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

REPLY TO
ATTENTION OF

Planning, Programs, and
Project Management Division

SEE REPORT DISTRIBUTION LIST I (APPENDIX M)

Enclosed is the final Definite Project Report (DPR) (R-14F) with integrated Environmental Assessment and Technical Appendices for the Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project. This project is a part of the Upper Mississippi River System - Environmental Management Program.

The Lake Odessa project was proposed by the U.S. Fish and Wildlife Service (USFWS) and the Iowa Department of Natural Resources and is being developed in cooperation with the Corps' Rock Island District and other appropriate Federal and State agencies.

The goals of the proposed project are to restore and protect wetland, terrestrial, and aquatic habitats. The objectives identified to meet these goals were: (1) reduce forest fragmentation; (2) increase bottomland hardwood diversity; (3) enhance migratory bird habitat; (4) restore sand prairie habitat; (5) increase habitat for overwintering fish; (6) provide safe areas for developing fish; (7) protect habitat features; and, (8) protect archeological sites.

The recommended plan includes enhancing water level management capability at six moist soil units; enhancing fisheries by dredging Lake Odessa, Goose Pond, Yankee/Blackhawk Chutes, and Swarms/Bebee Ponds; improving forest habitat by planting mast-producing trees at four sites; protecting interior habitat features by restoring the existing perimeter levee; and improving habitat diversity by planting a sand prairie and developing a fish nursery (see Figure ES-1 of the enclosed final DPR).

All Lake Odessa project features will be located on federally owned lands managed through cooperative agreement, by the USFWS. As a result, first cost funding for enhancement features would be 100 percent Federal. Implementation of the recommended plan would increase the quality and quantity of preferred habitat.

Please provide any questions or comments regarding this report, no later than 30 days from the date of this letter, to Mr. Darron Niles, Technical Coordinator, Rock Island District Habitat Projects. You may reach Mr. Niles by calling 309/794-5400, or writing to the address above, ATTN: Planning, Programs, and Project Management Division (Darron Niles).

Sincerely,

for Duane P. Gapinski
Colonel, U.S. Army
District Engineer

Enclosure

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14F)

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

FINAL
APRIL 2005

US Army Corps of Engineers ®
Rock Island District

POOLS 17 AND 18
MISSISSIPPI RIVER
MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

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

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REPLY TO
ATTENTION OF

CEMVR-PM-F

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14F)

FINAL

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

April 2005

ACKNOWLEDGEMENT

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REPORT PREPARATION:	Mary Damewood
TECHNICAL DRAWINGS:	Nick Peschang Tom Dumoulin

US Army Corps of Engineers
Rock Island District

WE'RE PROUD TO SIGN OUR WORK

EXECUTIVE SUMMARY

The Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) is located 15 miles south of Muscatine, Iowa, on the right descending bank of the Mississippi River between river miles (RM) 434.5 and 441.5. The project lies in Louisa County, Iowa and encompasses the federally owned lands between the Iowa River on the south and Michael Creek on the north. All project lands are in Federal ownership and are managed by the U.S. Fish and Wildlife Service (USFWS) as part of the Mark Twain National Wildlife Refuge Complex. The USFWS has granted management of the project's lower half to the Iowa Department of Natural Resources (IDNR) through a cooperative agreement.

The Lake Odessa area was originally leveed off for agricultural purposes in 1913. Active wildlife management began in the mid-1950s with efforts to manipulate water levels to promote vegetative growth and provide high quality resting and feeding areas for migratory waterfowl. Levee overtopping and generally inadequate water level management capabilities often compromised these efforts. While Lake Odessa has traditionally had high fall duck and geese populations and significant duck production, levee breaks have resulted in frequent losses of emergent aquatic vegetation and mast trees when flooding is prolonged. Sedimentation from the flood events has decreased deep aquatic habitat, which reduces circulation of oxygenated water and increases the possibility of fish kills.

The goals of the proposed project are to restore and protect wetland, terrestrial, and aquatic habitat. The objectives identified to meet these goals were: (1) reduce forest fragmentation; (2) increase bottomland hardwood diversity; (3) enhance migratory bird habitat; (4) restore sand prairie; (5) increase habitat for overwintering fish; (6) provide safe areas for developing fish; (7) protect habitat features; and (8) protect archeological sites.

The following enhancement features, shown in Figure ES-1, page ES-4, and their associated plans were considered to achieve the project goals and objectives:

1. Moist Soil Unit (MSU) Enhancement
   - No action
   - Enhance water level management capability at Field 4 & 5, Field 21, and MSU 20.
   - Enhance water level management capability at Unit 2.
   - Enhance water level management capability at Fox Pond.
   - Dredge access channels to Swarms and Bebee Ponds.
   - Enhance water level management capability at IDNR MSU.

2. Fisheries Enhancement
   - No action
   - Dredge 1,490- x 751-foot area in Lake Odessa.
   - Dredge a 5,158-foot channel in Goose Pond.
   - Dredge a 6,040-foot channel between Yankee and Blackhawk Chutes.
   - Dredge access channels to Swarms and Bebee Ponds.

3. Mast tree planting
   - No action
   - Restore and improve the bottomland hardwood forest by planting 27 acres of mast trees at Sites A and B.
   - Restore and improve the bottomland hardwood forest by planting 26 acres of mast trees at Site C.
   - Restore and improve the bottomland hardwood forest by planting 40 acres of mast trees at Site D.

4. Levee Restoration
   - No action
   - Restore perimeter levee crown and interior levee side slopes, construct a spillway and wing dam, and protect archeological sites.

5. Sand Prairie Planting
   - No action
   - Plant a 36-acre field with sand prairie grasses and forbs.

6. Fish Nursery
   - No action
   - Replace a water control structure to allow for fish passage.

Evaluation of the project enhancement features and construction options was accomplished using the Wildlife Habitat Appraisal Guide (WHAG) and annualization of outputs and costs. The WHAG evaluation methodology quantifies habitat output in the form of habitat units (HUs) that are used in conjunction with project cost data and functional life expectancy to compare the construction options of the proposed enhancement features. This incremental analysis identifies which combinations of enhancement features would be both cost efficient and cost effective. This analysis also shows the changes in cost for increasing levels of environmental output.

The recommended plan—shown on Figure ES-1—includes:

(1) enhancing water level management capability at Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, and IDNR MSU, as well as dredging access to Swarms and Bebee Ponds;

(2) fisheries enhancement dredging in Lake Odessa, Goose Pond, Yankee/Blackhawk Chutes, and Swarms and Bebee Ponds;

(3) mast tree planting at Sites A through D;

(4) levee restoration;

(5) sand prairie planting; and

(6) fish nursery construction.

The benefit of each feature listed above is as follows:

(1) Enhancing water level management capability will provide more moist soil habitat, greater vegetation diversity and growth, and reliable food supplies to migratory waterfowl.

(2) Fisheries enhancement dredging will create areas of deeper water and/or access to deeper water for overwintering fish.

(3) Mast tree planting will improve the quality and quantity of forest habitat by reintroducing mast-producing species to a forest community increasingly dominated by silver maple and cottonwood.

(4) Levee restoration will provide reliable flood damage protection, reduce flood damages and levee failures, and protect archeological sites from further erosion.

(5) The sand prairie planting will increase habitat complexity and provide feeding and nesting opportunities for a wide variety of wildlife.

(6) The fish nursery will allow fry to be reared to the fingerling stage in a predator-free environment.

Implementation of the recommended plan will increase the quality and quantity of preferred habitats at this location. The project outputs meet site management goals and objectives and support the goals and objectives of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP), the North American Waterfowl Management Plan, and the Partners in Flight Program.

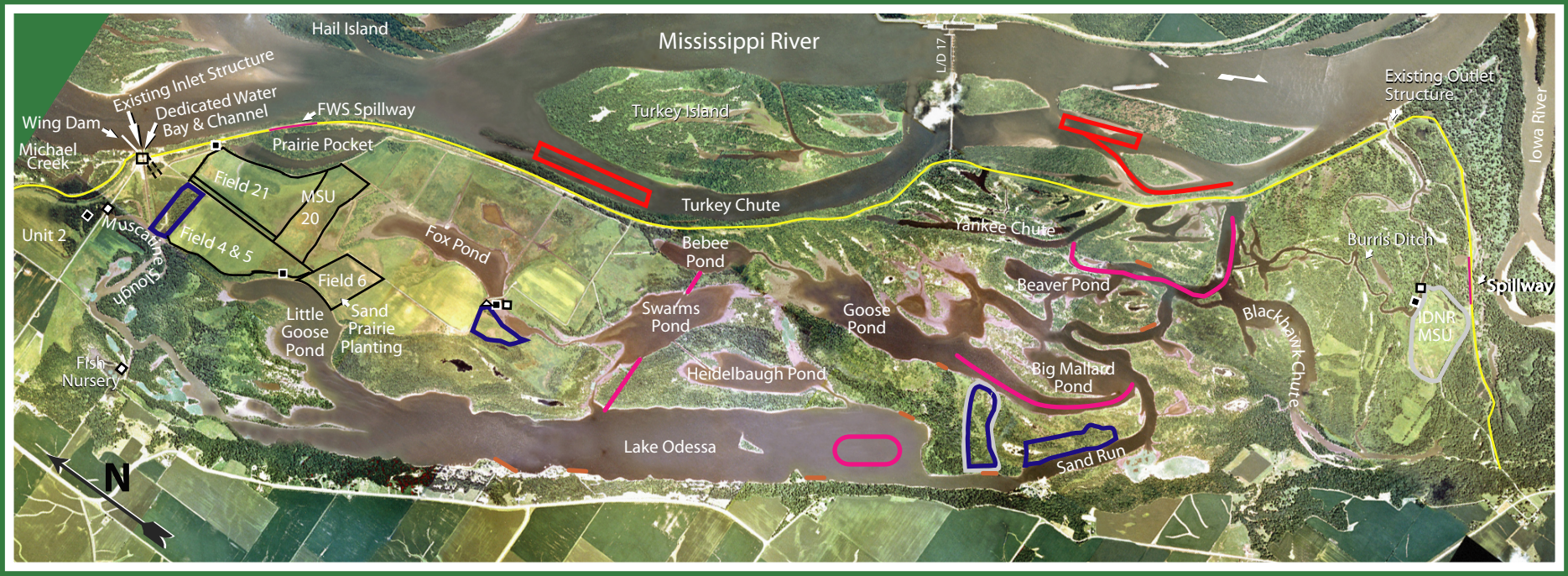
Section 906(e) of the 1986 Water Resources Development Act (WRDA) specifies that first cost funding for enhancement features "located on lands managed as a national wildlife refuge" will be 100 percent Federal. All Lake Odessa project features will be located on federally-owned lands managed through a cooperative agreement with the U.S. Fish and Wildlife Service (USFWS), the Federal project sponsor. Per Section 107(b) of the 1992 WRDA, the USFWS will accomplish project operation and maintenance at an estimated average annual cost of $63,176. The Iowa Department of Natural Resources (IDNR) is the non-Federal project sponsor.

The U.S. Army Corps of Engineers would be responsible for the Federal share of any mutually agreed upon major rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the final Definite Project Report (DPR) and that is needed as a result of specific storm or flood events. Major rehabilitation of the project is not included in the project cost estimate.

The District Engineer has reviewed the project outputs and determined that implementation of the selected plan is justified and in the Federal interest. Therefore, the Rock Island District Engineer recommends construction approval for the Lake Odessa Habitat Rehabilitation and Enhancement Project at an estimated Federal expense of $11,361,499. The total Federal cost estimate, including general design and construction management, is $14,818,648.

UMRS EMP

Figure ES-1
LAKE ODESSA
Project Location Map



LEGEND

- Restore Perimeter Levee
- Mast Tree Planting
- Dredged Material Placement Site
- Excavate Channel/Deep Holes
- Hydraulic Dredging Borrow Site
- Archeological Site Protection
- Portable Pump and/or Pad
- Replace / New Water Control Structure
- New Pump Station

0 ½ mile 1 mile
Scale

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

FINAL

CONTENTS

I. INTRODUCTION 1
- A. Purpose 1
- B. Resource Problems and Opportunities 1
- C. Project Selection 1
- D. Scope of Study 2
- E. Format of Report 2
- F. Authority 2

II. ASSESSMENT OF EXISTING RESOURCES 4
- A. Resource History and Description of Existing Features 4
- B. Water Resources and Flooding History 6
- C. Land Use and Current Area Management Objectives 7
- D. Aquatic Resources 9
- E. Water Quality 9
- F. Sedimentation 10
- G. Vegetation 10
- H. Fish and Wildlife 11
- I. Endangered Species 11
- J. Historic Properties 14
- K. Hazardous, Toxic, and Radioactive Waste 15

III. PROJECT OBJECTIVES 16
- A. Problem Identification 16
- B. General Fish and Wildlife Management Goals 17
- C. Project Goals, Objectives, and Potential Enhancement Features 18
- D. Criteria for Potential Enhancement Features 19

IV. POTENTIAL PROJECT FEATURES 20
- A. Moist Soil Unit (MSU) Enhancement 20
- B. Field 6 Sand Prairie Planting 21
- C. Fish Nursery 22
- D. Potential Deep-Water Fisheries Enhancements 22
- E. Mast Tree Planting 23
- F. Green Tree Reservoir 24
- G. Refuge Protection through Levee Restoration 24
- H. Leave Levee Breached 24
- I. Cross Dike 25
- J. Yankee Chute Gatewell 25

CONTENTS

V. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES 26
A. ENVIRONMENTAL OUTPUT EVALUATION 26
B. FEASIBLE PROJECT FEATURES 27
C. COST ESTIMATES FOR HABITAT IMPROVEMENT MEASURES 33
D. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS 34
E. SUMMARY 38

VI. RECOMMENDED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE CONSIDERATIONS 40
A. GENERAL DESCRIPTION 40
B. RECOMMENDED PLAN 40
C. PROJECT FEATURE SUMMARY 48
D. CONSTRUCTION CONSIDERATIONS 53
E. OPERATIONAL CONSIDERATIONS 53
F. MAINTENANCE CONSIDERATIONS 53
G. VALUE ENGINEERING 54

VII. SCHEDULE FOR DESIGN AND CONSTRUCTION 56

VIII. COST ESTIMATES 57

IX. ENVIRONMENTAL EFFECTS 63
A. SUMMARY OF EFFECTS 63
B. ECONOMIC AND SOCIAL IMPACTS 63
C. NATURAL RESOURCES IMPACTS 64
D. HISTORIC PROPERTIES 70
E. HUMAN USE 71
F. CUMULATIVE IMPACTS 71
G. ADVERSE IMPACTS WHICH CANNOT BE AVOIDED 72
H. SHORT-TERM VERSUS LONG-TERM PRODUCTIVITY 72
I. IRREVERSIBLE OR IRRETRIEVABLE RESOURCE COMMITMENTS 77
J. RELATIONSHIP OF THE PROPOSED PROJECT TO LAND-USE PLANS 77
K. COMPLIANCE WITH ENVIRONMENTAL QUALITY STATUTES 77

X. PROJECT PERFORMANCE ASSESSMENT MONITORING 78

XI. REAL ESTATE REQUIREMENTS 84

XII. IMPLEMENTATION RESPONSIBILITIES AND VIEWS 84
A. CORPS OF ENGINEERS 84
B. U.S. FISH AND WILDLIFE SERVICE 84
C. IOWA DEPARTMENT OF NATURAL RESOURCES 85

XIII. COORDINATION, PUBLIC VIEWS, AND COMMENTS 85
A. COORDINATION MEETINGS 85
B. COORDINATION BY CORRESPONDENCE 86

XIV. CONCLUSIONS 92

CONTENTS

RECOMMENDATIONS

FINDING OF NO SIGNIFICANT IMPACT

LITERATURE CITED

FIGURES

ES-1 Lake Odessa Project Location Map ES-4
2-1 UMR, Pool Land Cover/Land Use 5
5-1 MSU Best Buy Plans 36
5-2 Fisheries Best Buy Plans 37
9-1 Potential Lake Odessa EMP Project Features 76

TABLES

3-1 Project Goals, Objectives, and Potential Enhancement Features 18
3-2 Potential Enhancement Features Development Criteria 19

5-1 Environmental Output and Costs of Each Feature 27
5-2 Moist Soil Unit Enhancement: Best Buy Combinations 35
5-3 Fisheries Deep-Water/Access Enhancement: Best Buy Combinations 37

6-1 Lake Odessa Project Feature Summary Table 49
6-2 Probable Construction Sequence 55

7-1 Project Implementation Schedule 56

8-1 Project Cost Summary 57
8-2 Detailed Project Cost Summary 58
8-3 Estimated Annual Operation and Maintenance Costs 62
8-4 Estimated Post-Construction Annual Monitoring Costs 62

9-1 Archeological Site Status as Documented by Phase II Testing 73
9-2 Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements 77

10-1 Monitoring and Performance Evaluation Matrix 79
10-2 Resource Monitoring and Data Collection Summary 80
10-3 Sedimentation Transect Project Objectives Evaluation 82
10-4 Post-Construction Evaluation Plan 83

CONTENTS

PLATES

1	Location Plan, Index, and Vicinity Map
2	Orthophoto of Existing Features
3	Recommended Plan Upper End
4	Recommended Plan Lower End
5	Alternatives Evaluated Upper End
6	Alternatives Evaluated Lower End
7	Alternatives Not Evaluated Upper End
8	Alternatives Not Evaluated Lower End
9	Perimeter Levee Plan
10 through 30	Plans and Profiles
31	Typical Sections I
32	Typical Sections II
33	Dedicated Water Bay
34	Fish Nursery Stoplog Structure
35	Muscatine Slough Water Control Structure
36	Access Road Water Crossing for Dedicated Water Bay
37	Fox Pond Water Control Structure
38	Iowa DNR Moist Soil Unit Water Control Structure
39	Portable Pumps and Pump Pads
40	Fox Pond Pump Station Plan and Detail
41	Mast Tree Planting Details
42	Boring Locations Upper End
43	Offshore Borings-Upstream
44	Boring Locations Lower End
45	Offshore Borings-Downstream
46 through56	Boring Logs I-X
57	Pre-Construction Monitoring Plan
58	Future Monitoring Plan

APPENDICES

A	Correspondence
B	Clean Water Act, Section 404(b)(1) Evaluation
C	Draft Memorandum of Agreement
D	Habitat Evaluation and Quantification and Incremental Cost Analysis
E	Hazardous, Toxic, and Radioactive Waste Documentation Report
F	Water Quality
G	Geotechnical Considerations
H	Sedimentation
I	Hydrology and Hydraulics
J	Cost Estimate
K	Structural Analysis
L	Real Estate Plan
M	Distribution List

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

FINAL

I. INTRODUCTION

A. Purpose. The purpose of this report is to present a detailed proposal for the rehabilitation and enhancement of the Lake Odessa project area. This report provides planning, engineering, and sufficient construction details of the recommended plan to allow final design and construction to proceed subsequent to approval of this document.

B. Resource Problems and Opportunities. The northern portion of the Lake Odessa complex is part of the U.S. Fish and Wildlife Service (USFWS) Mark Twain National Wildlife Refuge Complex, Port Louisa National Wildlife Refuge, Louisa Division. The Iowa Department of Natural Resources (IDNR) through a cooperative agreement with the USFWS manages the southern portion of the area, the Lake Odessa State Wildlife Management Area. The project area is comprised of a large lake (Lake Odessa), several other backwater bodies of water, wooded land, and open fields.

Lake Odessa is highly susceptible to seepage, making it difficult to maintain wetlands that waterfowl populate. In addition, Lake Odessa has decreased in depth over the years, which is detrimental to overwintering fish. During multiple flood events, Lake Odessa's perimeter levee has been breached, causing severe damage to the habitat features of the refuge.

Significant opportunities are available for preserving, enhancing, and developing habitat for migratory birds, fish, and endangered species by enhancing and developing wetlands, planting mast trees, and creating deep holes/channels in the lake and backwater areas.

C. Project Selection. The USFWS nominated the Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) for inclusion in the Rock Island District's Environmental Management Program (EMP). The Fish and Wildlife Interagency Committee (FWIC) then ranked the project habitat benefits based on critical habitat needs along the Mississippi and Illinois Rivers. After considering resource needs and deficiencies pool by pool, the Lake Odessa HREP was recommended and supported by the FWIC and the River Resources Coordinating Team (RRCT) as providing significant aquatic, wetland, and terrestrial benefits with opportunities for habitat enhancement. Enhanced capability to manage the project area for migratory birds, fish, and wildlife use only would be achieved by implementing the proposed project enhancement features. Development of this report was actively coordinated with the project sponsors—the USFWS and the IDNR. Coordination occurred during on-site visits to the project area, team meetings, and phone conversations (Appendix A, *Correspondence*).

D. Scope of Study. The 6,788-acre Lake Odessa project area is located in Louisa County, Iowa, between River Miles (RM) 434.5 and 441.5 and is approximately 15 miles south of Muscatine, Iowa, in Pools 17 and 18. All project lands are in Federal ownership. Plate 1 provides vicinity and general location maps for Lake Odessa.

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

Field surveys, aerial photography, and habitat quantification procedures were completed to support the planning and assessment of proposed project alternatives. Hydrographic soundings were performed in developing sedimentation rates and estimating excavation quantities. Soil borings were taken to determine soil types and construction difficulty. Soil tests were performed to determine the characteristics of the material to be worked with. Baseline water quality monitoring was performed to define present water quality conditions/problems.

The USFWS and the IDNR have made wildlife and resident fish observations within the study area. These observations, along with future studies and monitoring, will assist in evaluating project performance.

E. Format of Report. The report is organized to follow a general problem-solving format. The purpose, problems, and project selection process are presented in section I. Section II establishes the baseline for existing resources. Section III provides the goals and objectives of the project. Sections IV and V propose and evaluate project alternatives. Section VI describes the recommended plan and lists general design and construction considerations. Section VII describes the schedule for design and construction. Section VIII contains cost estimates for initial construction and annual operation and maintenance. Section IX assesses the environmental effects of the recommended plan. Section X details the performance evaluation and monitoring plans. Section XI describes real estate requirements. Sections XII and XIII summarize implementation requirements and coordination. Sections XIV and XV present the conclusions and recommendations. Section XVI contains a Finding of No Significant Impact statement. Drawings (plates) and appendices have been furnished to provide sufficient detail to review the existing features and the recommended plan.

F. Authority. The Upper Mississippi River System - Environmental Management Program (UMRS-EMP) is currently a Federal-State partnership to (1) plan, construct, and evaluate measures for fish and wildlife habitat improvement through Habitat Rehabilitation and Enhancement Projects (HREP) and (2) monitor the natural resources of the river system through the Long Term Resource Monitoring Program (LTRMP). The Water Resources Development Act (WRDA)t of 1986 (P.L. 99-662) states: "To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. Congress further recognizes that the system provides a diversity of opportunities and experiences. The system shall be administered and regulated in recognition of its several purposes" (Section 1103). The Environmental Management Program was originally comprised of five elements: HREP; LTRMP; Recreation Projects; Economic Impacts of Recreation; and Navigation Monitoring. Currently, EMP is only comprised of two elements—HREP and LTRMP. The other EMP elements either have been successfully completed or are now carried out under other authorities.

The original authorizing legislation has been amended three times since its enactment. The 1990 WRDA, Section 405, extended the original EMP authorization an additional 5 years to FY 2002, which allowed for ramping up of the program. The 1992 WRDA, Section 107, amended the original authorization by allowing limited flexibility in how funds are allocated between the habitat projects program and the long-term resource-monitoring program. WRDA 1992 also assigned sole responsibility for operation and maintenance of habitat projects to the agency that manages the lands on which the project is located. The 1999 WRDA, Section 509, reauthorized EMP as a continuing authority with Reports to Congress every 6 years and changed the cost sharing percentage from 25 percent to 35 percent. The Lake Odessa HREP has no cost-sharing requirement because all project features are located on federally owned land managed by the USFWS as a national wildlife refuge.

II. ASSESSMENT OF EXISTING RESOURCES

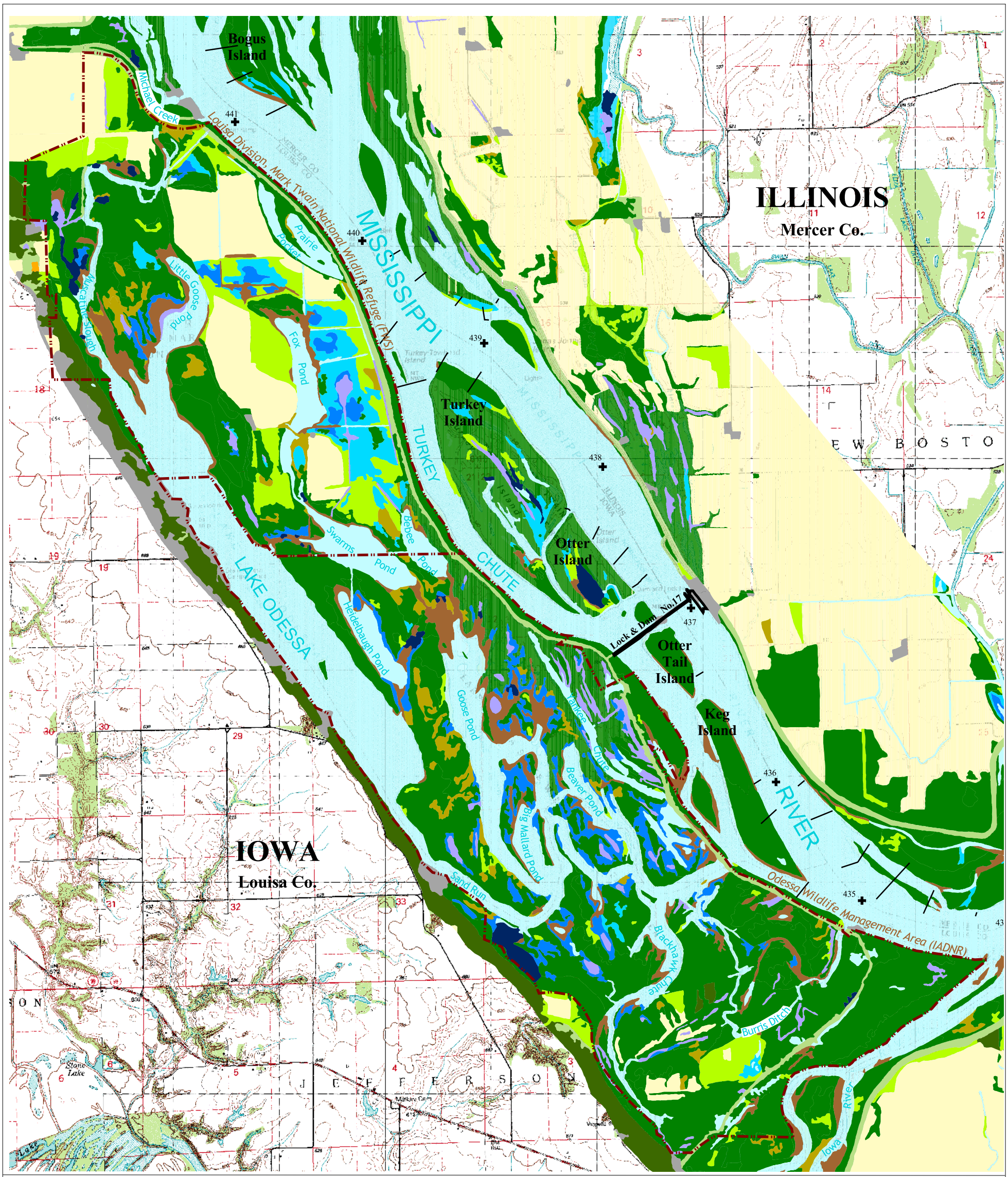
A. Resource History and Description of Existing Features. (See plate 1.) The Lake Odessa complex is Corps of Engineers fee title land that is managed jointly by the USFWS and the IDNR. The entire complex is located in Louisa County, Iowa. The USFWS lands, known as the Louisa Division, are located in the northern portion of the complex and are part of the Mark Twain National Wildlife Refuge Complex, Port Louisa National Wildlife Refuge. This 2,609-acre area stretches from RM 438 to 441. The 48-acre Port Louisa Refuge headquarters area, located on the bluff, is the only USFWS fee title property. The IDNR lands, in the southern portion of the complex, comprise the 4,179-acre Odessa Wildlife Management Area, from RM 434 to 438. The total IDNR acreage contains 3,828 acres of Federal land under license and 351 acres of State-owned land. Both areas are protected by a levee system along the Mississippi River to the east and the Iowa River to the south. The total acreage for the complex is 6,788 acres. The Lake Odessa complex boundaries and vegetative cover types are shown on Figure 2-1.

The Mississippi River corridor, also known as the Mississippi River Flyway, has historically been, and still is, the prime corridor for migratory waterfowl, neotropical migratory birds, and many other avian species. These birds utilize the flyway to migrate from breeding areas located in the northern United States and Canada and wintering areas in southern North America, Central America, and South America. The floodplain corridor, with its network of wetlands, bottomland forest, and grasslands, also provided habitat for a great variety of fish and wildlife species.

The Lake Odessa complex was formerly a part of the Muscatine-Louisa County Joint Drainage and Levee District Number 13. Construction of the levees originally began in 1913 for flood protection of agricultural land. Pumping plants were built in 1914 and 1920 to better drain the area inside the levee for farming. Because of seepage from the river through the levee and periodic flood events, pumping was necessary to allow farming of the area. Prior to completion of Lock and Dam 17, approximately 26 percent of the area was cultivated, though general crop production was poor. By 1937, control of water levels became too costly and all pumping operations ceased. Farming was reduced to a minimum, even two years before Lock and Dam 17 was placed in operation in 1939. Most of the Mississippi River floodplain was also leveed, drained, and farmed by that time. This cumulative change in land use, over time, influenced by agriculture, urbanization, flood control, and navigation, has led to a decline in both the quality and quantity of fish and wildlife habitat in the floodplain.

The Corps' involvement began in the late 1930s when the Odessa Bottoms were purchased in preparation for construction of the lock and dam system and the 9-foot navigation channel. In 1945, much of the land purchased by the Corps, but not needed for navigation purposes, was transferred to the USFWS for management. By the late 1940s, several of the Corps' General Plan units, managed by the USFWS, had been designated as individual National Wildlife Refuges, including the Louisa Refuge. The Mark Twain Refuge Complex, and the individual refuges within it, was officially established in 1958. The Lake Odessa area has been managed primarily in the interest of the national migratory bird management program.

The USFWS partnered with the Iowa Conservation Commission (ICC) in 1946 to transfer management of a portion of the Louisa Refuge lands to the State for wildlife management through a Cooperative Agreement. In 1947, the State purchased the land at the present Schafer Access and later purchased more land at the present Snively Access. In 1954, the ICC installed the first inlet and outlet structures at the Lake Odessa complex. This gave the ICC the ability to regulate Lake Odessa's water level, primarily for waterfowl management. This water level management continues to be a joint venture with the USFWS.



Lake Odessa

UMR Pools 17 and 18

2000 Land Cover

	Acres*		Acres*
Open Water	1,631	Grass/Forbs	121
Submerged Aquatic Vegetation	131	Upland Forest	41
Rooted Floating Aquatics	56	Sand/Mud	351
Deep Marsh	296	Agriculture	452
Shallow Marsh	182	Developed	19
Wet Meadow	412		
Wet Shrub	151		
Wet Forest	2,702		

River Mile Marker
Wing Dam
Refuge/Wildlife Area Boundary

* Acres within the Refuge /Wildlife Area

0.5 0 0.5 1 Miles

N

US Army Corps of Engineers
Rock Island District

Figure 2-1

In addition to the inlet and outlet structures and perimeter levee, interior features currently present in the Lake Odessa complex are numerous. On the USFWS-managed lands, Field 4 & 5, moist soil unit (MSU) 20, MSU 21, and Unit 2 are currently managed primarily for migrating waterfowl. Each of these areas has a low berm, a water control structure (stoplog), and water supply ditches. The current MSU water supply system, originating at the inlet structure, allows water entering the complex to flow into either the main lake or the water supply ditch, but not both. Portable pumps can be brought in to assist filling the MSUs in the fall. In addition, a pump at Fox Pond can be used to drain the area to promote wetland plant growth. The IDNR also has an MSU, although it can only be partially filled because of a sand lens or seam in the unit. In the past, access to Swarms and Bebee Ponds and Yankee Chute has been deepened. Siltation has reduced the depths of these ditches, stranding fish and reducing management options.

B. Water Resources and Flooding History. Lock and Dam 17 is located at RM 437.1 where it ties into Lake Odessa's perimeter levee. The normal water level upstream of the dam is 535.87 MSL, which corresponds to a flat pool stage of 9.3 feet. Water levels downstream of the dam are highly variable and range from a stage of 1.68 feet (1988) to 25.90 feet (1993). Flood stage is 14.0 feet.

Historically, the Lake Odessa complex was a braided side channel of the Mississippi River. The main lake was a flowing chute with smaller chutes throughout the area with interconnected backwater areas. The area was flooded during high water periods, primarily in the spring. During low water periods, usually in the summer, the water drained slowly from the area. This seasonal flooding and subsequent drying in the unrestricted floodplain created a diverse ecosystem.

The Lake Odessa complex has a long history of flooding, even after construction of the current levee system. The levee was breached in 1947, 1951, 1952, 1965, 1969, 1973, 1990, 1993, and 2001. The Corps, USFWS, and the IDNR have all participated in levee repairs. Some portions of the levee have been improved during repair operations, but other sections have never been improved, only maintained. This has resulted in a levee with numerous low spots and improper slopes.

The Flood of 1993, the worst for the complex, caused major impacts to the Lake Odessa complex. The levee was breached in two places; the inlet and outlet structures were rendered inoperable; large amounts of sediment were deposited inside the levee; and the entire area was flooded for 5 months, essentially the entire growing season. This prolonged flooding greatly impacted the seasonal vegetation and had long-term impacts on the bottomland hardwood forest. Tree mortality was increased, impacting mast-bearing trees such as oaks and pecans, while favoring more flood-tolerant species such as silver maple. The USFWS and IDNR, with assistance from the Corps and the NRCS, replaced the inlet and outlet structures and repaired damage to interior features.

The Flood of 2001 also caused major impacts to the Lake Odessa complex. In order to minimize the head differential between the river and the complex interior, water levels were raised inside the area to compensate for rising river levels. However, the inlet and outlet structures did not allow the interior of the complex to fill with water as fast as the rising river levels. The levee breached or was overtopped in seven places. On the USFWS managed land, approximately 1,800 feet of levee were lost, 2,000 feet of service roads and auto tour routes were damaged, 3 parking lots were scoured out, over 1,500 feet of ditches were filled in, and from 2 inches to over 4 feet of sediment was deposited into the refuge wetland units. Wind-driven waves damaged the entire length of the Michael Creek and Mississippi River levees. Water control structures were damaged and the main pumping station and

pump were disabled. The IDNR managed lands also suffered damage. Two levee breaks occurred on the Mississippi River levee: 150 feet long near Beebe Pond and 177 feet long at the outlet works. The levee separating the Odessa complex from the Iowa River broke in two places—a 332-foot-long break near the Toolesboro access road (with 8-foot-deep scour hole) and a 228-foot-long break between the base of the bluff and the Toolesboro sub-impoundment (IDNR MSU) (with a 10- to 15-foot-deep scour hole). In addition, several hundred feet of levee along the Mississippi River and a short area along the Iowa River were damaged by erosion.

C. Land Use and Current Area Management Objectives. The Lake Odessa complex is probably best known for migratory waterfowl concentrations. The complex's mixture of large shallow lakes, isolated ponds, marsh, and forest attract many fish and wildlife species. The abundance of wildlife makes the complex one of southeast Iowa's most popular destinations for outdoors enthusiasts. Although the current management and future goals of the USFWS and IDNR are similar, there are some minor differences.

The USFWS has a main management strategy of managing for migratory birds with a secondary focus on wading birds, shorebirds, and other wetland-dependent wildlife species. With waterfowl as the main focus, the area is kept as open and treeless as possible with adequate feeding and resting areas for the birds. This succession setback is accomplished through farming (up to 330 acres), burning (1,042 acres), mechanical treatment, and water level management (800 acres). While Lake Odessa currently has a strong waterfowl population and migratory bird use, a future goal for the USFWS is to make the refuge water level management more reliable. Their objective is to accomplish this by creating a constant and reliable water source for existing MSUs, and a capability to shallowly flood a larger area with less labor-intensive maintenance. This portion of the complex is closed to all public access during the fall migration period, from mid-September to February 1st t, thereby providing a valuable and protected resting and feeding area for migratory waterfowl.

The IDNR has similar management strategies, with the main emphasis on water level management of the entire complex. With water level management, the main objective is waterfowl management, but the total management strategy encompasses entire assemblages of species and the habitat complexes upon which they depend. For example, water level management at Lake Odessa benefits waterfowl, as well as wading birds, shorebirds, snakes, fish, etc. It is also aimed at maintaining a diverse bottomland forest, which is critical to a whole array of both migratory and resident songbirds and raptors. To enhance the current conditions, IDNR objectives are to create more reliable resting and feeding areas for migratory birds, improve the bottomland hardwood population through increased tree species diversity, create more deep-water fish habitat, and protect the refuge features by strengthening the main levee system.

Because the entire Lake Odessa complex is hydraulically connected, the USFWS and the IDNR work together to manipulate water levels within the levee. Water level management is accomplished by gravity flow through the inlet and outlet structures. River conditions permitting, the following illustrates the water level management goals for the main lake. Gage readings are taken at Schafer's Landing.

December 1 to April 1 – maintain at 534.5 MSL
April 1 to July 15 – slow drawdown to 532.5 MSL
July 15 to August 15 – maintain at 532.5 MSL
August 15 to September 15 – raise to 534.0 MSL
September 15 to October 15 – raise to 535.0 MSL
October 15 to November 1 – raise to 535.5 MSL
November 1 to December 1 – raise to 536.0 MSL

The current configuration of the inlet structure allows water to be directed to either the main lake or to the USFWS MSUs (4 & 5, 20, 21) supply ditches via a stoplog structure, but not both. During low-water years, water control reliability is lost, mainly at the expense of the MSUs. In addition, seepage through the perimeter levee, flooding, and levee breaches all contribute to make water level control more difficult.

Management techniques for MSUs can be passive or active. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires a dewatering (or drawdown) in the spring or early summer as an initial step. Gravity flow is the most common and most cost-effective method. The timing and rate of drawdown influence the plant germination and thus the usage by waterfowl and other wetland wildlife. MSUs are flooded gradually beginning in September, maximum water depths are maintained through early November, and slow drawdown begins after spring flooding. The current management scheme for the USFWS MSUs is as follows:

Unit 2 – flood in spring, for migratory waterfowl and shorebirds
Field 4 & 5 – flood in fall, but water availability limits depth (only 10 acres flood reliably)
MSU 20 – flood in fall, but water availability limits depth
MSU 21 – flood 25 percent of area in fall, but water availability limits depth
Fox Pond – summer drawdown followed by fall flooding, pumping capabilities limit the area of drawdown and fall flooding

Pumps can be utilized at the MSUs and at Fox Pond to augment the gravity flow system or to dewater a unit, but are not always available.

The area designated at the fish nursery (plate 3) is an existing refuge wetland that is primarily managed for migratory birds; however, the existing water control structure is inoperable. Therefore, water control of this area is tied directly to water levels in the main lake.

In addition, the USFWS also has up to 330 acres in crop production to provide supplemental high-energy food sources to waterfowl and as a method of reducing tree invasion. Typical crops are corn, winter wheat, milo, buckwheat, and Japanese millet. Beginning in the 1970s, the number of acres under cultivation has been slowly reduced, with an increased emphasis on wetlands and MSUs to provide a healthy, diverse food source for migratory waterfowl and other wildlife. In 1980, over 1,000 acres were still cultivated. A further reduction in cultivation, but still higher than present, can be seen in Figure 2-1, which shows Fields 4 & 5, 6, and 21, and Unit 2, as well as other areas, as agricultural fields. In 1985, a small, 25-acre sand prairie was established on the highest ridge of the refuge (portion of Field 6). Even though the 1993 flood heavily impacted this site, some warm season grasses and forbs survive. Prescribed burning of the unit helps maintain vegetation diversity.

The IDNR MSU (Toolesboro sub-impoundment) has water pumped into the unit during the fall but is otherwise left alone during the spring and summer. Because of seepage, the water level within the unit responds to interior lake levels to some degree. The unit can dry completely in the late summer. A suspected sand seam in the unit only allows one-third of the area to be flooded before the water escapes through seepage at a faster rate than pumping can maintain desired water levels.

The Corps' long-term forest management goal is to "manage project lands to provide a continuing public benefit from natural resources by perpetuating a diversity of ecological communities that are suitable for a variety of public purposes". The primary focus has been on restoration and conservation of floodplain forests. Through participation in EMP projects, such as Lake Odessa, the Corps foresters have played an active role in regenerating mast-producing trees on higher sites in the floodplain. At Louisa Division, the Corps planted five acres of trees at the northern end of MSU 21 in 2001.

The Corps continues a forest management program on the IDNR-managed lands as well. Forest resources have been inventoried, and a thinning cut was recently completed in 2002 to enhance pin oak acorn production and pin oak tree regeneration. Additional timber stand improvement projects were finished to release sapling pin oaks from the heavy shade of overstory cottonwood and silver maple. Since the Flood of 1993, almost all mature oaks, hickories, sycamores, and hackberries have died and pecans have begun to decline. Regeneration is now dominated by silver maple.

In addition, the IDNR maintains some small fields, totaling approximately 69 acres, in the southern portion of the complex. Crops of corn, grain sorghum, winter wheat, and legumes are rotated to provide a diversity of feeding options to deer, turkeys, quail, and songbirds. Waterfowl hunting is allowed on the IDNR-managed lands.

D. Aquatic Resources. The availability of overwintering habitat is critical to the survival of many species of fish, such as largemouth bass and bluegill. Those fish with low energy reserves in the spring will be less likely to have healthy and successful spawn, maturation of their eggs, and emergence of fry. Suitable overwintering habitat provides deeper, well-oxygenated water with little or no current velocity, ensures sufficient depth to prevent ice cover from blocking fish egress, and promotes dissolved oxygen ingress. These conditions are limited in the Lake Odessa complex. During the winter months, the current maximum water depth in the complex is at or about 6 feet, primarily in the main lake. Approximately 25 percent of the main lake is currently 5 to 6 feet deep, with less than 0.5 percent deeper than 6 feet. As late as 1952, the maximum depth was thought to be 15 feet, with an average depth of 4 feet.

Because the Lake Odessa complex was once connected to the main river, water flowed through the system more regularly, utilizing many different routes, and with higher velocities than current conditions allow. Construction of the main levee also isolated some former side channels from the river, such as Yankee Chute. Access channels to isolated waters, such as Bebee and Swarms Ponds, have lost depth over time due to siltation. This lack of free exchange of water and access at times led to reduced dissolved oxygen and fish kills.

E. Water Quality. Sedimentation in the Lake Odessa backwater complex has resulted in a preponderance of shallow water habitat that has negatively impacted water quality. The lake is highly susceptible to resuspension of bottom sediments from wind- and boat-induced waves. Circulation of oxygenated water has decreased in portions of the complex that have become isolated from the main

flow path due to sedimentation. This is particularly true for Yankee Chute, where winter fish kills have been reported. No formal records have been kept; however, anecdotal evidence suggests that minor fish kills, notably for bluegills, occur almost every winter. Larger kills of several hundred fish occur every 3-4 years.

Baseline water quality monitoring was performed between 1990 and 1998 at four sites within the Lake Odessa complex. (See plate 57 for locations.) Occasionally, dissolved oxygen concentrations below the state standard, and pH values above the state standard were measured. Most dissolved oxygen measurements less than 5 mg/l were observed during the summer months. Fewer low dissolved oxygen concentrations were observed during the winter months; however, winter fish kills reported prior to the initiation of baseline monitoring were presumably due to low dissolved oxygen concentrations. All pH values greater than 9 were most likely due to plant photosynthetic activity. A detailed analysis of baseline water quality monitoring results can be found in Appendix F, *Water Quality*.

F. Sedimentation. The Lake Odessa Wildlife Refuge has experienced continual sedimentation from the time Lock and Dam 17 went into operation in 1939. Before this, the refuge area was in a braided portion of the Mississippi River side channel. The islands in the braided channel consisted of sand bar deposits that exist in the refuge today. Much of the coarse-grained sediment was stopped from entering the refuge by the construction of a perimeter levee and inlet and outlet structures. Heavy deposition can still occur during periodic flood events that overtop the perimeter levee. Barring levee breaching, typical sedimentation rates are from 1-3 centimeters per year. The rate of sediment accumulation entering Lake Odessa from the Mississippi River was estimated using the findings of the *Upper Mississippi River and Illinois Waterway Cumulative Effects Study*, which examined sedimentation rates in many backwater locations of the Upper Mississippi River.

G. Vegetation. Non-forested wetlands and bottomland hardwood forest are the two main vegetation types found at the Lake Odessa complex. Figure 2-1 uses 2000 data to show the various vegetative cover types and acreages within the project boundary. These cover types can be grouped into three broad categories: nonforested wetland (~1,700 acres), bottomland hardwood forest (~2,900 acres), and open water (~1,800 acres). The remaining 388 acres of the 6,788-acre project area are comprised of uplands, developed areas, or cultivated lands. All lands within the leveed area of the Lake Odessa complex, with the exception of the bluff area, are considered wetlands. Most of the agricultural lands shown on this figure have been allowed to return to native vegetation (non-forested wetland). Most of the non-forested wetlands are found on the USFWS-managed lands, many within the actively managed MSUs. Common wetland plants include smartweeds, sedges, rushes, cattails, bulrushes, millet, arrowhead, beggar ticks, and burreed. Migrating waterfowl find this combination of water and natural seed an irresistible place to feed and rest. Selected areas have also been planted to native grass and mixtures of alfalfa, clover, and grasses in order to provide nesting habitat for waterfowl and other resident wildlife. These areas of dense cover also provide valuable shelter for resident wildlife during the winter months.

The majority of the bottomland hardwood forest is located on the IDNR-managed lands. This area displays typical silver maple association forest cover. Silver maple is the dominant species, which produces an edible seed in the spring but does not provide any hard or soft mast for wildlife consumption in the summer or fall months. Due to the agricultural clearing and changed hydrologic conditions, mast-producing tree species such as oak, hickory, pecan, and walnut have declined in the Rock Island District portion of the Upper Mississippi River. Mature, hard mast-producing species

such as oak or pecan are present on the Lake Odessa complex. Soft mast-producing species such as hackberry, sugarberry, and sycamore have had their numbers severely reduced by mortality resulting from severe flooding in 1993. Young, vigorous stands of mast trees are not common and, as such, river biologists and foresters are concerned about the future availability of mast as a winter food source for wildlife in the floodplain forests in the region.

Few actively cultivated agricultural fields remain at the complex. Over time, there has been a shift away from agricultural row crops as the primary wildlife food source to more reliance on naturally occurring plants. MSUs can be manipulated to enhance species diversity to provide a healthy, diverse diet for waterfowl. Row crops are still planted, but at a reduced level, as a supplementary, high-energy food source. Ducks and geese use these fields during the prime migration times. Squirrels and deer utilize this food throughout the winter. In many years, the crop fields are not planted due to spring floodwaters. In these years, invasive plant species dominate the site. Wildlife value derived at these sites during those years is variable, dependent on the plant species present.

H. Fish and Wildlife. Lake Odessa supports a diverse fishery in its complex of ponds, backwater sloughs, and in the main lake. The primary species are crappie, largemouth bass, bowfin, bluegills, carp, buffalo, and gizzard shad. The fish populations are relatively stable; however, this stability is disrupted by periodic flood events. In addition, fish kills have been documented in more isolated water bodies because of low dissolved oxygen concentrations.

Many different bird species use the Lake Odessa complex for all or part of their life cycle. The most common migratory waterfowl species are mallard, pintail, wigeon, blue-and green-winged teal, gadwall, black ducks, and Canada and snow geese. Common migrants include bald eagles, ospreys, and white pelicans. The Lake Odessa complex contains a mosaic of forest and shallow sloughs, and in addition, has several actively managed moist soil units. In the sloughs, wood ducks forage for duckweed and invertebrates during the migration and brooding periods of the year. Prothonotary warblers, pileated woodpeckers, wood ducks, hooded mergansers, and red-shouldered hawks are known to nest in the area. Herons, egrets, rails, bitterns, and a wide variety of other shore and wading birds are commonly seen feeding in the complex wetlands during the summer. Less commonly observed bird species include wild turkeys, ring neck pheasants, and bobwhite quail.

Common wildlife species include white-tailed deer, small-mouthed salamanders, and yellow-bellied water snakes. Other wildlife species using the complex include raccoons, deer, frogs, muskrat, beaver, opossum, red fox, and coyote.

I. Endangered Species. The following is a list of federally-threatened and endangered species potentially found in Louisa County, Iowa:

Status	Common Name	Scientific Name
E	Higgins' Eye Pearly Mussel	*Lampsilis higginsi*
E	Indiana Bat	*Myotis sodalis*
T	Bald Eagle	*Haliaeetus leucocephalus*
C	Eastern Massasauga Rattlesnake	*Sistrurus catenatus catenatus*

T = threatened
E = endangered
C = candidate

Higgins' eye pearly mussels usually inhabit coarse gravel, cobble substrate. Because of the dominance of sand and silty materials in the project area, these species are not likely to occur within the leveed area. Mussel beds are known to occur in the main channel of the Mississippi River in proximity to the Lake Odessa area. Dredging in Turkey Chute, as a source of material for the levee restoration, has been coordinated with the USFWS. No impacts to mussels are anticipated, and no mussel survey would be required prior to dredging in this area. (See Appendix A, *Correspondence*).

During the summer, Indiana bats frequent the corridors of streams with well-developed riparian woods, as well as mature upland forests in this part of Iowa and Illinois. They forage for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation, along the borders of croplands, along wooded fencerows, and over farm ponds and pastures. During the summer, the bats roost, rear their young beneath the loose bark of large dead or dying trees, and prefer standing dead trees with loose bark and enough space to roost between the bark and the trunk. These roost trees are typically located within 1,600 feet of a stream or river. Indiana bats winter in caves or mines.

Bald eagles are regularly seen using the Mississippi River corridor area in and around the Lake Odessa complex during migration for resting and feeding, as well as a nesting area. The Lake Odessa complex contains many mature trees that are a key component for eagle habitat, both for roosting and nesting. Two nests in the complex are currently active. Though proposed for de-listing, the bald eagle would still be protected by the Migratory Bird Treaty Act and the Bald Eagle Protection Act.

The eastern massasauga rattlesnake is a candidate for listing under the Endangered Species Act. Massasaugas show a strong affinity for wetlands, but also use upland habitats during part of the year. Structural characteristics of a site are more important than vegetation type. Important components include both sunny and shady areas for thermoregulation, the presence of the water table near the surface for hibernations, and variable elevations between the lowland and upland areas. No known populations of massasaugas remain at Lake Odessa.

The following is a list of Iowa threatened and endangered species potentially found in Louisa County, Iowa. Some of these species may only be found in the rare sand prairie complex located north of the Lake Odessa complex and south of the city of Muscatine, Iowa.

Status	**Common Name**	**Scientific Name**
E	Bald Eagle*	*Haliaeetus leucocephalus*
E	Red-shouldered Hawk*	*Buteo lineatus*
E	King Rail*	*Rallus elegans*
E	Indiana Bat*	*Myotis sodalis*
E	Higgins' Eye Pearly Mussel*	*Lampsilis higginsi*
T	Butterfly Mussel	*Ellipsaria lineolata*
T	Squawfoot Mussel	*Strophitus undulatus*
E	Copperbelly Water Snake*	*Nerodia erythrogaster neglecta*
E	Western Hognose Snake	*Heterodon nasicus*
T	Diamondback Water Snake*	*Nerodia rhombifer*
E	Yellow Mud Turtle	*Kinosternon flavescens*
T	Blanding's Turtle*	*Emydoidea blandingii*
T	Ornate Box Turtle	*Terrapene ornata*
T	Central Newt	*Notophthalmus viridescens*
T	Grass Pickerel	*Esox americanus*
T	Orangethroat Darter	*Etheostoma spectabile*

E	Dwarf Dandelion	*Krigia virginica*
E	Curved-pod Corydalis	*Corydalis curvisiliqua*
T	Flax-leaved Aster	*Aster linariifolius*
T	Slender Dayflower	*Commelina erecta*
T	Yellow Monkey Flower	*Mimulus glabratus*
T	Brittle Prickly Pear	*Opuntia fragilis*

T = threatened
E = endangered
*= likely or known in project area

Those species most likely to occur in the project area are discussed in more detail as follows.

Red-shouldered hawks (*Buteo lineatus*) are listed as a state-endangered species in Iowa. This species requires large tracts of mature floodplain or riparian forest for nesting. These birds prefer a mature forest structure, with a well-developed canopy and an open sub-canopy for nesting sites. Forests on the edge of the river valley, adjacent to upland or valley slope forests, have the highest occupancy rate. A nesting pair has been observed at the south end of the complex in recent years.

King rails (*Rallus elegans*) are listed as a state endangered species in Iowa. This migratory species usually arrives in Iowa beginning around mid-May. This species can adapt to a wide variety of wetland habitat types as long as the terrain supports a reasonable amount of vegetation and is frequently wet. Optimal habitat is freshwater marshes with emergent vegetation (sedge, bulrush, or cattail). Muskrats enhance marshes by opening up a network of pathways, providing potential feeding and drinking places. Vegetation growing in tussocks is attractive to nesting rails. Decline of this species in the Midwest has been due to habitat destruction and drainage of wetlands.

The presence of the copperbelly water snake, a state-endangered species, was recently confirmed at Lake Odessa. These snakes are frequently seen near the Toolesboro access road along the south end of the complex. Copperbelly habitat generally consists of wetlands and bottomland forests, although they sometimes hibernate in upland areas. They are often seen near shallow wetland edges in woodlands where buttonbush is the preferred vegetation type. This species is listed as a federally-threatened species in Michigan, Indiana, and Ohio (northern range). It is not a federally-listed species in Illinois and Kentucky (southern range) because of protections provided by a Conservation Agreement with the mining industry. At the time this agreement was established, the Iowa population had not been discovered.

The diamondback water snake, a state-threatened species, has been confirmed within the Lake Odessa complex. This large water snake is found only in southeastern Iowa near the Mississippi River. It inhabits rivers, sloughs, ponds, backwaters, and oxbows. It does not live in clear gravelly streams, and seems to avoid heavily wooded ponds. They feed on a wide variety of animals associated with water, including fish, amphibians, baby turtles, young snakes, insects, crayfish and small mammals.

Blanding's turtles, which are state-threatened, are found in shallow and deep marshes, the shallow bays of lakes, slow-moving streams and rivers, and backwater sloughs. They prefer slow-moving, shallow water and a muddy bottom with abundant emergent vegetation, duckweed, and mosses. Open, sandy areas are preferred for nesting sites. If suitable nesting areas are not located, they may nest on the shoulders of roads, or wander a considerable distance from their marsh until a suitable area is found. The presence of this species has been confirmed at the Lake Odessa complex.

The Lake Odessa complex is considered essential habitat for the river otter (*Lutra canadensis*), listed as threatened in Illinois. River otters are quite adaptable, utilizing a variety of habitat types. Although they frequent lakes and ponds, they typically live in marshes and along wooded rivers and streams with sloughs and backwater areas. Otters live in dens in the ground most of the year. Otters rarely dig dens themselves; instead, they utilize dens built by beavers, muskrats, or woodchucks. Brush piles, root areas under large trees, and similar sites are used as temporary homes. The presence of beavers in an area is important to otters, not only because of the dens they build, but also because the ponds created by beaver dams make ideal otter habitat.

J. Historic Properties. The Lake Odessa complex is one of the most archeologically rich areas in the Upper Mississippi River region. The first extensive occupation of the floodplain occurred during the Middle Archaic period. Early and Middle Woodland sites are distributed on almost every landform in the Lake Odessa bottoms. During the Mississippian period, the bottoms were occupied by the Oneota culture, with a principal village site on the bluff top at Toolesboro. The major historic site in the area is Burris City, dating from 1855-1859. This short-lived city and National-Register-eligible site was abandoned due to repeated flooding.

In his report on the Phase I cultural resources survey of the Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River Environmental Management Program (EMP), Benn (1996:table 2) documents a total of 64 recorded archeological sites from the Lake Odessa area. These sites are recorded in a "three-dimensional landscape context" based upon the Landform Sediment Assemblage (LSA) units from the geomorphological study by Benn and Anderson (1995). Benn (1996:50) states that:

> The goal of archeological research to understand past human culture is sometimes lost in the managerial review and compliance process. In this sense, one of the principal goals of an archeological survey project which produces site locational information from the Lake Odessa EMP should be the reconstruction of human settlement patterns.

Benn (1996) approaches this task beginning with an analysis of the landform sediment assemblages to establish the depositional context for historic and prehistoric sites. This is followed by looking at site density data and forming a preliminary picture of the settlement patterns for use in making recommendations for site testing and data recovery.

Benn (1996:56) reports no Paleoindian or Early Archaic sites in the Lake Odessa project area. The first extensive occupation of the floodplain occurred during the Middle Archaic. A significant proportion of both Middle and Late Archaic sites probably remain deeply buried and undiscovered.

Early and Middle Woodland sites are generally on landforms close to the bluff line while Late Woodland sites show an abrupt change in settlement with sites distributed on almost every landform in the Lake Odessa bottoms (Benn 1996:56-60).

During the Mississippian period, people of the Oneota culture occupied the Lake Odessa bottoms. These sites all occur in the southern half of the bottoms, and considering that the "principal Oneota village in this area is….on the bluff top at Toolesboro, these small sites in the bottom appear to have functioned as temporary stations for collecting of seasonal resources" (Benn 1996:60).

The Corps obtained the February 2003 report entitled, *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental*

Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa, by David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc., (Benn and Isenberger 2003) in order to update the status of historic properties coordination for this project.

K. Hazardous, Toxic, and Radioactive Waste. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with ASTM Practices E 1527-00 and E 1528-00, ER 1165-2-132, and MVD DIVR 1165-2-9 for the Lake Odessa HREP. (See Appendix E, *Hazardous, Toxic, and Radioactive Waste Documentation Report.*) Dense woodland, historical agricultural fields and low-lying backwaters of the Mississippi River characterize the Lake Odessa area.

This assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the project features as long as the project features do not include any areas associated with a small weapons firing range. The range is located along the existing perimeter levee in the vicinity of levee station 180+00. Appendix E, Figure 2, identifies the general location of the small weapons firing range.

The recommended project features do not include levee restoration work in the vicinity of the firing range. If the levee enhancement project feature would be changed to include the section of levee that was used as the ammunition trap for the small weapons firing range, then the Lake Odessa HREP would need to devise construction activities and disposal plans for the surface soils containing spent lead ball residue that are subject to Resource Conservation and Recovery Act (RCRA) statutory authority including sections 7002 and 7003.

Military Munitions Rule 40 CFR Part 260 (source reference in Appendix E) has assisted with defining when fired munitions are considered solid waste and when they fall under the RCRA requirements. According to US EPA-Region 2, “Lead shot is not considered a hazardous waste subject to RCRA at the time it is discharged from a firearm because it is used for its intended purpose. However, spent lead shot (or bullets) is subject to the broader definition of solid waste written by Congress and contained in the statute itself. Spent shot and bullets are thus potentially subject to RCRA statutory authority including section 7002 and 7003. Construction activities may pose a problem since heavy equipment would likely disturb the surface soils and cause the spent lead shot to migrate and become a hazard to the environment. If these surface soils, that contain lead ball residue, are disturbed then prompt removal of surface soil layers for the levee modification would become necessary under RCRA regulation.”

No further HTRW Assessment is recommended at this time.

III. PROJECT OBJECTIVES

A. Problem Identification. The floodplain habitat at the Lake Odessa Complex has been greatly influenced by human activities. Increased runoff within the basin has led to higher sediment loads carried by the Mississippi River. Construction of levees and the navigation system has altered the hydrologic regime of the floodplain by prohibiting floodwaters from slowly inundating the floodplain. Breaches of the existing levee have resulted in frequent losses of emergent aquatic vegetation used by migratory waterfowl. Prolonged flooding after levee breaches has increased the mortality of mast-producing trees. Sedimentation from frequent levee breaks and overtopping flood events has increased the extent of shallow water habitat and has reduced the amount of deeper water. Winter fish kills and reduced circulation of well-oxygenated water are being experienced as a result. The existing water control structures and pumps prevent optimal management of the moist soil units because the current configuration does not provide a reliable water supply or water level management capability. Frequent water level fluctuation has led to erosion of significant archeological sites located along the project's banklines. Significant opportunities are available for preserving, enhancing, and developing habitat for migratory birds, fish, and endangered species by enhancing and developing wetlands, planting mast trees, and creating deep holes/channels in the lake and backwater areas.

1. Inadequate Water Level Management. Water level management is used primarily for waterfowl management, but it also benefits many other wetland species as well. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires dewatering wetland areas beginning in the spring. The areas are slowly drawn down, with maximum drawdown occurring in mid summer. In the fall months of the year, which is the migratory period for waterfowl, the objective is to shallowly flood the moist soil areas. These areas are gradually flooded beginning in September, with maximum water depths through early November. This flooding, along with vegetation growth, attracts migrating birds for both resting and feeding. The current configuration of the inlet structure allows water to be directed either to the main lake or to the USFWS MSU (4 & 5, 20, and 21) supply ditches, but not both. During low water years, water control reliability is lost, mainly at the expense of the MSUs. During these times, most of the water is directed toward the Main Lake, and not the MSUs. In addition, a limited number of Crisafulli pumps are available when needed to increase the water depths in the MSUs when gravity flow is insufficient or unavailable. This inadequate number of pumps limits the number of MSUs that can be filled and/or limits the desired water depth achieved via pumping from other sources. A suspected sand seam in the IDNR MSU limits flooding to one-third of the area before water escapes, at a rate faster than pumping can maintain. This unit also has no water control structure to facilitate draining the unit. In addition, seepage through the levee, flooding, and levee breaches all contribute to make water level control more difficult.

2. Loss of Deep Aquatic Habitat. Due to sedimentation over the years, the refuge has experienced significant loss of deep-water habitat. Most of this sedimentation is believed to have come from the various flood events that have occurred over the years. At typical winter water elevations, Lake Odessa still has some deep habitat, with approximately 25 percent of the main lake 5 to 6 feet deep, but less than 0.5 percent marginally more than 6 feet deep. The typical sedimentation rate (assuming no levee breaches) is approximately 1 to 2 centimeters per year. (See Appendix H, *Sedimentation*.) Historical information from the 1950s stated that areas of the main lake had water as deep as 15 feet. In addition, siltation has reduced access to some water bodies, resulting in low concentrations of dissolved oxygen and isolating fish. Fish kills, primarily in the winter months, have

been documented because of this isolation and/or lack of sufficient depth. Operation of the inlet and outlet works has been modified to alleviate this problem somewhat in the main lake and channels only.

Studies by the IDNR have illustrated the importance of deep aquatic habitat as overwintering areas for centrarchids. Species in this family include bluegill, largemouth bass, and white and black crappie. General characteristics of suitable overwintering sites include off-channel areas that do not freeze to the bottom and have suitable dissolved oxygen levels, slightly warmer waters (stratification), and protection from currents. Areas providing these types of habitat are presently minimal at the Lake Odessa complex, with depth as the limiting factor in most areas. In addition, Yankee Chute, Goose Pond, and Swarms and Bebee Ponds do not have reliable access to deep water.

3. Decline of Mast-Producing Trees. Prolonged flooding, such as the Flood of 1993, is responsible for significant losses of bur oak, pin oak, hickory, sycamore, and hackberry. Flooding also indirectly favors more water-tolerant and less valuable species such as silver maple. This gradual change in species composition is detrimental to local wildlife populations, by limiting more appropriate food sources and reducing the number of older trees needed by cavity nesting species. River biologists and foresters are concerned about the future availability of mast as a winter food source for wildlife in the floodplain forests of the region.

4. Damage of Interior Features Due to Flood Events. Over the years, Lake Odessa has experienced significant flood damage to its interior features. The floods of 1993 and 2001 reduced deep-water habitat due to sediment deposition. This flooding and sedimentation also increase the isolation of other waters inside the complex and reduce fish access to deeper water. Sediments left by flood events can also damage the MSUs, reducing vegetation in the short term and decreasing the depth in the MSUs themselves. Flooding has also damaged infrastructure in the Lake Odessa complex. The Flood of 1993 rendered both inlet and outlet structures inoperable. The Flood of 2001 breached the levee in seven places, washed out roads, isolated the inlet structure, and deposited massive amounts of silt and sediments in MSUs adjoining the levee.

5. Erosion of Archeological Sites. The Lake Odessa complex is one of the most archeologically rich areas in the Upper Mississippi River region. The first extensive occupation of the floodplain occurred during the Middle Archaic period. Early and Middle Woodland sites are distributed on almost every landform in the Lake Odessa Bottoms. During the Mississippian period, the Bottoms were occupied by the Oneota culture, with a principal village site on the bluff top at Toolesboro. The major historic site in the area is Burris City, dating from 1855-1859. This short-lived village, a site eligible for inclusion in the National Register of Historic Places, was abandoned due to repeated flooding. Historic records and bankline measurements have shown that bankline erosion is a persistent problem at Lake Odessa that has caused the project's lakes and sloughs to widen. The rate of bankline retreat during the 1970s-1990s is 0.7-1.6 feet per year. Historic properties coordination and compliance activities have resulted in a Programmatic Agreement under Section 106 of the National Historic Preservation Act for historic properties preservation emphasizing riprap shoreline protection and site avoidance supplemented by data recovery excavations where avoidance or riprap is not feasible. (See section IX. D.) This Programmatic Agreement is found in Appendix A, *Correspondence*, page A-184.

B. General Fish and Wildlife Management Goals. The Louisa Division, located in the northern portion of the Lake Odessa complex, is part of the Mark Twain National Wildlife Refuge Complex, one of more than 500 National Wildlife Refuges managed by the USFWS. The mission of the National Wildlife Refuge System is to preserve a national network of lands and waters for the

conservation of fish, wildlife, and plant resources of the United States for the benefit of present and future generations. The Mark Twain National Wildlife Refuge Complex, Louisa Division, was established specifically for the protection of migratory birds, although refuge lands also provide important habitat for many other species of resident and migratory wildlife. The refuge has developed a Draft Comprehensive Conservation Plan to guide future management activities. Draft goals of the plan that relate to the problems described above include:

- restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, and other wetland-dependent wildlife species
- conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife
- enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor
- identify and reduce the impacts of sedimentation and other water quality factors on fish and wildlife resources

The southern portion of the Lake Odessa complex is the Odessa Wildlife Management Area, managed by the IDNR. The IDNR goals, as outlined in the 2000 Annual Management Report and 2001 Annual Management Plan, that relate to the problems described above are:

- through water level manipulation, mimic the natural hydrologic cycle as the primary means of floodplain and ecosystem management, and ensure optimum migratory waterfowl habitat.
- Wood ducks, hooded mergansers, mallards, and Canada geese are known to nest in the area, with wood ducks predominating. Production of 2,000 wood duck on the area is desired, aided by forest management and installation of artificial nest boxes.

C. Project Goals, Objectives, and Potential Enhancement Features. Based on the identified problems and the fish and wildlife management goals of the cooperating agencies, the following goals, objectives, and potential enhancement features, shown in table 3-1, were considered by the interagency planning team during development of this DPR.

Table 3-1. Project Goals, Objectives, and Potential Enhancement Features

Goals	Objectives	Potential Enhancement Features
Restore and protect wetland and terrestrial habitat	Reduce forest fragmentation Increase bottomland hardwood diversity	Establish hardwood trees on existing agricultural fields and forested areas
	Enhance migratory bird habitat	Enhance MSUs with berm improvements Enhance MSUs water control with dedicated water supply, pumps, and/or control structures
	Restore sand prairie	Plant native sand prairie species
Restore and protect aquatic habitat	Increase habitat for overwintering fish	Dredge deep holes/channels in main lake and backwater areas
	Provide safe areas for developing fish	Construct fish nursery
	Protect habitat features	Restore existing perimeter levee Construct spillway Construct rock wing dam at inlet structure
	Protect archeological sites	Protect shoreline using riprap

D. Criteria for Potential Enhancement Features. Table 3-2 presents general and specific criteria developed to assess potential enhancement features.

Table 3-2. Potential Enhancement Features Development Criteria

Item	Purpose of Criteria
A. General Criteria	
Locate and construct features consistent with EMP directives	Comply with program authorities
Construct features consistent with Federal, state, and local laws	Comply with environmental laws
Develop features that can be monitored (e.g., sedimentation, stability, water quality)	Provide baseline for project effects
Design features to facilitate operation and maintenance	Minimize operation and maintenance costs; realize logistical difficulties in accessing the sites.
Locate and construct features consistent with best planning and engineering practices	Provide basis for project evaluation and alternative selection
Construct features which meet one or more of the project objectives	Meet project goals and objectives
B. Restore and Protect Wetland and Terrestrial Habitat	
Establish hardwood trees on existing agricultural fields and forested areas	Reduce forest fragmentation and increase species diversity
Locate plantings in existing forested areas	Increase bottomland hardwood species diversity and provide nesting and feeding habitat for wood ducks
Locate forest plantings on higher ground	Maximize tree survival rate and increase species diversity
Enhance MSUs with dedicated water supply, pumps, and control structures	Improve existing habitat suitability for migratory birds and other wetland-dependent species by improving water level control
Restore sand prairie	Increase size and diversity of an existing sand prairie site
C. Restore and Protect Aquatic Habitat	
Dredge deep holes/channels in main lake and backwater areas	Ensure fisheries access to the main lake throughout the year and ensure adequate dissolved oxygen and depths during winter and summer stress months, for centrarchids and associated species
Construct fish nursery	Create protected area for small fish (fry) to develop while reducing mortality from predatory fish
Restore main stem levee	Protect interior features of refuge from flooding by restoring the height and correcting the slope of the perimeter levee
Construct spillway	Limit damage to interior features by constructing a spillway to facilitate a controlled flooding situation in the event the perimeter levee is overtopped and to reduce potential levee failure
Construct rock wing dam at inlet structure	Reduce sedimentation in the inlet channel by placing a rock wing dam between the mouth of Michael Creek and the inlet channel for Lake Odessa
Protect archeological sites by placing riprap on the shoreline	Protect and preserve National Register eligible sites from erosion or wave-induced damage

IV. POTENTIAL PROJECT FEATURES

This section describes and assesses a preliminary number of potential enhancement features that will meet the goals described in Section III. Potential enhancement features were determined based on their contribution to the project goals and objectives, engineering considerations, and local restrictions or constraints. Features that were not considered feasible were not subject to further evaluation. These features are shown on plates 7 and 8, *Alternatives Not Evaluated*. Section V discusses the evaluation of the feasible project alternatives. These features are shown on plates 5 and 6, Alternatives Evaluated. For planning purposes, project life was established as the Corps' standard 50 years for all potential features.

A. Moist Soil Unit (MSU) Enhancement. As previously mentioned, the main management aspect of Lake Odessa is that of water level management. Currently, the sponsors (USFWS and IDNR) lack the control to efficiently manage water levels at certain times of the year. It is proposed that areas be developed to better aid in water level management for enhancement of vegetation growth in the summer months, and flooding for migratory birds in the fall migration season (plates 5 and 6). Proposed MSU enhancement is as follows:

1. Field 4 & 5. (Note: Fields 4 and 5 are one field.) A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the area of water coverage would be approximately 83 acres. An additional 12.5 acres can be raised north of this field and mast tree-planting Site A by utilizing a proposed water control structure in the north perimeter berm to move water from Field 4 & 5. The 12.5-acre area was not pursued because management goals changed for this area.

2. Field 21. Proposed details are similar to Field 4 & 5, except that no new water control structures are proposed. A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the approximate area of water coverage would be 83 acres.

3. MSU 20. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). The typical depth of 1.5 feet would be obtained by gravity flow and by directing water pumped into Field 21 through an adjoining water control structure. When flooded to 538.5, the approximate area of water coverage would be 72 acres.

Note. A dedicated water bay would be included as an enhancement measure for the Field 4 & 5, Field 21, and MSU 20 features. The dedicated water bay would consist of extending the bay walls of the last downstream bay of the inlet structure with concrete and sheet piling, and excavating a new ditch to connect the bay to an existing ditch to empty water into the fields stated above. This dedicated water supply would allow gravity filling of the MSUs to approximately 536.0 feet MSL.

4. Unit 2. A portable pump would be provided to augment existing control structures to furnish a consistent flow of water to the field. Existing berms around Unit 2 are assumed to be

adequate to impound water up to elevation 538.5 feet MSL. At this elevation, water depths range from 0 to 2.7 feet (typically 1.5 feet). To assist in water level management, a new water control structure is proposed to augment an existing water control structure under the adjacent road. When flooded to 538.5, the approximate area of water coverage would be 92 acres.

5. Fox Pond. The Fox Pond option would consist of utilizing the region noted on plate 5. Currently, Fox Pond has a pump station that is dated and under-capacity to obtain desired water levels in the area. It is proposed that a new fixed pump station be constructed that has the capacity to raise water levels from 536.0 to 537.0 feet MSL, with 537.0 being maintained for approximately 2 months. Also at Fox Pond, a water control structure, along with a pump pad for a portable pump, is proposed to drain the area. One of the portable pumps from the above units would be utilized here because Fox Pond pumping would take place in the summer versus the fall for the other MSUs. The approximate area of water coverage would be 336 acres.

6. Swarms/Bebee Ponds. This option would consist of dredging the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. This action would allow drawdown of these ponds to occur when the main lake is drawn down, thereby increasing the area and diversity of wetland vegetation growth. Conversely, in the fall, when lake levels are raised, this area would be inundated, providing access to food resources for migrating waterfowl. This action also provides fisheries benefits, described in Section D, *Potential Deep-water Fisheries Enhancement.*

7. IDNR MSU. This area has an existing berm that is adequate for the intended water levels in the unit. This unit also is proposed as a placement site for fine sediment dredged from the Blackhawk Chute/Yankee Chute feature which would act as a liner and enable the unit to better hold water. A portable pump, pump pad, and water control structure are proposed for construction to better facilitate water level management. The management plan for the unit is to raise the water level in the unit 4 feet in 14 days and then hold that water elevation for approximately 2.5 months through maintenance pumping. The approximate area of water coverage would be 49 acres.

8. Sand Field MSU. This feature was proposed for the area noted on plate 7. This area was proposed to have a perimeter levee constructed, a pump installed to supply water to the unit, and an elevated ditch constructed to supply water to the MSU from the river. This feature was eliminated due to its relatively high elevation, cost, and potential seepage problems.

9. Field Scraping. This feature was proposed for the area noted on plate 7. This proposed alternative consists of performing shallow scrapes in the depicted fields to create more diversity in topography. Through the scraping and sidecasting of material, deeper areas would be created for ponding water and the sidecast material would create elevated resting areas out of the ponds. This feature was not evaluated due to some of the fields being removed from consideration by the sponsors, and the remaining fields were reevaluated for MSUs by means of berm construction (Field 4 & 5 and Field 21). Other areas, closer to the levee, could be flooded with the Fox Pond improvements described above.

B. Field 6 Sand Prairie Planting. Restoring and increasing the size of the previously established sand prairie, which was damaged during the Flood of 1993, would increase plant diversity of this unique area. This feature would consist of planting this field with a predetermined seed mix, locally harvested, from a local supplier. See plate 5 for location.

C. Fish Nurseries. The proposed fish nurseries would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. A nursery would allow the stocking of fry and provide a safe environment for the fish to reach a larger size, prior to release into the main lake. A nursery would be managed for fish periodically, about one year in five, at the discretion of the refuge manager. During the other years, the nursery would continue to function as a wetland, providing habitat for migratory birds.

1. Upper Fish Nursery. This feature would consist of utilizing an existing containment area to construct a fish nursery. The area currently has a stoplog control structure, which is damaged and would be replaced. The area, with the new structure, would be able to pond water, allowing the area to be stocked with fry in the spring that would be released into Lake Odessa later in the season. This would allow fish to reach a larger size in a more protected environment, resulting in decreased mortality. See plate 5 for location.

2. Lower Fish Nursery. This feature would be utilized in a similar manner to the upper fish nursery described above. A small bay off Sand Run would be screened off in the spring to allow stocked fry to grow in the absence of larger predatory fish. Proposed construction included a screen across the outlet and adding dredged material to the spit of land separating the bay from Sand Run. This nursery was eliminated from further consideration because it has a higher likelihood of drying up in the summer months and is currently providing good moist soil habitat. See plate 8 for location.

3. Little Goose Pond Fish Nursery. This nursery would also allow stocked fry to grow in absence of larger predatory fish within a bermed area of Little Goose Pond. This location was eliminated from further consideration because ponding water would be difficult without construction of a lengthy perimeter berm. See plate 7 for location.

D. Potential Deep-Water Fisheries Enhancements. This feature would improve water quality and habitat for fish by means of hydraulic/mechanical dredging. Deep habitat would be created in the form of channels and deep holes. The deeper areas would provide oxygenated water as well as escape routes and habitat during the winter months (overwintering). All depths reflect the final water depth, not the amount of dredging. Proposed fisheries enhancements are as follows:

1. Dredge Main Lake (Lake Odessa). This option would consist of dredging a deep hole in Lake Odessa that is approximately 1,490 feet long by 751 feet wide to a depth of 8 feet. The dredged material is mainly fine sediment, and would be hydraulically dredged into a 40-acre containment site (Site D) that would be constructed in the forested area between the Main Lake and Goose Pond. See plate 6 for location.

Note. See plates 7 and 8 for other variations that were considered for deep hole/channel dredging in Lake Odessa. Sponsors eliminated other locations. Access by equipment is major limiting factor, with limited placement sites. An 8-foot depth is based on sedimentation rate and 50-year project life.

2. Dredge Goose Pond. This option would consist of dredging a deep channel to connect Goose Pond and Sand Run Chute. The approximate size of the channel is 5,158 feet long by 142 feet wide to a depth of 8 feet. The dredged material is mainly fine sediment and would be

hydraulically dredged into a 40-acre containment site that would be constructed in the forested area between the Main Lake and Goose Pond. See plate 6 for location.

3. Dredge Blackhawk Chute/Yankee Chute Access. This option would consist of dredging a deep channel to connect Yankee Chute and Blackhawk Chute. The approximate size of the channel is 6,040 feet long by 95 feet wide to a depth of 8 feet. The dredged material is mainly fine sediment, and would be hydraulically dredged into the IDNR MSU that was detailed above. See plate 6 for location.

4. Dredge Swarms/Bebee Access Channels. This option would consist of deepening the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. The approximate size of the dredge cuts would be 650 feet long by 126 feet wide by 1 foot deep between Bebee and Swarms, and 1,517 feet long by 118 feet wide by 1 foot deep between Swarms and Odessa. The dredged material is mainly fine sediment, and would be mechanically dredged and sidecast on the downstream embankment next to the channel. See plate 5 for locations.

5. Dredge Continuous Channel From Lake Odessa to Blackhawk Chute. This option would consist of dredging a deep channel that begins at Lake Odessa, runs up Sand Run Chute, and eventually ends in Blackhawk Chute, with a connector to Big Mallard Pond. This feature was not evaluated due to sponsor input, limited placement site capacity, and high preliminary cost estimate. See plate 8 for layout of channel.

6. Dredge Deep Holes in Blackhawk Chute. This option would consist of dredging deep holes in Blackhawk Chute. This feature was not evaluated due to sponsor input, placement site considerations, and preliminary cost estimates. See plate 8 for layout of channel.

E. Mast Tree Planting. This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting would be to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree planting would restore some of the historic diversity of the bottomland forest community and reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. Mast tree species to be planted would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). Only those sites at higher elevations or on ridges were considered to maximize tree survival. See plates 5 and 6 for locations.

1. RPM Trees. This option would consist of planting Root Production Method™ (RPM) trees at a density of 30-50 trees per acre. These hardy containerized trees, grown from locally collected seed, are able to survive the dynamic nature of the floodplain and herbaceous competition, and require much less maintenance. In addition, they begin bearing acorns as soon as 18 months after planting, much earlier than trees produced through traditional methods.

2. RPM Trees and Seedlings. This option would be the same as E. (1) above, with the addition of planting seedlings. This option was eliminated from further evaluation because of higher tree mortality and increased maintenance with this option.

Note. Other mast tree planting sites were considered, but due to sponsor preference for location, the above sites were the only areas that were evaluated. See plates 7 and 8 for other conceptual locations of mast tree planting sites.

F. Green Tree Reservoir. See plate 8 for location. This feature would involve construction of a low perimeter berm and small pump station to shallowly flood a 50-acre area of pin oaks each fall to provide invertebrate food resources for waterfowl. This feature was eliminated from further consideration because increased mast tree mortality may result from the periodic flooding proposed for this feature.

G. Refuge Protection through Levee Restoration. Various spots on the perimeter levee fall below the minimal level of protection, and a majority of the levee has slopes that are too steep on the interior side. This feature would restore the Lake Odessa Refuge perimeter levee by improving the crown and interior side slopes. Spillways would allow controlled filling of the interior from the downstream end, thus reducing the likelihood of uncontrolled levee breaches during flood events. See plates 5 and 6 for locations.

1. Restore Perimeter Levee to 25-50 Year Level of Protection and Construct Spillway. This option would establish a sloping levee profile starting at the 25-year level of protection (downstream) and gradually rising to the 50-year level of protection (upstream), while also flattening all slopes to 5H:1V to improve section reliability. Hydraulically dredging sand material from the Mississippi River and grading it into the existing levee section would accomplish this. In addition, two spillways are proposed to allow for a controlled flooding scenario of the refuge interior. One of the spillways would be located in the lower end of the refuge and is proposed to be 1,100 feet in length and built to the 10-year level of protection. The second spillway would be located in the upper end and is proposed to be 700 feet long and built to the 17-year level of protection.

2. Restore Perimeter Levee to 20-Year Level of Protection and Construct Spillway. This option would restore the levee to a 20-year level of protection and improve interior side slopes to 5H:1V in order to improve section reliability. The spillway lengths for the 20-year level of protection levee would be longer, approximately 1,200 feet long at the 11.1-year level of protection in the upper end, and 1,500 feet long at the 10-year level of protection in the lower end. This feature was eliminated because the spillways for the 20-year level of protection would be longer than for the 25-year level of protection. This would result in higher costs and environmental impacts for a similar level of flood damage reduction and habitat protection.

Note: Both (1) and (2) above include constructing a rock wing dam between Michael Creek and the inlet structure in the upper end so as to reduce sedimentation at or near the inlet structure. In addition, shoreline protection of National Register Eligible archeological sites in the interior of the complex by means of riprap placement was included in both of the items.

H. Leave Levee Breached. This feature would involve leaving the breaches in the perimeter levee caused by the 2001 flood event to maintain connectivity with the main channel. This connectivity would allow access to the Lake Odessa complex for a variety of fish species, which would utilize the shallow sloughs for spawning and fry habitat. However, the Lake Odessa complex still contains a mosaic of forest and shallow sloughs, resulting from its isolation from the Mississippi and Iowa Rivers. This feature was not pursued due to concerns over increased sedimentation and potential impacts to buttonbush habitat and other wetland habitats, which require water levels that are

manipulated to resemble more natural levels than what is possible from connection to main channel flows. In addition, prolonged high water levels associated with flood events could adversely impact the bottomland forest tree health and regeneration that is provided within the more controlled leveed environment.

I. Cross Dike. This feature would involve constructing a dike between the USFWS and IDNR managed lands to provide independent water level management capability. This feature was eliminated from further consideration because hydraulic analysis determined that the dike would not pool enough water to allow the USFWS managed lands to operate independently of the IDNR managed lands; the majority of water would simply flow around the western end of the cross dike. See plate 7 for location.

J. Yankee Chute Gatewell. This feature would consist of constructing a gatewell structure in the perimeter levee at the head end of Yankee Chute to provide oxygenated water to this backwater. This feature was eliminated from further consideration because another project feature, channel dredging, would provide the same habitat benefit. See plate 8 for location.

V. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES

This section describes the features that met the goals and objectives of this project. Each feature was evaluated to determine its potential for environmental restoration and enhancement. Costs also were derived for all feasible (practical, cost effective, and environmentally acceptable) project features. Feasible project features are those features determined to have positive benefits and no obvious reason for removal from consideration, such as not meeting the goals and objectives, high cost, or in the case of a dredging feature, no placement site.

A. Environmental Output Evaluation. Habitat evaluation models have been used to assist the decision-making process to determine what project features should be built based on habitat benefits (outputs) that meet the goals and objectives of the project. A habitat analysis was completed for the Lake Odessa project, with the goal of enhancing terrestrial, wetland, and aquatic habitat. This analysis employed a multi-agency team approach with representatives from the Corps of Engineers, the USFWS, and the IDNR.

Analysis of existing study area conditions, future conditions without the project, and impacts of several proposed features and alternatives was completed using the Wildlife Habitat Appraisal Guide (WHAG) procedures developed by the Missouri Department of Conservation and the Natural Resources Conservation Service. The WHAG is a numerical habitat appraisal methodology based on USFWS Habitat Evaluation Procedures (HEP) (1980). Though models can be effective tools to assist decision makers, they may not always capture all of the benefits of a proposed project feature.

The WHAG procedures evaluate the quality and quantity of particular habitats for preselected species communities, with each species representing a different guild. Different groups of species represent different habitats for that community. The WHAG team also selected target species from the list provided by the WHAG model. The qualitative component of the analysis is known as the Habitat Suitability Index (HSI) and is rated on a 0.1 to 1.0 scale. The quantitative component of the WHAG analysis is the measure of acres of habitat that are available for the selected evaluation species. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula (HSI x Acres = HUs).

The WHAG team evaluated existing habitat conditions by using existing survey data, aerial photographs, vegetative cover maps, and first hand knowledge of the area. Projections of future with- and without-project conditions were based on predicted changes in the physical conditions of the project sites and professional judgment as to how these changed physical conditions would affect habitat components such as vegetation diversity and species composition.

Changes in the quality and/or quantity of HUs will occur as a habitat matures naturally or is influenced by development. To capture these changes, habitat conditions were estimated at selected target years for both with- and without-project conditions. The target years selected for this project were Year 0, 1, 25, and 50, with an estimated project life of 50 years. These changes influence the cumulative HU derived over the life of the project. Cumulative HUs are annualized and averaged. This determines what is known as Average Annual Habitat Units (AAHUs). AAHUs are used as an output measurement to compare all the features and project as a whole and to evaluate the difference between the environmental outcomes of with- and without-project conditions. This difference results in the net AAHUs for the project or project feature. For a more detailed description of the habitat analysis, refer to Appendix D, *Habitat Evaluation and Quantification and Incremental Cost Analysis.*

B. Feasible Project Features. Table 5-1 summarizes the outputs and costs associated with each management measure.

T able 5-1. Environmental Output and Costs of Each Feature

Feature	Symbol	Output [1]	Cost [2]	Annualized Cost [3]
Moist Soil Unit (MSU) Enhancement				
No action	M0,U0,F0, S0,D0	0	0	0
Improve Field 4 & 5, Field 21, MSU 20 water control	M1	83.2	516.2	33.3
Improve Unit 2 water control	U1	69.2	110.0	7.1
Improve Fox Pond water control	F1	236.6	291.2	18.8
Improve Swarms & Bebee Pond access	S1	207.5	47.9	3.1
Improve IDNR MSU seepage and water control	D1	43.6	235.1	15.2
Sand Prairie Restoration				
No Action	P0	0	0	0
Seed 36 acres of Field 6 to prairie	P1	11.3	22.2	1.4
Fish Nursery Enhancement				
No Action	N0	0	0	0
Construct fish nursery	N1	-0.7	31.3	2.0
Deep-Water Fish Habitat Dredging				
No Action	L0,GO,B0,S0	0	0	0
Dredge Main Lake	L1	418.6	938.9	60.6
Dredge Goose Pond	G1	67.8	1038.1	67.0
Dredge Blackhawk Chute/Yankee Chute access	B1	32.3	731.4	47.2
Dredge Swarms/Beebe Pond access	S1	5.9	47.9	3.1
Containment berm for L1, G1, or L1+G1[4]			74.0	4.8
Mast Tree Planting				
No Action	A0, C0, D0	0	0	0
USFWS Sites A & B (old field)	A1	60.2	70.8	4.6
IDNR Site C (interplanting)	C1	1.3	68.3	4.4
IDNR Site D (dredged material placement site)	D1	-24.0	105.7	6.8
Main Stem Levee Restoration				
No Action	R0	0	0	0
Restore levee w/spillway	R1	1671.5	5216.7	336.7

[1] Outputs are calculated as Average Annual Habitat Units (AAHUs) for all species in WHAG model.
[2] All costs in $1000s. Represents initial construction costs only.
[3] Annualized cost is initial construction cost based on a 50-year project life, 6.125% interest rate.
[4] The containment berm is not considered to be a feature and therefore has no code or out put. This area can be used for dredged material from Main Lake, Goose Pond, or both. See section V. D.(2) for more detailed description. The berm itself has no environmental outputs until the dredging is completed and this area becomes mast tree planting site D.

This section describes the environmental evaluation process for each feasible project feature. Detailed descriptions, by feature, of the environmental evaluation are provided in Appendix D, *Habitat Evaluation and Quantification and Incremental Cost Analysis*. Plates 5 and 6 show the locations of all feasible project features described below.

1. Moist Soil Unit (MSU) Enhancement. Water level management is used primarily for waterfowl management but encompasses many other wetland species as well. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires dewatering wetland areas beginning in the spring. The areas are slowly drawn down, with maximum drawdown occurring in mid summer. In the fall months of the year, which is the migratory period for waterfowl, the objective is to shallowly flood the moist soil areas. These areas are gradually flooded beginning in September, with maximum water depths through early November. This flooding, along with vegetation growth, attracts migrating birds for both resting and feeding. Improvement at the following locations would lead to enhanced wetland vegetation diversity and growth during the summer months and provide better, more reliable food supplies to migratory waterfowl during fall migration times.

This management feature may be implemented at the following sites (32 possible combinations):

a. No Action (M0, U0, F0, S0, D0). No action would result in no additional management efforts. No Average Annual Habitat Units (AAHUs) gain or loss would be realized other than what occurs under the current management objectives. Only portions of the existing MSUs could be flooded as desired under normal conditions. During low water years, water supply to flood the MSUs may be inadequate, leading to decreased value and use of the areas by migratory waterfowl and other wildlife species.

b. Field 4 & 5, Field 21, MSU 20 (M1). This option consists of utilizing existing berms to allow water impoundment to elevation 538.5 MSL maximum, providing portable pumps and permanent pump pads (Field 4 & 5 and Field 21), and constructing a dedicated water bay at the inlet structure to provide a reliable water supply to all three MSUs and increase water level management control. Because these three areas are in very close proximity, contain similar habitat, and share a common water supply system, they will be considered as one site for evaluation purposes. This feature yields a net benefit of 83.2 AAHUs; 34.5 AAHUs for Field 4 & 5 and Field 21, and 14.2 AAHUs for MSU 20.

c. Unit 2 (U1). This feature consists of adding one new water control structure and portable pump to increase water level management control. This feature yields a net benefit of 69.2 AAHUs.

d. Fox Pond (F1). This option consists of constructing a new pump station for filling the area, replacing a water control structure, and providing a permanent pump pad for draining the area. A portable pump from another MSU area would be utilized here. These features would increase water level control and promote the growth of desirable vegetation. This feature yields a net benefit of 236.6 AAHUs.

e. Swarms and Bebee Ponds (S1). This option consists of deepening the access channels to both Swarms and Bebee Ponds through mechanical dredging. The dredged material would be sidecast, adding to the topographic diversity. Dredging would hydraulically connect these ponds to the main lake during most water levels. Dredging also allows a drawdown of these ponds during the late spring and early summer, in conjunction with lowering the water levels in Lake Odessa, to increase diversity and extent of wetland vegetation growth. Conversely, the main lake water levels are increased in the fall, which allows flooding of the wetland vegetation in these areas. Enhancing access

to the main lake also provides fisheries benefits, described in the deep-water fish habitat section that follows (section V.D). This feature yields a net benefit of 207.5 AAHUs for nonforested wetlands.

f. IDNR MSU (D1). This option consists of clearing and grubbing the MSU's interior, then lining the existing MSU with a layer of fine, silty material generated from the Yankee/Blackhawk Chutes deep-water fisheries dredging feature (section V.D.(4)). Portions of this MSU currently drain faster than pumping can raise them, which allows only partial flooding and limited use of the area. In addition, a water control structure, portable pump, and permanent pump pad would be provided. This feature yields a net benefit of 43.6 AAHUs.

2. Sand Prairie Restoration. In 1985, the USFWS established a 25-acre sand prairie on one of the highest ridges within the floodplain (Field 6). This site was heavily impacted during the Flood of 1993. Replanting and increasing the footprint of this area (36 acres) will provide feeding and nesting opportunities for a wide variety of wildlife.

a. No Action (P0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally.

b. Restore Sand Prairie (P1). This option consists of reseeding this unique area and expanding the area to 36 acres. Seed would come from a local source, produced under similar site conditions. This prairie contributes to the complexity of terrestrial habitats within the refuge. This feature yields a net benefit of 11.3 AAHUs.

3. Fish Nursery Enhancement. The proposed upper fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake.

a. No Action (N0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally. If no action would take place, stocked fry would experience increased mortality and low survival rates, or fingerlings that are more expensive would be stocked in an effort to reduce stocked fish mortality.

b. Construct Upper Fish Nursery (N1). This option consists of replacing the damaged stoplog structure. With this option, a predator-free environment would be provided for rearing fish fry to the fingerling stage. Conserving fish stocking dollars through the ability to buy the less expensive fry while reducing their mortality would provide benefits. This feature, similar in function to a hatchery pond, yields a net benefit of -0.7 AAHUs. The decrease in benefits was expected because this habitat model is not designed to capture benefits of artificial features or unnatural functions. Model results were included for completeness, but the assumption was made that this feature would provide the intended nursery benefits, resulting in a savings in fish stocking expenses to the complex. The proposed 21-acre fish nursery is an existing USFWS wetland, managed primarily for migratory birds. At the discretion of the refuge manager, the refuge has agreed to periodically—about one year in five—manage the unit to benefit native fish fry for stocking by the IDNR. Fish species for stocking will be limited to species native to the Upper Mississippi River.

4. Deep-Water Fish Habitat. These features would improve water quality and habitat for fish. By means of hydraulic/mechanical dredging, deep habitat would be created in the form of channels and deep holes. The deeper areas would provide oxygenated water (during summer and winter) as well as escape routes and habitat during the winter months (overwintering). Dredging to improve access to areas of deeper water further decreases the risk of fish kills when fish populations in isolated water bodies are subjected to temperature extremes or low levels of dissolved oxygen, or both, by providing escape routes to areas that are more hospitable. All depths reflect the final water depth, not the amount of dredging.

This management feature may be implemented at the following sites (16 possible combinations):

a. No Action (L0, G0, B0, S0). No action would result in no additional management efforts. If no action would take place, it is expected that sedimentation would continue to occur, resulting in increasingly shallow water. This may result in more frequent summer and winter fish kills due to low dissolved oxygen or insufficient refuge from freezing water conditions.

b. Dredge Lake Odessa (Main Lake) (L1). This option consists of dredging a deep hole in the main lake, approximately 1,490 feet long, 751 feet wide, to a depth of 8 feet, based on an average winter water elevation of 534.5 MSL. This deep-water area would provide overwintering habitat for fish from the surrounding 776 acres of adjacent aquatic habitat. The dredged material, consisting of primarily fine sediment, would be placed in a nearby low area, currently dominated by flood-tolerant silver maple. Mast trees would be planted on the placement site after the dredged material has drained and consolidated (section V. E.(4)). The increased elevation of the placement site would maximize mast tree survival by keeping the root systems from becoming saturated during high water or prolonged flood events, thereby promoting greater tree species diversity. This feature yields a net benefit of 418.6 AAHUs.

c. Dredge Goose Pond (G1). This option consists of dredging a deep channel to connect Goose Pond to Sand Run, thereby providing better access to the main lake via Sand Run. The channel would be approximately 5,158 feet long, 142 feet wide, to a depth of 8 feet, providing deep-water overwintering habitat for fish from the surrounding 305 acres. The dredged material, consisting of primarily fine sediment, would be placed in a nearby low area; the same area as described above for the main lake dredging option, providing the same benefits to mast trees. This feature yields a net benefit of 67.8 AAHUs.

d. Dredge Blackhawk Chute/Yankee Chute Access (B1). This option consists of two components: 1) deepening the access to Yankee Chute; and 2) connecting it with a dredged channel in Blackhawk Chute. The entire channel would be 6,040 feet long, 95 feet wide, to a depth of 8 feet. The dredged material, consisting of primarily fine sediment, would be placed in the IDNR MSU and would act as a liner for that unit, stopping the current leak and allowing for full use and flooding of that MSU (as described in 1. f. on the preceding page). This feature yields a net benefit of 32.3 AAHUs for fisheries.

e. Dredge Swarms/Bebee Ponds Access Channels (S1). This option consists of deepening the access channels to both Swarms and Bebee Ponds through dredging. The size of the dredge cuts would be approximately 650 feet long, 126 feet wide between Bebee and Swarms, 1,517 feet long, 118 feet wide between Swarms and the main lake and 1 foot deeper than the existing channel depth (to be equal to the pond depth). These ponds would then be hydraulically connected to

the main lake during most water levels. The current channels can dry up during low-water conditions, isolating fish and increasing the potential for fish kills. This feature yields a net benefit of 5.9 AAHUs for fisheries.

5. Mast Tree Planting. This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting would be to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree planting would restore some of the historic diversity of the bottomland forest community and reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. All options would consist of planting Root Production Method™ (RPM) trees at a density of 40 trees per acre and would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). Only those sites at higher elevations or on ridges were considered to maximize tree survival. This management feature may be implemented at the following sites:

a. No Action (A0, C0, D0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally. If no action takes place, it is anticipated that the habitat would not regenerate sufficient mast-bearing trees on its own. Species like silver maple and cottonwood would eventually dominate these areas, resulting in a gradual loss of habitat quality and species diversity.

b. Plant Mast-Producing Trees on USFWS Sites A & B (A1). This option consists of planting mast trees on Site A - the northern portion of Field 4 & 5, adjacent to the existing pecan grove, and Site B - an old crop field near the outlet of Fox Pond, both areas with higher elevations. This would result in approximately 27 acres total of primarily old agricultural fields being planted. These areas are in close proximity, making it more cost effective to plant both areas rather than one or the other. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of 60.2 AAHUs.

c. Plant Mast-Producing Trees on DNR Site C (C1). This option consists of interplanting mast trees over 26 acres adjacent to Sand Run, near the outlet of the main lake, in an area of slightly higher elevations. This site is currently dominated by silver maple with limited species diversity. Some hand clearing may be necessary around each proposed tree planting location, depending on the immediate area conditions. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of 1.3 AAHUs. The reintroduction of mast-producing tree species into an area of existing forest habitat is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another. In these circumstances, the results of the analysis may not reflect real life expectations; actual benefits are anticipated to be higher than calculated.

d. Plant Mast-Producing Trees on DNR Site D (D1). This option consists of planting mast trees over the entire 40-acre dredged material placement site. This new site would be raised approximately 2-3 feet (final elevation) over the existing elevation, providing a slightly drier site that increases tree survival rates. The existing trees, primarily silver maple, would die off over a

period of time from the added dredged material placed over the root systems. The proposed tree planting species mixture would provide better habitat over time than the existing habitat does. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of -24.0 AAHUs. This loss represents the significant disturbance of the existing floodplain forest by the construction of the containment berm and the dredged material placement. A temporary berm will be pushed up around the perimeter of the site, creating a containment area for the fine sediment from the dredging. A 100-foot wide area around the perimeter of the site, for the berm location and the borrow for construction; will require clearing and grubbing of the existing vegetation, impacting approximately 13 acres. However, the current forest is dominated by silver maple and cottonwood, more flood-tolerant species and less desirable for wildlife. The replacement of the existing soft mast-producing forest by primarily hard mast-producing tree species is a relatively subtle change in habitat quality. In addition, increasing the elevation of the site will greatly favor natural regeneration of hard mast-producing trees. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another. Long-term benefits, though subtle, are expected from this action. In addition, this site is the confined placement site for dredging for fisheries enhancements in the Main Lake, Goose Pond, or both.

6. Restore Perimeter Levee. The objective of levee restoration is to reduce flood damages to the Lake Odessa complex and reduce incidences of levee failure. In addition, the inlet structure would be protected from excessive sediment accumulation and interior archeological sites would be protected from further erosion.

a. No Action (R0). No action would result in no new work to the levee, although the USFWS would construct the upper spillway to the 17-year level of protection. Without the lower spillway proposed with this potential project feature, the upper spillway would still allow controlled entry of floodwaters, but the interior water levels of the complex could not be raised as planned to prevent flood damage and/or levee failure. If no action would take place, it is expected that the interior features would gradually lose their functions and increased sedimentation from flooding would further reduce water depths throughout the Lake Odessa complex. No action would result in a loss of habitat over time.

b. Restore levee and construct spillway (R1). This alternative will be accomplished by restoring all sections of the current perimeter levee system that fall below the 25-year level of protection to the 50 to 25-year level of protection (upstream to downstream), while also flattening the interior slopes steeper than 5H:1V to improve section reliability. Sandy material, hydraulically dredged from Turkey Chute, a side channel of the Mississippi River, will be used for this repair.

Based on existing levee cross sections, it is estimated that approximately 44,396 feet of levee will require restoration to the new design grade and/or regrading of the interior slopes to 5H:1V. The approximate lengths of restoration are 22,496 feet upstream of Lock and Dam 17 and 21,900 feet downstream of the dam. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetland by construction activities. Details for the levee restoration can be found on plates 10-31.

An additional fisheries benefit would result from dredging in Turkey Chute, below Lock and Dam 17. This dredge cut was planned to provide additional overwintering habitat in Pool 18. Overwintering habitat within 3-5 miles of the proposed dredge cut is limited to an area at Boston Bay, located near River Mile 434.5. River fisheries biologists believe that this additional deeper off-channel area would be beneficial to the overall fishery of Pool 18. Immediately below Lock and Dam 17 and adjacent to the Lake Odessa complex, the current water depths are relatively shallow, with the exception of three existing deep-water areas. These three areas currently provide excellent fisheries habitat and will be avoided as dredging areas. In this portion of Turkey Chute, the proposed dredging would increase both the deep-water areas as well as the total water area in the side channel complex. The amount of deep-water habitat, as a percentage of the total water area, was increased proportionately. The MOFISH side channel model lacked sufficient sensitivity to detect the benefits of this increase in deep-water habitat. However, the proposed dredge cut would ensure the continued presence of deep-water habitat in this area.

The proposed dredge cut upstream of Lock and Dam 17 is located in Turkey Chute, which currently has a large amount of deeper water. Dredging in this area will ensure that deep-water areas utilized by fish will persist; however, the WHAG model is not sensitive enough to document benefits for this action. More information for these dredge cuts can be found on plates 3, 4, and 32.

As part of the levee restoration, two spillways will be added to the system. Construction of the upper spillway (17-year level of protection) is a USFWS initiative, currently under construction, that was included under the 'with project conditions' of the habitat evaluation. The lower spillway, providing a 10-year level of protection, is part of this HREP. These spillways will allow the interior to flood in a more controlled manner, rather than by levee overtopping or breaching. This feature yields a total net benefit of 1671.5 AAHUs; 1030.6 AAHUs in nonforested wetlands, 209.5 AAHUs in bottomland hardwood forest, and 431.4 AAHUS in fisheries.

The second portion of the levee restoration includes construction of a wing dam between Michael Creek and the upper inlet structure in the Mississippi River. This wing dam will reduce sedimentation at or near the inlet structure that, if allowed to build up, interferes with water control capabilities of the inlet structure. No habitat evaluation was done for the wing dam feature.

The final component of the restoration involves archeological site protection. Shoreline protection of nine archaeological sites will be accomplished with riprap. No habitat evaluation was done for this feature. However, any rock placed in the water will provide ancillary aquatic benefits, primarily for fish, to an area with little to no rocky structure.

C. Cost Estimates for Habitat Improvement Measures. Table 5-1 summarizes the outputs and costs associated with each management measure. This analysis was performed in 2002, using the cost estimate prepared at that time and using the 2002 interest rate of 6.125 percent.

D. Formulation and Evaluation of Alternative Plans. For environmental planning, traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units. However, cost effectiveness and incremental cost analysis can provide decision-makers with relative benefit-cost relationships of various enhancement or restoration solutions. While these analyses are not intended to lead to a single best solution, they do improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs. These tools aid the decision-makers in selecting a recommended plan to pursue in more detail.

1. Methodology. The Corps of Engineers' guidance requires incremental cost analysis for recommended environmental restoration plans. Two analytical techniques are conducted to meet these requirements. The Corps of Engineers Institute developed this methodology for Water Resources (Orth 1994). First, a cost-effective analysis is conducted to ensure that the least-cost solution is identified for each possible level of environmental output. Then, incremental cost analysis of the least-cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analyses are valuable tools to assist in decision-making.

Cost effectiveness and incremental analysis is basically a three-step procedure: (1) calculate the environmental outputs of each feature; (2) determine a cost estimate for each feature; and (3) combine the features to evaluate the best overall project alternative based on habitat benefits and cost. Only features that provided positive environmental outputs were considered for this analysis, beginning with the lowest cost increment. While cost and environmental output are necessary factors, other factors such as constructability and meeting the goals and objectives (tables 3-1 and 3-2) of the sponsor are very important in deciding on the preferred alternative.

Several steps were taken to incrementally analyze this project. This project was evaluated using guidance prepared by the Corps of Engineers Institute for Water Resources. Each project feature's various alternatives were combined into two distinct groups for analysis—MSUs (nonforested wetlands) and fisheries enhancements. Different feature types were not combined in this analysis since the targeted species for these features were not directly comparable.

Environmental outputs were calculated as AAHUs. The annualized costs were calculated by applying a 6.125 percent interest rate to the construction costs over the 50-year life of the project. All costs are shown in dollars. The incremental analysis for each feature was accomplished using the Institute of Water Resources (IWR) Plan Decision Support Software. Further information on the analysis can be found in Appendix D of this report.

Incremental analysis is not necessary for features with only one possible or cost-effective alternative, other than no action, such as the fish nursery, sand prairie restoration, and levee restoration. Incremental analysis was also not performed for the mast tree planting alternatives. The mast tree-planting alternative has three potential features: USFWS Site A & B (evaluated as one site), Site C, and Site D. Habitat benefits can be clearly shown when one habitat type is converted to another, as is the case for Site A & B (idle field to forest). Interplanting, as proposed for Site C, is a relatively subtle change in land use. Lack of model sensitivity for this feature skews the habitat impacts, and results of the analysis may not reflect real life expectations. Site D (dredged material placement site) was

included as a potential mast tree site, but planting the containment area mitigates for the habitat loss of containment construction and use and is considered a fisheries dredging feature primarily, with secondary use as a mast tree-planting site. Though planting this site with mast trees incurs additional costs, this action offsets the habitat lost through containment site construction and use. In addition, replacing the existing soft mast-producing forest, dominated by cottonwood and silver maple, with a mix of hard mast-producing tree species is expected to give long-term habitat benefits to the area over existing conditions.

2. Results. Combinations of features were grouped by function for incremental analysis: all MSU features were grouped together; all similar fisheries enhancements, except the fish nursery, were grouped together. Alternative increments of each group's features were then analyzed to identify the most cost-effective increments of each feature type included in the selected plan. The same procedure was performed for the fisheries enhancements. The results for MSUs and fisheries dredging features are summarized in Tables 5-2 and 5-3 below.

The incremental analysis for MSU enhancement evaluated alternatives M0, U0, F0, S0, D0, M1, U1, F1, S1, and D1. A total of 32 potential combinations may be formulated with the identified increments of feasible project features. Eight cost-effective plans resulted from the analysis, six of which were considered best buys. Table 5-2 and Figure 5-1 present the results of the incremental analysis and the best buy plans identified for the MSU features.

Although enhancing Swarms Pond, Fox Pond, and Unit 2 (S1+F1+U1) is also a best buy plan, this combination does not address improvements for the USFWS MSU complex (Fields 4&5, 21, MSU 20), considered to be the most important MSUs at the Lake Odessa complex. In addition, improvement to IDNR MSU provides a confined placement site for the dredged material from Blackhawk/Yankee Chutes fisheries enhancement feature, yielding 32.3 AAHUs for fish.

Table 5-2. Moist Soil Unit Enhancement: Best Buy Combinations

Feature Alternative	Output (AAHUs)	Annual Cost ($1)	Average Cost ($/AAHU)	Incremental Cost ($1s)	Incremental Output (AAHUs)	Incremental Cost per Unit ($/AAHU)
M0+U0+F0+S0+D0	0.0	0	0.0	0	0.0	0.0
M0+U0+F0+S1+D0	207.5	3,097	14.9	3,097	207.5	14.9
M0+U0+F1+S1+D0	444.1	21,893	49.3	18,786	236.6	79.4
M0+U1+F1+S1+D0	513.3	28,996	56.5	7,103	69.2	102.6
M0+U1+F1+S1+D1	556.9	44,169	79.3	15,173	43.6	348.0
M1+U1+F1+S1+D1	640.1	77,490	121.1	33,321	83.2	400.5

Outputs are calculated as Average Annual Habitat Units (AAHUs).
All costs are listed in dollars, costs annualized at 6.125% interest, 50-yr project life. Initial construction costs only.

M0, U0, F0, S0, D0 - No Action
M1 - Enhance USFWS Complex (Field 4 & 5, Field 21, MSU 20)
U1 - Enhance Unit 2
F1 - Enhance Fox Pond
S1 - Enhance Swarms/Bebee Ponds
D1 - Enhance IDNR MSU

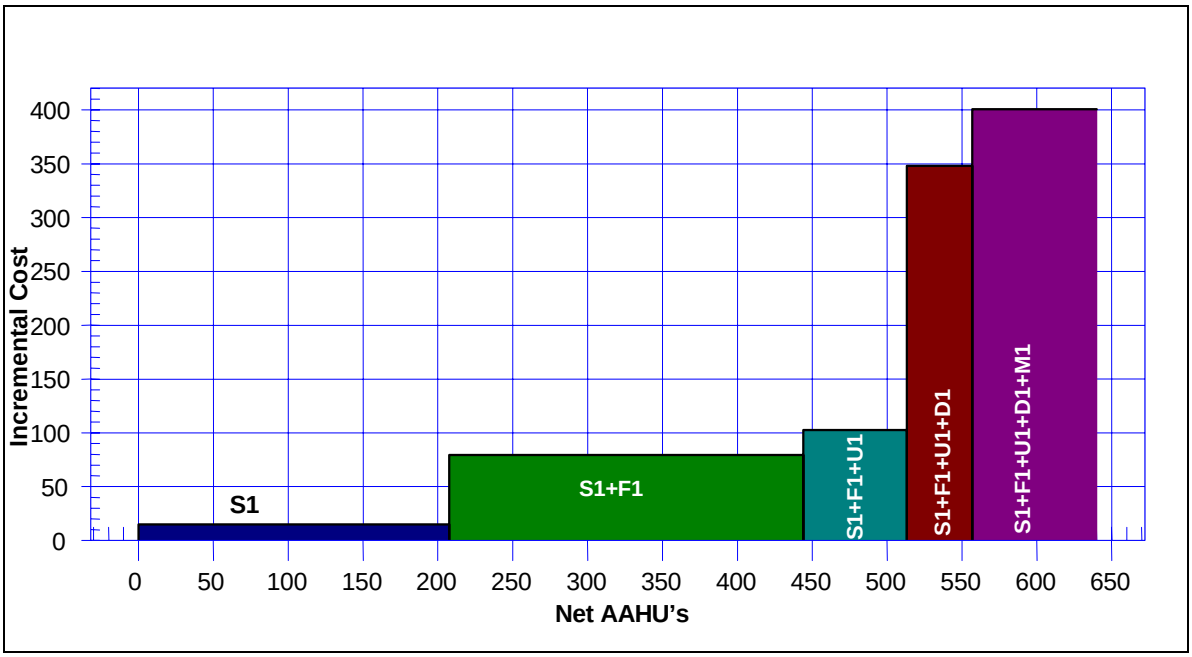


Figure 5-1. MSU Best Buy Plans

The incremental analysis for fisheries enhancement evaluated alternatives S0, L0, G0, B0, C0, S1, L1, G1, B1, and C1. A total of 32 potential combinations were possible, but due to non-combinable features, only 16 actual combinations were analyzed as the identified increments of feasible project features. Costs and AAHUs for dredging the Main Lake were combined with the containment costs for alternative L1. Costs and AAHUs for dredging Goose Pond were combined with the containment costs for alternative G1. Another alternative was added which included costs and AAHUs for dredging both the Main Lake and Goose Pond, and containment, alternative C1. This combined feature was therefore not combinable in the analysis with either the Main Lake or Goose Pond. Containment costs remained essentially unchanged regardless which of the three alternatives above was considered. Table 5-3 and Figure 5-2 present the results of the incremental analysis and the best buy plans identified for the fisheries, deep-water/access features.

This combination includes features that also have moist soil enhancement benefits, not included in the incremental analysis for fisheries features. Swarms/Bebee Pond dredging provides an additional 207.5 AAHUs and dredging Blackhawk/Yankee provides liner material for the IDNR MSU, providing 43.6 AAHUs.

Table 5-3. Fisheries Deep-Water/Access Enhancement: Best Buy Combinations

Feature Alternative	Output (AAHUs)	Annual Cost ($1)	Average Cost ($/AAHU)	Incremental Cost ($1s)	Incremental Output (AAHUs)	Incremental Cost per Unit ($/AAHU)
S0+L0+G0+B0+C0	0.0	0	0.0	0	0.0	0.0
S0+L1+G0+B0+C0	418.6	65388	156.2	65388	418.6	156.2
S1+L1+G0+B0+C0	424.5	68485	161.3	3097	5.9	524.9
S1+L0+G0+B0+C1	492.3	135499	275.2	67014	67.8	988.4
S1+L0+G0+B1+C1	524.6	182714	348.3	47215	32.3	1461.8

Outputs are calculated as Average Annual Habitat Units (AAHUs).
All costs are listed in dollars, costs annualized at 6.125% interest, 50-yr project life. Initial construction costs only.

S0, L0, G0, B0, C0 - No Action
S1 – Dredge Swarms/Bebee Ponds
L1 – Dredge Main Lake+containment
G1 – Dredge Goose Pond+containment
B1 – Dredge Blackhawk/Yankee Chutes
C1 – Dredge Main Lake+Goose Pond+containment

The following features are not combinable: L+G, L+C, G+C (containment costs would be counted twice)

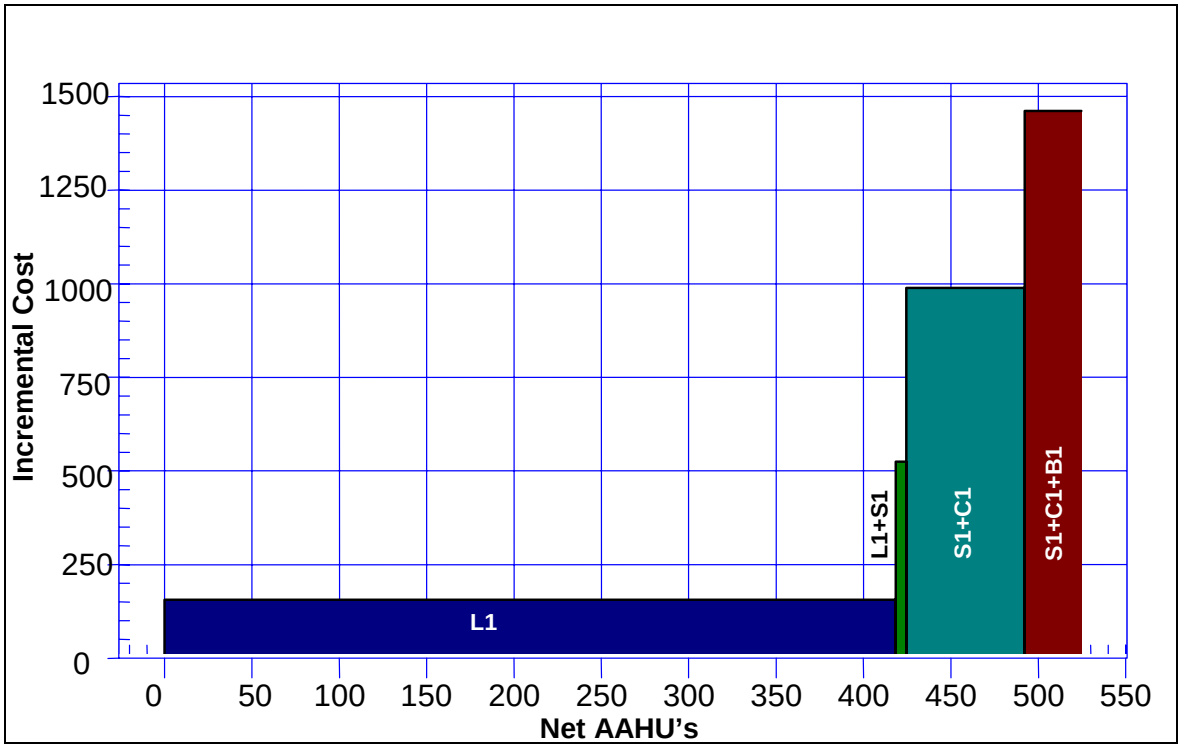


Figure 5-2. Fisheries Best Buy Plans

E. Summary. The proposed projects for the Lake Odessa complex involve four primary enhancement features: enhancing the current MSUs, primarily through increased water level control; increasing the amount of deep-water overwintering habitat for fish; planting mast-producing trees on higher elevations; and protecting the interior features with levee improvements and a spillway. Additional, but minor, features included reestablishing the sand prairie (terrestrial habitat enhancement) and constructing the fish nursery (fisheries enhancement).

The results of the WHAG analysis suggest that the Lake Odessa complex can be enhanced with the features proposed for this project. Results of the WHAG application were compared as increments to costs, where applicable, for the MSU and fisheries dredging features. No incremental analysis was performed where only one possible alternative, other than no action, was possible, such as for the fish nursery, sand prairie restoration, and levee restoration. Incremental analysis also was not performed for the mast tree planting alternatives. Lack of model sensitivity for these features skews the habitat impacts and the results of the analysis may not reflect real life expectations. However, all of these features will enhance the Lake Odessa complex and increase the species diversity of the area.

The results of the incremental analyses shown in this section were considered with other factors, including site topography, management objectives of the resource agencies, critical needs of the region, and ecosystem needs of the Upper Mississippi River System.

Based on the results of the MSU analyses presented above, the most cost-effective or "best buy" plan that would meet all project objectives for the MSU component would be enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Bebee Ponds + IDNR MSU (M1+U1+F1+S1+D1). Based on comments and input received from both the USFWS and the IDNR (project sponsors) during the alternative formulation process of the DPR, the best buy plan mentioned here is the sponsors' preferred plan.

Based on the results of the dredging analyses presented above, the most cost-effective or "best buy" plan that would meet all project objectives for the fisheries enhancement (dredging) would be dredging Swarms/Bebee Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes (S1+L0+G0+B1+C1). Based on comments and input received from both the USFWS and the IDNR during the alternative formulation process of the DPR, the best buy plan mentioned here is the sponsors' preferred plan.

In conclusion, the WHAG and incremental cost analyses indicate that the following features would provide the greatest outputs in a cost-effective manner:

- enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Bebee Ponds + IDNR MSU;
- dredging Swarms/Bebee Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes;
- restoring the sand prairie;
- constructing the upper fish nursery;
- mast tree planting at Sites A, B, C, and D and restoring the perimeter levee

This combination would meet HREP goals and objectives, would add to habitat diversity as well as quality, and would best meet the overall management objectives for the site.

In cooperation with the USFWS and IDNR, the Corps has planned and designed a project that serves the needs of the resources and the resource managers, while being cost conscious. The preferred alternative for this study includes all of the features evaluated in this section. The preferred alternative has an overall output of 2,884.3 AAHUs, which consists of 640.1 AAHUs gained from moist soil unit enhancement, 11.3 AAHUs from the sand prairie, -0.7 AAHUs from the fish nursery, 524.6 AAHUs from deep-water/access for fisheries, 37.5 AAHUs from mast tree planting, and 1,671.5 AAHUs gained from levee restoration. Table 5-1 gives a breakdown for the specific features within each of these categories.

A breakdown of costs for the recommended plan is outlined in Section VIII, *Cost Estimates.* The costs shown in table 8-1 and 8-2 reflect further refinement of the project features of the recommended plan, including updated costs and interest rates.

VI. RECOMMENDED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE CONSIDERATIONS

A. General Description. The following preferred alternatives were developed by the planning team and supported by the project sponsors (USFWS and IDNR):

- moist soil unit (MSU) enhancement (includes Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, Swarms/Bebee Ponds, and IDNR MSU) (M1+U1+F1+S1+D1)
- fisheries enhancement through deep hole/access dredging (includes Main Lake, Goose Pond, Blackhawk/Yankee Chutes, Swarms/Bebee Ponds) (B1+S1+C1)
- mast tree planting at four separate sites (A through D) (A1+C1+D1)
- enhancement of the perimeter levee by restoring the crown (includes enhancing slopes, a spillway, a wing dam, snake pools, and archeological site protection) (R1)
- reestablishment of the sand prairie (P1)
- construction of the upper fish nursery (N1)

Plates 3 and 4 show the recommended plan.

B. Recommended Plan. Note, all elevations listed are in the 1912 datum.

1. MSU Enhancement (M1+U1+F1+S1+D1). The recommended plan for this feature involves enhancing the MSU's water level management capability (Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, IDNR MSU, and Swarms/Bebee Ponds). Currently, the water supply/levels and area flooded are limiting factors in all the MSUs. The proposed improvements would increase water level control, reliability, and increase the flooded area; thereby providing moist soil habitat. Improvement at the following locations would lead to more moist soil habitat, enhanced wetland vegetation diversity and growth during the summer months, and provide better, more reliable food supplies to migratory waterfowl during fall migration. In general, fields are dewatered after spring floodwaters have receded using pumps or control structures (gravity). During the drier summer months, wetland vegetation flourishes in the MSUs. Beginning in September, water is gradually added to the units, attracting migrating waterfowl by providing feeding and resting opportunities.

a. Field 4 & 5 (M1). Enhanced water level management capability will be accomplished by providing a portable pump and pump pad, and modifying the existing inlet structure to dedicate 1 of its 4 bays for filling this MSU as well as Field 21 and MSU 20. The dedicated water bay is described in 6.b.(1)(d). Perimeter berms that delineate and contain water in field 4 & 5 are already in place and are of acceptable condition. The existing berms will allow water impoundment to elevation 538.5. The dedicated water bay and a portable pump will be used to raise the water to this level (83 acres flooded at 538.5). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. A pump pad, located on Little Goose Pond, will be constructed using an articulated concrete mat and will include a permanent hose hookup to reduce operation costs (plate 39). This feature yields a net benefit of 34.5 AAHUs.

b. Field 21 (M1). Enhanced water level management capability will be accomplished by providing a portable pump and pump pad, and modifying the existing inlet structure to dedicate 1 of its 4 bays for filling this MSU as well as Field 4 & 5 and MSU 20. The dedicated water bay is described in section VI. B(1)(d). Perimeter berms that delineate and contain water in field 21 are already in place and are of acceptable condition. The existing berms will allow water impoundment to elevation 538.5. The dedicated water bay and a portable pump will be used to raise the water to this

level (83 acres flooded at 538.5). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. A pump pad, located near Prairie Pocket, will be constructed using an articulated concrete mat and include a permanent hose hookup to reduce operation costs (plate 39). This feature yields a net benefit of 34.5 AAHUs.

c. MSU 20 (M1). Enhanced water level management capability will be accomplished by modifying the existing inlet structure to dedicate one of its four bays for filling this MSU as well as Field 21 and Field 4 & 5. The dedicated water bay is described in section VI. B(1)(d). The existing berm will allow water impoundment to elevation 538.5. The dedicated water bay will be used to gravity fill this MSU to elevation 536.0. Water levels may be raised to elevation 538.5 by moving water from Field 4 & 5 and/or Field 21 through existing control structures (72 acres flooded at 538.5). This feature yields a net benefit of 34.5 AAHUs.

d. Dedicated Water Bay (M1). The dedicated water bay is needed to improve operation of the overall complex. Currently, water level management is dependent on raising and lowering a stoplog structure in the ditch leading from the inlet structure. The problem is that diverting water to the MSUs using the stoplog structure precludes water from filling the main lake and vice versa. A dedicated bay will allow filling of the MSUs and the main lake simultaneously. The dedicated water bay will divert flow from the downstream bay of the 4-bay inlet structure by extending the bay's concrete wall to meet a sheet pile wall (40 feet) that then leads to a newly excavated ditch (500 feet, 4,559 cubic yards), which then meets an existing ditch that leads to the MSUs (plate 33). Construction of the bay will allow gravity filling of Field 4 & 5, Field 21, and MSU 20 to an approximate elevation of 536.0. The new ditch section will also include a 64-inch by 43-inch pipe arch to provide access over the ditch (plate 36).

e. Unit 2 (U1). Enhanced water level management capability will be accomplished by providing a portable pump and new water control structure. A portable pump will be used to raise interior water levels and flood 92 acres at 538.5. The portable pump (4,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. The existing berm is 2,800 feet long and requires no additional work (an existing roadbed and the project's perimeter levee are used as Unit 2's north and west berms). The new water control structure is a 36-inch CMP with slide gate that will be located next to the existing 24-inch stoplog structure under the road across Muscatine Slough (plate 35). This structure's purpose is to assure that an adequate supply of water from Muscatine Slough reaches the portable pump. This feature yields a net benefit of 69.2 AAHUs.

f. Fox Pond (F1). Enhanced water level management capability will be accomplished by constructing a new pump station, water control structure, and pump pad. The pumping plan for this unit involves raising water levels from 536.0 to 537.0 in two 6-inch increments. Each increment will be pumped in over a 7-day period with the 537.0 elevation maintained for approximately 2 months to maximize feeding opportunities for waterfowl (336 acres flooded at 537.0). The proposed new pump station will be a concrete-lined sheet pile sump housing a vertical pump. The pump will be a submersible 25,000 gpm vertical belt driven propeller pump powered by an external power unit (stored off site). Immediately adjacent to the pump, will be an 8-inch thick concrete pad to support the power unit. The pump station will pump water into Fox Pond via a steel pipe that will run through the berm (plate 40). The existing 14,000-gpm pump station will be left in place to facilitate draw down of Fox Pond.

A new 36-inch CMP water control structure with slide gate will replace the existing gatewell structure (plate 37). A portable pump pad located on the Fox Pond side of the embankment will also be constructed near the pump station to allow a near total dewatering of the unit in early summer using a portable pump. An additional portable pump is not needed for this MSU because one of the other portable pumps used at Field 4 & 5, Field 21, or Unit 2 can be used here in early summer and then moved back for early fall pumping at the other units. The pump pad will be constructed using articulated concrete matting and include a permanent hose hookup to reduce operation costs (plate 39). This dewatering will promote vegetation growth desired as a food source by migrating waterfowl. This feature yields a net benefit of 236.6 AAHUs.

g. IDNR MSU (D1). Enhanced water level management capability will be accomplished by providing a portable pump, constructing a new water control structure, and reducing the seepage rate. A portable pump will be used to raise interior water levels 4 feet over 14 days (541.0) and then maintain that level for approximately 2.5 months to maximize feeding opportunities for waterfowl (49 acres flooded at 541.0). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the IDNR Refuge Office when not in use. A pump pad, located on Burris Ditch, will be constructed using articulated concrete matting, and include a permanent hose hookup to reduce operation costs (plate 39). The existing berm is 5,925 feet long, encompasses 49 acres, and requires no additional work. A new 36-inch CMP water control structure with slide gate will replace the existing gatewell structure (plate 38).

The seepage rate for portions of this MSU is greater than pumping can raise them, which limits successful management for waterfowl use. The seepage rate will be reduced by placing fine-grained material (63,531 cubic yards) hydraulically dredged from the Yankee/Blackhawk Chutes deep-water fisheries project feature (see 6.b.(2)(c)) into the MSU to act as a liner. Following placement, the dredged material will be incorporated into the existing material to a depth of ~1 foot to enable the MSU to better hold water. Prior to placement, the MSU interior will be cleared and grubbed to create a better seal between the new and existing materials. The cleared and grubbed material will be stockpiled outside the MSU in an adjacent field. In addition to the clearing and grubbing, a structure will be constructed prior to dredging to allow run off water to leave the area. Various options exist for the structure, and one will be chosen during design that ensures IDNR water quality requirements are met (plate 4). This feature yields a net benefit of 43.6 AAHUs.

h. Swarms/Bebee Ponds (S1). This feature consists of mechanically dredging the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. The approximate size of the dredge cuts will be 650 feet long by 126 feet wide between Bebee and Swarms, and 1,517 feet long by 118 feet wide between Swarms and Lake Odessa. Both channels will be dredged 1 foot deeper than the existing channel bed to a depth equal to the adjacent pond. The side slopes of the channel will be 6H:1V and encompass ~2 acres between Bebee and Swarms and ~4 acres between Swarms and Lake Odessa. The excavated material is mainly fine-grained sediment that will be mechanically dredged and sidecast on the downstream embankment next to the channel. The channel dredging will allow both ponds to drain during drawdown periods, which will promote vegetation growth that when re-flooded, can be used by migratory waterfowl. Under existing conditions, vegetation is primarily found around the pond's edges because the trapped water does not allow germination of moist soil plants. This feature yields a net benefit of 207.5 AAHUs for moist soil species.

2. Fisheries Enhancement (B1+S1+C1). The recommended plan for this feature includes dredging channels and/or deep holes in the main lake (Lake Odessa), Goose Pond, Blackhawk/Yankee Chute Access, and Swarms/Bebee Ponds. The dredging plant will need to be trucked to Lake Odessa and reassembled on site, as there is no navigable connection to the Mississippi River. The primary emphasis of fisheries enhancement is creating areas of deeper water and/or access to existing deeper water at the Lake Odessa complex. Sedimentation and flood damage have reduced deep-water habitat over time. Additionally, access channels to Swarms/Bebee Ponds and Yankee Chute have silted in, reducing the ability of fish to leave some areas if conditions would necessitate (low dissolved oxygen in the summer, escape from freezing water in the winter). Both of these problems can result in localized fish kills. Water depths in the Lake Odessa complex are currently no deeper than 6 feet. Water depths of 8 feet or more are considered ideal, primarily for overwintering habitat. For the deep-water dredging, a sedimentation rate of 1-2 cm/yr was calculated. This rate assumes that the levee restoration will reduce flood damages and sediment deposition over existing conditions. The access channel dredging depths were adjusted to include the estimated 50 years of sedimentation. The deeper areas will provide oxygenated water (during summer and winter) as well as escape routes (all season) and overwintering habitat during the winter months.

a. Dredge Main Lake (Lake Odessa) + Dredge Goose Pond (C1). In the Main Lake, an area approximately 1,490 feet long by 751 feet wide will be dredged hydraulically to a depth 2 feet deeper than the existing lakebed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 30-acre area at normal water elevations. A total of 81,555 cubic yards of fine-grained sediment will be placed on land in a 40-acre confined site dominated by silver maples. (See plate 4 for location.) Dredging in the Main Lake yields a net benefit of 418.6 AAHUs.

In Goose Pond, this feature consists of dredging a deep channel to connect Goose Pond and Sand Run. An area approximately 5,158 feet long by 142 feet wide will be dredged hydraulically to a depth 4 feet deeper than the existing channel bed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 17-acre area at normal water elevations. A total of 90,170 cubic yards of fine-grained sediment will be placed on land in a 40-acre confined site. Dredging in Goose Pond yields a net benefit of 67.8 AAHUs.

The confined site used for these areas will require low-level berm work (5 feet high), using adjacent material, in advance of placement. Minimal tree clearing (100 feet) is needed where the low-level berm is constructed. Once dry, mast trees will be planted on the placement site at a rate of 40 per acre. The mast tree planting benefits are discussed under mast tree planting site D.

b. Dredge Blackhawk Chute/Yankee Chute Access (B1). This feature consists of dredging a deep channel to connect Yankee Chute to Blackhawk Chute. The channel will be approximately 6,040 feet long by 95 feet wide and will be dredged hydraulically to a depth 4 feet deeper than the existing channel bed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 13-acre area at normal water elevations. A total of 63,530 cubic yards of fine-grained sediment will be placed in the IDNR MSU to reduce seepage (see 6.b.(1)(f)). This feature yields a net benefit of 32.3 AAHUs.

c. Dredge Swarms/Bebee Ponds (S1). This feature consists of mechanically dredging the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. The approximate size of the dredge cuts will be 650 feet long by 126 feet wide between Bebee and Swarms, and 1,517 feet long by 118 feet wide between Swarms and Lake Odessa. Both channels will be dredged 1 foot

deeper than the existing channel bed to a depth equal to the adjacent ponds. The side slopes of the channel will be 6H:1V and encompass ~2 acres between Bebee and Swarms and ~4 acres between Swarms and Lake Odessa. The excavated material is mainly fine-grained sediment that will be mechanically dredged and sidecast on the downstream embankment next to the channel. These ponds would then be hydraulically connected to the main lake during most water levels. The current channels can dry up during low-water conditions, isolating fish, increasing the potential for fish kills. This feature yields a net benefit of 5.9 AAHUs.

3. Mast Tree Planting (A1+C1+D1). This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting is to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree plantings would restore some of the historic diversity of the bottomland forest community and reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. Mast tree species to be planted would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). Only those sites at higher elevations or on ridges were considered to maximize tree survival. This feature would consist of planting Root Production Method™ (RPM) trees at a density of 40 trees per acre at all sites. These hardy containerized trees, grown from locally-collected seed, are able to survive the dynamic nature of the floodplain and herbaceous competition, and require much less maintenance. In addition, they begin bearing acorns as soon as 18 months after planting, much earlier than trees produced through traditional methods.

a. Mast Tree Planting Site A (A1). Site A is a 13-acre site just north of Field 4 & 5 that has mostly scrubby vegetation except for a small grove of pecan trees. The 530 trees planted on this site's higher elevations will avoid impacts to the existing pecan grove. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree, treating the area with herbicide, and mowing periodically. Mast tree planting Sites A and B were evaluated as one area in the habitat analysis. This combined feature yields a net benefit of 60.2 AAHUs.

b. Mast Tree Planting Site B (A1). Site B is a 14-acre former crop field near the Fox Pond pump station that currently has mostly scrubby vegetation. The 560 trees will be planted on this site's higher elevations. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree, treating the area with herbicide, and mowing periodically. Mast tree planting Sites A and B were evaluated as one area in the habitat analysis. This combined feature yields a net benefit of 60.2 AAHUs.

c. Mast Tree Planting Site C (C1). Site C is a 26-acre interplanting site bordering Sand Run that currently is dominated by silver maple and cottonwood trees. The 1,020 trees will be planted on this site's higher elevations. The recommended planting rate is 40 trees per acre. Some hand clearing may be necessary around each proposed tree planting location, depending on the immediate area conditions. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree and treating the area with herbicide. Mowing is not possible due to the site's remoteness (boat access only). This feature yields a net benefit of 1.3 AAHUs. The reintroduction of mast-producing tree species into an area of existing forest habitat is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies are generally less sensitive to such

qualitative changes within habitat types than to more drastic changes from one habitat type to another. In these circumstances, the results of the analysis may not reflect real life expectations; actual benefits are anticipated to be higher than calculated.

d. Mast Tree Planting Site D (D1). Site D is a 40-acre site that is also being used as a placement site for fisheries enhancement dredging of the main lake (Lake Odessa) and Goose Pond (section VI. B.(2)(a)). After the dredged material has dried sufficiently, the 1,584 trees will be planted on this site's higher elevations. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree and treating the area with herbicide. Mowing is not possible due to the site's remoteness (boat access only). Analysis of this feature resulted in a calculated loss of 24.0 AAHUs in habitat benefits. This loss represents the significant disturbance of the existing floodplain forest by the dredged material placement. However, the current forest is dominated by silver maple and cottonwood, more flood-tolerant species, and less desirable for wildlife. The replacement of the existing soft mast-producing forest by primarily hard mast-producing tree species is a relatively subtle change in habitat quality. In addition, increasing the elevation of the site will greatly favor natural regeneration of hard mast-producing trees. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to changes that are more drastic from one habitat type to another. Long-term benefits, though subtle, are expected as a result of this action.

As noted in the above paragraph, site D will be elevated prior to planting the trees by placing dredged material in the area. Site D will have to be elevated approximately 2.7 feet to create proper growing conditions for the mast trees. To facilitate this, a temporary berm will be pushed up around the perimeter of the site, creating a containment area for the fine sediment from the dredging. A 100-foot wide area around the perimeter of the site, for the berm location and the borrow for construction, will require clearing and grubbing of the existing vegetation, impacting approximately 13 acres of existing low quality bottomland forest. This temporary berm will be approximately 5,800 feet in length, 5.0 feet high, have an 8 foot wide crown, 2.5H:1V side slopes, will require approximately 21,800 cubic yards of material to construct, and will provide approximately 40 acres of storage area. The containment area will provide approximately twice the volume required for the dredged material. This extra volume will provide the capacity required to allow the fine sediment time to settle out from the dredging operations, which can be as much as 90 percent water. As a part of the containment berm, a structure will be constructed to allow run off water to leave the area. Various options exist for the structure, and one that ensures IDNR water quality requirements are met will be chosen during design (plates 4 and 32).

4. Levee Restoration (R1). The objective of levee restoration is to reduce flood damages to the Lake Odessa complex and reduce incidences of levee failure. Restoration will be accomplished by establishing a sloping levee profile starting at the 25-year level of protection (downstream) and gradually increasing the height to the 50-year level of protection (upstream), while also grading interior sideslopes to 5H:1V and constructing an overflow spillway (plates 9 through 31). The levee's sloping profile will provide for gradual overtopping of the levee system during extreme flood events, and the 5H:1V sideslopes would improve section reliability during flood events. The spillway would allow controlled filling of the interior to minimize the incidence of levee breaching during flood events.

The perimeter levee is 9.5 miles long and is composed of a composite of material (sand, clay, and/or silt) with sand more common toward the upstream end. Approximately 8.4 miles of levee will require

regrading, including crown enhancement to ~548.0-551.2, and/or slope enhancement to 5H:1V. Current levee heights range between the 10 and 500-year protection level with levee slopes generally between 2H:1V and 2.5H:1V.

Borrow for the restoration will consist of sand hydraulically dredged from Turkey Chute, a side channel of the Mississippi River (279,987 cubic yards). Borrow will be dredged from an upper and lower site to reduce pumping lengths. The upper borrow site is the portion of Turkey Chute above the spillway of Lock and Dam 17, and will supply borrow for the levee work upstream of the dam. The lower borrow site is the portion of Turkey Chute below the dam, and will provide borrow for the levee work downstream of the dam. The dredge cuts in the lower portion of Turkey Chute will consist of channels that will be dredged deep enough to provide over-wintering habitat.

The dredged borrow material will be worked into the slope using bulldozer type equipment. The material will be spread and shaped to create the specified levee slope of 5H:1V. Some of the work areas will not have any material directly dredged to their location due to the minimal amount of work in those areas. For those areas, borrow will be brought from adjacent sites that will receive dredged material via a rubber tracked scraper that can traverse sand slopes causing minimal damage. The volume of material to be hauled to minimal work sites is approximately 10,200 cubic yards. Prior to dredging, the levee crown and interior slope will have the top 6 inches stripped to forge a better bond between the new borrow and the existing levee material. The stripped material will be placed at the new levee slope toe for use in containing the dredged material's return water. Due to levee slope repairs, 5,496 feet of existing gravel road will have to be replaced or relocated. Of the 5,496 feet, 2,100 are upstream of the dam, and will need to be replaced. The remaining 3,396 feet is located in the tieback section of the levee downstream of the dam, with the majority of it needing to be relocated. All roads needing relocation or replacement will be 12 feet wide by 8 inches thick.

Based on existing levee cross sections, it is estimated that approximately 44,396 feet of levee will require restoration to the new design grade and/or regrading of the interior slopes to 5H:1V. The approximate lengths of restoration are 22,496 feet upstream of Lock and Dam 17 and 21,900 feet downstream of the dam. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland and open water areas within the levee system. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetlands by construction activities. Note, earthwork quantities were obtained from modeling software (INROADS), utilizing survey data obtained from aerial and ground surveys. Plates 9-31 provide additional details of the proposed levee restoration.

Iowa DNR biologists have identified the areas inside and adjacent to the Mississippi and Iowa River levees, as well as Site D, as copperbelly and diamondback watersnake habitat. As part of the levee construction, no fewer than seven shallow pools, approximately 1.5 feet deep or less, will be constructed to enhance habitat for these state-listed watersnakes, in more forested areas. Some of the cleared trees and brush will be placed around these pools to provide basking habitat. Buttonbush cutting will be planted by the DNR along the shoreline and edges of the pools to provide the scrub-shrub habitat component.

The total acreage of habitat protected by the levee restoration is 1,700 acres of non-forested wetland, 3,900 acres of bottomland hardwood forest, and 1,800 acres of open or deep water. The habitat benefits of this protection are described in more detail below. The amount of wetland or open water habitat adversely affected by the levee restoration is a very small percentage of the total habitat protected and would not be a noticeable factor in the WHAG evaluation.

Habitat benefits calculated for the levee restoration yielded a net total benefit of 1671.5 AAHUs (non-forested wetlands=1030.6 AAHUs, bottomland hardwood forest=209.5 AAHUs, fisheries=431.4 AAHUs). Restoration is important because past levee failures have resulted in losses of emergent aquatic vegetation used by migratory waterfowl. Prolonged flooding after levee breaches has also increased the mortality of mast-producing trees. Sedimentation from frequent levee breaks and overtopping flood events has increased the extent of shallow water habitat, which results in more frequent fish winterkills and reduced circulation of well-oxygenated water.

a. Spillways. In conjunction with the levee slope and crown improvements, two spillways will be constructed. The 700-foot upper spillway has already been constructed by the USFWS using design standards and parameters specified and approved by the Rock Island District. The upper spillway is at approximately the 17-year protection level (elevation 548.8). The lower spillway will be constructed as a part of this HREP (plate 31). The 1,100-foot lower spillway will be constructed by shaping the existing levee section and placing 87,300 square feet of concrete matting on the crown and landside slope, 3,245 tons of riprap on the riverside slope and 1,489 tons of riprap on the landside toe, 4,672 tons of bedding stone on the landside and riverside slopes, 150,800 square feet of geo-textile fabric to be placed under the bedding stone, riprap, and concrete mat collectively, and a 6-foot high reinforced concrete cutoff wall running the length of the spillway. The finished crown of the spillway will be at approximately the 10-year protection level (elevation 545.2). The riprap will be a 2 feet thick on the riverside, and 3 feet thick on the landside, both for the entire length of the spillway. The bedding stone will be placed 6 inches thick under the concrete mat, and 9 inches thick under the riprap. The concrete cutoff wall will be located on the crown of the levee, and shall prevent water infiltrating through the levee at an elevation lower than the spillway crown elevation. The spillways are designed to work together to fill the interior in a controlled manner, minimizing damage to the levee and interior features by reducing head differential at time of overtopping (~1 foot). The upper spillway is required because the levee's length and river slope prevents the lower spillway from filling the upper end to the elevation needed to prevent damages. To construct the spillway, approximately 14,400 cubic yards of excavated material will have to be relocated. It is anticipated that this material will be placed on adjacent levee sections requiring work.

b. Archeological Site Protection (R1). Shoreline protection of nine known archeological sites will be accomplished through rock protection. The protection will have a 50-year project life. Due to the lack of slope at two of the sites, they will be protected with a breakwater structure. The breakwater structures shall be located immediately off shore from the sites, and shall be constructed of riprap having an 8 feet wide crown and 2H:1V side slopes. For the remaining seven sites, the protection shall be riprap placed directly on the shoreline that will extend 3 feet out from the bank and have a 2H:1V side slope. (plate 32.) The total amount of riprap required for the proposed archeological site protection is 8,619 tons. Shoreline protection of archeological sites is needed to protect known sites from further erosion caused by frequent water level fluctuation. Habitat benefits for the proposed protection for the archeological sites were not evaluated. However, any rock placed in the water will provide ancillary aquatic benefits, primarily for fish, to an area with little to no rocky structure.

c. Michael Creek Wing Dam (R1). The Michael Creek wing dam will be located just upstream of the project's inlet structure. The wing dam will have 2H:1V side slopes, an 8-foot top width, extend 25 feet into the river (additional 10-feet inland), and stand 3 feet taller than the existing river bottom along its 25-foot length (plate 32). The total amount of riprap required for the proposed wing dam is 90 tons. The wing dam will be submerged to avoid impacts to navigation, but high enough to deflect heavy sediments from Michael Creek and the Mississippi River into faster currents that will transport the material downstream, away from the inlet structure. Habitat benefits for the wing dam itself were not evaluated.

5. Sand Prairie Planting (P1). This feature consists of planting the 36-acre field with a commercial, predetermined bulk seed mix harvested from a local mesic to dry prairie. The mix will contain both grasses and forbs. Approximately 25 acres of this site were previously restored, but heavily damaged by the 1993 flood. The remaining 11 acres are currently row cropped to provide food resources for waterfowl and other wildlife. The planting will be done by the USFWS using a seed drill at a rate of 12-16 pounds of seed per acre. Prior to planting, the USFWS will prepare the site, as appropriate. This may include burning, disking, and/or other measures, as needed. This feature yields a net benefit of 11.3 AAHUs.

6. Upper Fish Nursery (N1). The proposed fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake. The refuge manager would select which species to stock in the nursery each year. This feature consists of utilizing an existing containment area for use as a fish nursery that is approximately 21 acres in area. The area currently has a stoplog control structure, which is damaged and will be replaced. This existing structure will be replaced with a 36-inch reinforced concrete pipe (RCP) culvert and stop log water control structure in a 48-inch RCP riser (plate 34). With the new structure, the area will be able to pond water up to approximately 3 feet deep, allowing the stocking of fingerlings that will be released into Lake Odessa at a later date (plate 3). This feature yields a net benefit of -0.7 AAHU. This structure is an artificial feature and could not be properly evaluated with the habitat models available. Model results were included for completeness. This apparent lack of benefits reflects the MOFISH model's design to evaluate natural situations. The negative impacts reflect the isolation of this area from the main lake. The assumption was made, using best professional judgment, that this feature would provide the intended nursery benefits. Post-construction monitoring will be implemented to document the results of this feature.

C. Project Feature Summary. Table 6-1 summarizes project data.

Table 6-1. Lake Odessa Project Feature Summary Table

Feature	Measurement	Unit of Measure
Moist Soil Unit		
Field 4 & 5		
Site Area	83	acres
Pump Pad	1	items
Portable Pump with Power Pack (10,000 gpm)	1	items
Field 21		
Site Area	83	acres
Pump Pad	1	items
Portable Pump with Power Pack (10,000 gpm)	1	items
MSU 20		
Site Area	72	acres
Fox Pond		
Site Area	336	acres
Pump Station (25,000 gpm)	1	items
Pump Pad	1	items
Slide Gate Control Structure (36-inch CMP)	1	items
Dedicated Water Bay		
Sheet Pile	40	feet
Concrete	2	cubic yards
64” by 43” CMP Pipe Arch	62.5	feet
	500	feet
Excavated Channel	3203	cubic yards
Unit 2		
Site Area	92	acres
Portable Pump with Power Pack (4,000 gpm)	1	items
Slide Gate Control Structure under Muscatine Slough Road (36-inch CMP)	1	items
IDNR MSU		
Site Area	49	acres
Clear/Grub	49	acres
Pump Pad	1	Items
Portable Pump with Power Pack (10,000 gpm)	1	items
Slide Gate Control Structure (36-inch CMP)	1	items
Sand Prairie Restoration		
Field 6 Sand Prairie Planting		
Area	36	acres

Table 6-1. Lake Odessa Project Feature Summary Table

Feature	Measurement	Unit of Measure
Fisheries Enhancement		
Fish Nursery		
Area	21	acres
Stoplog Control Structure (36-inch RCP)	1	items
Dredge Lake Odessa (Main Lake) (Hydraulic)		
Length	1490	feet
Top Width	751	feet
Depth	2	feet
Dredged Material	81555	cubic yards
Channel Side Slopes	6:1	H:V
Dredge Goose Pond (Hydraulic)		
Length	5158	feet
Top Width	142	feet
Depth	4	feet
Dredged Material	90170	cubic yards
Channel Side Slopes	6:1	H:V
Dredge Blackhawk Chute/Yankee Chute (Hydraulic)		
Length	6040	feet
Top Width	95	feet
Depth	4	feet
Dredged Material	63530	cubic yards
Channel Side Slopes	6:1	H:V
Dredge Channel Between Swarms and Bebee Ponds (Mechanical)		
Length	650	feet
Top Width	126	feet
Depth	1	feet
Dredged Material	2890	cubic yards
Channel Side Slopes	6:1	H:V
Dredge Channel Between Swarms Pond and Lake Odessa (Mechanical)		
Length	1517	feet
Top Width	118	feet
Depth	1	feet
Dredged Material	6290	cubic yards
Channel Side Slopes	6:1	H:V
Main Stem Levee Restoration		
Levee		
Crown Width	12	feet
Side Slopes (Interior Only)	5:1	H:V
Levee Length (Pre-Construction)	50396	feet
Levee Length (Work Areas))	44396	feet
Crown Elevation: River Mile 441.1 River Mile 437.2 River Mile 437.2 River Mile 434.8	551.0 549.3 549.0 548.0	feet
Borrow Volume (Sand)	279987	cubic yards
Strip Layer	6	inches

Feature		Measurement	Unit of Measure
Gravel Road Relocation	Width	12	feet
	Length	5496	feet
	Thickness	8	inches
	Mass	2931	tons
Spillway			
Crown Width		12	feet
Side Slopes: Interior Exterior		5:1 4:1	H:V
Crown Elevation (MSL)		545.2	feet
Length		1100	feet
Concrete Matting		87300	square feet
Geotextile Fabric		150800	square feet
Riprap Thickness: Land Side (key in) River Side		36 24	inches
Riprap Mass (400 lb)		3245	tons
Riprap Mass (700 lb)		1489	tons
Bedding Thickness: Under Concrete Mat Under Riprap		6 9	inches
Bedding Mass		4672	tons
concrete Cutoff Wall	Length	1100	feet
	Height	6	feet
Excavation (Spoil)		14400	cubic yards
Michael Creek Wing Dam			
Crown Width		8	feet
Side Slopes		2:1	H:V
Height		3	feet
Length		35	feet
Riprap Mass		90	tons
Archeological Site Shoreline Protection			
Crown Width		3	feet
Side Slope		2:1	H:V
Height (average)		4	feet
Length (Shoreline)		3410	feet
Riprap Mass		8619	tons
Mast Tree Planting			
Site A			
Mast Tree Plantings		13	acres
Northern Pecan		88	trees
Swamp White Oak		88	trees
Bur Oak		88	trees
Pin Oak		88	trees
Sycamore		89	trees
Shellbark Hickory		89	trees
Total Trees		530	trees
Weed Barrier Mats		530	mats
Herbicide		530	treatment sites
Red Top Grass		13	acres

Table 6-1. Lake Odessa Project Feature Summary Table

Feature	Measurement	Unit of Measure
Mast Tree Planting		
Site B		
Mast Tree Plantings	14	acres
Northern Pecan	93	trees
Swamp White Oak	93	trees
Bur Oak	93	trees
Pin Oak	93	trees
Sycamore	94	trees
Shellbark Hickory	94	trees
Total Trees	560	trees
Weed Barrier Mats	560	mats
Herbicide	560	treatment sites
Red Top Grass	14	acres
Site C		
Mast Tree Plantings	26	acres
Northern Pecan	170	trees
Swamp White Oak	170	trees
Bur Oak	170	trees
Pin Oak	170	trees
Sycamore	170	trees
Shellbark Hickory	170	trees
Total Trees	1020	trees
Weed Barrier Mats	1020	mats
Herbicide	1020	treatment sites
Red Top Grass	26	acres
Site D		
Mast Tree Plantings	40	acres
Northern Pecan	264	trees
Swamp White Oak	264	trees
Bur Oak	264	trees
Pin Oak	264	trees
Sycamore	264	trees
Shellbark Hickory	264	trees
Total Trees	1584	trees
Weed Barrier Mats	1584	mats
Herbicide	1584	treatment sites
Red Top Grass	40	acres
Containment Berm for placement site		
Length	5800	feet
Height (average)	5	feet
Containment Area	40	acres

D. Construction Considerations

1. Storm Water Pollution/Erosion Control. The potential for storm water pollution during construction is minimal for this project. Storm water runoff from nearly all construction activity would be contained within the confines of the project. Temporary stabilization measures would be employed on disturbed areas of the side channel until stabilization occurs. Stabilization practices may include mulching, temporary seeding, and/or the erection of silt fencing. Overall, the long-term storm water runoff characteristics of the site would not be expected to change. All disturbed areas would reseed through natural succession with similar vegetation types as before project conditions.

2. Permits. A public notice, as required by Section 404 of the Clean Water Act, was distributed on November 18, 2004. A Section 401 water quality certificate from the State of Iowa and a Section 404(b)(1) Evaluation are included in this report. Because all land disturbances associated with this project are addressed in the 404(b)(1) Evaluation, a National Pollutant Discharge Elimination System (NPDES or Section 402) permit for storm water discharges will not be required.

3. Construction Sequence. The probable construction sequence is summarized in table 6-2; however, no sequence will be required contractually.

E. Operational Considerations. A brief description of pump operation, water control structures, pumping stations, inlet and outlet structures, and the fish nursery is given here. A complete list of Lake Odessa operation needs will be published in an O&M manual after construction.

1. Pumps. There are multiple pumps included with this project, a fixed in place pump station, and four mobile Crisafulli type pumps with self contained powering units. The pumps will have to be operated with manpower to keep them fueled and running, and relocate the portable pumps as needed.

2. Water Control Structures. Multiple water control structures are a part of the recommended plan. The control structures include a gated controlled water bay, stop log structure, and multiple gated culverts. The gate on the water bay will have to be raised and lowered as needed to supply water to the MSU's in the upper end of the refuge. The stop log structure, which acts as the water control for the fish nursery, will have to be operated via installing and removing logs from the structure. The slide gate controlled culverts will have to be operated by raising and lowering gates.

3. Refuge Inlet and Outlet Structures. In addition, the refuge's inlet and outlet structures will have to be opened during extreme high water events. This will work concurrently with the spillways that are to be constructed to create a controlled flooding scenario.

4. Upper Fish Nursery. The proposed 21-acre fish nursery is an existing USFWS wetland, managed primarily for migratory birds. The refuge has agreed to periodically, about one year in five; manage the unit to benefit native fish fry for stocking by the IDNR, at the discretion of the refuge manger. Fish species for stocking will be limited to species native to the Upper Mississippi River.

F. Maintenance Considerations. The proposed features have been designed to ensure low annual maintenance requirements. Maintenance may include performing inspections, adding riprap,

performing routine tree planting maintenance activities, mowing sites, prairie burning, and performing routine maintenance on the portable pumps and pump station. A complete list of maintenance needs for Lake Odessa will be published in an O&M manual after construction. The estimated annual maintenance costs are presented in table 8-2. These quantities and costs may change during final design.

G. Value Engineering. A Value Engineering (VE) study was completed in December 2003 for this project in accordance with ER 11-1-321, Army Programs, Value Engineering, dated 28 February 2005 (formerly EC 11-1-114, Army Programs, Value Management/Value Engineering, dated 28 February 2003). The VE study recommendations have been reviewed for technical acceptance and coordinated with the sponsor. The adopted recommendations have been incorporated into this DPR and are as follows: articulated mat construction for the spillway, articulated mat construction for the pump pads, modification of the riprap for the archeological site protection and wing dam features. Additional opportunities to provide added value to the project will be pursued during the development of the plans and specifications and construction phases of the project.

Table 6-2. Probable Construction Sequence

Sequence [1]	Construction Work Item	Instructions	Purpose
1	Construct spillway in lower end of refuge	Construct before restoring levee or ensure that section will not be Included in the levee restoration.	Eliminate the possibility of restoring the section and then excavating it out again to construct the spillway
2	Restore perimeter levee	Dredge Turkey Chute upstream and downstream of the lock and dam. Avoid dredging during late-fall and winter months.	Eliminate the need to obstruct river traffic. Perimeter levee will be restored as first step to offer added protection to interior features
3	Construct Michael Creek wing dam.	Construct as detailed in report.	Wing dam needed to focus flow of river to main channel. This will help limit sediment transport into Lake Odessa.
4	Construct containment berm at mast tree Site D and clear/grub IDNR MSU	Construct as detailed in report.	Containment areas needed for placing dredged material from deep holes/channels.
5	Dredge deep holes/channels	Avoid dredging during late-fall and winter months for the Main Lake. Allow water to drain from placement sites, and disk material into IDNR site.	At Site D, the dredged material will provide a dry, elevated surface to perform mast tree planting. At the IDNR MSU, it will provide a sealed unit to contain water when desired. No winter dredging to avoid overwintering fish impacts in Main Lake. No dredging June-August for water quality reasons.
6	Place shoreline protection	Ensure that equipment and dredged material/riprap does not disturb the existing shoreline during placement.	Reduce possibility of causing damage to archeological features that are being protected
7	Install/construct water control structures	Construct in manner that minimizes damage to existing berms and maintains access into refuge.	Ensure access at all times and minimize damage to existing berms
8	Plant mast trees	Plant mast trees after Site D has dried adequately, which will take approximately 1 year. [2]	Area will be dewatered to provide suitable conditions for planting.
9	Plant sand prairie	Plant during dormant season (Nov 5 - Mar 5)	Sowing seeds during dormant season allows incorporation of the seed into the soil through frost heaving.

[1] Shoreline protection, water control structures, and Michael Creek wing dam could be done concurrently, and in general, at any time.
[2] Sites A, B, and C could be planted prior to D, as they will be planted in areas that will require no dewatering. But, it is anticipated that all the sites will be planted at approximately the same time.

VII. SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 7-1 presents the schedule for project completion steps.

Table 7-1. Project Implementation Schedule

REQUIREMENT	SCHEDULED DATE
Distribute Draft DPR	Mar 03
Complete ITR and VE study	Sep 03
Submit DPR for public and agency review	Aug 04
Submit Final DPR to Mississippi Valley Division	Apr 05
Independent Technical Review of plans and specifications	Jun 05
Approval of plans and specifications	Aug 05
Construction approval by Mississippi Valley Division	Sep 05
Advertise contract	Sep 05
Award contract	Oct 05
Complete construction	Dec 07

VIII. COST ESTIMATES

Table 8-1 compares costs for the fully funded estimate (FFE) and the current work estimate (CWE) (Appendix J, *Cost Estimate*.) The FFE was calculated based on the proposed construction schedule, expected escalation costs, and a contingency factor, and represents the money expected to be spent at the end of project construction. The CWE, with an approximate 20 percent contingency factor, is shown in a detailed estimate of project design and construction costs as presented in table 8-2. A detailed estimate of operation, maintenance, and rehabilitation costs is presented in table 8-3. Table 8-4 presents the annual monitoring costs. Quantities and costs may vary during final design. All cost estimates are calculated using present worth (May 2004) and do not include future inflation escalation.

Table 8-1. Project Cost Summary, May 2004 Price Level

Account	Feature	Fully Funded Estimate [1] (FFE) ($)	Current Working Estimate (CWE) ($)
01	Lands and Damages	0	0
02	Relocations	0	0
06	Fish and Wildlife Facilities	$11,918,451	$11,361,499
30	Planning, Engineering and Design	$2,777,318	$2,774,549
31	Construction Management	$716,047	$682,600
	Total Project Costs [2]	**$15,411,816**	**$14,818,648**

[1] Fully funded estimate is marked up to midpoint of construction. Markup equals 4.9%.
[2] Project features are on Federal land and therefore 100% federally funded.

Table 8-2. Detailed Project Cost Summary, May 2004 Price Level

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
01	**LANDS AND DAMAGES**						
	Real Estate	-	-	$ -	$ -	$ -	0%
02	Relocation	-	-	$ -	$ -	$ -	0%
06	**FISH AND WILDLIFE FACILITIES**						
06.10	**MSUs**						
	Field 4 & 5						
	Portable Pump with Power Source	1	lump sum	$49,277	$49,277	$9,855	20%
	Pump Pad	1	lump sum	$55,932	$55,932	$11,186	20%
	Field 21 MSU						
	Portable Pump with Power Source	1	lump sum	$49,277	$49,277	$9,855	20%
	Pump Pad	1	lump sum	$55,932	$55,932	$11,186	20%
	Fox Pond						
	Permanent Pump Station	1	lump sum	$187,740	$187,740	$37,548	20%
	Sump Channel	1	lump sum	$5,667	$5,667	$1,133	20%
	36” CMP with Slide Gate	1	lump sum	$22,125	$22,125	$4,425	20%
	Pump Pad	1	lump sum	$55,932	$55,932	$11,186	20%
	Dedicated Water Bay						
	Structure Construction	1	lump sum	$26,565	$26,565	$5,313	20%
	Supply Ditch	3,203	cubic yards	$15.58	$49,903	$9,981	20%
	64” x 43” CMP Pipe Arch	1	lump sum	$15,665	$15,665	$3,133	20%
	Unit 2						
	Portable Pump with Power Source	1	lump sum	$40,828	$40,828	$8,166	20%
	36” CMP with Slide Gate	1	lump sum	$13,418	$13,418	$2,684	20%
	IDNR MSU						
	Portable Pump with Power Source	1	lump sum	$49,277	$49,277	$9,855	20%
	36” CMP with Slide Gate	1	lump sum	$23,302	$23,302	$4,660	20%
	Pump Pad	1	lump sum	$55,932	$55,932	$11,186	20%
	Clearing/Grubbing	49	acres	$2,264	$110,936	$22,187	20%
		TOTAL	**MSUs**		**$867,708**	**$173,542**	
06.20	**Sand Prairie Planting**						
	Field 6						
	Seed	36	acres	$676	$24,336	$4,867	20%
		TOTAL	**Sand Prairie Planting**		**$24,336**	**$4,867**	

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
06.30	**Fish Nursery**						
	Structure						
	36" RCP With Stop Log Structure	1	lump sum	$36,565	$36,565	$7,313	20%
	TOTAL	**Fish Nursery**			**$36,565**	**$7,313**	
06.40	**Fisheries Enhancement (Deep Hole/Channel Dredging)**						
	Lake Odessa (Main Lake)	81,555	cubic yards	$9.12	$743,782	$148,756	20%
	Goose Pond	90,170	cubic yards	$9.12	$822,350	$164,470	20%
	Blackhawk Chute/Yankee Chute [1]	63,530	cubic yards	$9.12	$579,394	$115,879	20%
	Swarms Pond/Beebe Pond [4]	9,185	cubic yards	$7.79	$71,551	$14,310	20%
	Hydraulic/Mechanical Mob/Demob[7]	1	lump sum	$42,903	$42,903	$8,581	20%
	Sonar Surveys	1	lump sum	$30,530	$30,530	$6,106	20%
	Containment Berm [2]						
	Clearing/Grubbing	13.3	acres	$4,060	$53,998	$10,800	20%
	Berm Work	21,799	cubic yards	$3.67	$80,002	$16,000	20%
	TOTAL	**Fisheries Enhancement**			**$2,424,510**	**$484,902**	
06.50	**Mast Tree Planting**						
	Site A						
	Northern Pecan	88	trees	$12.60	$1,109	$222	20%
	Swamp White Oak	88	trees	$12.60	$1,109	$222	20%
	Bur Oak	88	trees	$12.60	$1,109	$222	20%
	Pin Oak	88	trees	$12.60	$1,109	$222	20%
	Sycamore	89	trees	$12.60	$1,121	$224	20%
	Shellbark Hickory	89	trees	$12.60	$1,121	$224	20%
	Labor/Tools For Planting	1	lump sum	$9,596	$9,596	$1,919	20%
	Weed Barrier Mat	530	mats	$3.15	$1,670	$334	20%
	Herbicide	530	trees	$3.14	$1,664	$333	20%
	Red Top Grass	13	acres	$827.36	$10,756	$2,151	20%
	Site B						
	Northern Pecan	93	trees	$12.60	$1,172	$234	20%
	Swamp White Oak	93	trees	$12.60	$1,172	$234	20%
	Bur Oak	93	trees	$12.60	$1,172	$234	20%
	Pin Oak	93	trees	$12.60	$1,172	$234	20%
	Sycamore	94	trees	$12.60	$1,184	$237	20%
	Shellbark Hickory	94	trees	$12.60	$1,184	$237	20%
	Labor/Tools For Planting	1	lump sum	$10,139	$10,139	$2,028	20%
	Weed Barrier Mat	560	mats	$3.15	$1,764	$353	20%
	Herbicide	560	trees	$3.14	$1,758	$352	20%
	Red Top Grass	14	acres	$827.36	$11,583	$2,317	20%

Table 8-2. Detailed Project Cost Summary, May 2004 Price Level

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
06.50	**Mast Tree Planting**						
	Site C						
	Northern Pecan	170	trees	$12.60	$2,142	$428	20%
	Swamp White Oak	170	trees	$12.60	$2,142	$428	20%
	Bur Oak	170	trees	$12.60	$2,142	$428	20%
	Pin Oak	170	trees	$12.60	$2,142	$428	20%
	Sycamore	170	trees	$12.60	$2,142	$428	20%
	Shellbark Hickory	170	trees	$12.60	$2,142	$428	20%
	Labor/Tools For Planting	1	lump sum	$18,461	$18,461	$3,692	20%
	Weed Barrier Mat	1020	mats	$3.15	$3,213	$643	20%
	Herbicide	1020	trees	$3.14	$3,203	$641	20%
	Site Access [6]	1	lump sum	$1,169	$1,169	$234	20%
	Site D [3]						
	Northern Pecan	264	trees	$12.60	$3,326	$665	20%
	Swamp White Oak	264	trees	$12.60	$3,326	$665	20%
	Bur Oak	264	trees	$12.60	$3,326	$665	20%
	Pin Oak	264	trees	$12.60	$3,326	$665	20%
	Sycamore	264	trees	$12.60	$3,326	$665	20%
	Shellbark Hickory	264	trees	$12.60	$3,326	$665	20%
	Labor/Tools For Planting	1	lump sum	$28,671	$28,671	$5,734	20%
	Weed Barrier Mat	1584	mats	$3.15	$4,990	$998	20%
	Herbicide	1584	trees	$3.14	$4,974	$995	20%
	Site Access [6]	1	lump sum	$1,815	$1,815	$363	20%
	TOTAL	**Mast Trees**			**$161,969**	**$32,394**	
06.60	**Main Stem Levee Restoration**						
	Levee crown & side slope improvements						
	Hydraulic Dredging/ Placement [5]	279,987	cubic yards	$11.80	$3,303,847	$660,769	20%
	Borrow Placement by Scraper [8]	10,149	cubic yards	$1.48	$15,021	$3,004	20%
	Clearing / Grubbing	75	acres	$2,706	$202,950	$40,590	20%
	6” Surface Scrape	90, 086	cubic yards	$3.00	$270,258	$54,052	20%
	Survey	1	lump sum	$59,209	$59,209	$11,842	20%
	Mob/Demob[7]	1	lump sum	$200,004	$200,004	$40,001	20%
	Spillway						
	Earthwork	14,400	cubic yards	$3.54	$50,976	$10,195	20%
	6” Surface Scrape	14,178	square feet	$0.96	$13,611	$2,722	20%
	Concrete Matting	87,300	square feet	$9.55	$833,715	$166,743	20%
	Geotextile Fabric	16,757	square yards	$2.96	$49,601	$9,920	20%
	Riprap (400 lb)	3,465	tons	$37.54	$130,076	$26,015	20%
	Riprap (700 lb)	1,567	tons	$37.54	$58,825	$11,765	20%
	Bedding Stone	4,944	tons	$21.05	$104,071	$20,814	20%
	Concrete Cutoff Wall	1,170	feet	$94.75	$110,858	$22,172	20%
	Michael Creek Wing Dam						
	Riprap	90	tons	$41.69	$3,752	$750	20%
	Mob/Demob	1	lump sum	$30,970	$30,970	$6,194	20%

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
	Archeological Site						
06.60	**Protection**						
	Riprap (400 lb)	8,619	tons	$40.43	$348,466	$69,693	20%
	Mob/Demob	1	lump sum	$61,884	$61,882	$12,376	20%
	Gravel Road						
	Gravel (CA-6)	2,931	tons	$29.33	$85,966	$17,193	20%
	Grading	1,628	cubic yards	$11.53	$18,771	$3,754	20%
	TOTAL	**Main Stem Levee**			**$5,952,828**	**$1,190,566**	
	FISH AND WILDLIFE FACILITIES COST SUBTOTAL				**$9,467,916**		
	Contingencies Subtotal					**$1,893,583**	
	FISH AND WILDLIFE FACILITIES COST TOTAL				**$11,361,499**		
30	**PLANNING ENGINEERING AND DESIGN**						
	Definite Project Report				$2,120,000		
	Plans and Specifications				$598,049		
	Engineering During Construction				$56,500		
	SUBTOTAL				**$2,774,549**		
31	**CONSTRUCTION MANAGEMENT**						
	Contract Administration				$102,500		
	Shop Drawing Review				$68,300		
	Inspection and Quality Assurance				$511,800		
	SUBTOTAL				**$682,600**		
	TOTAL PROJECT COST				**$14,818,648**		

[1] Dredged material from Blackhawk Chute to Yankee Chute shall be placed in IDNR MSU.

[2] Containment berm shall be constructed to act as a placement site for material dredged from Lake Odessa and Goose Pond.

[3] Mast tree Site D shall be planted when area is dry.

[4] Swarms and Bebee Ponds shall be mechanically dredged with amphibious backhoe, with the dredged material placed on the downstream bank.

[5] Cost includes dredging and placement of sand to establish levee section.

[6] Cost to access Sites C and D by water.

[7] Mob/Demob cost includes reconfiguration costs to move between the dredge sites. Cost also includes the costs to mobilize the hydraulic and mechanical dredges. Restoration of levee only entails hydraulic dredging.

[8] Borrow placement by scraper is item to place hydraulically dredged borrow material by hauling from one area to another area by a mall floating type scraper.

Table 8-3. Estimated Annual Operation and Maintenance Costs, April 2004 Price Level

Operation	Quantity	Unit	Unit Price	Amount
Pump Operation [1]	2715	hrs	$8.90	$24,166
Maintenance				
Mowing/Disking of MSUs [2]	132	acres	$20.02	$2,643
Mowing Main Stem Levee Annually	137	acres	$8.50	$1,165
Mowing Mast Tree Sites A and B	27	acres	$17.00	$459
Mowing/Burning of Sand Prairie (Field 6) [3]	36	acres	$17.86	$643
Riprap	132	tons	$17.80	$2,515
Road Gravel [4]	1,200	tons	$15.00	$18,000
Site Inspection [5]	64	hrs	$47.75	$3,056
Rehabilitation [6]			$-	$ -
			Subtotal:	$52,647
Contingencies (20%)				$10,529
			Total:	$63,176

[1] Pump operation costs include fuel and upkeep costs for all pumps.
[2] Annually, the USFWS plans to mow 25% of Field 4 & 5, Field 21, MSU 20, and Unit 2 (82.5 acres) and the IDNR plans to mow all of their MSU (49 acres), which totals ~ 132 acres.
[3] Represents an average cost over the first 5 years. Includes mowing four times the first year, two times the second year, and burning one time per year for years 3 through 5. After year 5, field will be burned off every 3 years at $12 per acre.
[4] One time cost to place additional gravel that may have been lost due to settlement, etc.
[5] Yearly cost to inspect all items.
[6] Rehabilitation cannot be accurately measured. Rehabilitation is the reconstructive work that significantly exceeds the annual operation and maintenance requirements identified above and that is needed as a result of major storms or flood events.

Table 8-4. Estimated Post-Construction Annual Monitoring Costs, April 2004 Price Level

Item			Annual Cost
Engineering Data			$ 5,200
Natural Resource Data			$ 2,000
	Subtotal		$ 7,200
	Contingencies (20%)		$ 1,440
		Subtotal:	$ 8,640
Planning, Engineering, Design [1]			$ 2,100
		Total:	**$ 10,740**

[1] Includes cost of annual performance evaluation report.

IX. ENVIRONMENTAL EFFECTS

A. Summary of Effects. Lake Odessa is a large, complex site with a variety of terrestrial and aquatic habitats that vary in quantity and quality. Overall goals for the project area are to protect some of these resources from future reductions in quantity and quality and to increase the quantitative and qualitative values of other resources. Increasing the value of some habitat types usually occurs at the expense of other habitat types. In most cases, the trade-off for higher quality habitat is a loss of lower quality habitat. In other cases, habitats of similar quality may be altered in order to carry out management objectives for the site.

The primary goals for the Lake Odessa HREP are to restore and protect wetland, terrestrial, and aquatic habitat. The proposed project features for the Lake Odessa complex involve four primary enhancement features: enhancing the current MSUs, primarily through increased water level control; increasing the amount of deep-water overwintering habitat for fish; planting 93 acres of mast-producing trees on higher elevations; and protecting the interior features through levee restoration and a spillway. Additional features include restoring the sand prairie (terrestrial habitat enhancement) and constructing the upper fish nursery (fisheries enhancement).

Management measures selected to meet these objectives include enhancing the following MSUs; USFWS complex (Field 4 & 5, Field 21, MSU 20), Unit 2, Fox Pond, Swarms/Bebee Ponds, and IDNR MSU; dredging the following areas to enhance fisheries habitat; Swarms/Bebee Ponds, Main Lake, Goose Pond, and Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; mast tree planting at Sites A, B, C, and D; and restoring the perimeter levee. This combination would meet HREP goals and objectives, would add to habitat diversity and quality, and would best meet the overall management objectives for the site.

The management measures planned for this project are consistent with and support the goals of the North American Waterfowl Management Plan and the Partners in Flight Program.

B. Economic and Social Impacts

1. Community and Regional Growth. No impacts to the growth of the community or region would be realized as a result of the project. The project indirectly would improve recreation opportunities at the Lake Odessa complex by increasing the attractiveness of the area for fishing, hunting, wildlife observation, photography, recreational boating, birding, and swimming.

2. Community Cohesion. The proposed environmental enhancement project would positively impact community cohesion by attracting visitors and recreationists from other communities to the wildlife area. The potential increase in recreation activities at the Lake would not adversely impact area property owners. No public opposition to the enhancement measures has been expressed, nor is any expected.

3. Displacement of People. No residential displacements would be caused by the proposed habitat rehabilitation and enhancement project.

4. Property Values and Tax Revenues. The Lake Odessa Wildlife Area is located on federally-owned land managed by the IDNR and the USFWS. No change in property values or tax revenues would occur.

5. Public Facilities and Services. The project site currently experiences annual visitations in excess of 140,000 for non-consumptive uses, plus 20,000 hunter days per year and 50,000 angler days per year. The proposed project would positively impact public facilities and services by increasing overall habitat diversity, resulting in heightened opportunities for recreational use of the Lake Odessa Wildlife Area.

Public boat ramps located at the upper and lower ends of the lake would not be affected by the proposed project.

6. Life, Health and Safety. There would be no impacts to life, health, or safety.

7. Business and Industrial Growth. Changes in business and industrial activities during project construction would be insignificant. Long-term impacts to business activity would be related to tourism and recreational activities. No business or industrial relocations would be required.

8. Employment and Labor Force. Project construction would slightly increase short-term employment opportunities in the project area. The project would not directly affect the permanent employment or labor force in Louisa County, Iowa.

9. Farm Displacement. No farms or farmsteads would be displaced. No prime and unique farmland would be impacted.

10. Noise Levels. Heavy machinery would generate an increase in noise during project construction and temporarily disturb wildlife and recreationists in the area. Construction would be done in phases with the majority of work occurring during the summer when the water levels are the lowest. The project is located in an area with limited residential or other development, and no significant long-term noise impacts would result.

11. Aesthetics. The clearing of some woody vegetation would occur because of construction activities. Following construction, the area would be reseeded and planted with mast trees. No permanent adverse impacts to area aesthetics are anticipated. The enhancement of habitat areas would make the wildlife area more aesthetically pleasing to visitors. There are approximately 200 seasonal and 5 permanent residences on the bluff overlooking the complex. The proposed project would not be expected to adversely impact the viewscape for these properties.

C. Natural Resources Impacts. Effects of the project on natural resources were evaluated using WHAG (Urich *et al.* 1984). This habitat evaluation method was used during project planning to evaluate various features in terms of increased benefits to wildlife resources. Optimization of benefits (expressed as habitat units, or HUs) in relation to project cost is considered to be the goal of feature selection. Results of the habitat evaluation are summarized in table 5-1, with a more detailed analysis in Appendix D. Assessment of project impacts was based on sound management practices and the experience of USFWS, IDNR, and Corps natural resource professionals.

1. Wetland and Floodplain Terrestrial Habitat. The primary benefits to wetland, floodplain, and terrestrial habitats include: (1) enhancing existing MSUs with increased water level control and reliability, thereby increasing germination and growth of desired wetland plants, and use of these plants by waterfowl and wildlife; (2) reseeding the former sand prairie area with locally

grown, native seed, restoring a unique habitat and increasing the diversity of the area; (3) increasing forest acreage and diversity, accomplished through a combination of active planting of mast-producing trees in former cropfields, interplanting in existing forest, and replanting the dredged material containment site to a more beneficial mixture of species; and (4) preserving existing MSU, sand prairie, and bottomland hardwood forest acreage from future losses due to flooding and/or levee failure by levee restoration.

All MSU areas disturbed during construction would be replanted following construction or would be allowed to revegetate from the existing seed bank. Material removed for construction of the water supply ditch from the dedicated bay would be sidecast and the area would be reseeded after construction.

The proposed project would take place entirely within the Mississippi River floodplain and within the Lake Odessa complex levee. No measurable change in floodplain storage would occur as a result of the proposed project, and the project would not directly or indirectly induce additional development within the floodplain.

Additional benefits would be incurred through levee restoration, which protects interior features from degradation by flooding and/or levee failure. Construction of the proposed features would disrupt use of surrounding areas by wildlife, but the majority of disruption would only be temporary. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetlands by construction activities. There is no practicable alternative to such construction and the resulting wetlands impacts if the overall environmental benefit, including protection of other existing wetland acreages, is to be achieved.

2. Aquatic Habitat. Construction activity would temporarily increase turbidity immediately downstream of the proposed dredge cuts in the Main Lake, Goose Pond, Blackhawk/Yankee Chutes, Swarms/Bebee Ponds, and the two locations in Turkey Chute. Material hydraulically dredged from the Main Lake and Goose Pond would be placed into the new containment area. Material hydraulically dredged from Blackhawk/Yankee Chutes would be used to line the IDNR MSU. Material mechanically dredged from Swarms/Bebee Ponds would be sidecast on the downstream embankment next to the channel. Material hydraulically dredged from Turkey Chute, a side channel of the Mississippi River, would be placed inside the levee to restore design heights and side slopes. Minor increases in turbidity during construction are not expected to have any long-term impacts on aquatic resources. Disruption and loss of some benthic organisms would occur at construction sites, but these areas should be re-colonized following project completion. However, levee restoration at open water areas would increase the existing levee footprint by up to 100 feet, impacting some open water areas.

Construction of the wing dam between Michael Creek and the inlet structure for the Lake Odessa complex would deflect heavy sediments away from the inlet structure. The structure itself

may provide fisheries benefits by increasing substrate and water velocity diversity in the immediate area. Only minor, temporary increases in turbidity are expected from these actions.

Riprap placement on the archeological sites would provide protection from erosion of these areas, with only minor temporary increases in turbidity. The riprap may provide additional substrate diversity in the Main Lake.

None of these actions is believed to have detrimental impacts to the aquatic resources of the area. Instead, these actions will provide much needed deep-water, and access to such, for the areas' fisheries. These habitat benefits are described in the following section. Additional benefits would be incurred through levee restoration, which protects the interior features from degradation by flooding and/or levee failure.

3. Fish. Fish use of the deeper water areas in the Main Lake, Goose Pond, and Yankee/Blackhawk Chutes is expected to increase as a result of the project, particularly during winter months. In addition, access and egress from Swarms and Bebee Ponds, and Yankee Chute will be improved with the proposed project features. Lack of deep-water overwintering areas is a limiting factor at Lake Odessa. These areas would also serve as summer refugia. For these reasons, the fisheries enhancement features are expected to increase the quality of existing deep-water habitat and help to ensure its future availability in the Lake Odessa complex.

Construction of the fish nursery feature would provide a protected environment for fry to reach a larger size, before release into the Main Lake. This would decrease mortality of the fry and such stocking efforts could augment existing fish populations, as needed.

Restoration of the levee would protect the deep-water habitats from increased sedimentation incurred during floods and/or levee failures. Dredging in Turkey Chute to provide material for the restoration would increase water depths and enhance habitat for fish in the side channels where the dredge cuts are proposed as well as providing additional, needed overwintering habitat for Pool 18.

Placement of rock shoreline protection on selected archeological sites is expected to benefit aquatic resources by increasing substrate diversity. Additional discussion of aquatic and water quality impacts is contained in Appendix B - Clean Water Act, Section 404(b)(1) Evaluation.

4. Wildlife. Enhancement of the MSUs would primarily benefit migrating waterfowl. Increased water level control and reliability would increase the germination and growth of moist soil plants. This improved control would also allow fall flooding of the units, making the food resources more readily available to waterfowl, such as dabbling and diving ducks. These areas would also provide benefits to other wildlife species. Construction of the proposed features would disrupt use of these areas by wildlife, but that disruption would only be temporary.

Preparation and seeding of the sand prairie area would eliminate use of that area for row crops grown for wildlife use. However, restoration of this unique sandy area within the floodplain would contribute to the overall diversity of the complex.

Mast tree planting would increase tree species diversity within the Lake Odessa complex. Planting on higher areas would increase the expected amount of tree regeneration. This increase in diversity, and production of mast by these trees, would benefit such species as the wood duck, one of

the target species for this proposed action. Disruption of the habitat during planting would be minor. Sites A and B would have periodic mowing during tree establishment in order to reduce weedy competition. Once the trees are well established, the maintenance procedure would no longer be necessary. Once Site D has dried sufficiently, it would be graded prior to planting to ensure proper rainfall and floodwater runoff. No significant impacts to the system are expected from these actions.

Additional benefits would be incurred through levee restoration, which protects interior features from degradation by flooding and/or levee failure. Construction of the proposed features would disrupt use of surrounding areas by wildlife, but that disruption would only be temporary. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetland by construction activities.

5. Endangered Species. The following is a list of federally-endangered or threatened species potentially found in Louisa County, Iowa:

Status	Common Name	Scientific Name
E	Higgins' Eye Pearly Mussel	*Lampsilis higginsi*
E	Indiana Bat	*Myotis sodalis*
T	Bald Eagle	*Haliaeetus leucocephalus*
C	Eastern Massasauga Rattlesnake	*Sistrurus catenatus catenatus*

T - threatened
E - endangered
C - candidate

Higgins' eye pearly mussels usually inhabit coarse gravel or cobble substrate. Because of the dominance of sand and silty materials in the project area, these species are not likely to occur within the leveed area. Mussel beds are known to occur in the main channel of the Mississippi River in proximity to the Lake Odessa area. Dredging areas in Turkey Chute for levee restoration would be located away from any mussel beds in the area. For this reason, the proposed action is not expected to impact these mussel species.

During the summer, Indiana bats frequent the corridors of streams with well-developed riparian woods, as well as mature upland forests in this part of Iowa and Illinois. They forage for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation, along the borders of croplands, along wooded fencerows, and over farm ponds and pastures. During the summer, the bats roost and rear their young beneath the loose bark of large dead or dying trees, and prefer standing dead trees with loose bark and enough space to roost between the bark and the trunk. These roost trees are typically located within 1,600 feet of a stream or river. Indiana bats winter in caves or mines. Tree clearing should not be conducted during the April 1-September 30 timeframe. Prohibiting clearing activity during this 6-month timeframe would avoid potential impacts to summer roosting Indiana bats.

Bald eagles are regularly seen using the Mississippi River corridor area in and around the Lake Odessa complex during migration for resting and feeding, as well as a nesting area in the past. The Lake Odessa complex contains many mature trees that are a key component for eagle habitat, both for roosting and nesting. Tree clearing for project construction would be limited to a zone approximately 65 feet wide for construction of the water supply ditch from the dedicated water bay at the inlet structure, and 100 feet wide for the dredged material containment berm. In addition, placement of the dredged material into the containment site will increase tree mortality within the area. The proposed levee restoration may increase the existing levee footprint by up to 65 feet on land (100 feet in open water areas). Any clearing of trees suitable for roosting would be avoided during times that eagles are present. No known eagle nests are located within the immediate levee restoration area. Prior to construction and one week after the latest known date of nest establishment in the region, the proposed construction zone will be surveyed for active bald eagle nests. If any nesting activity is observed, all activities within 660 feet of the nest will be avoided. In addition, the Lake Odessa complex provides many wooded areas. The impacted areas are very small in comparison. Therefore, no significant impacts to bald eagles are expected.

The eastern massasauga rattlesnake shows a strong affinity for wetlands, but also uses upland habitats during part of the year. No known populations of massasaugas remain at Lake Odessa and the proposed construction is not expected to impact this species.

The following is a list of State of Iowa threatened and endangered species potentially found in Louisa County, Iowa. Some of these species may only be found in the rare sand prairie complex located north of the Lake Odessa complex and south of the city of Muscatine, Iowa, several miles upstream. Those species most likely to occur in the project area are discussed in more detail below.

Status	**Common Name**	**Scientific Name**
T	Bald Eagle*	*Haliaeetus leucocephalus*
E	Red-shouldered Hawk*	*Buteo lineatus*
E	King Rail*	*Rallus elegans*
E	Indiana Bat*	*Myotis sodalis*
E	Higgins' Eye Pearly Mussel*	*Lampsilis higginsi*
T	Butterfly Mussel	*Ellipsaria lineolata*
T	Squawfoot Mussel	*Strophitus undulatus*
E	Copperbelly Water Snake*	*Nerodia erythrogaster neglecta*
E	Western Hognose Snake	*Heterodon nasicus*
T	Diamondback Water Snake*	*Nerodia rhombifer*
E	Yellow Mud Turtle	*Kinosternon flavescens*
T	Blanding's Turtle*	*Emydoidea blandingii*
T	Ornate Box Turtle	*Terrapene ornata*
T	Central Newt	*Notophthalmus viridescens*
T	Grass Pickerel	*Esox americanus*
T	Orangethroat Darter	*Etheostoma spectabile*
E	Dwarf Dandelion	*Krigia virginica*
E	Curved-pod Corydalis	*Corydalis curvisiliqua*
T	Flax-leaved Aster	*Aster linariifolius*
T	Slender Dayflower	*Commelina erecta*
T	Yellow Monkey Flower	*Mimulus glabratus*
T	Brittle Prickly Pear	*Opuntia fragilis*

T - threatened
E - endangered
* - likely or known in project area

Red-shouldered hawks are listed as a state endangered species in Iowa. This species requires large tracts of mature floodplain or riparian forest for nesting. These birds prefer a mature forest structure, with a well-developed canopy and an open sub-canopy for nesting sites. Forests on the edge of the river valley, adjacent to upland or valley slope forests have the highest occupancy rate. Prior to construction and one week after the latest known date of nest establishment in the region, the proposed construction zone will be surveyed for active red-shouldered hawk nests. If any nesting activity is observed, all activities within 660 feet of the nest will be avoided. No adverse impact to this species is anticipated.

The king rail (*Rallus elegans*) is listed as a state endangered species in Iowa. This migratory species usually arrives in Iowa beginning around mid-May. This species can adapt to a wide variety of wetland habitat types as long as the terrain supports a reasonable amount of vegetation and is frequently wet. Optimal habitat is freshwater marshes with emergent vegetation (sedge, bulrush or cattail). Decline of this species in the Midwest has been due to habitat destruction and drainage of wetlands. No adverse impact to this species is anticipated. Several of the proposed moist soil unit improvements will benefit this species.

The presence of the copperbelly water snake, a state endangered species, was recently confirmed at Lake Odessa. Copperbelly habitat generally consists of wetlands and bottomland forests, although they sometimes hibernate in upland areas. They are often seen near shallow wetland edges in woodlands where buttonbush is the preferred vegetation type. The proposed construction is not expected to adversely impact these species.

The diamondback water snake, a state-threatened species, has been confirmed within the Lake Odessa complex. This large water snake is found only in southeastern Iowa near the Mississippi River. It inhabits rivers, sloughs, ponds, backwaters, and oxbows. It does not live in clear gravelly streams, and seems to avoid heavily wooded ponds. The IDNR believes that the proposed habitat restoration within the Lake Odessa complex should help protect their habitat. No adverse impacts to this species are anticipated.

Iowa DNR biologists have identified the areas inside and adjacent to the Mississippi and Iowa River levees, as well as Site D, as copperbelly and diamondback watersnake habitat. IDNR biologists will monitor the levee and Site D construction areas when the ambient temperature reaches 64-72 degrees F. Heavy equipment will be restricted for 7-10 days from the snakes' habitat in the these areas as a precaution to keep snakes, that have just emerged from hibernation, from being destroyed while they are still lethargic. As part of the levee restoration, no less than 7 shallow pools, approximately 1.5 feet deep or less, will be constructed to enhance habitat for these state-listed watersnakes, in more forested areas. Some of the cleared trees and brush will be place around these pools to provide basking habitat. Buttonbush cutting will be planted by the DNR along the shoreline and edges of the pools to provide the scrub-shrub habitat component.

Blanding's turtles, state-threatened, are found in shallow and deep marshes, the shallow bays of lakes, slow-moving streams and rivers, and backwater sloughs. They prefer slow-moving, shallow water and a muddy bottom with abundant emergent vegetation, duckweed, and mosses. Open, sandy areas are preferred for nesting sites. If suitable nesting areas are not located, they may nest on the shoulders of roads or wander a considerable distance from their marsh until a suitable area is found. No adverse impact to this species is anticipated.

The Lake Odessa complex is considered essential habitat for the river otter. The river otter, while not listed in Iowa, is listed as threatened in Illinois. River otters are quite adaptable, utilizing a variety of habitat types. Although they frequent lakes and ponds, they typically live in marshes and along wooded rivers and streams with sloughs and backwater areas. No adverse impact to this species is anticipated.

6. Hazardous, Toxic, and Radioactive Waste. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with ASTM Practices E 1527-00 and E 1528-00, ER 1165-2-132, and MVD DIVR 1165-2-9 for the Lake Odessa HREP. Dense woodlands, historical agricultural fields, and low-lying backwaters of the Mississippi River characterize the Lake Odessa area. The assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the Lake Odessa project features. Found within the Lake Odessa study area was a small, minimally used firing range. This firing range is not in direct connection with any of the project features, and therefore was considered a *de minimus* environmental condition in association with this project. After a thorough review of all information, there were no indications of any environmental concerns. Under the current locations of project features, there are no recommendations to be made at this time. Work on the section of levee bordering the firing range should be avoided. If the decision is made to execute the levee restoration in the reach directly behind the firing range, further HTRW assessments will be required.

D. Historic Properties. The Corps' historic properties coordination letter dated March 28, 2003 (Appendix A, includes all enclosures), presented the current status of historic properties at the Lake Odessa EMP project and proposed a Programmatic Agreement (PA) under Section 106 of the National Historic Preservation Act to address the adverse effects to historic properties resulting from the project. Table 9-1, is the same as Enclosure 4 to that letter and derives from Benn and Isenberger (2000:table 2).

Table 9-1 lists all known historic properties sites at Lake Odessa; states the sites' National Register of Historic Places (NRHP) Status (Eligible, Not Eligible, Unknown); determines whether the site is within the Area of Potential Effect (APE) for the Lake Odessa EMP Project (see discussion of APE, below); and lists the Mitigation Treatment Recommendations for the sites located within the APE, which have been determined eligible for the NRHP. Three sites recently added to the APE (13LA288, 312, and 455) still require fieldwork to evaluate them for NRHP significance (13LA288 and 455) or to establish horizontal and vertical site boundaries (13LA312). Provisions for this work are included in the PA along with provisions for unanticipated discoveries, including human remains and items of cultural patrimony subject to Native American Graves Protection and Repatriation Act (NAGPRA) compliance.

At 36 CFR 800.16(d) the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

The Lake Odessa APE currently includes the footprint of project features defined at figure 9-1 and all of the shoreline of Lake Odessa because it is affected by the fluctuating water levels designed into the water control aspects of the project. The project features are in six basic categories: moist soil unit enhancements; fisheries enhancements; mast tree plantings; levee restoration; sand prairie planting; and a fish nursery. If the project features change from those in figure 9-1and as described in

the Corps' March 28, 2003, coordination letter (Appendix A), additional field investigations for historic properties may be required. The APE is all on Federal land; none is on tribal lands [36 CFR 800.4(a)(1)].

Figure 9-1 illustrates the Lake Odessa EMP project features that have received Phase I survey and Phase II archeological testing. The information in table 9-1 is valid only in relation to the area of the project features found on figure 9-1.

Responses to the Corps' March 28th letter are all found at Appendix A. There were communications from the Peoria Tribe of Indians of Oklahoma (letter dated April 2, 2003), the Advisory Council on Historic Preservation (ACHP, letter dated April 3, 2003), the State Historical Society of Iowa/State Historic Preservation Officer (SHSI/SHPO, letter dated April 16, 2003), and the Ho-Chunk Heritage Preservation (facsimile dated May 5, 2003). The Corps responded to the ACHP by letter dated May 9, 2003, and to the SHSI/SHPO by letter dated June 18, 2003 (see Appendix A). The other communications required no responses.

The Mitigation Treatment Recommendations as set out in table 9-1 have been concurred with by the State Historical Society of Iowa/State Historic Preservation Officer (SHSI/SHPO) in their letter of April 16, 2003, found in Appendix A. No other respondents had comments on these recommendations or on the proposed PA for historic properties contained in the March 28th letter. The SHSI/SHPO's comments on the draft PA were addressed in the Corps' response dated June 18, 2003 (Appendix A). The finalized PA takes into account the changes made as a result of the SHSI/SHPO comments and is found at Appendix C. In a Corps letter dated October 28, 2003 (Appendix A), the fully executed PA was filed with all signatories and with the ACHP. Implementation of its terms will evidence Corps compliance with its responsibilities under Section 106 of the National Historic Preservation Act.

Post-PA coordination was conducted for a change in the location of the spillway notched into the levee near the mouth of the Iowa River in a Corps letter dated December 10, 2004 (Appendix A). This letter provided clarification about the design and function of the spillway and documented its new alternative location in an area outside the boundaries of Burris City (13LA312). In a response dated January 6, 2005 (Appendix A), the SHSI/SHPO stated that they agreed with the proposed change and that no further historic properties investigation would be required as a result of the new alternative spillway location.

E. Human Use. No mining activity is present in the project area, and no use of mineral resources would be affected by this project. The proposed action will not result in the conversion of any prime, unique, or designated state or locally important farmland to nonagricultural uses. Construction activity may cause some temporary disruption of recreational use in the project area. No negative effects to navigation will result from the proposed actions. All work in the Mississippi River (wing dam construction, dredging for levee restoration) will be conducted outside the confines of the navigation channel.

F. Cumulative Impacts. Although short-term impacts are likely to occur to local and migratory animals during construction, no negative cumulative impacts to fish or wildlife are expected. The proposed habitat measures should have positive long-term benefits to fish and wildlife using the project area. This project, in concert with other EMP HREPs on the Upper Mississippi River, should counter some of the long-term adverse impacts to the river ecosystem such as sedimentation, pollution, and general declines in riverine and floodplain habitat. Currently, 41 HREPs

have been completed, resulting in the restoration of approximately 71,000 acres. Planning is underway on 28 additional HREPs that will restore another 54,000 acres.

G. Adverse Impacts Which Cannot Be Avoided. Unavoidable adverse impacts will primarily result from the clearing of vegetation for supply ditch and dredged material containment construction. Clearing of vegetation will be limited to the minimum extent necessary for project construction. An increase in the existing levee footprint is anticipated because of the proposed levee restoration, affecting 39 acres of wetlands temporarily and converting approximately 17 acres to levee. The benefits of levee restoration, reducing flood damages to 1,700 acres of non-forested wetland, 2,900 acres of bottomland hardwood forest, and 1,800 acres of aquatic habitat, will offset the relatively minor losses in these areas.

H Short-Term Versus Long-Term Productivity. Construction impacts (land clearing, dredging, equipment movement, etc.) will temporarily disrupt wildlife as well as human use. Conversion of the mast tree Sites A and B from idle crop field to bottomland hardwood forest with mast-producing tree species as a significant component would result in a short-term loss of some herbaceous food plants used by some species of migratory waterfowl. However, long-term productivity would be enhanced as woody vegetation develops and matures, providing higher quality food and cover for a more diverse group of wildlife species. Construction of the dredged material containment site will result in the loss of silver maple-cottonwood dominated forest but replanting to hard mast-producing trees will result in a higher quality forest than currently exists.

Protecting the complex interior with the levee restoration should preserve long-term productivity. Long-term productivity also should be enhanced by increases in bottomland hardwood habitat (particularly mast-bearing trees) and substrate diversity in aquatic habitats. Finally, long-term productivity of the MSU will be ensured through the proposed improvements.

Table 9-1. Archeological Site Status as Documented by Phase II Testing [1]

Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect (APE)	Mitigation Treatment and Other Recommendations for Sites Within the Area of Potential Effect	Length of Bank Protection (ft) [rounded to nearest 10 ft]	Comment
3	NE	No	N/A		This NR Status applies only to that small portion of site area in Federal ownership
13	NE	Yes	N/A		
27	**E**	**Yes**	**Data Recovery** & Riprap Bank Protection	200	**Data Recovery Completed,** but Bank Protection needed since erosion will be in undisturbed deposits before 50 years
30	E	Yes	Riprap Bank Protection & Prohibit Dredge Material Placement	1330	No Dredged Material Placement will be allowed on 13LA30
38	NE	Yes	N/A		Site has been mitigated through excavation.
47	NE	Yes	N/A		National Register status changed from E to NE due to destruction by recent bank erosion.
84	E	No			
97	NE	Yes	N/A		
98 & 99	E	Yes	Riprap Bank Protection	520	
100	NE	Yes	N/A		
104	E	No	N/A		
261	UNK	No	N/A		
288	UNK	Yes	To Be Determined (TBD)		Requires Phase II Testing
289	NE	Yes	N/A		
290	NE	Yes	N/A		
291	NE	Yes	N/A		
292	UNK	No	N/A		
293 b & f	NE	Yes	N/A		
293 a, c-e, g, & h	NE	Yes	N/A		National Register status changed from E to NE due to destruction by recent bank erosion.
296	UNK	No	N/A		
297	UNK	No	N/A		
298	UNK	No	N/A		
299	E	Yes	Riprap Bank Protection	250	
300	E	Yes	Riprap Bank Protection	400	
301	NE	Yes	N/A		
302	NE	Yes	N/A		
303	NE	Yes	N/A		
304	NE	Yes	N/A		
305	UNK	No	N/A		
308	UNK	No	N/A		
309	**E**	**Yes**	**Data Recovery**		**Data Recovery Completed**
312	E	Yes	Potential Mitigation (TBD) and/or Preserve by Avoidance (TBD)		Burris City in APE due to spillway in vicinity. Boundary establishment and Phase II testing to be accomplished in order to evaluate potential effects from spillway.

Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect (APE)	Mitigation Treatment and Other Recommendations for Sites Within the Area of Potential Effect	Length of Bank Protection (ft) [rounded to nearest 10 ft]	Comment
318	UNK	No	N/A		
420	UNK	No	N/A		
421	UNK	No	N/A		
422	UNK	No	N/A		
423	E	Yes	Riprap Bank Protection	270	
424	E	Yes	Riprap Bank Protection	200	
425	NE	Yes	N/A		
426	NE	Yes	N/A		
427	UNK	No	N/A		
430	UNK	No	N/A		
431	NE	Yes	N/A		
432	NE	Yes	N/A		
433	UNK	No	N/A		
434	UNK	No	N/A		
435	UNK	No	N/A		
436	UNK	No	N/A		
437 North	NE	Yes	N/A		
437 South	E	Yes	Preserve by Avoidance		
438	E	Yes	Preserve by Avoidance		
439	NE	Yes	N/A		
440	NE	Yes	N/A		
441	UNK	No	N/A		
442	NE	Yes	N/A		
443	NE	Yes	N/A		
444	NE	Yes	N/A		
445	NE	Yes	N/A		
446	E	Yes	Bank Protection	240	
447	UNK	No	N/A		
448	UNK	No	N/A		
449	UNK	No	N/A		
450	NE	Yes	N/A		
451	NE	Yes	N/A		
455	UNK	Yes	To Be Determined (TBD)		Requires Phase II Testing
458	UNK	No	N/A		
459	UNK	No	N/A		
			Total Length of Bank Protection	**3410**	

E: Eligible
NE: Not Eligible
UNK: Unknown
N/A: Not Applicable

[1] Historic Properties Site Status for the Lake Odessa (Iowa) , Habitat Rehabilitation and Enhancement Project (HREP), Environmental Management Program (EMP), as Documented by Phase II Testing (Benn 1998), a Corps Letter Dated 26 January 1998, a State Historical Society of Iowa Letter Dated 20 April 1998, a report by Benn and Isenberger (2003), and a 4 February 2003 Corps Meeting. Lake Odessa Habitat Rehabilitation and Enhancement Project Environmental Management Program - Upper Mississippi River System

NOTE: This table summarizes the Corps' opinion following the reevaluation and recommendations in the Phase II final report dated April 1998 (BCA# 466) -- and the State Historical Society of Iowa letter dated 20 April 1998 (SHSI R&C#: 950558014) -- and the January 2003 draft report (Benn and Isenberger 2003) -- and a 4 February 2003 Corps in-house meeting on site mitigation methods (riprap chosen as the only feasible shoreline protection method).

Highlighting marks 14 sites which require mitigation of some type based on the Phase I Survey of Potential Lake Odessa EMP Project Features summarized in Benn (1998:Figure 5). **(13LA27 and 13LA309** are marked in **bold type** and have data **recovery completed.)**

Highlighting marks changes resulting from information in Benn and Isenberger (2003).

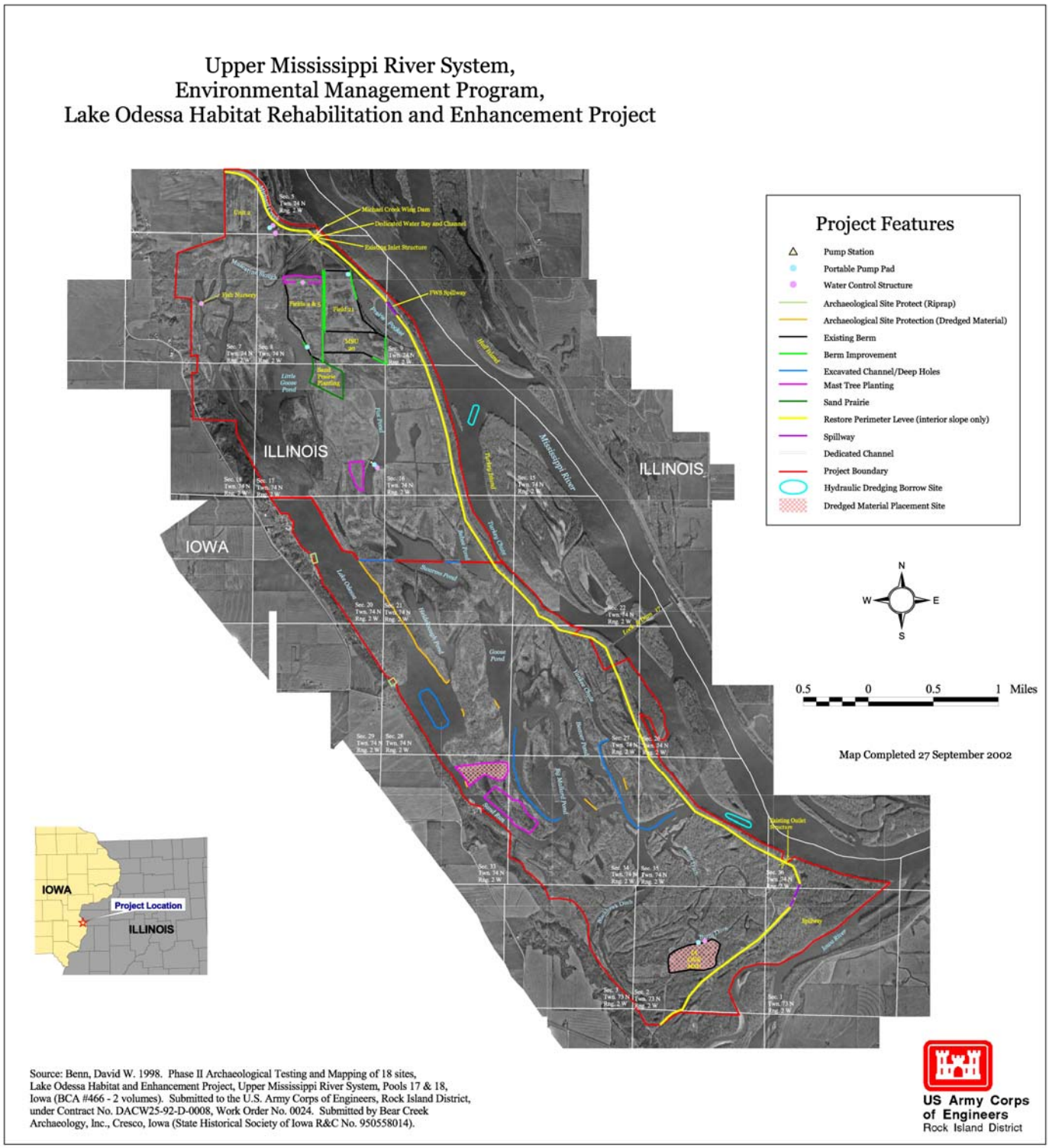
Highlighting marks Corps mitigation methods chosen (or remaining to be determined) after a 4 February 2003 Corps in-house meeting on site mitigation methods.

References:

Benn, David W.
1998 *Phase II Archeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa.* Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 24, Modifications 1 and 2. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #466 - 2 volumes).

Benn, David W., and Bill Isenberger
2003 *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa.* Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 37. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #1094, February 2003).

Figure 9-1. Potential Lake Odessa EMP Project Features



Source: Benn, David W. 1998. Phase II Archaeological Testing and Mapping of 18 sites, Lake Odessa Habitat and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #466 - 2 volumes). Submitted to the U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0024. Submitted by Bear Creek Archaeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

I. Irreversible or Irretrievable Resource Commitments. The purchase of materials and the commitment of labor, fuel, and machinery to construct the project are considered irretrievable. Other than the aforementioned, none of the proposed actions is considered irreversible.

J. Relationship of the Proposed Project to Land-Use Plans. The proposed action is in agreement with the *Land Use Allocation Plan* (Corps 1989). The proposed project is not in conflict with any land-use plans currently being used for the site.

K. Compliance with Environmental Quality Statutes. Compliance with applicable environmental statutes is summarized in table 9-2.

Table 9-2. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Federal Policies	Compliance
Archeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Full compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full compliance
Clean Water Act, 33 U.S.C. 1857h-7, et seq.	Full compliance
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Full compliance
Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Full compliance
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.	Not applicable
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Full compliance
Flood Plain Management (Executive Order 11988)	Full compliance
Protection of Wetlands (Executive Order 11990)	Full compliance
Farmland Protection Act	Full compliance
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)	Full compliance

Full compliance - Having met all requirements of the statute for the current stage of planning.
Not applicable - No requirements for the statute required.

X. PROJECT PERFORMANCE ASSESSMENT MONITORING

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

Table 10-1 presents overall types, purposes, and responsibilities of monitoring and data collection.

Table 10-2 presents actual monitoring and data parameters grouped by project phase, as well as data collection intervals.

Table 10-3 presents sedimentation transect assignment to project objectives for post-construction monitoring.

Table 10-4 presents the post-construction evaluation plan, which displays the specific parameters and the levels of enhancement that the project hopes to achieve.

Table 10-1. Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluate planning assumptions.	USFWS	USGS (UMESC)	LTRM	--
	Pre-Project Monitoring	Identify and define problems at HREP site. Establish need of proposed project features.	Sponsor	Sponsor	Sponsor	--
	Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field Station or Sponsor through Cooperative Agreements or Corps	HREP/-Sponsor	see table 10-2
Design	Data Collection for Design	Include quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	see table 10-2
Construction	Construction Monitoring	Assess construction impacts; assures permit conditions are met.	Corps	Corps	HREP	see State Section 401 Stipulations
Post-Construction	Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative) Sponsor (field observations)	Sponsor through O&M, or Corps	HREP/-Sponsor	see table 10-4

Table 10-2. Resource Monitoring and Data Collection Summary [1]

	Water Quality Data						Engineering Data			Natural Resource Data				
	Pre-Project Phase		**Design Phase**		**Post-Const. Phase**		**Pre-Project Phase**	**Design Phase**	**Post-Const. Phase**	**Pre-Project Phase**	**Design Phase**	**Post-Const. Phase**		
TYPE MEASUREMENT	**Apr-Sep**	**Oct-Mar**	**Apr-Sep**	**Oct-Mar**	**Jun-Sep**	**Dec-Mar**							**Sampling Agency**	**Remarks**
Point Measurements														
Water Quality Stations [2]														
Turbidity	2W	M			2W	6W							Corps	
Secchi Disk Transparency	2W	M			2W	6W							Corps	
Suspended Solids	2W	M			2W	6W							Corps	
Dissolved Oxygen	2W	M			2W	6W							Corps	
Specific Conductance	2W	M			2W	6W							Corps	
Water Temperature	2W	M			2W	6W							Corps	
pH	2W	M			2W	6W							Corps	
Total Alkalinity	2W	M			2W	6W							Corps	
Chlorophyll	2W	M			2W	6W							Corps	
Velocity	-	M			-	6W							Corps	
Water Depth	2W	M			2W	6W							Corps	
Ice Thickness	-	M			-	6W							Corps	
Snow Depth	-	M			-	6W							Corps	
Wind Direction	2W	M			2W	6W							Corps	
Wind Velocity	2W	M			2W	6W							Corps	
Wave Height	2W	M			2W	6W							Corps	
Air Temperature	2W	M			2W	6W							Corps	
Percent Cloud Cover	2W	M			2W	6W							Corps	
Elutriate Analysis [3]	1												Corps	
Boring Stations [4]														
Geotechnical Borings							1						Corps	
Transect Measurements														
Sedimentation Transects [5] Hydrographic Soundings							1	1	5Y				Corps	
Vegetation Transects[6] (sand prairie, mast trees) Visual Survey										1	1	Y	Corps, USFWS, IDNR	

	Water Quality Data						Engineering Data			Natural Resource Data				
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
TYPE MEASUREMENT	**Apr-Sep**	**Oct-Mar**	**Apr-Sep**	**Oct-Mar**	**Apr-Sep**	**Oct-Mar**							**Sampling Agency**	**Remarks**
Point Measurements														
MSU Water Level Control [7] Visual Survey										W	W	W	USFWS/IDNR	
Area Measurements														
Waterfowl Survey[8] Visual Survey										W	W	W	IDNR	
Fish Nursery[9] Visual survey												M	IDNR	
Mapping [10]														
Aerial Photography/ Remote Sensing										1			Corps	

W = Weekly nW = n-Week interval
M = Monthly nY = n-Yearly interval
Y = Yearly 1,2,3, … = number of times data are collected within designated project phase

[1] See plates 57 and 58 for monitoring sites
[2] Water Quality Stations
Pre-Project - W-M439.4C, W-M438.6M, W-M436.3O, W-M435.3J
Post-Project - W-M437.5D, W-M436.3O

[3] Elutriate Analysis - E-M438.8F, E-M437.5E

[4] Corps of Engineers Geotechnical Borings - See plates 42-56 for locations and boring data
[5] Sedimentation Transects
Post-Project Phase - SM441.2P-SM441.1P, SM439.0F-SM438.9E, SM438.5K-SM438.4J, SM437.4A-SM437.4F, SM436.3F-SM436.4G, SM436.0K-SM436.0L, SM435.6R-SM435.5R

[6] Vegetation Transects (sand prairie, mast trees – species, survival, tree regeneration)
Pre- and Post- Project Phase - VM441.0I-VM439.8M, VM441.2M-VM440.9O, VM439.6H-VM439.5I, VM436.9D-VM436.3D, VM435.9C-VM435.8C

[7] MSU Water Level Control Points
Post-Project Phase - Lowest points of Field 4&5, Field 21, MSU 20, Unit 2, Fox Pond, IDNR MSU, visual survey of water surface elevations DM440.7M, DM440.6N, DM440.5N, DM441.4L, DM439.5J, DM435.0G

[8] Waterfowl Survey
Pre- and Post Project Phase - Continue current waterfowl survey of MSU use (MSU 20, Field 21, Unit 2, Field 4&5, Fox Pond, IDNR MSU) on a weekly basis, Sept through mid-Dec

[9] Fish Nursery
Post-Project Phase - Monitor fish growth and survival; Document release of fish into the main lake

[10] Mapping (Pre-Construction Phase) - Date, type of mapping (aerial, etc.)

Table 10-3. Sedimentation Transect Project Objectives Evaluation

	Project Objectives to Be Evaluated			
Transects / Points	**Reduce Sedimentation**	**Increase Overwintering for Fish**	**Vegetation Growth**	**Water Level Control & Waterfowl**
SM441.2P--SM441.1P	X			
SM439.0F--SM438.9E		X		
SM438.5K--SM438.4J		X		
SM437.4A--SM437.4F		X		
SM436.3F--SM436.4G		X		
SM436.0K--SM436.0L		X		
SM435.6R—SM435.5R		X		
WM437.5D		X		
WM436.30		X		
VM441.0I—VM 439.8M			X	
VM441.2M—VM440.9O			X	
VM439.6H--VM439.5I			X	
VM436.9D--VM436.3D			X	
VM 435.9C—VM435.8C			X	
DM440.7M				X
DM440.6N				X
DM440.5N				X
DM441.4L				X
DM439.5J				X
DM435.0G				X

Table 10-4. Post-Construction Evaluation Plan

Enhancement Potential									
Goal	**Objective**	**Enhancement Feature**	**Unit**	**Year 0 Without Alternative**	**Year 1 With Alternative**	**Year 25 With Alternative**	**Year 50 Target With Alternative**	**Feature Measurement**	**Annual Field Observations by Site Manager**
Enhance Wetland and Terrestrial Habitat	Increase bottomland hardwood diversity and reduce forest fragmentation	Establish hardwood trees in existing areas, old fields, on dredge placement area	Mast tree survival and regeneration	NA	100%	100%	100%	Tree count/random sample	Estimate effective acreage and wildlife use, presence/absence of mast
	Enhance migratory bird habitat	Enhance moist soil management units with reliable water control	Acres of reliably flooded wetlands	199	380	380	380	Surveys/aerial photo interpretation / mapping	Effective water level control, waterfowl usage, Observe vegetation growth
	Restore sand prairie	Reseed 36 acres	% cover of native prairie species	10%	50%	100%	100%	Vegetation transects	Number of species; % cover with native plants
Enhance Aquatic Habitat	Provide safe area for developing fish	Fish nursery (operate 1 year in 5)	Fish nursery	0	20%	20%	NA	Visual survey	Survival and growth of fish, ease of release into main lake
	Increase habitat for over-wintering fish	Deep hole/channel excavation	Acres with depth of 6' or greater	0	62	62	62	Sediment transects	Presence of fish, fishing activity; reports of kills
	Increase habitat for over-wintering fish	Deep hole/channel excavation	Acres with depth of 6' or greater	0	62	62	62		Fish presence or absence; reports of kills
		Deep hole/channel excavation	D.O. (Mg/l)	< 5.0 during critical periods	> 5.0	> 5.0	> 5.0	Perform water quality measurements	Fish presence or absence; reports of kills
Enhance Wetland, Terrestrial, and Aquatic Habitat	Protect habitat features	Restore perimeter levee height and slopes	Level of protection	10-year	25-year	25-year	25-year	Profile survey	Visual inspection to note defects (i.e., sloughs, rodent holes, etc.)
		Reduce flood damage by constructing spillway	Reduce levee breaching, Spillway level of protection	NA	10-year	10-year	10-year	Profile survey	Visual inspection to note defects (i.e., loss of riprap, debris, etc.)

XI. REAL ESTATE REQUIREMENTS

The Lake Odessa Habitat Rehabilitation and Enhancement Project is a part of the Upper Mississippi River System-Environmental Management Program authorized by Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended. The project is located on the Mississippi River in Pools 17 and 18 between RM 434.5 and 441.5.

The project is comprised of two different areas: Lake Odessa State Wildlife Management Area and the Mark Twain National Wildlife Refuge Complex, both of which are located in Louisa County, Iowa. All of the project lands are on Government-owned property. A full description of the project area and Real Estate information is noted in Appendix L, *Real Estate Plan*.

The project sponsor is the U.S. Fish and Wildlife Service (USFWS). The project will be constructed at 100 percent Federal cost, therefore, a formal Project Cooperation Agreement is not required. The proposed project lands are currently managed under a cooperative agreement between the Department of Interior, the USFWS, and the U.S. Army Corps of Engineers. A portion of the proposed project lands that the USFWS manages have been out-granted with a successive cooperative agreement between the USFWS and the Iowa Department of Natural Resources (IDNR). The IDNR will be responsible for the operation and maintenance of the out-granted lands. Therefore, the USFWS will enter into two separate Memorandums of Agreement (MOA) with the Department of the Army, U.S. Army Corps of Engineers in order to establish relationships, arrangements, and to decipher the operation and maintenance responsibilities of the USFWS and the operation and maintenance responsibilities of the IDNR. A map attached to the Real Estate Plan (Appendix L of this report) identifies the lands which are to be operated and maintained by the USFWS and the lands which are to be operated and maintained by the IDNR.

The draft MOA between the USFWS and the Corps of Engineers, and the draft MOA between the USFWS and the Corps of Engineers, Managed by the Iowa Department of Natural Resources, are included as Appendix C.

XII. IMPLEMENTATION RESPONSIBILITIES AND VIEWS

A. Corps of Engineers. The U.S. Army Corps of Engineers, Rock Island District, is responsible for project management and coordination with the USFWS, the State of Iowa, and other affected agencies. The Rock Island District will submit the subject Definite Project Report (DPR); program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration. Section 906(e) of WRDA 1986 states that first cost funding for enhancement features will be 100 percent Federal cost because the project features will be located on federally owned land that is managed by the USFWS as a national wildlife refuge. Any mutually agreed upon major rehabilitation of the project that exceeds the identified annual operation and maintenance cost requirements will be the Corps of Engineers' responsibility. Major rehabilitation would be considered as a result of specific storm or flood events and is not included in the project cost estimate. (See table 8-2.)

B. U.S. Fish and Wildlife Service. The USFWS is the Federal project sponsor and has provided a Coordination Act Report (CAR) for this project. Operation and maintenance of the project, as described in table 8-3, is the responsibility of the USFWS in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. The Corps will further specify these functions in the Project

Operation and Maintenance Manual, which will be provided prior to the sponsor's final acceptance of the project.

C. Iowa Department of Natural Resources. The IDNR, the non-Federal project sponsor, has provided technical and other advisory assistance during all phases of the project and will continue to provide assistance during project implementation. Specifically, the IDNR will monitor any bald eagle and red-shouldered hawk nests for activity prior to construction. The IDNR will also have the responsibility for approving the locations and design for the pools constructed for copperbelly and diamondback watersnakes.

XIII. COORDINATION, PUBLIC VIEWS, AND COMMENTS

Coordination with the following State and Federal agencies has been made throughout the planning and design process:

Iowa Department of Natural Resources - IDNR
Natural Resources Conservation Service
U.S. Fish and Wildlife Service - USFWS
U.S. Environmental Protection Agency - USEPA
Iowa State Historic Preservation Agency – Iowa SHPO

A. Coordination Meetings

Ongoing coordination with project cooperators was demonstrated by the following meetings:

May 29, 1990. Baseline monitoring meeting with the Corps, USFWS, and IDNR

December 17, 1991. General scooping meeting with the USFWS and IDNR

January 21, 1992. Planning meeting with the USFWS and IDNR

January 22, 1992. Plan formulation meeting with the Corps, USFWS, and IDNR

March 21, 1995. General scooping meeting with the Corps, USFWS, and IDNR

August 15, 1996. Archeology site visit with the Corps, IDNR, Iowa SHPO, Bear Creek Archeology, UNI (Iowa), and Office of the State Archeologist

September 24, 1997. Archeological meeting with the Corps, USFWS, IDNR, and Bear Creek Archeology

July 17, 2000. On-site visit with the Corps, USFWS, and IDNR

October 30, 2000. Baseline WHAG meeting with the Corps, USFWS, and IDNR

February 12, 2001. General coordination meeting with the Corps, USFWS, and IDNR

December 5, 2001. General coordination meeting with the Corps, USFWS, and IDNR

January 31, 2002. Phone conference with the Corps, USFWS, and IDNR

February 15, 2002. Phone conference with the Corps, USFWS, and IDNR regarding project features

April 23, 2002. Spillway coordination meeting with the Corps, USFWS, IDNR, and FEMA

May 7, 2002. Phone conference with the Corps, USFWS, and IDNR to review habitat analysis results

January 28, 2003. Spillway coordination meeting with the Corps, USFWS, and IDNR

February 11, 2004. Phone conference with the Corps, USFWS, and IDNR

August 26, 2004. Public Open House at the Brigg's Civic Center in Wapello, Iowa

B. Coordination by Correspondence. The following letters are contained in Appendix A, C*orrespondence*:

CENCR-PD-W Memorandum, dated June 1, 1990, subject: UMRS-EMP: On-Site Meeting for Lake Odessa, Iowa, Habitat Project

CENCD-PE-PD-PL Memorandum, dated December 10, 1990, subject: Upper Mississippi River System Environmental Management Program

Meeting Report, Lake Odessa HREP Interagency Meeting, Wapello, Iowa, December 17, 1991

Meeting Report, Lake Odessa HREP Service/State Planning Meeting, Wapello, Iowa, January 21, 1992

CENCR-PD-W Memorandum for Record, dated January 22, 1992, subject: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting

CENCR-PD-W Memorandum for Record, dated March 23, 1995, subject: Environmental Management Program Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project C Coordination Meeting

Letter dated April 28, 1995, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding draft geomorphological investigation report by Bear Creek Archeology

Letter dated May 5, 1995, from Ms. Kirsten Hoffman, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, commenting on report of geomorphological investigations for historic property contexts, Lake Odessa HREP

Letter dated August 2, 1995, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding a final report by Bear Creek Archeology, Inc

Letter dated January 23, 1996, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Beth Foster, State Historical Society of Iowa, regarding sites eligible for inclusion on National Register of Historic Properties

Letter dated March 15, 1996, from Ms. Kathy Gourley, State Historical Society of Iowa, to Mr. Dudley Hanson, U.S. Army Corps of Engineers, Rock Island District, concerning National Register sites, Louisa County, Lake Odessa Project

Letter dated April 30, 1996, from Mr. Ronald E. Pulcher, U.S. Army Corps of Engineers, Rock Island District, to Mr. David G. Stanley, Bear Creek Archeology, Inc., concerning review of draft Phase I cultural resources survey report

Letter dated May 24, 1996, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding May 1966 final Phase I cultural resources survey report

CENCR-PD-W Memorandum for Record, dated January 6, 1997, subject: UMRS-EMP Lake Odessa, Iowa, HREP Archeological Site Visit.

Letter dated March 24, 1997, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding draft Phase II archeological testing report

Letter dated January 26, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding October 1997 draft Phase II archeological testing report

Letter dated March 2, 1998, from Dr. Allen Farris, Iowa Department of Natural Resources, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, commenting on archeological site treatments for Lake Odessa HREP

Letter dated April 2, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding Memorandum of Agreement for signature

Letter from Ms. Kira E. Kaufmann, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, dated April 20, 1998, commenting on Phase II archeological testing of 14 sites at the Lake Odessa HREP

Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Fish and Wildlife Service, dated April 24, 1998, forwarding Memorandum of Agreement for signature

Letter dated May 19, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, forwarding Memorandum of Agreement for signature

Letter dated May 22, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding April 1998 final report of Phase II Archeological testing and mapping of 18 sites for Lake Odessa HREP

Letter dated June 16, 1998, from Mr. Patrick T. Burke, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding fully executed Memorandum of Agreement for mitigation of adverse effects occurring at Horseshoe Site at Lake Odessa

CEMVR-PM-R Memorandum for Record, dated February 9, 1999, subject: Lake Odessa EMP Historic Properties 50-Year Mitigation

Letter dated April 16, 1999, from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding MOA for signature

Letter dated April 16, 1999, from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Mr. Paul W. Johnson, Iowa Department of Natural Resources, forwarding MOA for signature

Letter dated May 13, 1999, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Department of the Interior, forwarding MOA for signature

Letter dated June 16, 1999, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, forwarding MOA for mitigation of adverse effects occurring at Cross Site

Letter dated April 11, 2000, from Mr. Mike Griffin, Iowa Department of Natural Resources, to Ms. Barb Kimler, U.S. Army Corps of Engineers, Rock Island District, outlining information needs and project features for Lake Odessa HREP

CEMVR-ED-DG Memorandum for Record, dated July 25, 2000, subject: 17 July 2000 on-site coordination meeting for Lake Odessa EMP DPR

Letter dated August 3, 2000, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, requesting preliminary comments on proposed Lake Odessa project

Letter dated October 25, 2000, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding for comment draft archeological report on Cross Site

CEMVR-PM-AR Memorandum for Record, dated November 7, 2000, subject: Baseline WHAG Meeting Summary for Lake Odessa HREP

CEMVR-ED-DG Memorandum for Record, dated December 6, 2001, subject: 5 December 2001 On-Site Coordination Meeting for the EMP Lake Odessa HREP DPR

MFR of Phone Conversation, dated January 31, 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District

MFR of Phone Conversation, dated February 15, 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District

Draft Fish and Wildlife Coordination Act Report, dated September 30, 2002, prepared by the U.S. Fish and Wildlife Service, Rock Island Field Office

Letter from Bear Creek Archeology to Mr. Ron Pulcher, Engineers, Rock Island District, dated January 8, 2003, submitting invoice for investigation

CEMVR-PM-A Memorandum for Record, dated 6 February 2003, subject: Lake Odessa EMP Meeting on Historic Properties

Letter from Mr. Ron Pulcher, Archaeologist, U.S. Army Corps of Engineers, Rock Island District to Dr. David Benn of Bear Creek Archeology, dated 12 February 2003, requesting that the final report be updated

Letter from Bear Creek Archeology to Mr. Ron Pulcher, Engineers, Rock Island District, dated February 19, 2003, submitting Corporate Release Form

MFR of Phone Conversation, 24 February 2003, prepared by Ms. Karen Hagerty, U.S. Army Corps of Engineers, Rock Island District with Ms. Heidi Woeber, Rock Island Field Office of the FWS, discussing the need for mussel survey for the Lake Odessa HREP

Letter dated March 28, 2003, from Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, requesting comments and views from consulting parties on historic properties (with 5 enclosures)

Letter dated April 2, 2003, from Mr. John P. Froman, Chief, Peoria Tribe of Oklahoma, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, stating that the Tribe has no objection to the proposed project

Letter dated April 3, 2003, from Mr. Don Klima, Director, Advisory Council on Historic Preservation, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, requesting additional information on Sites 13LA27 and 13LA309

Letter dated April 16, 2003, from Mr. Daniel K. Higginbottom, Archaeologist, State Historical Society of Iowa, to Mr. Ron Pulcher, Archaeologist, U.S. Army Corps of Engineers, Rock Island District, providing comments and recommendations

Letter dated May 2, 2003, from Mr. Mike Griffin, Iowa Department of Natural Resources, to Colonel William J. Bayles, District Engineer, U.S. Army Corps of Engineers, Rock Island District, concurring with draft DPR

FAX dated May 5, 2003, from Ms. Emma Snowball, Ho-Chunk Heritage Preservation, to Mr. Ron Pulcher, U.S. Army Corps of Engineers, Rock Island District, forwarding Findings Summation

Letter dated May 9, 2003, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, responding to Mr. Klima's letter of April 3, 2003

Letter dated May 28, 2003, from Mr. Raymond V. Wallace, Advisory Council on Historic Preservation, to Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, stating their participation in consultation to resolve adverse effects is not needed

Letter dated June 18, 2003, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Lavon Grimes, State Historical Society of Iowa, responding to questions in her March 28, 2003, letter

Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Jeffery Vonk, Director Iowa Department of Natural Resources, dated July 17, 2003, forwarding the signed Programmatic Agreement

Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Lavon Grimes, State Historical Society of Iowa, dated July 17, 2003, forwarding the signed Programmatic Agreement

Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Richard Steinbach, Complex Manager Mark Twain Refuge, dated August 15, 2003, forwarding the signed Programmatic Agreement

Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, dated October 28, 2003, forwarding the signed Programmatic Agreement

Final Programmatic Agreement signed by representatives of the U.S. Army Corps of Engineers, State Historical Society of Iowa, Iowa Department of Natural Resources, and U.S. Fish and Wildlife Service

After Action Report dated August 26, 2004, prepared by the U.S. Army Corps of Engineers, Rock Island District, for the Lake Odessa HREP Public Open House, held at the Briggs Civic Center, Wapello, Iowa.

Public Notice dated November 18, 2004, from the U.S. Army Corps of Engineers, Rock Island District, soliciting comments from the public and Federal, state and local agencies and officials on the proposed project

Letter dated November 24, 2004, from Zach Pahmahmie, Tribal Chairman, NAGPRA Representative, Prairie Band Potawatomi Nation, stating that the Tribe has no objection to the proposed project

Letter dated December 3, 2004, from the IDNR issuing Construction Permit 04-118 to the U.S. Army Corps of Engineers, Rock Island District for a portion of the construction features. Guidelines for Protection of Indiana Bat Summer Habitat are also included

Letter dated December 6, 2004, from Ms. Lavon Grimes, State Historical Society of Iowa, responding to the project's public notice

Fax from USFWS dated December 8, 2004, containing the Public Notice with stamped *NO OBJECTION*

Letter dated December 10, 2004, from Kenneth Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms Lavon Grimes, State Historical Society of Iowa, concerning the change in the Area of Potential Effect, requiring that the spillway be moved to an alternate location

Letter dated December 15, 2005, from Mr. Anthony P. Whitehorn, Tribal Enterprise Manager, Osage Tribal Council, referencing the religious and cultural significance of the project area to the Osage Tribe

Phone Conversation Record dated January 7, 2005, prepared by Karen Hagerty, U. S. Army Corps of Engineers, Rock Island District, discussing the IDNR construction permit

Letter dated January 24, 2005, from Mr. David Lee Smith, Director, Repatriation Program, Winnebago Tribe of Nebraska, stating that the tribe at one time lived where construction will occur and wants notification if any remains or cultural objects are found

Letter dated January 25, 2005, from Ms. Christine M. Schwake, Environmental Specialist, IDNR, referencing the issuance of 401 Water Quality Certification for a portion of the construction features

Letter dated February 1, 2005, from Ms, Christine M. Schwake, Environmental Specialist, IDNR, amending the 401 Water Quality Certification to include all construction features

Letter dated February 3, 2005, from Ms. Deanne Bahr, NAGPRA Contact Representative, Sac and Fox Nation of Missouri in Kansas & Nebraska, expressing their interest in inadvertent finds of human remains or funerary objects

Letter dated February 8, 2005 from Denny Lundberg, U.S. Army Corps of Engineers, Rock Island District to Keith Dohrmann, IDNR, requesting an amendment to Sovereign Lands Construction Permit #04-118, with Telephone Conversation Record, dated Jan 19, 2005, between Bill Ohde, IDNR and Karen Hagerty, U.S. Army Corps of Engineers.

Letter dated March 1, 2005, from Mr. Richard C. Nelson, USFWS Field Supervisor, providing the final Fish and Wildlife Coordination Act Report for the Lake Odessa HREP Project.

Letter dated March 7, 2005, from the IDNR issuing Construction Permit 05-033, to the U.S. Army Corps of Engineers, Rock Island District for all the construction features

XIV. CONCLUSIONS

Full realization of the potential habitat value in the Lake Odessa project area has been hindered by repeated levee failure, flooding, sedimentation, and lack of water level management capability. Establishing areas containing reliable aquatic/wetland habitat will allow the project area to realize the highest benefit to migratory birds, wintering fish, and other local wildlife.

The recommended project enhancement features for Lake Odessa—moist soil unit enhancement, fisheries dredging, levee restoration, fish nursery, and mast tree/sand prairie plantings—are designed to meet the project's goals of restoring and protecting wetland, terrestrial, and aquatic habitat. These goals will be met by reducing forest fragmentation, increasing bottomland hardwood diversity, enhancing migratory bird habitat, restoring sand prairie habitat, increasing habitat for overwintering fish, providing safe areas for developing fish, and protecting habitat areas and archeological sites.

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

The project is consistent with and fully supports the overall goals and objectives of the Upper Mississippi River System-Environmental Management Program, the North American Waterfowl Management Plan, and the Partners in Flight Program.

RECOMMENDATIONS

I have weighed the outputs to be obtained from the full implementation of this habitat rehabilitation and enhancement project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. In my judgment, this project, as proposed, justifies expenditure of Federal funds. I recommend that the Secretary of the Army for Civil Works approve the proposed project to include enhancing water level management capability at moist soil units; dredging channels and deep holes for fisheries enhancement; planting mast trees; restoring the perimeter levee; planting a sand prairie; and constructing a fish nursery.

The current estimated Federal construction cost of this project is $11,361,499. Total Federal estimated project cost, including general design and construction management, is $14,818,648.

At this time, I further recommend that funds in the amount of $598,000 be allocated for the preparation of plans and specifications.

5/15/05
(Date)

for Duane P. Gapinski
Colonel, U.S. Army
District Engineer

FINDING OF NO SIGNIFICANT IMPACT

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

An array of management features and alternatives was considered for habitat enhancement, including:.

A. No Federal Action
B. Moist Soil Unit Enhancement
C. Sand Prairie Restoration
D. Upper Fish Nursery Construction
E. Creation of Deep-Water Fish Habitat
F. Reforestation (Mast Tree Planting)
G. Restoration of the Perimeter Levee

The preferred alternative consists of enhancing the following MSUs: USFWS complex (Field 4 & 5, Field 21, MSU 20), Unit 2, Fox Pond, Swarms/Bebee Ponds, and IDNR MSU; dredging the following areas to enhance fisheries habitat: Swarms/Bebee Ponds, Main Lake, Goose Pond, and Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; mast tree planting at Sites A, B, C, and D; and restoring the perimeter levee.

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

A. The project is anticipated to improve the value of the Lake Odessa complex for migratory and resident birds, fish, and wildlife species.

B. Aside from temporary disturbance during construction periods, no long-term adverse effects to natural or cultural resources are anticipated. No State or Federal endangered or threatened species would be adversely affected by the proposed action.

C. The project is in compliance with Sections 401 and 404 of the Clean Water Act. The project is in compliance with Section 106 of the National Historic Preservation Act (NHPA) based upon the fully executed "Programmatic Agreement Among the Rock Island District of the U.S. Army Corps of Engineers, the Iowa State Historic Preservation Officer, the State of Iowa Department of Natural Resources, and the United States Fish and Wildlife Service, Regarding Implementation of the Lake Odessa Habitat Rehabilitation and Enhancement Project, under the Upper Mississippi System – Environmental Management Program" signed by the Corps on June 27, 2003, and filed with the Advisory Council on Historic Preservation as required under Chapter 36 of the Code of Federal Regulations, Part 800, the rules implementing Section 106 of the NHPA.

D. No significant adverse impacts are expected to occur in the project area.

5/15/05
(Date)

for Duane R. Gapinski
Colonel, U.S. Army
District Engineer

LITERATURE CITED

Benn, David W., and Jeffrey D. Anderson
1995. *Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17-18, Iowa* (BCA #342-2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0011. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W.
1996. *Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa* (BCA #405-2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0018. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W.
1998. *Phase II Archaeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa* (BCA #466-2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0024. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W. and Bill Isenberger
2003. *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, prepared under Corps Contract No. DACW25-98-D-0001, Work Order No. 37 (David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc.).

Orth, Kenneth D.
1994. *Cost Effective Analysis for Environmental Planning: Nine Easy Steps*. Institute for Water Resources, Water Resources Support Center, Arlington, VA.

Urich, D. L., J.P. Graham, and E.A. Gaskins
1984. *Habitat Appraisal of Private Land in Missouri*, Wildlife Society Bulletin 12 (1984): 350-356.

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Sept 1989. *Mississippi River, Nine-Foot Channel Navigation Project, Pools 11-22, Land Use Allocation Plan*. Rock Island District.