISLAND

Pharrs Island Wetland Habitat Rehabilitation Project, Pike County, MO.
U.S. Army Corps of Engineers, St. Louis District

VEGETATION, NORTHWEST SIDE OF ISLAND

Pharrs Island Wetland Habitat
Rehabilitation Project, Pike
County, MO.
U.S. Army Corps of Engineers,
St, Louis District

APPENDIX DPR-H

FISH AND WILDLIFE COORDINATION ACT DOCUMENTATION

FOREWORD

APPENDIX DPR-H provides the Fish and Wildlife Service's Fish and Wildlife Coordination Act Report (FWCAR), prepared by the FWS for the Pharrs Island DPR. The Service (original June 13, 1989 letter and supplemental letter of March 7, 1990) is in agreement with the project design and gives its full support, and has also (_____ letter) determined that the project is compatible with the purposes for which the National refuge was established. Accordingly, the District has no comments to make regarding the Service's letters. The District will continue to involve the Service in all future phases of the project effort.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MARION SUBOFFICE (ES)
Rural Route 3, Box 328
Marion, Illinois 62959

IN REPLY REFER TO:

June 13, 1989

Colonel James E. Corbin
U.S. Corps of Engineers
St. Louis District
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

ATTN: PD-A

Dear Colonel Corbin:

We have reviewed the draft 404(b)(1) Evaluation Report for the Pharrs Island, Missouri, Habitat Rehabilitation Project, a component of the Upper Mississippi River System Environmental Management Program (Program). The following comments constitute our Fish and Wildlife Coordination Act Report.

PROJECT LOCATION AND GENERAL DESCRIPTION OF FISH AND WILDLIFE RESOURCES

The Pharrs Island Wetland Complex is located in mid-river, Mississippi River Pool 24, near river mile 276, Pike County, Missouri. The proposed project area is situated on land owned by the U.S. Army Corps of Engineers (Corps).

Lock and Dam 24 at Clarksville, Missouri, is located 2.6 miles downstream of the Island. The proposed Clarksville Refuge Program project is found along the nearby Missouri shoreline.

The project would consist of approximately 400 acres of land and water. Included in this complex is an area referred to in pre-impoundment days as Island Number 461. Today this island is fragmented into four islands separated by small side channels. The complex was acquired for the navigation project and is managed by the Missouri Department of Conservation (Department) under cooperative agreements between the state, Department of the Interior, and the Corps. Historically, the island complex supported a prime wetland used extensively by migratory waterfowl, wintering bald eagles, and other wetland-oriented species. The shallow water areas also provided spawning and nursery habitat for a wide variety of river fishes.

Unfortunately, over the years sedimentation has significantly deteriorated the quality and quantity of the wetlands within the complex. Presently there are no means to control interior water levels and past measures to reopen the wetlands have been ineffective.

PROPOSED PROJECT FEATURES

A 15,311-foot rock upper closure dike would be constructed in order to retard deposition of sediment on interior wetlands and provide additional backwater habitat. This structure would be upstream of the complex, and would then train in a southeasterly direction to the opposite end of the complex. To enhance the management potential of the area, interior wetland water levels on Pharrs Island would be controlled independent of river stage by the construction of a bullet-shaped 4,370-foot rock lower closure dike at the southeastern end of the island.

A five-acre tract of forest on the island would be cleared of trees and excavated to create a containment berm. This area would be subsequently filled with dredge disposal material via hydraulic dredging.

A single 36" diameter CMP gravity drain would be installed in the lower closure dike and used for water release and control of interior water level fluctuations on Pharrs Island. Water input into the interior of the island would be via the large backwater and interior ditch when the pool is at normal stage or higher. A 60" diameter vertical gatewell pipe to protect the sluice gate structure would also be constructed.

To ensure adequate water control on the Pharrs Island interior, two existing depressions along the southwest perimeter of the island would be plugged and filled to normal grade.

PROJECT EFFECTS ON FISH AND WILDLIFE RESOURCES

Without the project, the Pharrs Island complex will continue to deteriorate due to sedimentation. The area occupied by shallow water wetlands will probably succeed into a cottonwood/willow ecotype while the higher elevations, presently vegetated with tree species such as silver maple and hackberry, should not change significantly. The loss of the wetlands with emergent vegetation would be particularly harmful to migratory waterfowl, furbearers, and other water-oriented wildlife.

With the project, sedimentation rates would be reduced and through control of interior water levels, the area could be managed for migratory waterfowl and fisheries. Deepening the island's interior drainage ditch would provide improved aquatic habitat for numerous species of Mississippi River fish. The five acres of trees which would be lost from construction of the bermed disposal area would be planted with mast-producing trees as mitigation. The Department indicates that river otter, a state endangered species, would be introduced when they become available. The project would also be compatible with the intent of the North American Waterfowl Management Plan.

FEDERALLY LISTED ENDANGERED SPECIES

A list of threatened and endangered species which may occur in the area of the proposed project was provided to your office by letter of January 3, 1989.

CONCLUSIONS AND RECOMMENDATIONS

We have worked closely with the Corps and Department in planning this project. Any suggested modification or change has previously been incorporated into the present design. We therefore have no recommendations other than to urge the Corps to progress to the construction phase as expeditiously as possible.

Please contact Bruce Stebbings of this office should you have any questions or comments on this letter (618-997-5491).

Sincerely,

for Thomas M. Groutage
Assistant Field Supervisor

COMPATIBILITY DETERMINATION

Station Name: Mark Twain National Wildlife Refuge, (Pharr's Island)

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

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

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

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

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

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

Description of Proposed Use: The Pharrs Island wetland complex, located in Mississippi River Pool 24 about three miles upstream from Lock and Dam 24, consists of approximately 525 acres of Federal lands and waters. The Pharrs Island Habitat Rehabilitation and Enhancement Project will provide a high degree of sediment protection to the project area. Included will be 180 acres of newly created slackwater fisheries habitat, and a 250 acre water level controlled waterfowl management unit. Construction would be completed in 1992.

The project will consist of (1) a 10,200-foot long rock dike, (2) 7,200 feet of earthen levee, (3) four small earthen slough closures, (4) about 45 acres of borrow area, (5) 10 acres of dredged material disposal area, (6) 45 acres of vegetation clearing, (7) a 36-inch gated culvert drain, (8) three deepwater interior summer fish refuges -- each 50 feet wide and 500 feet long, and (9) a 15,000 GPM portable pump.

Anticipated Impacts on Refuge Purposes: This project is intended

to reclaim wetland habitat which was once a prime backwater area used extensively by migratory waterfowl, bald eagles, and other wetland wildlife. The area also provided important spawning and nursery areas for river fishes. The impounded area will provide approximately 200 acres of clear water for the recovery of aquatic macrophytes. Siltation from minor flood events would be excluded from the area. Light penetration in the water column would be improved and photosynthesis and primary production would be enhanced.

Production of waterfowl food would increase significantly. The wetlands would be enhanced as a spawning and nursery area for fish. The terrestrial site for the dredge spoil disposal area will initially loose its tree cover. Seeding and tree planting on the site will provide a long term gain in wildlife habitat. Initial loss of trees is not significant.

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

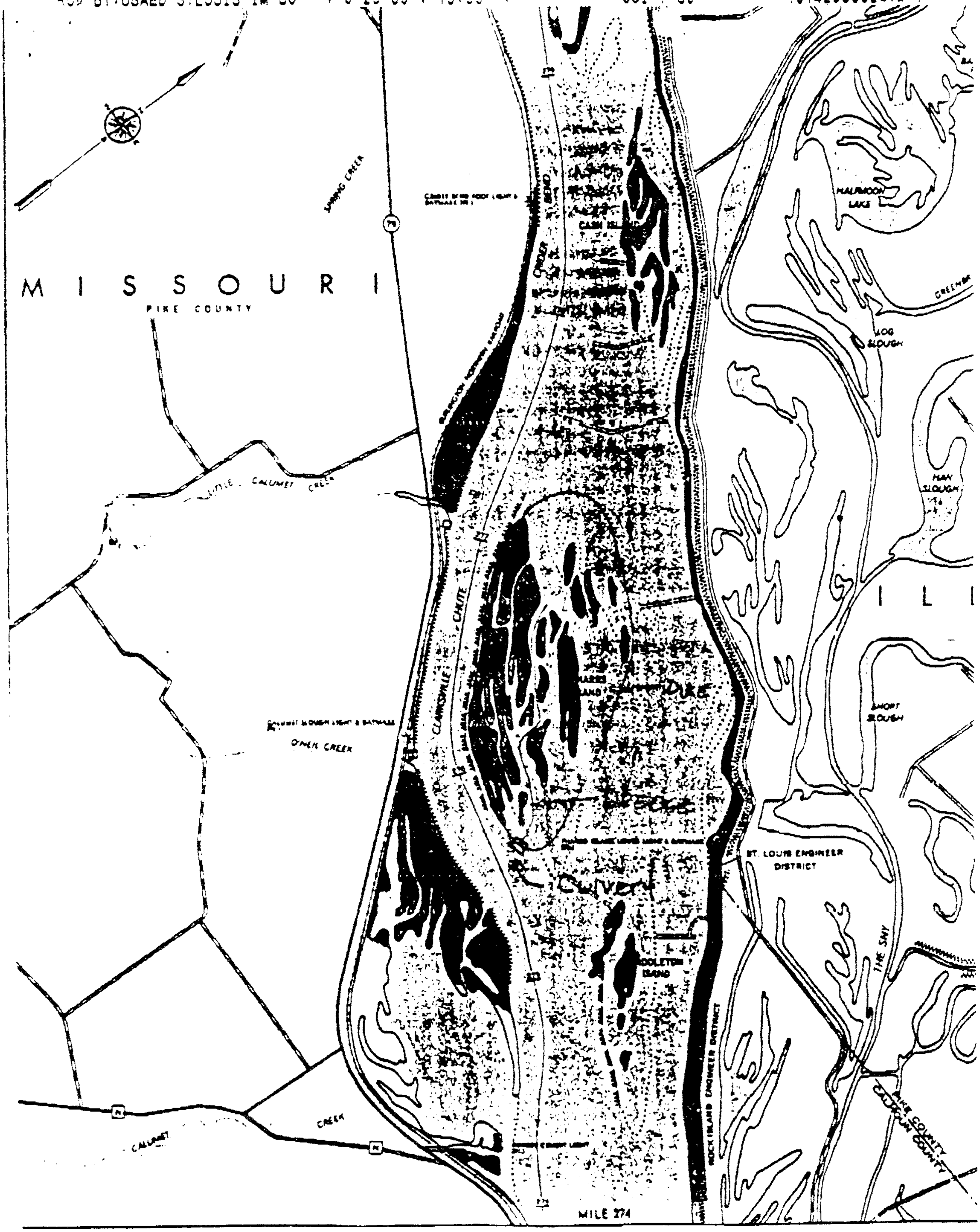
Justification: This project facilitates attainment of both primary management objectives of the refuge on this unit. It also contributes to each of the four secondary objectives and maintains current habitats utilized by endangered species. It does not, so far as can be determined, have incompatible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

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

Determined by: _____ Date: 3/22/90
Project Leader

Reviewed by: _____ Date: 3/26/90
Acting Associate Manager

Concurred by: _____ Date: 3/27/90
Acting Regional Director


MISSOURI
PIKE COUNTY
SPRING CREEK
LITTLE CALUMET CREEK
OWEN CREEK
CALUMET CREEK
CLARKSVILLE CHUTE
HALFMOON LAKE
LOG SLOUGH
MAN SLOUGH
SHORT SLOUGH
ST. LOUIS ENGINEER DISTRICT
ROCK ISLAND ENGINEER DISTRICT
THE SNY
PIKE COUNTY
CALHOUN COUNTY
MIDDLETON ISLAND
CASH ISL
MILE 274

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MARION SUBOFFICE (ES)
Rural Route 3, Box 328
Marion, Illinois 62959

IN REPLY REFER TO:

March 7, 1990

Colonel James E. Corbin
U.S. Corps of Engineers
St. Louis District
210 Tucker Boulevard, North
St. Louis, MO 63101-1986

ATTN: Dave Gates

Dear Colonel Corbin:

This supplements our June 13, 1989, Fish and Wildlife Coordination Act Report for the proposed Pharrs Island, Missouri, Habitat Rehabilitation Project, a component of the Upper Mississippi River System Environmental Management Program.

We understand the project plans have been modified as follows:

- the rock dike has been deleted and replaced with a supplement of the existing natural levee for approximately one-half of the island's perimeter (10,200');
- one slough opening at the southern end of the island and two at the navigation channel will be closed off with dikes;
- all borrow material will be obtained on site;
- three 500' x 50' summer fish refuges will be created;
- a 36' CMP at downstream corner of island will empty into navigation channel;
- the Corps of Engineers will purchase a portable pump which the Missouri Department of Conservation (MDOC) will transport to the island;
- generally a 150' buffer will be left between the new levee and the Mississippi River for bald eagle perching sites;
- two disposal areas with a 5' high containment berm will hold about 3' of fill;
- the major interior sloughs will be deepened about 2 feet;

- the MDOC will plant mast-producing trees on berms and disturbed areas; and

- younger-age forest will be cleared for moist soil plant production and borrow areas.

Although the project design has changed, the concept remains essentially the same. Therefore, we continue to expect positive effects on fish and wildlife resources very similar to that described in our June 13, 1989, letter.

We appreciate the opportunity to comment on the revised plan. Please contact us should you need any additional correspondence to move the project along.

Sincerely,

for Thomas M. Groutage
Assistant Field Supervisor

cc: MDOC (Stucky)

APPENDIX DPR-I

ENDANGERED SPECIES ACT DOCUMENTATION

APPENDIX DPR-I provides the June 3, 1989 letter from the USFWS listing Federally threatened and endangered species which may occur in the area of the proposed project.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MARION SUBOFFICE (ES)
Rural Route 3, Box 328
Marion, Illinois 62959

IN REPLY REFER TO

January 3, 1989

Colonel James E. Corbin
U.S. Corps of Engineers
St. Louis District
210 Tucker Boulevard, North
St. Louis, MO 63101-1986
Attn: Environmental Analysis Branch
Planning Division

Dear Colonel Corbin:

As requested, we are providing you with the following list of threatened and endangered species which may occur in the area of the proposed Pharrs Island project which would be constructed under the Environmental Management Program:

Classification	Common Name	Scientific Name	Habitat
Endangered	Bald Eagle	Haliaeetus leucocephalus	breeding and wintering
Endangered	Fat Pocketbook Pearly Mussel	Potamilus capax	Mississippi River
Endangered	Indiana Bat	Myotis sodalis	caves and riparian
Endangered	Gray Bat	Myotis grisescens	caves

This letter provides comment only on the endangered species aspect of the project. Comments on other aspects under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.; 48 Stat. 401), as amended, may be forwarded under separate cover.

Sincerely,

Thomas M. Groutage

Thomas M. Groutage
Assistant Field Supervisor

APPENDIX DPR-J

PROJECT HABITAT QUANTIFICATION

APPENDIX DPR-J provides a quantification of habitat conditions for project planning. The appendix establishes a basis for evaluating the biological impacts of the various project alternatives, and provides a biological baseline for post-project performance evaluation monitoring.

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (SL-3)

PHARRS ISLAND HABITAT REHABILITATION PROJECT
POOL 24, UPPER MISSISSIPPI RIVER, PIKE COUNTY, MISSOURI

APPENDIX J

PROJECT HABITAT QUANTIFICATION

SECTION I. INTRODUCTION

This appendix provides a quantification of habitat conditions for project planning. Such quantification is needed to evaluate project features where traditional benefit:cost evaluation procedures are not applicable. To date, the unit of measure that has gained the widest acceptance among technical and policy elements, both within and outside the Corps, is the habitat unit (HU). This unit has been applied to the evaluation of the Pharrs Island HREP. A habitat unit is the product of an estimated acreage for a given habitat type times a habitat suitability index (HSI) value for that habitat type. HSI's result from the numeric ranking of site characteristics at sample sites for a habitat throughout a given project area. HU's can be annualized for specific target years to project changes in habitat values over time. The effects of various plans or plan features can then be compared by applying the HSI's to the acreages of habitats for each alternative considered.

For the Pharrs Island HREP there is a need for both wildlife and fisheries based HU accounting methodologies. At the present time a number of such methodologies are available. These include the U. S. Fish and Wildlife Service's (USFWS) Habitat Evaluation Procedures or HEP, the U.S. Army Corps of Engineers' Habitat Evaluation System or HES, and U. S. Bureau of Reclamation's Habitat Management Evaluation Method (HMEM). Among the Federal and state agencies, the HEP procedure is the most familiar to all participants in the UMRS-EMP. The Missouri Department of Conservation (MDOC) and the U. S. Soil Conservation Service have developed an appraisal system, based on the USFWS's HEP. The system, referred to as the Missouri Habitat Appraisal Guide (WHAG) method, represents a regional fine tuning of HEP and is structured to more efficiently input field data. The WHAG is accepted by UMRS agencies as the method of choice for EMP wildlife habitat analysis, and for this reason it was applied to the Pharrs Island project.

To date, HU methodologies for wildlife evaluation have received greater support and acceptance among biologists than have fisheries evaluation methods. The most promising fisheries evaluation developed thus far for use on the EMP is one developed by the Corps' Rock Island District and the Corps' Waterways Experiment Station (WES). The HSI models for the methodology, referred to here as the Aquatic Habitat Appraisal Guide (AHAG) method, follow the format of the Missouri WHAG. The AHAG is still evolving, and it has not yet been field verified; however, the procedure does represent the state-of-the-art. For that reason, the AHAG with some site-specific modifications made by WES, has been applied to the Pharrs Island HREP. The specific details of the application of the WHAG and AHAG procedures to Pharrs Island are described in the next two sections of this appendix.

SECTION II. WILDLIFE HABITAT APPRAISAL GUIDE (WHAG) METHOD

1. BACKGROUND

The WHAG is a field evaluation procedure designed to measure the quality of a habitat for particular species of wildlife, and also accounts for land management practices. The method provides HSI values for areas classified into broad land-use types such as forested wetland and nonforested wetland. WHAG is based on the assumption that habitat can be numerically described by HSI's calculated from species-habitat models.

WHAG utilizes checklist-type appraisal guides for each habitat type. The guide breaks habitat into the most important characteristics which are rated on a 1-to-5 or 1-to-10 scale, depending on their importance. Field data values are entered into a computer program which rates habitat types based on life requisite requirements for a variety of species. The resulting index ranges from a low habitat suitability value of 0.1 to a high of 1.0.

Computer results are provided for estimated total HU's and HSI's. The results can be used to assess the value of various proposed habitat improvements on habitat quality. HU's are annualized for target years in order to evaluate changes in project features over time. In the Pharrs Island project, water control, borrow-area and vegetation clearing are habitat improvement measures considered. Since habitat units can change over time, a number of target years were selected over the life of the project. These target years were year 0 (or existing conditions), year 2 (or early post-construction) and years 15 and 50 of the project life.

Habitat can potentially be improved by: (1) increasing the acreage of habitat types in short supply, (2) altering a habitat limiting factor, such as unpredictable water levels, (3) altering a management strategy, such as food crop composition, or (4) a combination of the above.

The major wildlife project goal for the management of Pharrs Island per se was the enhancement of wetland values for migratory waterfowl. Therefore, the WHAG team selected the appraisal guides for wetland habitats and selected the mallard as a target species of emphasis. The WHAG team included representation from the USFWS, MDOC and the Corps. Prior to site sampling, the study team reviewed aerial photography, topographic maps, and preliminary design drawings to select representative sample sites for WHAG application.

2. ASSUMPTIONS

During the WHAG analysis, certain assumptions were developed regarding existing conditions and future conditions. These assumptions are listed below.

a. Existing Conditions

(1) Water levels fluctuate greatly during the growing season and during waterfowl migrations, resulting in food production that is unreliable for or unavailable to waterfowl.

(2) Little suitable shallow-water habitat exists for waterfowl at the project site or within Pool 24 at large.

b. Future Conditions

(1) General. The following three general assumptions were applied to the analysis of all future changes in habitat during the 50-year project life.

(a) Target years of 0, 2, 15 and 50 are sufficient to annualize HU's and to characterize habitat changes over the life of the project.

(b) The mallard is a suitable species of emphasis and adequately characterizes life requisite requirements of the migratory waterfowl group for the purposes of the incremental analysis of this project.

(c) The Canada goose, muskrat, green-backed heron, wood duck, beaver, northern parula, and prothonotary warbler are suitable species for comparative evaluation of overall wetland values and changes in wetland values.

(2) Specific. Specific assumptions employed in evaluating alternative Plans A, B and D are given below. Plan C was not evaluated since it was determined to be engineeringly infeasible to implement.

(a) Alternative Plan A, No Action Plan (also represents future without project conditions).

1 Severe water level fluctuations will continue to limit the island's food value for waterfowl.

2 The island's nonforested wetlands will be lost over the next 50 years.

3 The existing HSI values developed from the field data are a fair representation of the habitat quality of unprotected habitat in all target years, and for all future conditions with or without a project.

(b) Alternative Plan B, Wetlands Excavation.

1 Severe water level fluctuations would continue to limit the island's food value for waterfowl, even with deliberate plant seeding.

2 Even though initially dredged out, all of the non-forested wetlands would fill in with sediment during the life of the project and successionally these areas would change to forested habitat.

(c) Alternative Plan D, Wetlands Protection.

1 Most years water levels would be predictable and controlled (via levee, gated culvert and pump). This would greatly increase the reliability of plant production, and ensure that the food produced is innundated, and thus available to waterfowl during migration.

2 In the fall, water would be raised to an elevation of 451 NGVD which would make water present on 188 acres of the island. Permanent water during the summer would remain the same.

3 The levee would prevent nonforested wetlands from draining when the navigation pool goes on tilt.

4 Sedimentation would be reduced by at least 90 percent from its existing rate. Little loss of wetland depth or acreage would occur. The maximum water level at which the unit is managed could be elevated slightly to compensate for sedimentation that did ocur.

5 The clearing of vegetation at lower elevations on the island, with subsequent planting to waterfowl preferred moist-soil plant species, would enhance the total food value of the island for waterfowl.

6 Smartweeds and millet would replace lotus with 75 percent coverage. Areas dominated by lotus would be eliminated by management (water, chemical or mechanical).

7 Distance to bottomlands changes to fall flooded condition.

8 Plan D HSI's can be applied to all target years. This is adequate, since this habitat is anticipated to degrade very little in quality over the life of the project. HU change will be much more responsive to changing habitat acreage rather than changing HSI value.

3. RESULTS

Sample plot locations were assigned by the WHAG team, as shown in FIGURE J-1. The number and placement of these plots was judged by the team to be sufficient to be representative of the prevailing habitat conditions. TABLE J-1 provides a listing of the appraisal guide items and potential ratings utilized for in the WHAG for wetlands evaluation. TABLE J-2 lists the particular appraisal item numbers used in evaluating the project's non-forested wetland, forested wetland and river habitats. The items used to evaluate river habitat were the same as those used for non-forested wetland. TABLE J-2 also provides the teams assigned ratings for each appraisal item for each habitat type, depending on whether that habitat is sediment protected or fall flooded by a project alternative. TABLE J-3 provides the HSI values resulting from the application of the WHAG software to the TABLE J-2 ratings. TABLE J-4 provides a tabulated prediction of habitat acreage changes expected for the project area over the next 50 years for various alternative plan or plan features. A rough indication of the existing rate of water to land conversion was determined by examining acreage changes over the last 15 years. The acreage conversion rate in areas protected by project features was estimated to be one tenth that of the existing rate. This determination is consistent with our hydraulic engineering estimate of a 90 percent reduction in sediment input into the project area. TABLE J-5 provides the HU value changes resulting from the application of the Corps' HES software to the TABLE J-3 HSI values and the TABLE J-4 acreages. The HU's are tabulated by species for each project alternative and individual habitat type. TABLE J-6 provides a similar accounting, but combines the HU's for all habitat types. Given in parentheses is the percent net change in HU's expressed as a percentage of the HU's for the future without project condition (or Plan A).

4. DISCUSSION

The mallard was selected by the team as the species best characterizing the life requisite requirements for migratory waterfowl. The improvement of the Pharrs Island wetland complex for migratory waterfowl is a primary purpose of the Pharrs Island HREP. TABLE E-6 shows the incremental effects of the various study options on the mallard duck. Plan B showed no overall improvement in mallard habitat over that of the no project condition. Plan D showed very substantial increases in HU's (118 HU's). The single major

contributor to this habitat improvement is from the water control and sediment protection afforded by a levee structure (105 HU's). The addition of on-site borrow pits (a necessity for a cost-effective project) adds a further increase HU's +8 HU's as does the inclusion of forest vegetation clearing (+10 HU's) which effectively increases the total amount of non-forested wetland at the project site. While the incremental increase in HU's for vegetation clearing is low compared to that of a levee, so too is the relative cost of vegetation clearing. For that reason, clearing was considered to be a desirable project feature. The inclusion of an on-site disposal area into the selected project plan negates some (5 HU's) of the project's overall benefits. Under the selected project plan (which includes a levee, borrowareas, vegetation clearing and disposal areas) other species showing net habitat gains are the Canada goose, muskrat and heron. The warbler would be little affected by the plan, but the forest associated wood duck, beaver and parula would be somewhat adversely impacted by the selected project plan.

5. CONCLUSION

The selected plan provides substantial benefits to migratory watefowl consistent with the need for cost-effectiveness, without major adverse impacts to other wetland species.

WETLAND SAMPLE SITE LOCATIONS

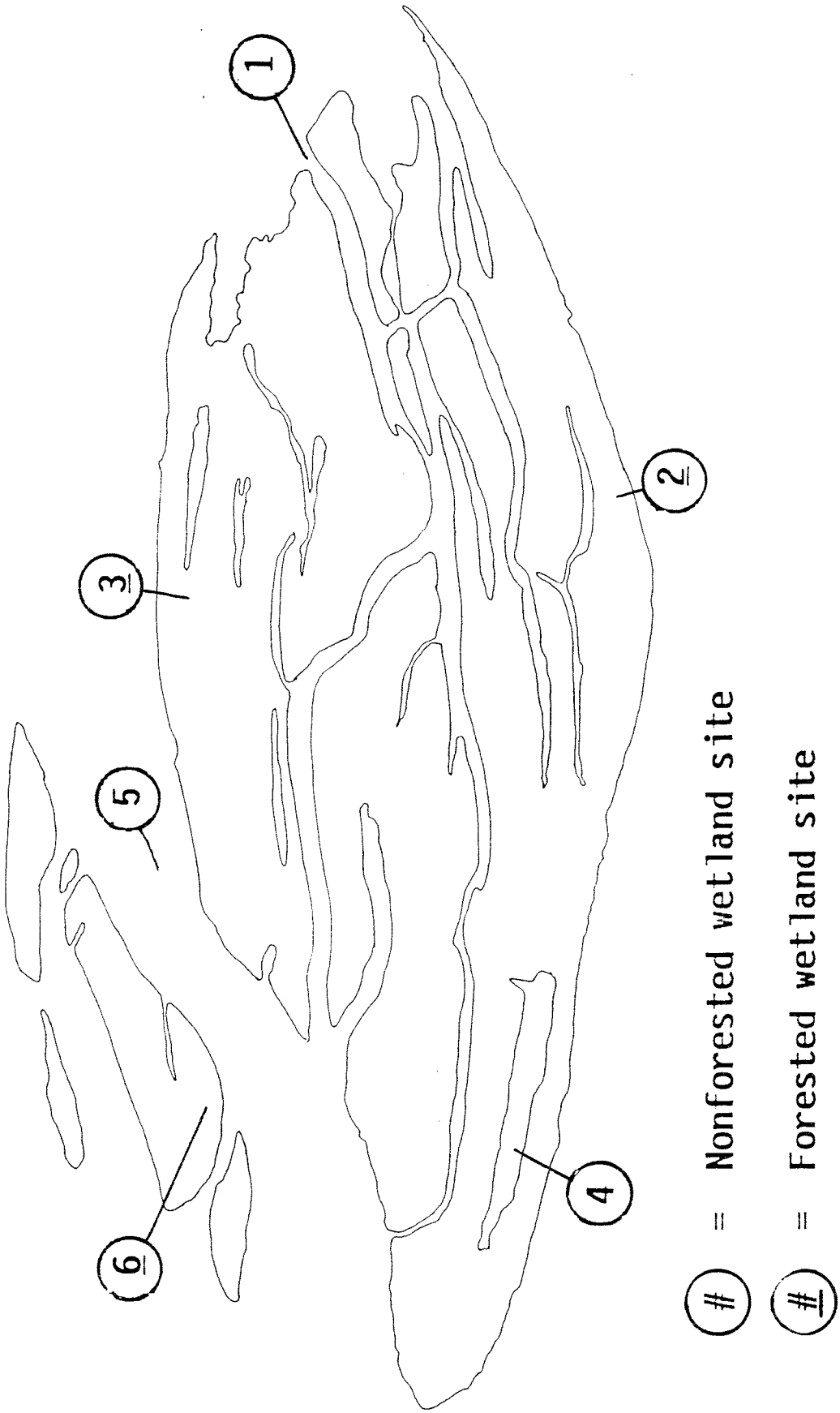


Figure J-1

TABLE J-1

Wetland Species Characteristic Matrix

Wildlife Area: _____

Date: _____

Habitat Type: _____

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
1.	**Percent Nonforest Wetlands in 2 Mile Wide Circle**	N,B												
	1. >75%				10	10	10	10				10		
	2. 50 - 75%				8	8	8	8				8		
	3. 25 - 50%				6	6	6	6				6		
	4. 10 - 25%				4	4	4	4				4		
	5. <10%				1	1	1	1				1		
2.	**Percent Nonforest Wetlands and Lakes or Reservoirs Water in 2 Mile Wide Circle**	All												
	1. >75%			10										
	2. 50 - 75%			8										
	3. 25 - 50%			6										
	4. 10 - 25%			4										
	5. <10%			LF										
3.	**Percent Bottomland Hardwoods and Nonforest Wetlands in 2 Mile Wide Circle**	All												
	1. >75%		10						10	10	10			
	2. 50 - 75%		8						8	8	8			
	3. 25 - 50%		6						6	6	6			
	4. 10 - 25%		4						4	4	4			
	5. <10%		LF						1	1	1			
4.	**Fall Winter Water Conditions**	N,B,C												
	1. Water present annually (predictable & water levels controlled		10	10										
	2. Water present most years with occasional lapse & water levels controlled		7	7										
	3. Water present 1 out of 3 years (opportunistic) & water levels controlled		4	4										
	4. Water unpredictable; dry during fall and winter; or no control when present		LF	LF										
5.	**Fall-Winter Flood Conditions (food plant availability)**	N,B	M	M										
	1. Food plants unaffected		10	10										
	2. Reduced 1 - 25% (Multiply index by .75)		8	8										
	3. Reduced 25 - 50% (Multiply index by .50)		6	6										
	4. Reduced 50 - 75% (Multiply index by .25)		4	4										
	5. Reduced >75% (Multiply index by .25)		1	1										
6.	**Water Depth 1" - 18" Fall - Winter**	N,B,C												
	1. >90%		10	10										
	2. 75 - 90%		8	8										
	3. 50-75%		6	6										
	4. 25 - 50%		4	4										
	5. <25%		1	1										
7.	**Water Depth <4" May-June**	N												
	1. >90%					10								LF
	2. 75 - 90%					8								2
	3. 25 - 75%					6								4
	4. 1 - 25%					4								7
	5. ZERO or all >4" Deep					1								10
8.	**Water Depth 4 - 18" By August**	N												
	1. >75%				1		10	1	10			10		
	2. 50 - 75%				7		7	7	7			7		
	3. 25 - 50%				10		4	10	4			4		
	4. <25%				4		1	4	1			1		
9.	**Permanent Water Entire Year**	N					M							
	1. >90%						10							
	2. 75 - 90% (Multiply index by .90)						8							
	3. 50 - 75% (Multiply index by .75)						6							
	4. 25 - 50% (Multiply index by .50)						4							
	5. <25% (Multiply index by .25)						1							
10.	**Percent Emergent Vegetation Within 2 yds. of water**	N												
	1. >75% of emer. veg. within 2 yd. of water				10							10		
	2. 50-75% of emer. veg. within 2 yd. of water				7							7		
	3. 25-50% of emer. veg. within 2 yd. of water				4							4		
	4. <25% of emer. veg. within 2 yd. of water				1							1		

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
11.	**Woody Invasion**	N												
	1. <10%				10		5	6	1					
	2. 10 - 25%				8		4	8	6					
	3. 25 - 50%				6		3	10	8					
	4. 50 - 75%				4		2	4	10					
	5. >75%				1		1	1	4					
12.	**Emergent Vegetation Coverage**	N,B												
	1. >90%				6	LF			1					
	2. 75 - 90%				10	2			2					
	3. 50 - 75%				8	4			4					
	4. 25 - 50%				4	6			10					
	5. 10 - 25%				2	8			7					
	6. <10%				LF	10			1					
13.	**Cattail and Bulrush Coverage**	N												
	1. >75%						10	LF				8		
	2. 50 - 75%						8	2				10		
	3. 25 - 50%						6	4				6		
	4. 10 - 25%						4	7				4		
	5. <10%						1	10				LF		
14.	**Wetland Size**	N,B												
	1. >200 acres				10	10	10	10	10			10		
	2. 100 - 200 acres				10	8	8	8	10			10		
	3. 50 - 100 acres				8	6	6	6	10			8		
	4. 25 - 50 acres				6	4	4	4	10			6		
	5. 5 - 25 acres				4	1	2	2	5			4		
	6. <5 acres				LF	LF	1	1	LF			LF		
15.	**Wetland Edge**	N,B												
	1. >75% Bottomland H. - % adj. to water								10					
	2. 50-75% Nonforest w.-% woody or adj. to bottomland hardwoods								8					
	3. 25 - 50%								6					
	4. 10 - 25%								4					
	5. <10%								1					
16.	**Water Regime**	N												
	1. Gradual drying with >75% water remaining by Aug. 1				4	4	8	2	10			8		
	2. Gradual drying with 50 - 75% water remaining by Aug. 1				6	6	6	6	6			6		
	3. Gradual drying with 25 - 50% water remaining by Aug. 1				10	10	4	10	4			4		
	4. Gradual drying with <25% water remaining by Aug. 1				8	8	2	8	2			2		
	5. Stable water				2	4	10	4	10			10		
	6. Rapid drying; or no water after June 1				LF	LF	LF	LF	LF			LF		
17.	**Important Food Plant Coverage**	N,B	M	M										
	1. >75%		10	10										
	2. 50 - 75% (Multiply index by .75)		8	8										
	3. 25 - 50% (Multiply index by .50)		6	6										
	4. 10 - 25% (Multiply index by .25)		4	4										
	5. <10% (Multiply index by .25)		1	1										
18.	**Plant Diversity**	N,B												
	1. >7		5	5										
	2. 4 - 7		3	3										
	3. <4		1	1										
19.	**Persistent Emergent and Woody Vegetation Coverage**	N												
	1. 5 - 15%		5	5										
	2. 15 - 25%		4	4										
	3. 25 - 50%		2	2										
	4. <5% or >50%		1	1										

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
20.	**Substrate - Surface Water Interspersion**	N												
	1. Substrate interspersed with shallow water					10								
	2. Shallow water occurring as one or few pools					1								
21.	**Percent Open Water**	N												
	1. <10%		5	5			10					6		
	2. 10 - 25%		3	3			8					10		
	3. 25 - 50%		1	1			6					8		
	4. 50 - 90%		1	1			4					4		
	5. >90%		1	1			1					1		
22.	**Winter Water Depth (Oct. - March)**	N												
	1. 15 - 24"						10							
	2. 10 - 15" or 24 - 30"						7							
	3. 6 - 10" or 30 - 36"						4							
	4. <6" or >36"						1							
23.	**Sedge Canopy Coverage**	N												
	1. <90%							8						
	2. 75 - 90%							10						
	3. 50 - 75%							6						
	4. 25 - 50%							4						
	5. 1 - 25%							2						
	6. Zero							1F						
24.	**Wetland Substrate**	N												
	1. Muddy					5								
	2. Sandy					3								
	3. Gravel					1								
25.	**Percent Soil Waterlogged Substrate May-June**	N												
	1. >90% of substrate waterlogged					10								
	2. 75 - 90% of substrate waterlogged					8								
	3. 50 - 75% of substrate waterlogged					6								
	4. 25 - 50% of substrate waterlogged					4								
	5. <25% of substrate waterlogged					1								
26.	**Percent Exposed Wetland Substrate and 1-4" Shallow Water Covered by Vegetation May-June**	N												
	1. <10%					10								
	2. 10 - 25%					8								
	3. 25 - 50%					6								
	4. 50 - 75%					4								
	5. 75 - 90%					2								
	6. >90%					1F								
27.	**Percent Channel with Aquatic Vegetation**	B												
	1. >10%									10	10			
	2. 5 - 10%									7	7			
	3. 1 - 5%									4	4			
	4. None									1	1			
28.	**Average Water Fluctuation in Channel**	B												
	1. Bank full <3 times per year										10			
	2. Bank full 3-5 times per year										7			
	3. Bank full 5-7 times per year										4			
	4. Bank full >7 times per year										1			
29.	**Cropfield Management**	C												
	1. No fall tillage		10	10										
	2. Winter Wheat		2	10										
	3. Chisel plowing		8	8										
	4. Chopped, baled, grazed		6	6										
	5. Fall disc		4	4										
	6. Fall moldboard		1	1										

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
30.	Cropping Practice	C												
	1. >50 unharvested		10	10										
	2. 25-50% harvested		7	7										
	3. 10 - 25% unharvested		4	4										
	4. <10% unharvested		1	1										
31.	Crop Rotation	C												
	1. SG - RC - L			5										
	2. SG - RC; or idle some years			3										
	3. Continuous SG - RC			1										
32.	Field Size (% w/in 660' Woodland or Treeline)	C,G												
	1. <25%			10										
	2. 25 - 50%			6										
	3. 50 - 75%			3										
	4. >75%			1										
33.	Grassland Composition	G												
	1. Bluegrass, clover, alfalfa			10										
	2. Timothy, orchardgrass or mixed CSG			5										
	3. Fescue or WSG			1										
34.	Average Height Herbaceous Vegetation (Fall)	G												
	1. <6"			10										
	2. >6"			1										
35.	Woodland Tree Species	B												
	1. >50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		1							8	10			
	2. 25 - 50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		4							10	8			
	3. <25% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash; or <25% pin oak		6							1	6			
	4. 25 - 50% pin oak		8							4	4			
	5. >50% pin oak		10							6	1			
36.	Permanent Water Within Woodland	B												
	1. >25%		1						10	10				10
	2. 10 - 25%		3						7	7				7
	3. 5 - 10%		5						4	4				4
	4. 1 - 5%		3						2	2				2
	5. Zero		2						1	1				1
37.	Forest Openings (<2 ac. in size)	B												
	1. 15 - 30% scattered		1						10	10	5			
	2. 15 - 30% one or few		3						7	7	4			
	3. 5 - 15%		5						4	4	3			
	4. <5% or >30%		1						1	1	1			
38.	Woodland Size Class	B												
	1. Sawtimber - open canopy		10						4	10	4		10	10
	2. Sawtimber - close canopy		8						1	8	1		10	10
	3. Pole with 25-50% sawtimber		6						10	6	6		7	7
	4. Regeneration with 25-50% sawtimber		4						8	4	8		2	2
	5. Regeneration		1						8	LF	10		LF	LF
	6. Pole		1						6	2	6		4	4
39.	Percent Canopy From Old Growth (>16" dbh)	B												
	1. >25%									10	1			
	2. 10 - 25%									8	4			
	3. 5 - 10%									6	6			
	4. 1 - 5%									4	8			
	5. Zero									1	10			

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
40.	Woodland Overstory Canopy Height (feet)	B												
	1. >80'												10	10
	2. 65-80'												7	7
	3. 40-65'												4	4
	4. <40'												1	1
41.	Percent Subcanopy Closure	B												
	1. >75%												10	1
	2. 50-75%												7	4
	3. 25-50%												4	10
	4. <25%												1	7
42.	Woodland (Stand) Size													
	1. <25%												10	10
	2. 25-50%												7	7
	3. 50-75%												4	4
	4. >75%												1	1
43.	Percent Forest Canopy Adjacent to or Over Permanent Water	B												M
	1. >25%													10
	2. 10-25%													7
	3. 5-10%													4
	4. <5%													1
44.	Number of Snags >9"dbh per Acre	B												
	1. >4									5				10
	2. 3-4									5				7
	3. 1-2									3				4
	4. <1									1				1
45.	Number of Cavity Trees Per Acre	B												
	1. >9									10				10
	2. 3 - 9									7				7
	3. 1 - 3									4				4
	4. None									LF				1
46.	Stems per Square Yard of Shrub and Tree Reproduction >3 Feet Tall													
	1. >3									1	10		10	1
	2. 1-3									3	7		6	4
	3. .5-1									5	4		4	10
	4. <.5									2	1		1	7
47.	Percent Woodland Within 660' of Permanent Water	B							M	M	M			
	1. >75%								10	10	10		10	10
	2. 50 - 75% (Multiply Index by .75)								6	6	6		7	7
	3. 25 - 50% (Multiply Index by .50)								4	4	4		4	4
	4. <25% (Multiply Index by .25)								1	1	1		1	1
48.	Distance to Nonforest Wetland, Oxbow or Slough	B,C,G												
	1. <250' water predictable		10	10					10	10	10			
	2. 250'-1/8 mi. water predictable		10	10					10	10	5			
	3. 1/8-1 mi. water predictable		10	10					1	1	1			
	4. <250' water predictable 1 of 3 years		5	5					5	5	3			
	5. 250'-1/8 mi. water predictable 1 of 3 yrs.		5	5					5	5	2			
	6. 1/8-1 mi. water predictable 1 of 3 yrs.		5	5					1	1	1			
	7. >1 mi.; or <1 mi. water unpredictable		1	1					1	1	1			
49.	Distance to Bottomland Hardwoods	C,N												
	1. <1/4 mi. water predictable		10						5					
	2. 1/4-1/2 mi. water predictable		10						3					
	3. 1/2-1 mi. water predictable		8						1					
	4. <1/4 mi. water predictable 1 of 3 yrs.		6						5					
	5. 1/4-1/2 mi. water predictable 1 of 3 yrs.		6						3					
	6. 1/2-1 mi. water predictable 1 of 3 yrs.		4						1					
	7. >1 mi.; or <1 mi. water unpredictable		1						1					

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
50.	**Distance to Cropland**	N,B,G												
	1. <1/4 mi., unharvested or partially unharvested and water predictable		10	10										
	2. 1/4-1 mi. unharvested or partially unharvested and water predictable		8	8										
	3. 1/4-1 mi. unharvested or partially unharvested and water predictable		6	6										
	4. <1/4 mi., unharvested or partially unharvested and water predictable 1 of 3 years; or adjacent, unflooded with residues undisturbed		5	5										
	5. 1/4-1 mi. unharvested or partially unharvested and water predictable 1 of 3 years; or 1/4-1 mi. unflooded with residues and undisturbed		4	4										
	6. <1/4-1 mi. unharvested or partially unharvested and water predictable 1 of 3 yrs; or 1/2-1 mi. unflooded with residues undisturbed; or winter wheat		2	2										
	7. >1 mi. to any cropfield; or <1 mi. unflooded cropfield with residues disced or plowed		1	1										
51.	**Distance to Grassland**	N,C												
	1. <1/2 mi. with winter height <6" and field size >40 acres			10										
	2. 1/2-1 mi. with winter height <6" and field size >40 acres			7										
	3. <1 mi. with winter height <6" and field size <40 acres			4										
	4. >1 mi. to any grassland with winter height <6"; or grassland with winter height>6"			1										
52.	**Distance to Stream or River (permanent flow or pools)**	N,B												
	1. <1/4 mi.								10					
	2. 1/4 - 1/2 mi.								5					
	3. >1/2 mi.								1					
53.	**Distance to Major River, Lake or Reservoir >100 Acres**	N,C,G												
	1. <1 miles Missouri, Mississippi,			10										
	2. 1 - 5 miles Grand, St. Francis			7										
	3. 5 - 10 miles			4										
	4. >10 miles			1										
54.	**Distance to Major Canada Goose Winter Area**	N,C,G		M										
	1. <4 miles			10										
	2. 4 - 10 miles (Multiply Index by .75)			7										
	3. 10 - 25 miles (Multiply Index by .50)			4										
	4. >25 miles (Multiply Index by .25)			1										

TABLE J-1 (CONTINUED)

Wetland Species Characteristic Matrix

	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
Total													
Maximum Possible													
HTSI													
Multiplier													
Revised HTSI													
	N	85	105	70	85	85	70	85			80		
	B	105						100	110	95		60	100
	C	70	105										
	P		80										

Abbreviations

C = cropfield, G = grassland, N = nonforest wetland, B = bottomland hardwoods,
LF = limiting factor, score Habitat Type Suitability Index (HTSI) as .1 if characteristic scores .1.
M = multiplier. Multiply HTSI by the appropriate value to calculate revised HTSI. Use lowest value if 2 multiplier values apply.

Limiting Factors

	Character Number
Mallard - If Percent in Bottomland Hardwood and Nonforest Wetland or Fall Winter Flood Conditions score 1, HTSI = .1.	3
Canada goose - If Percent in Nonforest Wetland or Fall Winter Flood Conditions score 1, HTSI = .1.	2,4
Lesser yellowlegs - If Wetland Size, Water Regime or Percent Wetland Substrate score 1, HTSI = .1.	14,16
Green-backed heron - If Wetland Size Water Regime HTSI = .1.	40,47
Wood duck - If Woodland Size Class or Number of Tree Cavities score 1, HTSI = .1.	14,12,16
Least bittern - If Wetland Size, Emergent Vegetation Coverage, or Water Regime score 1, HTSI = .1.	13,14,16
American Coot - If Cattail and Bulrush Coverage, Wetland Size or Water Regime score 1, HTSI = .1.	
King Rail - If Sedge Canopy Coverage Water Regime	
Northern Parula - If Woodland Size Class	40
Prothonotary Warbler - If Woodland Size Class	40

Multiplier

Mallard - Important Food Plant Coverage (Nonforest wetland)	17
Canada goose - Distance to Major Canada Goose Winter Area	56
Important Food Plant Coverage (Nonforest wetland)	17
Muskrat - Percent Permanent Water Entire Year	9
Wood duck - Percent Woodland Within 660' of Permanent Water	49
Beaver - Percent Woodland Within 660' of Permanent Water	49
Green-backed Heron - Percent Woodland Within 660' of Permanent Water	49
Northern Parula - Percent Woodland Within 660' Water	49
Prothonotary Warbler - Percent Forest Canopy Adjacent to or Over Permanent Water	45

3/89

TABLE J-2

WILDLIFE HABITAT APPRAISAL GUIDE RATINGS -

NON-FORESTED WETLAND

Appraisal	Ratings		
	Existing	Future	
Item	NUU 1/	NPF	NPU
1	4	4	4
2	2	2	2
3	3	3	3
4	4	1	4
5	2	1	2
6	4.5	1	4.5
7	4.5	1	4.5
8	4	1	4
9	4	5	4
10	2	1	2
11	2.5	1	2.5
12	3.5	2	3.5
13	4	4	4
14	5	2	5
15	2	2	2
16	2.5	1	2.5
17	3	1	3
18	1	1	1
19	3.5	1	3.5
20	1.5	1	1.5
21	2	2	2
22	1.5	1	1.5
23	5	5	5
24	1	1	1
25	2	1	2
26	4	1	4
49	7	1	7
50	7	7	7
51	4	4	4
52	1	1	1
53	1	1	1
54	2	2	2

1/ Based on averaged appraisal items for field sample Sites 1 and 4.

NNU = Non-forested, sediment unprotected, fall unflooded.
NPF = Non-forested, sediment protected, fall flooded.
NPU = Non-forested, sediment protected, fall unflooded.

TABLE J-2 (Continued)

FORESTED WETLAND

Appraisal Item	Ratings		
	Existing	Future	
	FUU 1/	FPF	FPU
1	4	4	4
2	2	2	2
3	3	3	3
4	4	1	4
5	2	1	2
6	5	3	5
12	6	2	6
14	5.7	3	4
15	1	1	1
17	5	5	5
18	1	1	1
27	2.3	2.3	2.3
28	4	4	4
35	1	1	1
36	5	5	5
37	2	2	2
38	3.7	2	2
39	3	2	2
40	3	2	2
41	3	4	4
42	3.7	3.7	3.7
43	3.3	2	3.2
44	2	1	1
45	3.3	1	1
46	2.3	2.3	2.3
47	1.3	1	1.3
48	7	1	3
50	7	7	7
52	1	1	1

1/ Based on averaged appraisal items for Field Sample Sites 2, 3, & 6.

FUU = Forested, sediment unprotected, fall unflooded.
FPF = Forested, sediment protected, fall flooded.
FPU = Forested, sediment protected, fall unflooded.

TABLE J-2 (Continued)

RIVER

Appraisal Item	Ratings: Existing RU	Ratings: Future RP
1	4	4
2	2	2
3	3	3
4	4	2
5	5	5
6	5	2
7	5	2
8	4	4
9	1	1
10	4	4
11	1	1
12	1	2
13	5	5
14	4	4
15	1	1
16	1	1
17	5	1
18	3	1
19	4	4
20	2	2
21	5	5
22	4	4
23	6	6
24	1	1
25	1	1
26	1	1
49	7	4
50	7	7
51	4	4
52	1	1
53	1	1
54	2	2

RU = River, flow & sediment unprotected.
RP = River, flow & sediment protected.

TABLE J-3

WILDLIFE HABITAT SUITABILITY INDICES

	Habitat Suitability Index							
Species	NUU	NPF	NPU	FUU	FPF	FPU	RU	RP
Mallard	.10	.82	.10	.10	.60	.10	.10	.14
Goose	.10	.57	.10	.00	.00	.00	.10	.11
Muskrat	.11	.17	.11	.00	.00	.00	.41	.41
Heron	.62	.73	.62	.10	.67	.57	.59	.65
Wood Duck	.00	.00	.00	.56	.75	.67	.00	.00
Beaver	.00	.00	.00	.63	.63	.54	.00	.00
Parula	.00	.00	.00	.47	.60	.60	.00	.00
Warbler	.00	.00	.00	.24	.50	.32	.00	.00

TABLE J-4

WILDLIFE HABITAT ACRES -

PLAN A (FUTURE WITHOUT)

Habitat Condition	1990	1992	2005	2040
NUU	101	91	37	0
NPF	0	0	0	0
NPU	0	0	0	0
FUU	265	275	329	366
FPF	0	0	0	0
FPU	0	0	0	0
RU	160	160	160	160
RP	0	0	0	0
Total	526	526	526	526

PLAN B (WETLANDS EXCAVATION)

Habitat Condition	1990	1992	2005	2040
NUU	101	174	110	0
NPF	0	0	0	0
NPU	0	0	0	0
FUU	265	192	256	366
FPF	0	0	0	0
FPU	0	0	0	0
RU	160	160	160	160
RP	0	0	0	0
Total	526	526	526	526

PLAN D (WETLANDS PROTECTION - COMPLETE PLAN)

Habitat Condition	1990	1992	2005	2040
NUU	101	0	0	0
NPF	0	116	112	101
NPU	0	58	54	44
FUU	265	0	0	0
FPF	0	70	72	78
FPU	0	122	128	143
RU	160	0	0	0
RP	0	160	160	160
Total	526	526	526	526

TABLE J-4 (CONTINUED)

PLAN D (WETLANDS PROTECTION - LEVEE ONLY)

Habitat Condition	1990	1992	2005	2040
NUU	101	0	0	0
NPF	0	33	29	19
NPU	0	58	54	44
FUU	265	0	0	0
FPF	0	162	164	169
FPU	0	113	119	134
RU	160	0	0	0
RP	0	160	160	160
Total	526	526	526	526

PLAN D (WETLANDS PROTECTION - LEVEE & BORROW AREAS ONLY)

Habitat Condition	1990	1992	2005	2040
NUU	101	0	0	0
NPF	0	70	66	56
NPU	0	58	54	44
FUU	265	0	0	0
FPF	0	125	127	132
FPU	0	113	119	134
RU	160	0	0	0
RP	0	160	160	160
Total	526	526	526	526

PLAN D (WETLANDS PROTECTION - LEVEE, BORROW AREAS & VEGETATION REMOVAL ONLY)

Habitat Condition	1990	1992	2005	2040
NUU	101	0	0	0
NPF	0	116	112	102
NPU	0	58	54	44
FUU	265	0	0	0
FPF	0	79	81	86
FPU	0	113	119	134
RU	160	0	0	0
RP	0	160	160	160
Total	526	526	526	526

TABLE J-5

ANNUALIZED HABITAT UNITS - MALLARD

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	8	3	5	0	0	0	0	0	0	28	33	-5	0	0	0	0	0	0	16	16	0	0	0	0	52	52	0
Plan D (Complete)	0	3	-3	87	0	87	5	0	5	0	33	-33	43	0	43	13	0	13	0	16	-16	22	0	22	170	52	118
Plan D (Levee Only)	0	3	-3	21	0	21	5	0	5	0	33	-33	97	0	97	12	0	12	0	16	-16	22	0	22	157	52	105
Plan D (Levee + Borrow Only)	0	3	-3	51	0	51	5	0	5	0	33	-33	75	0	75	12	0	12	0	16	-16	22	0	22	165	52	113
Plan D (Levee + Borrow + Veg. Removal (Only)	0	3	-3	88	0	88	5	0	5	0	33	-33	48	0	48	12	0	12	0	16	-16	22	0	22	175	52	123

ANNUALIZED HABITAT UNITS - CANADA GOOSE

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	8	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	0	0	0	0	24	19	5
Plan D (Complete)	0	3	-3	61	0	61	5	0	5	0	0	0	0	0	0	0	0	0	0	16	-16	17	0	17	83	19	64
Plan D (Levee Only)	0	3	-3	15	0	15	5	0	5	0	0	0	0	0	0	0	0	0	0	16	-16	15	0	15	35	19	16
Plan D (Levee + Borrow Only)	0	3	-3	35	0	35	5	0	5	0	0	0	0	0	0	0	0	0	0	16	-16	17	0	17	57	19	38
Plan D (Levee + Borrow + Veg. Removal Only)	0	3	-3	61	0	61	5	0	5	0	0	0	0	0	0	0	0	0	0	16	-16	17	0	17	83	19	64

TABLE J-5 (CONTINUED)

ANNUALIZED HABITAT UNITS - MUSKRAT

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	9	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	66	0	0	0	0	75	70	5
Plan D (Complete)	0	3	-3	18	0	18	6	0	6	0	0	0	0	0	0	0	0	0	1	65	-64	64	0	64	89	68	21
Plan D (Levee Only)	0	3	-3	4	0	4	6	0	6	0	0	0	0	0	0	0	0	0	1	66	-64	64	0	64	75	69	6
Plan D (Levee + Borrow Only)	0	3	-3	11	0	11	6	0	6	0	0	0	0	0	0	0	0	0	1	65	-64	64	0	64	82	68	14
Plan D (Levee + Borrow + Veg. Removal Only)	0	3	-3	15	0	15	6	0	6	0	0	0	0	0	0	0	0	0	1	65	-64	64	0	64	86	68	18

ANNUALIZED HABITAT UNITS - GREEN-BACKED HERON

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	50	21	29	0	0	0	0	0	0	28	33	-5	0	0	0	0	0	0	94	94	0	0	0	0	172	148	24
Plan D (Complete)	1	20	-19	78	0	78	31	0	31	0	33	-33	48	0	48	74	0	74	2	94	-92	102	0	102	336	147	189
Plan D (Levee Only)	1	20	-19	19	0	19	31	0	31	0	33	-33	109	0	109	71	0	71	2	94	-92	102	0	102	335	147	188
Plan D (Levee + Borrow Only)	1	20	-19	45	0	45	31	0	31	0	33	-33	84	0	84	71	0	71	2	94	-92	102	0	102	336	147	189
Plan D (Levee + Borrow + Veg. Removal Only)	1	20	-19	78	0	78	31	0	31	0	33	-33	54	0	54	71	0	71	2	94	-92	102	0	102	339	147	192

TABLE J-5 (CONTINUED)

ANNUALIZED HABITAT UNITS - WOOD DUCK

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	0	0	0	0	0	0	0	0	0	160	186	-26	0	0	0	0	0	0	0	0	0	0	0	0	160	186	-26
Plan D (Complete)	0	0	0	0	0	0	0	0	0	3	186	-183	54	0	54	87	0	87	0	0	0	0	0	0	144	186	-42
Plan D (Levee Only)	0	0	0	0	0	0	0	0	0	3	186	-183	122	0	122	84	0	84	0	0	0	0	0	0	209	186	23
Plan D (Levee + Borrow Only)	0	0	0	0	0	0	0	0	0	3	186	-183	95	0	95	84	0	84	0	0	0	0	0	0	182	186	-4
Plan D (Levee + Borrow + Veg. Removal Only)	0	0	0	0	0	0	0	0	0	3	186	-183	61	0	61	84	0	84	0	0	0	0	0	0	148	186	-38

ANNUALIZED HABITAT UNITS - BEAVER

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	0	0	0	0	0	0	0	0	0	180	210	-30	0	0	0	0	0	0	0	0	0	0	0	0	180	210	-30
Plan D (Complete)	0	0	0	0	0	0	0	0	0	3	210	-206	46	0	46	70	0	70	0	0	0	0	0	0	119	210	-91
Plan D (Levee Only)	0	0	0	0	0	0	0	0	0	3	210	-206	103	0	103	68	0	68	0	0	0	0	0	0	174	210	-36
Plan D (Levee + Borrow Only)	0	0	0	0	0	0	0	0	0	3	210	-206	80	0	80	68	0	68	0	0	0	0	0	0	151	210	-59
Plan D (Levee + Borrow + Veg. Removal Only)	0	0	0	0	0	0	0	0	0	3	210	-206	51	0	51	68	0	68	0	0	0	0	0	0	122	210	-88

TABLE J-5 (CONTINUED)

ANNUALIZED HABITAT UNITS - NORTHERN PARULA

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	0	0	0	0	0	0	0	0	0	134	156	-22	0	0	0	0	0	0	0	0	0	0	0	0	134	156	-22
Plan D (Complete)	0	0	0	0	0	0	0	0	0	2	156	-154	43	0	43	78	0	78	0	0	0	0	0	0	123	156	-33
Plan D (Levee Only)	0	0	0	0	0	0	0	0	0	2	156	-154	97	0	97	75	0	75	0	0	0	0	0	0	174	156	18
Plan D (Levee + Borrow Only)	0	0	0	0	0	0	0	0	0	2	156	-154	75	0	75	75	0	75	0	0	0	0	0	0	152	156	-4
Plan D (Levee + Borrow + Veg. Removal Only)	0	0	0	0	0	0	0	0	0	2	156	-154	48	0	48	75	0	75	0	0	0	0	0	0	125	156	-31

ANNUALIZED HABITAT UNITS - PROTHONOTARY WARBLER

	NUU			NFP			NPU			FUU			FPF			FPU			RU			RP			TOTAL		
Alternative	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	0	0	0	0	0	0	0	0	0	69	80	-11	0	0	0	0	0	0	0	0	0	0	0	0	69	80	-11
Plan D (Complete)	0	0	0	0	0	0	0	0	0	1	80	-79	36	0	36	41	0	41	0	0	0	0	0	0	78	80	-2
Plan D (Levee Only)	0	0	0	0	0	0	0	0	0	1	80	-79	82	0	82	40	0	40	0	0	0	0	0	0	123	80	43
Plan D (Levee + Borrow Only)	0	0	0	0	0	0	0	0	0	1	80	-79	64	0	64	40	0	40	0	0	0	0	0	0	105	80	25
Plan D (Levee + Borrow + Veg. Removal Only)	0	0	0	0	0	0	0	0	0	1	80	-79	41	0	41	40	0	40	0	0	0	0	0	0	82	80	2

TABLE J-5 (CONTINUED)

ANNUALIZED WILDLIFE HABITAT UNITS - SUMMARY FOR ALL HABITATS

	Plan B			Plan D (Complete Levee + Borrow + Clearing + Disposal)			Plan D (Levee Only)			Plan D (Levee + Borrow Only)			Plan D (Levee + Borrow + Clearing)		
Species	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Mallard	52	52	0(0)	170	52	118(227)	157	52	105(202)	165	52	113(217)	175	52	123(237)
Goose	24	19	5(26)	83	19	64(337)	35	19	16(84)	57	19	38(200)	83	19	64(337)
Muskrat	75	70	5(7)	89	68	21(31)	75	69	6(9)	82	68	14(21)	86	68	18(26)
Heron	172	148	24(16)	336	147	189(129)	335	147	188(128)	336	147	189(129)	339	147	192(131)
Wood Duck	160	186	-26(-14)	144	186	-42(-23)	209	186	23(12)	182	186	-4(-2)	148	186	-38(-20)
Beaver	180	210	-30(-14)	119	210	-91(-43)	174	210	136(-17)	151	210	-59(-28)	122	210	-88(-42)
Parula	134	156	-22(-14)	123	156	-33(-21)	174	156	18(12)	152	156	-4(-3)	125	156	-31(-20)
Warbler	69	80	-11(-14)	78	80	-2(-3)	123	80	43(54)	105	80	25(31)	82	80	2(3)
Totals	866	921	-55(-6)	1142	918	224(24)	1282	919	363(39)	1230	918	312(34)	1160	918	242(26)

SECTION III. AQUATIC HABITAT APPRAISAL GUIDE (AHAG) METHOD

1. BACKGROUND

An Aquatic Habitat Appraisal Guide (AHAG) was developed by the U. S. Waterways Experiment Station for the St. Louis Corps District to evaluate changes in fishery habitat resulting from the Pharrs Island Project. As noted earlier, the AHAG is based on the concept of the Habitat Evaluation Procedure (USFWS 1980), and followed the format of the Missouri WHAG (Baskett et. al. 1980).

Subsection 2 below provides a description by WES of the overall AHAG methodology, including its assumptions, use of guilds, habitat quality ratings and usage. In subsection 3, WES provides the supporting documentation used in developing the AHAG method. Subsection 4 provides the results of the District's application of the AHAG to the Pharrs Island HREP.

2. DESCRIPTION OF AHAG METHOD

There were two phases of AHAG development: prepare habitat guilds of fishes that have been collected in Pool 24, and rate the quality of the habitat for each guild according to habitat preference and life history stage. Each phase is discussed below, including assumptions made in the development of this guide.

a. Assumptions

Habitat-based assessment techniques make specific assumptions on species-habitat relationships (Terrell 1984; O'Neil 1985). Each assumption may be intuitively correct, but can only be verified from field studies. This guide was developed specifically for fishes of Pool 24 based on literature reviews (see Literature Cited section) and makes the following assumptions:

(1) The abundance and distribution of species respond in a predictable and measurable fashion to changes in habitat quality.

(2) Species within a guild have similar habitat requirements which can be described by the same set of habitat variables.

(3) At least one of the habitat variables used in the guide can potentially limit the distribution and abundance of the guild members.

It should be recognized that due to limited life history information on many species, influence of competition and predation on habitat preferences, and variation in temporal distribution patterns of fishes, this guide may not necessarily represent a casual relationship. Although seasonal effects are partially accounted for by separating fishes into three life history stages (i.e., spawning, rearing, and adults), it is beyond the scope of this guide to incorporate all temporal environmental influences on fish distribution and abundance. As new information becomes available from field studies, components of the AHAG should be more rigorously defined.

b. Guild Development

A list of fish species that occur in pool 24 was compiled from Sternberg (1971) and Van Vooren (1983) and were separated into guilds (TABLE J-7). A guild is defined as a group of species that exploit the same environmental

resources (e.g., habitats) in a similar way (Root 1967), therefore members of a guild should be affected similarly by the alteration of those resources (Roberts and O'Neil 1985).

Water velocity is a major habitat axis along which fish species segregate in riverine environments (Leonard and Orth 1988; Baker et al. 1989). Therefore, fish species that occur in Pool 24 were classified as either slackwater or swiftwater inhabitants. The classification was also based on the premise that tolerance to habitat alteration varies with size of the species, while some species utilize a wide range of conditions (generalists). These criteria result in the formation of five guilds: swiftwater-large fishes (Group 1), swiftwater-small fishes (Group 2), slackwater-large fishes (Group 3), slackwater-small fishes (Group 4), and generalists (Group 5). Although there are exceptions, most members of a guild share important morphological similarities (e.g., fusiform shape for swiftwater fishes and laterally compressed for slackwater fishes) and exhibited the same ontogenetic shifts in preferred habitat (e.g., shallow vegetated areas to open water).

Most species in Groups 1 and 2 are uncommon or occur only on a seasonal basis. These fishes prefer swiftwater habitats usually associated with coarse grain substrate. Their presence is indicative of good riverine habitat. Groups 3 and 4 are usually found in slackwater, although they occasionally enter swiftwater areas for feeding, dispersal, or spawning. Many of these species are economically important. Species in Group 5 are ubiquitous and can tolerate a wide range of habitat conditions. Since they have no well-defined habitat preference, no guides were developed for Group 5.

c. Habitat Quality Ratings

The AHAG uses Habitat Suitability Index (HSI) scores to relate the value of selected habitat variables to a defined guild. Physical and water quality variables used in the guides (TABLE J-8) have been identified as important in structuring fish communities in a variety of stream ecosystems (Baker et al. 1990; Barnickol and Starrett 1951; Becker 1983; Gorman and Karr 1978; Leonard and Orth 1988; Ross 1986; Smith 1979). Furthermore, they characterize physical changes associated with high sedimentation rates and altered water level regimes that have influenced habitat quality in the Upper Mississippi River. Each variable may limit the abundance and distribution of guild members, is directly affected by the engineering objectives of the project, is readily measured in the field, and can be predicted for future environmental conditions. Methods to measure most of these variables are described by Hamilton and Bergersen (1984).

For each guild, the range of habitat values were divided into classes and an HSI score was assigned to each class by life history stage (spawning, rearing, and adults). Each variable class is rated as excellent (1), good (.75), fair (.5), poor (.25), or unusable (0) habitat. The rating is based on information found in the Habitat Suitability Index Models published by the U.S. Fish and Wildlife Service and other data sources cited in the Reference Section. A final HSI score is obtained using either an arithmetic mean of all variable scores (compensatory relationships) or taking the lowest HSI score (limiting factor or threshold value). Habitat Units (HU) can be determined by multiplying HSI times area (e.g., acres) of interest. The AHAG data forms allow the user to enter all habitat measurements and calculate HSI values directly in the field.

d. Discussion

AHAG is a community-level evaluation technique that should be used as a general planning tool to rate habitat quality for guilds of species. It provides a qualitative assessment of the effects of habitat alteration on fishes and can be used without extensive field data collection. However, efforts should be made to evaluate the validity of AHAG. This should include sampling fish in both swiftwater and slackwater habitats to more rigorously define the guilds. Further classification of swiftwater and slackwater fishes into functional feeding (e.g., insectivores, piscivorous) or reproductive groups (e.g., nest builders) may increase the predictive capability of AHAG. Also, the relationships between habitat quality and fish abundance should be reviewed by biologists familiar with habitat requirements of the fish. Only through critical review of AHAG components combined with monitoring studies will the validity of AHAG be determined.

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TABLE J-7

Fishes found in Pool 24, Upper Mississippi River and their respective size/habitat guild: 1=swiftwater, large fish, 2=swiftwater, small fish, 3=slackwater, large fish, 4=slackwater, small fish, and 5=generalist).

Family and Species	Group
Acipenseridae	
Lake sturgeon (*Acipenser fulvescens*)	1
Pallid sturgeon (*Scaphirhynchus albus*)	1
Shovelnose sturgeon (*S. platorynchus*)	1
Polyodontidae	
Paddlefish (*Polyodon spathula*)	3 (1 for spawning)
Lepisosteidae	
Spotted gar (*Lepisosteus oculatus*)	5
Longnose gar (*L. osseus*)	5
Shortnose gar (*L. platostomus*)	5
Amiidae	
Bowfin (*Amia calva*)	3
Anguillidae	
American eel (*Anguilla rostrata*)	3
Clupeidae	
Skipjack herring (*Alosa chrysochloris*)	1
Gizzard shad (*Dorosoma cepedianum*)	5
Hiodontidae	
Goldeye (*Hiodon alosoides*)	1
Mooneye (*H. tergisus*)	1
Esocidae	
Northern pike (*Esox lucius*)	3
Cyprinidae	
Central stoneroller (*Campostoma anomalum*)	2
Common carp (*Cyprinus carpio*)	5
Goldfish (*Carrassius auratus*)	5
Speckled chub (*Hybopsis aestivalis*)	2
Silver chub (*H. storeriana*)	4
Golden shiner (*Notemigonus crysocleucas*)	5
Emerald shiner (*Notropis atherinoides*)	2
River shiner (*N. blennius*)	2
Ghost shiner (*N. buchanani*)	4
Bigmouth shiner (*N. dorsalis*)	2
Spottail shiner (*N. hudsonius*)	4
Red shiner (*N. lutrensis*)	5
Spotfin shiner (*N. spilopterus*)	2
Sand shiner (*N. stramineus*)	2
Redfin shiner (*N. umbratilis*)	4
Mimic shiner (*N. volucellus*)	2
Steelcolor shiner (*N. whipplei*)	2
Bullhead minnow (*Pimephales vigilax*)	5
Bluntnose minnow (*P. notatus*)	5
Fathead minnow (*P. promelas*)	5
Catostomidae	
River carpsucker (*Carpiodes carpio*)	5
Quillback (*C. cyprinus*)	3 (1 for spawning)
Highfin carpsucker (*C. velifer*)	1
White sucker (*Catostomus commersoni*)	1

TABLE J-7 (CONTINUED)

Family and Species	Group	
Catostomidae (Cont.)		
Blue sucker (*Cycleptus elongatus*)	1	
Smallmouth buffalo (*Ictiobus bubalus*)	3	
Bigmouth buffalo (*I. cyprinellus*)	3	
Black buffalo (*I. niger*)	3	
Spotted sucker (*Minytrema melanops*)	3	
Silver redhorse (*Moxostoma anisurum*)	1	
Golden redhorse (*M. crythrurum*)	1	
Shorthead redhorse (*M. macrolepidotum*)	1	
Ictaluridae		
Blue catfish (*Ictalurus furcatus*)	1	(3 for spawning)
Black bullhead (*I. melas*)	5	
Yellow bullhead (*I. natalis*)	5	
Brown bullhead (*I. nebulosus*)	3	
Channel catfish (*I. punctatus*)	3	
Stonecat (*Noturus flavus*)	2	
Tadpole madtom (*N. gyrinus*)	4	
Flathead catfish (*Pylodictis olivaris*)	3	
Cyprinodontidae		
Blackstripe topminnow (*Fundulus notatus*)	4	
Poeciliidae		
Mosquitofish (*Gambusia affinis*)	5	
Atherinidae		
Brook silverside (*Labidesthes sicculus*)	4	
Percichthyidae		
White Bass (*Morone crysops*)	1	
Yellow bass (*M. mississippiensis*)	3	(1 for swawning)
Centrarchidae		
Green sunfish (*Lepomis cyanellus*)	5	
Warmouth (*L. gulosus*)	4	
Orangespotted sunfish (*L. humilis*)	5	
Bluegill (*L. macrochirus*)	5	
Longear sunfish (*L. megalotis*)	4	
Smallmouth bass (*Micropterus dolomieui*)	1	
Largemouth bass (*M. salmoides*)	3	
White crappie (*Pomoxis annularis*)	3	
Black crappie (*P. nigromaculatus*)	3	
Percidae		
Western sand darter (*Ammocrypta clara*)	4	
Johnny darter (*Etheostoma nigrum*)	4	
Logperch (*Percina caprodes*)	4	
River darter (*P. shumardi*)	2	
Sauger (*Stizostedion canadense*)	1	
Walleye (*S. vitreum*)	1	
Sciaenidae		
Freshwater drum (*Aplodinotus grunniens*)	5	

TABLE J-7 (CONTINUED)

DESCRIPTION OF GROUPS

Group 1
Swiftwater-Large Fishes

Most species in this group are rare to uncommon. They are large, pelagic-oriented fish that prefer rather clear, fast-flowing water over a sand or gravel substrate. Most species are migratory, travel in schools, and often constitute an important commercial fishery. Spawning occurs over sand or gravel shoals in the spring. The fry of this group are usually pelagic and move into shallower water as they grow feeding on plankton and small invertebrates. The adults feed on large invertebrates or fishes.

Group 2
Swiftwater-Small Fishes

This group is comprised of small minnows and darters, most of which are rare to uncommon. Species in this group are important forage fishes and their presence generally indicates good riverine habitat. They often travel in schools and occupy similar habitat as described for species in Group 1, but generally occur in shallower water and do not migrate greater distances. Reproduction behavior is variable, but spawning usually occurs during the spring over sand or gravel in flowing water. Their diet consists of plankton and small invertebrates.

Group 3
Slackwater-Large Fishes

Fishes in this group inhabits slackwater areas and generally avoids strong current. Because of their large size and relative high abundance, many of these species are important commercial and recreational fish. They often associate with vegetation, woody debris, or other forms of cover in deeper parts of pools, occasionally entering flowing water to feed. The majority of the species in this group are piscivorous as adults, except for the suckers and bullheads which feed on mollusks, insects, and plankton. Spawning occurs during the spring and early summer in shallow, non-flowing water over vegetation, logs, or prepared nests. One notable exception is the American eel which spawns around the Sargossa Sea.

Group 4
Slackwater-Small Fishes

This group of relatively small fish are common in slackwater habitats. They are typically found in shallow, clear to moderately turbid water with little current. Most species associate with some form of submerged cover. Spawning occurs in spring and early summer in shallow water. Sunfish deposit eggs in prepared nests, while others spawn along a sandy or clay substrate without parental care. The young often school and become pelagic, but return to shallow areas with submerged timber or aquatic vegetation as they grow. The fry consume plankton and later small crustaceans and insects. Fish are also eaten, particularly by the adult sunfish.

TABLE J-7 (CONTINUED)

DESCRIPTION OF GROUPS

Group 5
Generalists

This group of species are considered generalists because they tolerate a wide range of environmental conditions including high turbidity, low dissolved oxygen, and high water temperatures. They are often the first inhabitants of disturbed habitats and can survive in isolated pools, but generally prefer shallow, sluggish waters with vegetation. Most have an extended spawning season throughout the spring and summer over a variety of substrates. Sunfish and bullheads prepare nests and guard the eggs, while others broadcast their eggs with no parental care. Mosquitofish eggs are fertilized internally and females give birth to living young. The young of this group are usually confined to shallow, protected areas. The diet consists of plankton and invertebrates. Bullheads and sunfish will also consume small fishes.

TABLE J-8

AQUATIC HABITAT APPRAISAL GUIDE
SPECIES CHARACTERSITC MATRIX
FISHES OF POOL 24, UPPER MISSISSIPPI RIVER

Sample site:_____ Date:_____

Season: Winter Spring Summer Fall

Comments:_____

Scoring Criteria: Excellent=1 Good=.75 Fair=.5 Poor=.25 Unusable=0

Habitat Variable	HSI Score by Species Group and Life Stage*											
	Group 1			Group 2			Group 3			Group 4		
	S	R	A	S	R	A	S	R	A	S	R	A
Average water temperature (C)												
1. >30	0	0	.25	0	0	.5	0	.25	.5	.25	.25	.75
2. 20-30	.5	.75	.75	.75	.75	.75	1	1	1	1	1	1
3. 15-20	1	1	1	1	1	1	1	1	1	1	1	1
4. 10-15	1	1	1	1	1	1	.75	.5	.75	.75	.5	.75
5. 4-10	.25	.5	.5	.25	.5	.5	0	.25	.5	0	.25	.5
6. 0-4	0	0	.25	0	0	.25	0	0	.25	0	0	.25
Average dissolved oxygen (mg/l)												
1. 1-3	0	.25	.25	0	.25	.25	.25	.25	.25	.25	.25	.25
2. 3-5	.5	.5	.5	.5	.5	.75	.5	.5	.75	.5	.75	1
3. > 5	1	1	1	1	1	1	1	1	1	1	1	1
Average turbidty and secchi depth												
1. Clear (<10 NTU, >2 m)	1	1	1	1	1	1	.75	.75	1	1	1	1
2. Moderate (10-75 NTU,.5-2.0 m)	.75	.75	1	.75	.75	1	1	1	1	1	1	1
3. Turbid (>75 NTU, < .5 m)	.25	.25	.25	.25	.25	.25	.5	.5	.5	.25	.5	.75
Percent of area with water depth greater than 1 m												
1. 0-25	.5	.25	.5	.75	.75	.75	1	.5	.25	1	.75	.75
2. 25-50	.75	.75	1	1	1	1	.75	1	.75	1	1	1
3. 50-75	1	1	1	1	1	1	.75	1	1	.5	.75	1
4. >75	.5	.75	1	.75	.75	.75	.5	.5	1	.25	.25	.75
Average water velocity (cm/sec)												
1. 0-20	.25	.25	.25	.25	.25	.25	1	1	1	1	1	1
2. 20-30	.5	.5	.5	.75	.75	.75	.5	.5	.75	.25	.5	.5
3. 30-40	1	1	1	1	1	1	.25	.5	.75	.25	.5	.5
4. 40-50	1	1	1	1	1	1	.25	.5	.75	.25	.5	.5
5. >50	1	1	1	1	1	1	0	.25	.5	0	.25	.25

*Habitat Suitablity Index (HSI) score for S=Spawning, R=Rearing, and A=Adults

TABLE J-8 (CONTINUED)

AQUATIC HABITAT APPRAISAL GUIDES
SPECIES CHARACTERISTIC MATRIX
FISHES OF POOL 24, UPPER MISSISSIPPI RIVER

Habitat Variable	HSI Score by Species Group and Life Stage*											
	Group 1			Group 2			Group 3			Group 4		
	S	R	A	S	R	A	S	R	A	S	R	A
Percent of surface area with cover (aquatic plants, logs, revetment, brush)												
1. 0-10	1	1	1	1	1	1	.25	.5	.5	.25	.25	.25
2. 10-25	1	1	1	1	1	1	.75	.75	1	.5	.5	.5
3. 25-50	.75	.75	.5	.75	.75	1	1	1	1	.75	.75	1
4. 50-75	.5	.5	.5	.5	.75	.5	.75	.75	.5	1	1	1
5. >75	.25	.25	.25	.25	.25	.25	.5	.25	.25	1	1	1
Dominant substrate compostion												
1. Vegetation/detritus	.5	.75	.5	.75	1	.75	1	1	1	1	1	1
2. Clay and silt (<1.0 mm)	.25	.5	.5	.25	.5	.5	.5	.5	.75	.75	.75	.75
3. Sand (1-2 mm)	.75	1	1	1	1	1	.75	.75	.75	.75	.75	.75
4. Gravel 2-64 mm)	1	1	1	1	1	1	.75	.5	.75	.75	.5	.75
5. Rocks (>64 mm)	1	1	1	1	1	1	.5	.25	.5	.5	.5	.5
Monthly water level fluctuation during spawning & egg incubation												
1. Slow rise (0.5-1 m) or stable	1	-	-	1	-	-	1	-	-	1	-	-
2. Rapid rise (1-2 m)	.75	-	-	.75	-	-	.5	-	-	.5	-	-
3. Rapid fall (0.5-1 m)	.25	-	-	.25	-	-	.25	-	-	.25	-	-
Calculations Total Score												
Maximum Score	8	7	7	8	7	7	8	7	7	8	7	7
Average HSI Value (Total score/maximum score)												
Minimum HSI Value/1 (optional)												
Total Hectares												
Habitat Units (HSI x Total Hectares)												

4. PHARRS ISLAND AHAG

a. General

The major fisheries goal of the project was to enhance aquatic habitat conditions for slackwater fish, particularly larger slackwater fish. Many of these species are important commercial fish (e.g., buffalo and catfish) and recreational fish (e.g., bullhead, catfish, bass and crappie). Thus AHAG guilds 3 and 4 were targeted for emphasis by the AHAG team. The AHAG team included representation from the MDOC, IDOC, WES, FWS and the Corps. Prior to the evaluation, the team reviewed hydrographic maps and existing biological data for the project area.

b. Assumptions

During the AHAG analysis, certain assumptions were developed regarding existing conditions and projected future conditions. These assumptions are listed below.

(1) Existing Conditions -

Side Channel and Main Channel Border - Physical conditions making this habitat less than optimal for slackwater fish include a somewhat low year-round water temperature, high turbidity, high water velocity in spring and low cover.

Shallow Slough - Conditions lowering the value of this habitat for slackwater fish include high water temperature in summer, low dissolved oxygen levels in summer and winter, shallow water depth and higher water velocities in the spring.

(2) Future Conditions -

(a) General. The following general assumptions were applied to the analysis of all future changes in habitat during the 50-year project life.

1 Target years of 0, 2, 15, and 50 are sufficient to annualize HU's and to characterize habitat changes over the life of the project.

2 Slackwater fish guild 3 is a suitable guild for management emphasis and adequately characterizes the life requisite requirements of the slackwater fish group for the purposes of the incremental analysis of this project.

3 Swiftwater fish guilds 1 and 2 are suitable guilds for comparative evaluation of overall aquatic values and changes.

(b) Specific. Specific assumptions employed in evaluating alternative Plans A, B and D are given below.

1 Alternative Plan A, No Action Plan

a Pool 24 already low in its supply of backwater fisheries habitat will lose much of its remaining backwater during the next century.

b Within the project area per se, it is assumed that all shallow slough habitat will convert to land within the next 50 years.

c Project area side channel and main channel border habitat will not become reduced in areal extent during the next 50 years, but these habitats will become more shallow.

d All of the habitat quality limiting factors described for the existing conditions will persist into the future condition without a project.

2 Alternative Plan B, Wetlands Excavation - Interior dredging on Pharrs Island would initially expand the shallow slough habitat for a short period of time. However, in the long-term the project under this alternative would be subject to the same sedimentation effects and outcome as that described for the no action plan.

3 Alternative Plan D, Wetlands Protection

a Dike Protected Area. The dike structure would reduce future sand deposition within the newly created backwater, consisting now of protected shallow slough and deep slough. Little loss of water depth is anticipated over the life of the project. The substrate composition would shift to include a greater silt and detritus component. Water level fluctuations would not change as a result of the dike. Water velocity would become reduced, particularly during the spring spawning season. Water temperatures would increase somewhat during all periods of the year. Dissolved oxygen levels would not change significantly from existing conditions. Turbidity would be reduced, thus contributing to improved light passage and increased food production. Available cover would be increased by the placement of cedar trees as habitat structures.

b Levee Protected Area. The levee would provide increased water depth within the interior slough due to fall-winter-spring innundation and the creation of deep water fish refuges. Temperature during the summer would be reduced in the deep water fish refuge areas. Dissolved oxygen would be less of a problem due to the increased water depth and reduced temperature. Water velocity in the Pharrs Island shallow slough habitat would become reduced during the spring spawning period. Decaying moist soil plants would contribute to the amount of increased detritus. Water level fluctuations in the island's sloughs would become much reduced. The conversion of slough to land would become reduced by about 90 percent.

c. Results

TABLE J-9 lists the team's appraisal item ratings for each habitat condition both existing and future. TABLE J-10 provides the HSI values for each habitat type, fish group, life stage and season. TABLE J-11 provides a tabulated prediction of the habitat acreage changes expected for the project area over the next 50 years for various alternative plan or plan features. A rough indication of the existing conversion rate of shallow slough to land was determined by examining acreage changes over the last 15 years. The acreage conversion in areas protected by project features was estimated to be one tenth that of the existing rate (i.e., consistent with the hydraulics estimate of 90 percent sediment reduction). TABLE J-12 provides the HU value changes resulting from the application of the Corps' HES software to the TABLE J-10 HSI values and the TABLE J-11 acreages. The HU's are tabluated by guild for each project alternative and individual habitat type. TABLE J-13 provides a similar accounting, but combines the HU's for all habitat types. Given in parenthesis is the percent net change in HU's expressed as a percentage of the HU's for the future without project conditions (or Plan A).

TABLE J-9

AQUATIC HABITAT APPRAISAL GUIDE RATINGS

Appraisal Item	Ratings																			
	Existing												Future							
	MCB (Unprotected)				SS (Unprotected)				SC (Unprotected)				SS (Protected)				DS (Protected)			
	W	SP	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F
Av. Water Temp	5	4	2	4	5	4	1	4	5	4	3	4	4	2	2	2	4	3	2	2
Av. D.O.	3	3	3	3	1	3	1	3	3	3	3	3	2	3	2	3	3	3	3	3
Av. Turbidity	2	3	3	3	1	3	2	2	2	3	3	3	1	2	2	2	2	2	2	2
% Water Depth	4	4	4	4	1	1	1	1	4	4	4	4	2	2	1	2	4	4	4	4
Av. Water Velocity	1	3	2	1	1	2	1	1	1	3	2	1	1	1	1	1	1	1	1	1
% Cover	1	1	1	3	2	2	3	3	1	1	1	3	3	3	3	3	3	3	3	3
Dominant Substrate	3	3	3	3	2	2	2	2	3	3	3	3	1	1	1	1	3	3	3	3
Water Fluctuation	-	2	-	-	-	3	-	-	-	2	-	-	-	1	-	-	-	2	-	-

MCB Main Channel Border
SS Shallow Slough
SC Side Channel
DS Deep Slough

Protected - Habitat sediment and/or flow protected by dike or levee.
Unprotected - No structural protection of the habitat.

TABLE J-10

HSI VALUES

McBorder and Side Channel Habitat - Unprotected

Fish Group	Life Stage	Winter	Spring	Summer	Fall
Group 1	S	-	0.78	-	-
	R	0.71	0.86	0.75	0.71
	A	0.82	0.89	0.79	0.71
Group 2	S	-	0.84	-	-
	R	0.71	0.86	0.79	0.71
	A	0.79	0.86	0.79	0.76
Group 3	S	-	0.56	-	-
	R	0.71	0.61	0.68	0.76
	A	0.82	0.75	0.79	0.86
Group 4	S	-	0.50	-	-
	R	0.64	0.54	0.61	0.68
	A	0.75	0.68	0.71	0.86

TABLE J-10 (CONTINUED)

Shallow Slough Habitat - Unprotected

Fish Group	Life Stage	Winter	Spring	Summer	Fall
Group 1	S	-	0.59	-	-
	R	0.50	0.64	0.39	0.64
	A	0.54	0.68	0.46	0.68
Group 2	S	-	0.66	-	-
	R	0.57	0.75	0.46	0.71
	A	0.57	0.75	0.61	0.79
Group 3	S	-	0.66	-	-
	R	0.57	0.61	0.64	0.79
	A	0.68	0.71	0.68	0.82
Group 4	S	-	0.59	-	-
	R	0.64	0.64	0.68	0.82
	A	0.68	0.71	0.79	0.89

TABLE J-10 (CONTINUED)

Shallow Slough Habitat - Protected

Fish Group	Life Stage	Winter	Spring	Summer	Fall
Group 1	S	-	0.69	-	-
	R	0.71	0.71	0.57	0.71
	A	0.68	0.71	0.57	0.71
Group 2	S	-	0.78	-	-
	R	0.79	0.79	0.68	0.79
	A	0.82	0.82	0.75	0.82
Group 3	S	-	0.97	-	-
	R	0.82	1.00	0.86	1.00
	A	0.89	0.96	0.86	0.96
Group 4	S	-	0.97	-	-
	R	0.86	0.96	0.89	0.96
	A	0.96	1.00	0.96	1.00

TABLE J-10 (CONTINUED)

Deep Slough Habitat - Protected

Fish Group	Life Stage	Winter	Spring	Summer	Fall
Group 1	S	-	0.66	-	-
	R	0.79	0.79	0.75	0.75
	A	0.79	0.79	0.79	0.79
Group 2	S	-	0.75	-	-
	R	0.75	0.76	0.75	0.75
	A	0.83	0.82	0.82	0.82
Group 3	S	-	0.84	-	-
	R	0.83	0.89	0.89	0.89
	A	0.89	0.96	0.96	0.96
Group 4	S	-	0.78	-	-
	R	0.76	0.83	0.82	0.82
	A	0.89	0.93	0.93	0.93

TABLE J-11

FISHERIES HABITAT ACRES

Plan A - No Action

Habitat		1990	1992	2005	2040
Main Channel Border	Unprotected	103	103	103	103
Slough - Shallow	Unprotected	67	65	50	0
Slough - Shallow	Protected	0	0	0	0
Slough - Deep	Protected	0	0	0	0
Side Channel	Unprotected	56	56	56	56
	TOTAL	226	224	209	159

Plan B - Wetlands Excavation

Habitat		1990	1992	2005	2040
Main Channel Border	Unprotected	103	103	103	103
Slough - Shallow	Unprotected	67	139	88	0
Slough - Shallow	Protected	0	0	0	0
Slough - Deep	Protected	0	0	0	0
Side Channel	Unprotected	56	56	56	56
	TOTAL	226	298	247	159

TABLE J-11 (CONTINUED)

Plan D - Wetlands Protected

Habitat		1990	1992	2005	2040
Main Channel Border	Unprotected	103	0	0	0
Slough - Shallow	Unprotected	67	0	0	0
Slough - Shallow	Protected	0	64	60	50
Slough - Deep	Protected	0	159	159	159
Side Channel	Unprotected	56	0	0	0
	TOTAL	226	223	219	209

TABLE J-12

HABITAT UNITS - GROUP 1 (LARGE SWIFTWATER FISHES), SPAWNING STAGE

Alternative	Season	MCB-U FW	MCB-U FWO	MCB-U NET	SS-U FW	SS-U FWO	SS-U NET	SC-U FW	SC-U FWO	SC-U NET	SS-P FW	SS-P FWO	SS-P NET	DS-P FW	DS-P FWO	DS-P NET	Total FW	Total FWO	Total NET
lan B	SP	80	80	0	38	21	17	44	44	0	0	0	0	0	0	0	162	145	17
Plan D (Complete)	SP	1	80	-79	1	21	-20	1	44	-43	39	0	39	103	0	103	145	145	0
Plan D (Dike Only)	SP	1	80	-79	1	21	-20	1	44	-43	39	0	39	107	0	107	149	145	4
Plan D (Dike + Refuge Only)	SP	1	80	-79	1	21	-20	1	44	-43	39	0	39	107	0	107	149	145	4

HABITAT UNITS - GROUP 1 (LARGE SWIFTWATER FISHES), REARING STAGE

Alternative	Season	MCB-U FW	MCB-U FWO	MCB-U NET	SS-U FW	SS-U FWO	SS-U NET	SC-U FW	SC-U FWO	SC-U NET	SS-P FW	SS-P FWO	SS-P NET	DS-P FW	DS-P FWO	DS-P NET	Total FW	Total FWO	Total NET
Plan B	W	73	73	0	32	17	15	40	40	0	0	0	0	0	0	0	145	130	15
	SP	89	89	0	41	22	19	48	48	0	0	0	0	0	0	0	178	159	19
	SU	77	77	0	25	14	11	42	42	0	0	0	0	0	0	0	144	133	11
	F	73	73	0	41	20	19	40	40	0	0	0	0	0	0	0	154	135	19
	AV	78	78	0	35	19	16	43	43	0	0	0	0	0	0	0	155	139	16
Plan D (Complete)	W	1	73	-72	1	18	-17	1	40	-39	40	0	40	123	0	123	166	131	35
	SP	2	89	-87	1	23	-22	1	48	-47	40	0	40	118	0	118	162	160	2
	SU	1	77	-76	1	14	-13	1	42	-41	32	0	32	117	0	117	152	133	19
	F	1	73	-72	1	23	-22	1	40	-39	40	0	40	117	0	117	160	136	24
	AV	1	78	-77	1	20	-19	1	42	-41	38	0	38	119	0	119	160	140	20
Plan D (Dike Only)	W	1	73	-72	1	18	-17	1	40	-39	40	0	40	128	0	128	171	131	40
	SP	2	89	-87	1	23	-22	1	48	-47	40	0	40	123	0	123	167	160	7
	SU	1	77	-76	1	14	-13	1	42	-41	24	0	24	123	0	123	150	133	17
	F	1	73	-72	1	23	-22	1	40	-39	40	0	40	123	0	123	166	136	30
	AV	1	78	-77	1	20	-19	1	42	-41	36	0	36	124	0	124	164	140	24
Plan D (Dike + Refuge Only)	W	1	73	-72	1	18	-17	1	40	-39	40	0	40	128	0	128	171	131	40
	SP	2	89	-87	1	23	-22	1	48	-47	40	0	40	123	0	123	167	160	7
	SU	1	77	-76	1	14	-13	1	42	-41	32	0	32	123	0	123	158	133	25
	F	1	73	-72	1	23	-22	1	40	-39	40	0	40	123	0	123	166	136	30
	AV	1	78	-77	1	20	-19	1	42	-41	38	0	38	124	0	124	166	140	26

TABLE J-12 (CONTINUED)

HABITAT UNITS - GROUP 1 (LARGE SWIFTWATER FISHES), ADULT STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	84	84	0	35	19	16	46	46	0	0	0	0	0	0	0	165	149	16
	SP	92	92	0	44	24	20	50	50	0	0	0	0	0	0	0	186	166	20
	SU	81	81	0	30	16	14	44	44	0	0	0	0	0	0	0	155	141	14
	F	73	73	0	44	24	20	40	40	0	0	0	0	0	0	0	157	137	20
	AV	83	83	0	38	20	18	45	45	0	0	0	0	0	0	0	166	148	18
Plan D (Complete)	W	2	85	-83	1	19	-18	1	46	-45	38	0	38	123	0	123	165	150	15
	SP	2	92	-90	1	24	-23	1	50	-49	40	0	40	123	0	123	167	166	1
	SU	1	81	-80	0	16	-16	1	44	-43	32	0	32	123	0	123	157	141	16
	F	1	73	-72	1	24	-23	1	40	-29	40	0	40	123	0	123	166	137	29
	AV	2	84	-82	1	21	-20	1	45	-44	38	0	38	123	0	123	165	150	15
Plan D (Dike Only)	W	2	85	-83	1	19	-18	1	46	-45	38	0	38	134	0	134	176	150	26
	SP	2	92	-90	1	24	-23	1	50	-49	40	0	40	134	0	134	178	166	12
	SU	1	81	-80	0	16	-16	1	44	-43	26	0	26	134	0	134	162	141	21
	F	1	73	-72	1	24	-23	1	40	-39	40	1	40	134	0	134	177	137	40
	AV	2	84	-82	1	21	-20	1	45	-44	36	0	36	134	0	134	173	149	24
Plan D (Dike + Refuge Only)	W	2	85	-83	1	19	-18	1	46	-45	38	0	38	134	0	134	176	150	26
	SP	2	92	-90	1	24	-23	1	50	-49	40	0	40	134	0	134	178	166	12
	SU	1	81	-80	0	16	-16	1	44	-43	32	0	32	134	0	134	168	141	27
	F	1	73	-72	1	24	-23	1	40	-39	40	0	40	134	0	134	177	137	40
	AV	2	84	-82	1	21	-20	1	45	-44	38	0	38	134	0	134	175	149	26

HABITAT UNITS - GROUP 2 (SMALL SWIFTWATER FISHES), SPAWNING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	SP	87	87	1	43	24	19	47	47	0	0	0	0	0	0	0	177	158	19
Plan D (Complete)	SP	2	87	-85	1	23	-22	1	47	-46	44	0	44	117	0	117	165	157	8
Plan D (Dike Only)	SP	2	87	-85	1	23	-22	1	47	-46	44	0	44	122	0	122	170	157	13
Plan D (Dike + Refuge Only)	SP	2	87	-85	1	23	-22	1	47	-46	44	0	44	122	0	122	170	157	13

TABLE J-12 (CONTINUED)

HABITAT UNITS - GROUP 2 (SMALL SWIFTWATER FISHES), REARING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	73	73	0	37	20	17	40	40	0	0	0	0	0	0	0	150	133	17
	SP	89	89	0	48	26	22	48	48	0	0	0	0	0	0	0	185	163	22
	SU	81	81	0	30	16	14	44	44	0	0	0	0	0	0	0	155	141	14
	F	73	73	0	46	25	21	40	40	0	0	0	0	0	0	0	159	138	21
	AV	79	79	0	40	21	19	43	43	0	0	0	0	0	0	0	162	143	19
Plan D (Complete)	W	1	73	-72	1	20	-19	1	40	-39	44	0	44	117	0	117	164	133	31
	SP	2	89	-87	1	26	-25	1	48	-47	44	0	44	118	0	118	166	163	3
	SU	1	81	-80	0	16	-16	1	44	-43	38	0	38	117	0	117	157	141	16
	F	1	73	-72	1	25	-24	1	40	-39	44	0	44	123	0	123	170	138	32
	AV	1	79	-78	1	22	-21	1	43	-42	43	0	43	117	0	117	163	144	19
Plan D (Dike Only)	W	1	73	-72	1	20	-19	1	40	-39	44	0	44	123	0	123	170	133	37
	SP	2	89	-87	1	26	-25	1	48	-47	44	0	44	123	0	123	171	163	8
	SU	1	81	-80	0	16	-16	1	44	-43	30	0	30	123	0	123	155	141	14
	F	1	73	-72	1	25	-24	1	40	-39	44	0	44	123	0	123	170	138	32
	AV	1	79	-78	1	22	-21	1	43	-42	41	0	41	123	0	123	167	144	23
Plan D (Dike + Refuge Only)	W	1	73	-72	1	20	-19	1	40	-39	44	0	44	123	0	123	170	133	37
	SP	2	39	-87	1	26	-25	1	48	-47	44	0	44	123	0	123	171	163	8
	SU	1	81	-80	0	16	-16	1	44	-43	38	0	38	123	0	123	163	141	22
	F	1	73	-72	1	25	-24	1	40	-39	44	0	44	123	0	123	170	138	32
	AV	1	79	-78	1	22	-21	1	43	-42	43	0	43	123	0	123	169	144	25

HABITAT UNITS - GROUP 2 (SMALL SWIFTWATER FISHES), ADULT STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	81	81	0	37	20	17	44	44	0	0	0	0	0	0	0	162	145	17
	SP	89	89	0	48	26	22	42	48	-6	0	0	0	0	0	0	179	163	16
	SU	81	81	0	39	21	18	44	44	0	0	0	0	0	0	0	164	146	18
	F	78	78	0	51	28	23	43	43	0	0	0	0	0	0	0	172	149	23
	AV	82	82	0	44	24	20	43	44	-1	0	0	0	0	0	0	169	150	19
Plan D (Complete)	W	1	81	-80	1	20	-19	1	44	-43	46	0	46	129	0	129	178	145	33
	SP	2	89	-87	1	26	-25	1	48	-47	46	0	46	128	0	128	178	163	15
	SU	1	81	-80	1	21	-20	1	44	-43	42	0	42	128	0	128	173	146	27
	F	1	78	-77	1	28	-27	1	43	-42	46	0	46	128	0	128	177	149	28
	AV	1	82	-81	1	24	-23	1	45	-44	45	0	45	128	0	128	176	151	25
Plan D (Dike Only)	W	1	81	-80	1	20	-19	1	44	-43	46	0	46	129	0	129	178	145	33
	SP	2	89	-87	1	26	-25	1	48	-47	46	0	46	128	0	128	178	163	15
	SU	1	81	-80	1	21	-20	1	44	-43	36	0	36	128	0	128	167	146	21
	F	1	78	-77	1	28	-27	1	43	-42	46	0	46	128	0	128	177	149	28
	AV	1	82	-81	1	24	-23	1	45	-44	44	0	44	128	0	128	175	151	24
Plan D (Dike + Refuge Only)	W	1	81	-80	1	20	-19	1	44	-43	46	0	46	129	0	129	178	145	33
	SP	2	89	-87	1	26	-25	1	48	-47	46	0	46	128	0	128	178	163	15
	SU	1	81	-80	1	21	-20	1	44	-43	42	0	42	128	0	128	173	146	27
	F	1	78	-77	1	28	-27	1	43	-42	46	0	46	128	0	128	177	149	28
	AV	1	82	-81	1	24	-23	1	45	-44	45	0	45	128	0	128	177	151	26

TABLE J-12 (CONTINUED)

HABITAT UNITS - GROUP 3 (LARGE SLACKWATER FISHES), SPAWNING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	SP	58	58	0	43	24	19	31	31	0	0	0	0	0	0	0	132	113	19
Plan D (Complete)	SP	1	58	-57	1	23	-22	0	31	-31	54	0	54	131	0	131	187	112	75
Plan D (Dike Only)	SP	1	58	-57	1	23	-22	0	31	-31	54	0	54	128	0	128	184	112	72
Plan D (Dike + Refuge Only)	SP	1	58	-57	1	23	-22	0	31	-31	54	0	54	128	0	128	184	112	72

HABITAT UNITS - GROUP 3 (LARGE SLACKWATER FISHES), REARING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	73	73	0	37	20	17	40	40	0	0	0	0	0	0	0	150	133	17
	SP	63	63	0	39	21	18	34	34	0	0	0	0	0	0	0	136	118	18
	SU	70	70	0	42	23	19	38	38	0	0	0	0	0	0	0	150	131	19
	F	81	81	0	51	28	23	44	44	0	0	0	0	0	0	0	176	153	23
	AV	72	72	0	42	23	19	39	39	0	0	0	0	0	0	0	153	134	19
Plan D (Complete)	W	1	73	-72	1	20	-19	1	40	-39	46	0	46	128	0	129	178	133	45
	SP	1	63	-62	1	21	-20	1	34	-33	56	0	56	139	0	139	198	118	80
	SU	1	70	-69	1	23	-22	1	38	-37	48	0	48	139	0	139	190	131	59
	F	1	81	-80	1	28	-27	1	44	-43	56	0	56	139	0	139	198	153	45
	AV	1	73	-72	1	23	-22	1	39	-38	52	0	52	137	0	137	192	135	57
Plan D (Dike Only)	W	1	73	-72	1	20	-19	1	40	-39	46	0	46	123	0	123	172	133	39
	SP	1	63	-62	1	21	-20	1	34	-33	56	0	56	134	0	134	193	118	75
	SU	1	70	-69	1	23	-22	1	38	-37	40	0	40	134	0	134	177	131	54
	F	1	81	-80	1	28	-27	1	44	-43	56	0	56	134	0	134	193	153	40
	AV	1	73	-72	1	23	-22	1	39	-38	50	0	50	131	0	131	184	134	50
Plan D (Dike + Refuge Only)	W	1	73	-72	1	20	-19	1	40	-39	46	0	46	123	0	123	172	133	39
	SP	1	63	-62	1	21	-20	1	34	-33	56	0	56	134	0	134	193	118	75
	SU	1	70	-69	1	23	-22	1	38	-37	48	0	48	134	0	134	185	131	54
	F	1	81	-80	1	28	-27	1	44	-43	56	0	56	134	0	134	193	153	40
	AV	1	73	-72	1	23	-22	1	39	-38	52	0	52	131	0	131	186	134	52

TABLE J-12 (CONTINUED)

HABITAT UNITS - GROUP 3 (LARGE SLACKWATER FISHES), ADULT STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	84	84	0	44	24	20	46	46	0	0	0	0	0	0	0	174	154	20
	SP	77	77	0	46	25	21	42	42	0	0	0	0	0	0	0	165	144	21
	SU	81	81	0	44	24	20	44	44	0	0	0	0	0	0	0	169	149	20
	F	84	84	0	53	29	24	46	46	0	0	0	0	0	0	0	183	159	24
	AV	82	82	0	47	26	21	45	45	0	0	0	0	0	0	0	174	153	21
Plan D (Complete)	W	1	84	-83	1	24	-23	1	46	-45	50	0	50	145	0	145	198	154	44
	SP	1	77	-76	1	25	-24	1	42	-41	54	0	54	150	0	150	207	144	63
	SU	1	81	-80	1	24	-23	1	44	-43	48	0	48	150	0	150	201	149	52
	F	1	84	-83	1	29	-28	1	46	-45	54	0	54	150	0	150	207	159	48
	AV	1	82	-81	1	26	-25	1	45	-44	52	0	52	149	0	149	204	153	51
Plan D (Dike Only)	W	1	84	-83	1	24	-23	1	46	-45	50	0	50	145	0	145	198	154	44
	SP	1	77	-76	1	25	-24	1	42	-41	54	0	54	150	0	150	207	144	63
	SU	1	81	-80	1	24	-23	1	44	-43	40	0	40	150	0	150	193	149	44
	F	1	84	-83	1	29	-28	1	46	-45	54	0	54	150	0	150	207	159	48
	AV	1	82	-81	1	26	-25	1	45	-44	50	0	50	150	0	150	201	153	48
Plan D (Dike + Refuge Only)	W	1	84	-83	1	24	-23	1	46	-45	50	0	50	145	0	145	198	154	44
	SP	1	77	-76	1	25	-24	1	42	-41	54	0	54	150	0	150	207	144	63
	SU	1	81	-80	1	24	-23	1	44	-43	48	0	48	150	0	150	201	149	52
	F	1	84	-83	1	29	-28	1	46	-45	54	0	54	150	0	150	207	159	48
	AV	1	82	-81	1	26	-25	1	45	-44	52	0	52	150	0	150	205	153	52

HABITAT UNITS - GROUP 4 (SMALL SLACKWATER FISHES), SPAWNING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	SP	52	52	0	38	21	17	28	28	0	0	0	0	0	0	0	118	101	17
Plan D (Complete)	SP	1	51	-50	1	21	-20	1	28	-27	54	0	54	122	0	122	179	100	79
Plan D (Dike Only)	SP	1	51	-50	1	21	-20	1	28	-27	54	0	54	118	0	118	175	100	75
Plan D (Dike + Refuge Only)	SP	1	51	-50	1	21	-20	1	28	-27	54	0	54	118	0	118	175	100	75

TABLE J-12 (CONTINUED)

HABITAT UNITS - GROUP 2 (SMALL SWIFTWATER FISHES), REARING STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	66	66	0	41	22	19	36	36	0	0	0	0	0	0	0	143	124	19
	SP	56	56	0	41	22	19	30	30	0	0	0	0	0	0	0	127	108	19
	SU	63	63	0	44	24	20	34	34	0	0	0	0	0	0	0	141	121	20
	F	70	70	0	53	29	24	38	38	0	0	0	0	0	0	0	161	173	24
	AV	64	64	0	45	24	21	35	35	0	0	0	0	0	0	0	144	123	21
Plan D (Complete)	W	1	66	-65	0	22	-22	1	36	-35	48	0	48	118	0	118	168	124	44
	SP	1	56	-55	1	23	-22	0	30	-30	54	0	54	129	0	129	185	109	76
	SU	1	63	-62	1	24	-23	1	34	-33	50	0	50	128	0	128	181	121	60
	F	1	70	-69	1	29	-28	1	38	-37	54	0	54	128	0	128	185	137	48
	AV	1	64	-63	1	25	-24	1	35	-34	52	0	52	126	0	126	181	124	57
Plan D (Dike Only)	W	1	66	-65	0	22	-22	1	36	-35	48	0	48	112	0	112	162	124	38
	SP	1	56	-55	1	23	-22	0	30	-30	54	0	54	123	0	123	179	109	70
	SU	1	63	-62	1	24	-23	1	34	-33	40	0	40	123	0	123	166	121	45
	F	1	70	-69	1	29	-28	1	38	-37	54	0	54	123	0	123	180	137	43
	AV	1	64	-63	1	25	-24	1	35	-34	49	0	49	120	0	120	172	123	49
Plan D (Dike + Refuge Only)	W	1	66	-65	0	22	-22	1	36	-35	48	0	48	112	0	112	162	124	38
	SP	1	56	-55	1	23	-22	0	30	-30	54	0	54	123	0	123	179	109	70
	SU	1	63	-62	1	24	-23	1	34	-33	50	0	50	123	0	123	176	121	55
	F	1	70	-69	1	29	-28	1	38	-37	54	0	54	123	0	123	180	137	43
	AV	1	64	-63	1	25	-24	1	35	-34	52	0	52	120	0	120	174	123	51

HABITAT UNITS - GROUP 4 (SMALL SLACKWATER FISHES), ADULT STAGE

Alternative	Season	MCB-U			SS-U			SC-U			SS-P			DS-P			Total		
		FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET	FW	FWO	NET
Plan B	W	77	77	0	44	24	20	42	42	0	0	0	0	0	0	0	163	143	20
	SP	70	70	0	46	25	21	38	38	0	0	0	0	0	0	0	154	133	21
	SU	73	73	0	51	28	23	40	40	0	0	0	0	0	0	0	164	141	23
	F	89	89	0	57	31	26	48	48	0	0	0	0	0	0	0	194	168	26
	AV	77	77	0	50	27	23	42	42	0	0	0	0	0	0	0	169	146	23
Plan D (Complete)	W	1	77	-76	1	24	-23	1	42	-41	54	0	54	139	0	139	196	143	53
	SP	1	70	-69	1	25	-24	1	38	-37	56	0	56	145	0	145	204	133	71
	SU	1	73	-72	1	28	-27	1	40	-39	54	0	54	145	0	145	202	141	61
	F	2	89	-87	1	31	-30	1	48	-47	56	0	56	145	0	145	205	168	37
	AV	1	77	-76	1	27	-26	1	42	-41	55	0	55	144	0	144	202	146	56
Plan D (Dike Only)	W	1	77	-76	1	24	-23	1	42	-41	54	0	54	130	0	130	187	143	44
	SP	1	70	-69	1	25	-24	1	38	-37	56	0	56	134	0	134	193	133	60
	SU	1	73	-72	1	28	-27	1	40	-39	46	0	46	134	0	134	183	141	72
	F	2	89	-87	1	31	-30	1	48	-47	56	0	56	134	0	134	194	168	26
	AV	1	77	-76	1	27	-26	1	42	-41	53	0	53	133	0	133	189	146	43
Plan D (Dike + Refuge Only)	W	1	77	-76	1	24	-23	1	42	-41	54	0	54	130	0	130	187	143	44
	SP	1	70	-69	1	25	-24	1	38	-37	56	0	56	134	0	134	193	133	60
	SU	1	73	-72	1	28	-27	1	40	-39	54	0	54	134	0	134	191	141	50
	F	2	89	-87	1	31	-30	1	48	-47	56	0	56	134	0	134	194	168	26
	AV	1	77	-76	1	27	-26	1	42	-41	55	0	55	133	0	133	191	146	45

TABLE J-13

HABITAT UNITS - SUMMARY

Alternative	Life Stage	Group 1 FW	Group 1 FWO	Group 1 NET	Group 2 FW	Group 2 FWO	Group 2 NET	Group 3 FW	Group 3 FWO	Group 3 NET	Group 4 FW	Group 4 FWO	Group 4 NET
Plan B	S	162	146	17 (12)	177	158	19 (12)	132	113	19 (17)	118	101	17 (17)
	R	155	139	16 (11)	162	143	19 (13)	153	134	19 (14)	144	123	12 (17)
	A	166	148	18 (12)	169	150	19 (13)	174	153	21 (14)	169	146	23 (16)
	AV	161	144	17 (12)	169	150	19 (13)	153	133	20 (15)	143	123	20 (17)
Plan D (Complete	S	145	145	0 (0)	165	157	8 (5)	187	112	75 (67)	149	100	79 (79)
	R	160	140	20 (14)	163	144	19 (13)	192	135	54 (42)	181	124	57 (46)
	A	165	150	15 (10)	176	151	25 (17)	204	153	51 (33)	202	146	56 (38)
	AV	157	145	12 (8)	168	151	17 (12)	194	133	61 (47)	187	123	64 (54)
Plan D (Dike Only)	S	149	145	4 (3)	170	157	13 (8)	184	112	72 (64)	175	100	75 (75)
	R	164	140	24 (17)	167	144	23 (16)	184	134	50 (37)	172	123	49 (40)
	A	173	149	24 (16)	175	151	24 (16)	201	153	48 (31)	189	145	43 (29)
	AV	162	145	17 (12)	171	151	20 (13)	190	133	57 (43)	179	123	56 (48)
Plan D (Dike + Refuge Only)	S	149	145	4 (3)	170	157	13 (8)	184	112	72 (64)	175	100	75 (75)
	R	166	140	26 (19)	169	144	25 (17)	186	134	52 (39)	174	123	51 (41)
	A	175	149	26 (17)	177	151	26 (17)	205	153	52 (34)	191	146	45 (31)
	AV	163	145	19 (13)	172	151	21 (14)	192	133	59 (44)	180	123	57 (49)

DISCUSSION

Slackwater fish guilds were selected by the team for fisheries management emphasis. TABLE J-13 shows the incremental effects of the various study options on the various fish guilds.

Plan B shows only minor improvement gains in all life stages of group 3 fish. Under Plan D, the placement of a dike structure results in moderate HU gains for rearing (37 percent) and adult (31 percent) fish with significant gains (64 percent) predicted for spawning fish. The addition of an interior slough fish refuge provides a 2-3 percent increase in habitat for rearing and adult fish, but no change for spawning fish. The addition of cedar trees to the deep slough habitat results in still additional habitat gains of 3 percent for spawning and rearing habitat, but a slight 1 percent decrease in habitat for adult group 3 fish. While the additional habitat gains resulting from the first refuge and cedar tree features was small, so too is the relative cost of those features, and for this reason they were included in the Selected Plan.

The changes to slackwater group 4 fish paralleled that of group 3 fish but with somewhat greater habitat gains, as indicated by TABLE J-13. TABLE J-13 indicated no adverse impacts to Group 1 and 2 swiftwater fishes in comparison to the future without condition; however, the net habitat gains in these two groups were relatively minor.

CONCLUSION

The Selected Plan provides important benefits to the slackwater fish groups without adverse impacts to swiftwater fish species.

APPENDIX DPR-K

BIOLOGICAL DATA

FOREWORD

APPENDIX DPR-K provides 1987-1988 MDOC fish sampling data for the Pharrs Island wetland complex. The appendix also provides a general picture of Pool 24 waterfowl use. The available tabulated waterfowl aerial survey data is for the years 1970 to 1974.

APPENDIX DPR-K

BIOLOGICAL DATA

FOREWORD

APPENDIX DPR-K provides 1987-1988 MDOC fish sampling data for the Pharrs Island wetland complex. The appendix also provides a general picture of Pool 24 waterfowl use. The available tabulated waterfowl aerial survey data is for the years 1970 to 1974.

Listing of fish species seined from Pharrs Island wetland complex Pool 24, field seasons 1987 and 1988. Collection made by Gordon B. Farabee, Fisheries Biologist, Missouri Department of Conservation.

Species	Number Collected	Percent of Harvest
Emerald shiner Notropis atherinoides	75	4
Bluegill Lepomis macrochirus	901	48
River shiner Notropis blennius	26	1
Gizzard shad Dorosoma cepedianum	125	7
Bullhead minnow Pimephales vigilax	171	9
Quillback carpsucker Carpiodes cyprinus	4	
Spottail shiner Notropis hudsonius	115	6
Drum Aplodinotus grunniens	11	
Smallmouth buffalo Ictiobus bubalus	65	3
Silver chub Hybopsis storeriana	94	5
Spotfin shiner Notropis spilopterus	51	2
White bass Morone chrysops	7	
Sand shiner Notropis stramineus	2	
Johnny darter Etheostoma nigrum	9	
Brook silverside Labidesthes sicculus	33	1
Common carp Cyprinus carpio	1	
Bluntnose minnow Pimephales notatus	2	
Largemouth bass Micropterus salmoides	8	
Walleye Stizostedion vitreum	1	
Mosquitofish Gambusia affinis	70	3
Orangespotted sunfish Lepomis humilis	64	3
Red shiner Notropis lutrensis	1	
Logperch Percina caprodes	4	
Central stoneroller Campostoma anomalum	4	
Longnose gar Lepisosteus osseus	2	
Green sunfish Lepomis cyanellus	1	
Black crappie Pomoxis nigromaculatus	3	
Slenderhead darter Percina phoxocephala	5	

POOL 24

1969-1970

	Sep 05	Sep 24	Oct 01	Oct 07	Oct 14	Oct 21	Oct 28	Nov 05	Nov 12	Nov 20	Nov 25	Dec 02	Dec 16	Jan 05	TOTAL
Mallard	20	10	0	30	600	6,500	20,500	55,000	68,500	195,000	55,000	77,600	133,000	52,000	663,760
Black Duck							60	95	280	670	300	300	700	250	2,655
Pin Tail	20	15		250	1,100	12,250	9,500	800	50						23,985
G. W. Teal	240	468		640	75	1,700	3,800		750	90			15		7,778
B. W. Teal	690	330		140		10									1,170
Bufflehead									20						20
Widgeon	10	120		250	600	2,400	10			5					3,395
Gadwall				80	10	3,800	115								4,005
Shoveler				10		15									25
Lessor Scaup						800			1,500						2,300
Ringneck						3,175	10,000								13,175
Canvasback									100				700		800
Ruddy							40								40
Goldeneye														40	40
Red Head															
Coot				650	3,300		400		4,000			350			8,700
Merganser														10	10
Small Canada							30	75	150	170		30			455
B+S Geese											700				700
Snow Geese				2	45		600	3,000	2,000	3,200	2,400	3,400	2,500		17,147
Canada Geese					130		50	90	150	225			450	25	1,120

POOL 24

1970-1971

	Sep 25	Oct 14	Oct 20	Oct 30	Nov 05	Nov 10	Nov 17	Nov 24	Dec 02	Dec 15	Jan 06	TOTAL
Mallard		1,550	4,400	10,000	6,250	41,000	66,000	185,000	83,000	69,300	182,000	648,500
Black Duck		20	15	60	50	35	300	240	350	400	1,500	2,970
Pin Tail	5	700			1,800	1,200	300					4,005
G. W. Teal		120	60		200	400						780
B. W. Teal	40	200	25									265
RG			175	275	175		400	50	80	25		1,180
Widgeon		4,550										4,450
Gadwall		400			75							475
Shoveler												
Lessor Scaup												
Ringneck				300		20						320
Canvasback											3,800	3,800
Ruddy												
Goldeneye											170	170
Coot	75	700	100	400	1,200							2,475
Merganser											540	540
B+S Geese			800	3,500	3,000		3,600	3,000	4,500	2,000		20,400
Canada Geese		170	60		125	175		125	300	250		980
Bald Eagle (Adults)											5	5
Bald Eagle (Juveniles)											3	3

POOL 24

1971-1972

	Sep 29	Oct 05	Oct 11	Oct 18	Oct 25	Nov 01	Nov 08	Nov 15	Nov 30	Dec 07	Dec 13	Jan 07	TOTAL
Mallard	35	40	120	135	330	2,270	24,045	36,100	69,400	41,000	39,030	33,000	245,505
Black Duck				1	15	25	150	380	350	100	250	50	1,321
Pin Tail		210	155	50		60	300	200	20	30			1,025
G. W. Teal	15	200	5										220
B. W. Teal	15	200	5										220
Bofflehead													
Widgeon		25	60	45		20							150
Gadwall													
Shoveler													
Lessor Scaup						9,645							9,645
Ringneck						860							860
Canvasback													
Ruddy													
Redhead						40							40
Goldeneye													
Coot	80	450	285	75	170	390	375	100		30			1,955
Merganser													
Ross Goose			90		100	200		120	100				610
B+S Geese			470		1,200	900	2,050	1,725	1,700	1,800	1,200	300	11,345
Canada Geese	20	5	75		327	200	300	190	400	900	550	500	3,467

POOL 24

1972-1973

	Oct 04	Oct 10	Oct 16	Oct 23	Oct 30	Nov 06	Nov 14	Nov 27	Dec 11	Jan 08	TOTAL
Mallard	15	410	380	2,215	19,000	12,000	33,065	57,100	325	6,550	131,060
Black Duck			20	170	1,900	200	465	650	15	275	3,695
Pin Tail			175	45	85	50	60				415
G. W. Teal			75		40						115
B. W. Teal			15								15
Bofflehead											
Widgeon					175	70	175				420
Gadwall					150		45	60			255
Shovler											
Lessor Scaup					475		6,630				7,105
Ringneck							5,420				5,420
Canvasback							75				75
Whistling Swan					2						2
Ruddy											
Red Head							40				40
Goldeneye									190	705	895
Coot	215	1,025	3,335	280	1,750	40	940	70			7,655
Mergansor									80	475	555
B+S Geese		20			3,500	4,100	3,900	1,750			13,270
Canada Geese		9			35	250	250	650	10		1,204

POOL 24

1973-1974

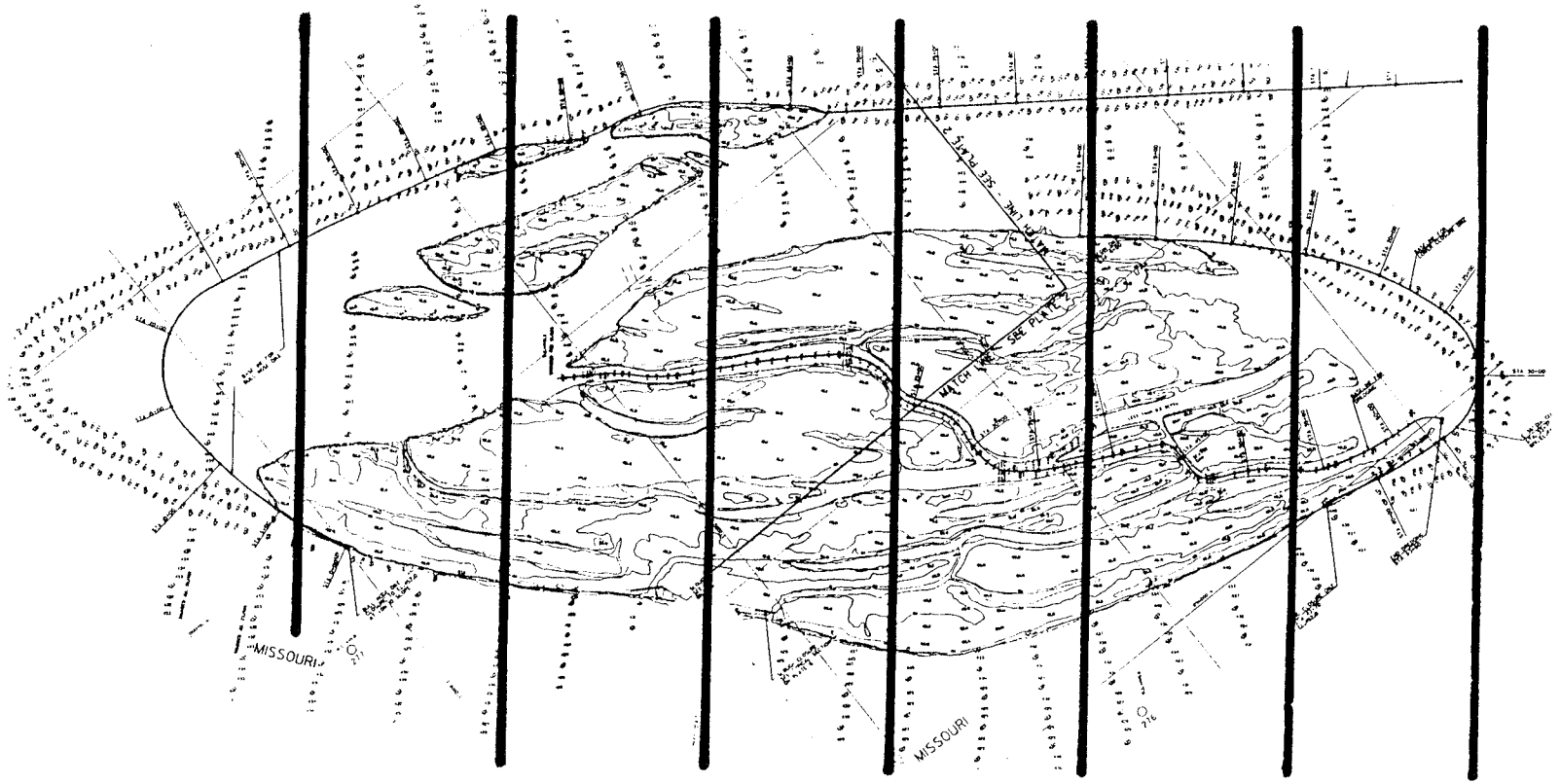
	Sep 13	Sep 25	Oct 05	Oct 15	Oct 22	Oct 29	Nov 05	Nov 12	Nov 26	Dec 03	Jan 07	TOTAL
Mallard	30	0	45	1,135	1,375	3,085	14,200	24,525	20,750	21,050	1,825	88,020
Black Duck	5				85	90	185	740	685	520	270	2,580
Pin Tail			120		570	30	515	175	275	150		1,835
G. W. Teal	25				550	150		325	200			1,250
B. W. Teal	115		305		50		25					495
Bofflehead												
Widgeon			90	900	290	195	100	150				1,725
Gadwall				170	75		70	80	90			485
Shovler												
Lessor Scaup							275					275
Ringneck							80					80
Canvasback							15					15
Ruddy												
Goldeneye											1,075	1,075
Coot			775	2,500	1,290	975	1,275	400	625	275		8,115
Merganser											775	775
B+S Geese				25		80	1,000	1,200	900	3,200		6,405
Canada Geese					75	25	150	375	400	650	30	1,705
Wood Duck												

APPENDIX DPR-L

PERFORMANCE EVALUATION - PHYSICAL, CHEMICAL SAMPLING LOCATIONS

FOREWORD

APPENDIX DPR-L provides the proposed ranges for post-project sedimentation monitoring and the proposed locations for limited water quality testing (i.e., water temperature, dissolved oxygen, Secchi disk).



NOTE: Sediment monitoring ranges to be field located using state coordinates system during P & S phase of project. No more than 7 stations to be established.

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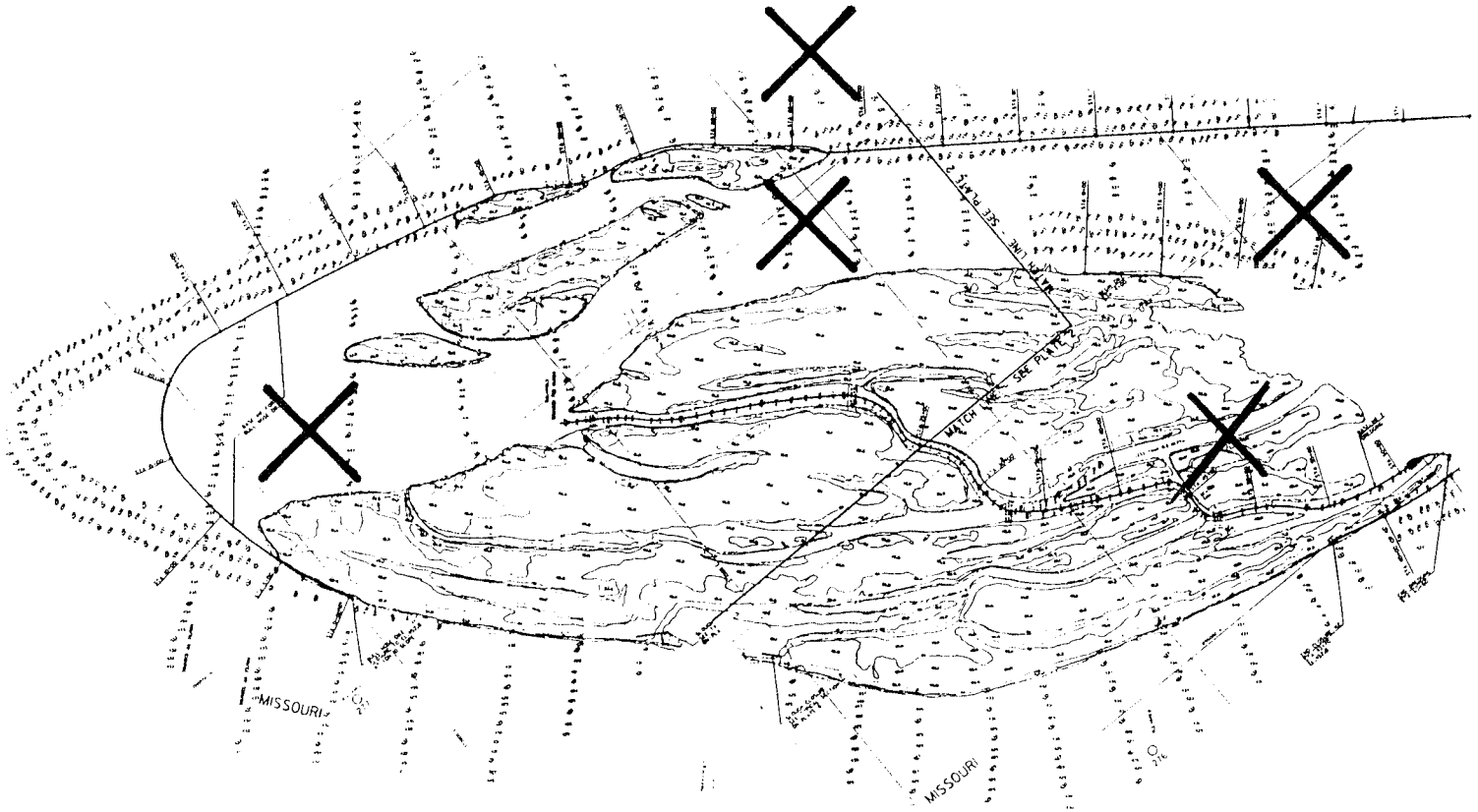
SEDIMENT MONITORING RANGES



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WATER QUALITY STATIONS