HORSESHOE LAKE
ALEXANDER COUNTY, ILLINOIS

AQUATIC ECOSYSTEM RESTORATION REPORT WITH ENVIRONMENTAL ASSESSMENT

DRAFT

September 2003

HORSESHOE LAKE
ALEXANDER, ILLINOIS
AQUATIC ECOSYSTEM RESTORATION REPORT
WITH ENVIRONMENTAL ASSESSMENT AND
FINDING OF NO SIGNIFICANT IMPACT
SECTION 206 OF THE WATER RESOURCES
DEVELOPMENT ACT OF 1996

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

HORSESHOE LAKE
ALEXANDER COUNTY, ILLINOIS
ECOSYSTEM RESTORATION REPORT AND ENVIRONMENTAL ASSESSMENT

EXECUTIVE SUMMARY

Purpose. This Aquatic Ecosystem Restoration Report is prepared under the authority of Section 206 of the Water Resources Development Act (WRDA) of 1996, as amended, in response to a request for Federal assistance from the Illinois Department of Natural Resources for an ecosystem restoration project.

Project Location. The project is located in the floodplain of the Mississippi River in Alexander County, Illinois. It is 15 miles northwest of Cairo and 2 miles south of Olive Branch, Illinois. The Horseshoe Lake State Conservation Area is managed by the Illinois Department of Natural Resources (IDNR) as a multipurpose conservation/recreation area.

The lake area consists of an ancient river cutoff meander and 2 separate nature preserve tracts. The preserves have been given special protection against future changes in land use. The shallow oxbow covers 2007 acres and was formed by the Mississippi River about 6,000 years ago (Bogner et al. 1985). This lake is a bottomland cypress swamp and its vegetation (bald cypress, tupelo gum and swamp cottonwood) is reminiscent of what is found in the Louisiana bayou country.

Background. This area has contained an abundance of aquatic resources for more than a 1000 years. These resources have been severely impacted as the result the introduction of a large population of exotic invasive and rough fish (bighead carp, silver carp, black carp, grass carp, common carp, buffalo, and gar) during the floods of 1993 and 1995. Effects of these fish introduced through flood events have hindered aquatic plant growth and degraded fisheries habitat. The foraging activity of bottom feeding fish creates turbidity, which prevents sunlight from reaching far enough into the water column to support plant growth. In addition, the turbidity makes it difficult for the targeted species (bass and crappie) to see their prey and to spawn. The turbidity also increases the potential for higher water temperature. Warmer water retains less oxygen and thereby provides a reduced dissolved oxygen level for the target species.

Since the flood of 1993 there has been a noticeable decline of habitat for invertebrates, hydrophytic vegetation, amphibians, reptiles, birds, fish, and mammals of which some species are listed as state or federally threatened and endangered. The restoration of a quality wetland ecosystem at this project requires water level management and reduction of the exotic invasive and rough fish.

Present conditions in and around the proposed project areas only provides limited habitat value for most species associated with marsh habitat. Forested wetlands that once existed in the project areas have been severely impacted by long periods of inundation due to the lack of adequate

water control, management of the entire lake for fish, and the use of the lake as a refuge for overwintering geese.
Many of the mature trees were damaged or killed due to the 1993 and 1995 flooding events. Regeneration of cypress-tupelo has not occurred for over 50 years (as a result of spillway construction that provided higher stable water levels) and is a concern with all stakeholders. The stable water levels in the cypress/tupelo forest area submerge the tree roots and the roots subsequently die from lack of oxygen.

The sponsor (Illinois Department of Natural Resources) has sponsored numerous studies/reports regarding the deteriorating condition of Horseshoe Lake. Considerable coordination was done with the scientific community, as well as the local interests. Initial analysis of the available scientific data indicated that sedimentation was a problem in the lake and an initial recommended plan was selected that focused on reducing sediment coming into the lake. A Draft Aquatic Ecosystem Report was released for public review in 2001. Upon further sedimentation analysis and additional surveys, however, it became apparent that a proposed sediment trap would not provide a cost effective solution, and in fact, that most of the lake actually had sufficient depth to support a fisheries habitat. Armed with this knowledge, the study changed focus and the project was re-scoped with three main focuses: 1) improved fisheries habitat, 2) cypress/tupelo restoration/regeneration, and 3) improved waterfowl habitat.

Alternatives Considered. Besides the no-action alternative, four alternatives were considered in detail. All the action alternatives address the reduction/elimination of the exotic invasive and rough fish population; some of the plans also address cypress/tupelo regeneration and moist soil management.

Proposed Features. Proposed features of the recommended restoration project consist an initial drawdown of the lake to control the exotic invasive and rough fish population, consolidate the lake bottom, and facilitate construction of one new causeway across the northern end of the lake's middle arm. A dewatering pump to be installed on the causeway will facilitate management of two of the lake's compartments for moist soil and cypress/tupelo regeneration. Watering wells will be installed for emergency rewatering of the lake following the drawdown if needed prior to the fall waterfowl migration and for general water level management within the lake. The lake will be restocked following its rewatering. Recreational features including new and improvements to existing boat ramps, and courtesy docks are also included.

Project Costs. Cost estimates were developed for each alternative. Combined first costs for the initially evaluated plans of each area ranged from $1,203,000 to $5,726,000. Average annual costs were based on an expected project life of 50 years, a Federal discount rate of 5.875 percent, and August 2003 price levels. Average annual costs include first costs, operation and maintenance costs for pumping costs, and planned maintenance and rehabilitation costs (at year 25) for the pumps. Average operation and maintenance costs range from $22,345 to $35,505. A detailed cost estimate was developed for the recommended plan; total project first cost for the recommended plan is estimated at $4,373,000.

Recommended Plan. The entire lake would be initially drawn down to facilitate construction and assist in the removal of the existing exotic invasive and rough fish population. It is

anticipated that limited pools of water would remain that contain trapped fish. These areas would be chemically treated to eliminate the remaining fish. The lake would be drawn down initially by opening the spillway gates. Obstructions in a portion of Lake Creek (which water exiting through the spillway drains into) will be cleared to facilitate the drawdown. Since the lake depth in the area of the spillway is generally shallower than the area further north, a shallow channel would be constructed on the east side of the lake above the spillway to facilitate drawdown of the remainder of the lake. An island (.4-acre with cypress plantings) will be created near the channel using the excavated material.

One causeway would be constructed in the middle arm of the lake toward the north end of the existing island. This new causeway would have a gated culvert and a boat pullover. A footpath would run along the causeway. A permanent unwatering pump would be installed at the new causeway to allow the Black Creek Delta/Miller City Arm compartments to be dewatered. The Miller City Arm culvert will be replaced with a water control structure to provide for independent management of this unit, resulting in dividing the lake into three management compartments. The largest compartment (east of the existing island causeway including the east arm of the lake south to the spillway, and north along the middle arm to the new causeway) would be managed for fisheries (this area contains the deepest part of the lake). The second compartment would be the Miller City Arm and the third compartment (Black Creek Delta) would be the northeast area of the lake between the three causeways. The second and third compartments would be managed for moist soil, waterfowl, and cypress/tupelo restoration/ regeneration using water level management techniques.

Deep wells will be installed to re-water the lake for waterfowl in case there is insufficient rainfall and to allow annual water level management of the moist soil management units for migrating and over wintering waterfowl habitat. Deep wells will also be used to supplement water volume in the fisheries area during dry periods or periods with a high evaporation rate (typically June-August). Once the lake is refilled it would be restocked with desirable fish species, including predatory fish to address future accidental reintroduction of exotic invasive and rough fish into the lake.

Recreation features include adding one new concrete boat ramp, replacement of two existing gravel boat ramps, lengthening six existing boat ramps, and adding a courtesy dock at each of the nine boat ramp locations.

Findings and Conclusions. Implementation of the proposed measures at Horseshoe Lake would result in positive benefits by allowing more control over water levels within the management areas, reduction of the exotic invasive and rough fish population, and improvement in the water quality in the lake. The long-term benefits of this proposed habitat restoration project outweigh the minor and temporary adverse impacts associated with project construction. The local sponsor has indicated that it wishes to pursue the project at this time.

Recommendation. It is recommended that the aquatic ecosystem restoration plan for Horseshoe Lake Conservation Area, Alexander County, Illinois, as discussed in this report be approved for implementation as a Federal project under authority of Section 206 of WRDA of 1996, as

amended, at a total project cost of $4,373,000, provided that, prior to construction, local interests provide the assurances of local cooperation as stated previously.

The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the state programs or the formulation of a national Civil Works construction program. Consequently, the recommendations may be modified prior to approval and implementation funding.

HORSESHOE LAKE
ALEXANDER COUNTY, ILLINOIS
AQUATIC ECOSYSTEM RESTORATION REPORT
WITH ENVIRONMENTAL ASSESSMENT AND
FINDING OF NO SIGNIFICANT IMPACT
SECTION 206 OF THE WATER RESOURCES
DEVELOPMENT ACT OF 1996

INTRODUCTION

STUDY AUTHORITY

1. This Ecosystem Restoration Report is prepared under the authority of Section 206 of the Water Resources Development Act (WRDA) of 1996, as amended, in response to a request for Federal assistance from the Illinois Department of Natural Resources for an aquatic ecosystem restoration project.

STUDY AREA DESCRIPTION

2. The project is located in the floodplain of the Mississippi River in Alexander County, Illinois. It is 15 miles northwest of Cairo and 2 miles south of Olive Branch, Illinois (Figure 1). The area for the proposed project is managed by the Illinois Department of Natural Resources (IDNR) as a multipurpose conservation/recreation area.

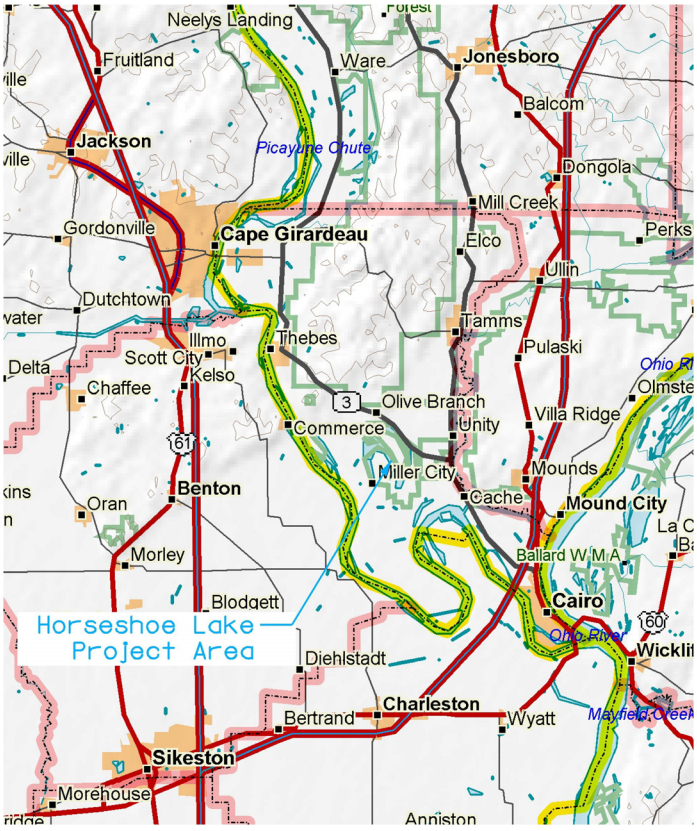


Figure 1. Horseshoe Lake Project Area

3. The lake area consists of an ancient river cutoff meander and 2 separate nature preserve tracts. See Figure 2. The preserves have been given special protection against future changes in land use. The shallow oxbow covers 2007 acres and was formed by the Mississippi River about 6,000 years ago (Bogner et al. 1985). This lake is a bottomland cypress swamp and its vegetation (bald cypress, tupelo gum and swamp cottonwood) is reminiscent of what is found in the Louisiana bayou country.

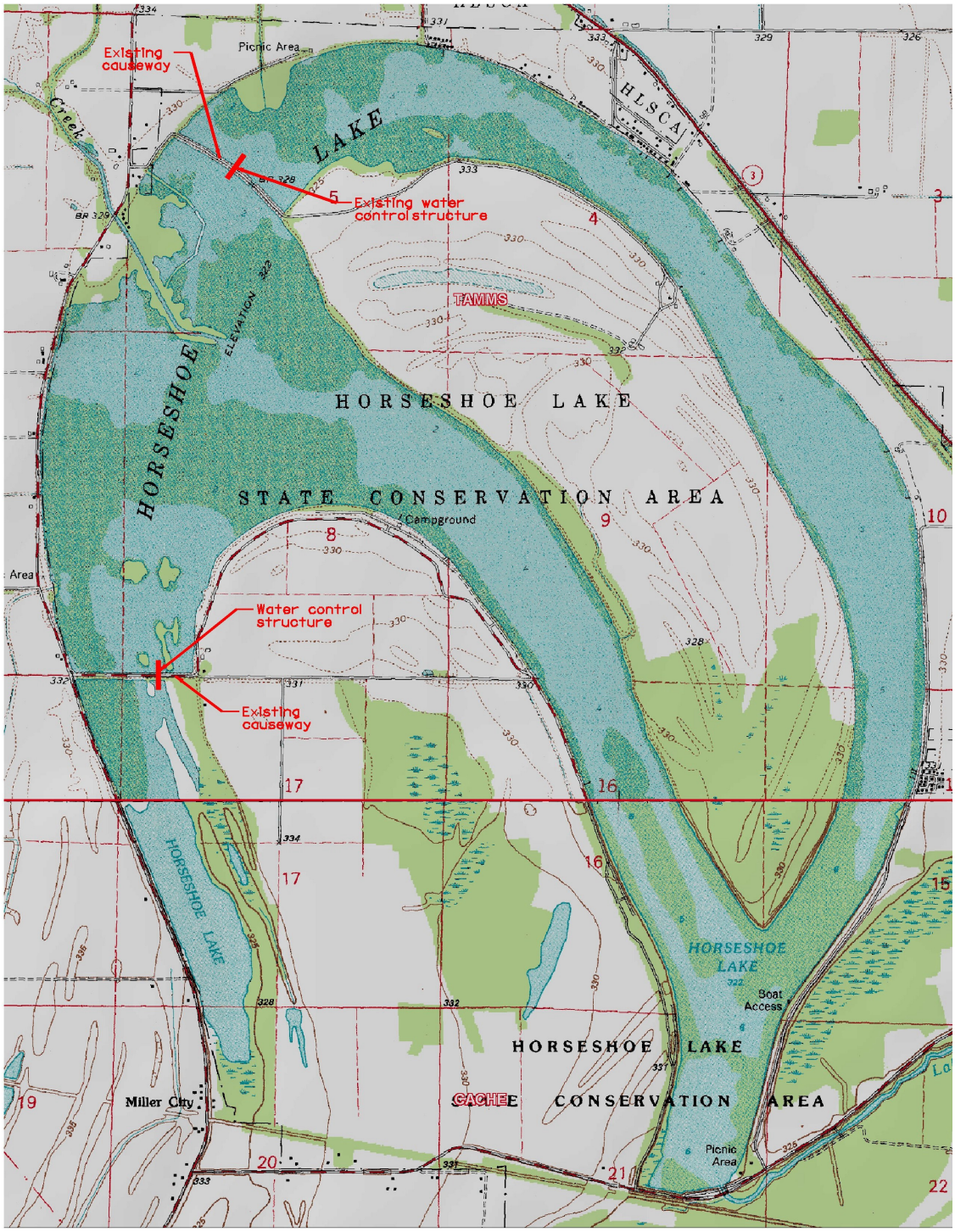


Figure 2. Horseshoe Lake Conservation Area

4. The purpose of protecting these special areas is to maintain the ecological diversity and natural features of the land. These features include the soils, plant and animal species, and terrestrial and aquatic ecosystems, including wetlands. In the 1920's, Horseshoe Lake was used primarily for hunting. In 1927 the state of Illinois began purchasing properties in and around Horseshoe Lake for a state conservation area (Lee 1993). The lake was dammed in 1931 to maintain a constant water level and to increase the water depth by approximately 4.5 feet. This lake was known for its excellent sport fishing opportunities, and as a major wintering ground for waterfowl (Canada geese and ducks).

5. The objective of this project is to restore a portion of the lake's lost aquatic and wetlands habitat function. Under the Section 206 program, this project is authorized to cost share (65 percent federal and 35 percent non-federal) cost-effective aquatic ecosystem features that improve the quality of the environment.

6. This restoration project consists of new construction to form separate management compartments within the lake, installation of wells and an unwatering pump, and draining and restocking of the lake to restore viable fisheries habitat. Additional proposed project features include the excavation of a ditch drainage system and construction of a small island with tree plantings. Limited recreational features (boat ramps and courtesy docks) are also included as part of the project.

7. The Corps has proposed a future Mississippi River and Tributaries (MR&T) study of alternative measures that could ensure the integrity of the Commerce to Birds-Point levee reach (including the nearby Len Small Drainage and Levee District). This study may indirectly provide additional restoration opportunities for Horseshoe Lake. One potential planning measure is the construction of a controlled overflow channel traversing Dogtooth Bend. Such an alternative could afford environmental opportunities, such as creating an enhanced barrier against the inflow of river sediments to Horseshoe Lake during floods, and to take advantage of a riverside levee to compartmentalize the southern end of the Horseshoe complex for moist-soil management.

STUDY PURPOSE AND SCOPE

8. This document presents the findings of the feasibility phase ecosystem restoration study conducted for Horseshoe Lake. Current and future ecosystem conditions were evaluated and plans developed to meet those needs. The study was conducted with sufficient detail to select a recommended plan and to determine Federal and non-Federal responsibility. An incremental cost analysis was performed to aid in final plan selection.

SIGNIFICANT RESOURCES

9. The following are significant resources recognized by institutional (existing laws, plans and policy), public interest or the scientific community (scientific knowledge) that will be components of the proposed ecosystem restoration project.

- Southern Bottomland Hardwood Cypress/Tupelo forest community reminiscent of what is found in the Louisiana bayou country.

- Significant resource base for migratory waterfowl and major wintering area

- Important recreational fisheries in Southern Illinois

- Horseshoe Lake is an old oxbow formed by the Mississippi River about 6000 years ago (Bogner et.al. 1985)

- Available habitat for threatened and endangered species and observed foraging/nesting/overwintering for Bald eagle

- Shorebird, wading bird and Neotropical migrant foraging and nesting habitat.

- Cypress/tupelo reproduction/restoration area

10. The ecological value of riparian habitats depends on their integration as units within the surrounding landscape because of the different and distinct habitats needed by organisms with complex life histories that use wetland sites. Restoration of the project area will provide for greater ecosystem functions by increasing energy flow into the ecosystem through restoring native aquatic and terrestrial vegetation. The total amount of energy available to the entire food chain is fixed by plants and moves to other trophic levels by consumption and/or predation.

11. The Horseshoe Lake Conservation Area encompass an ecosystem on the floodplain of the Mississippi River. The area occupies a total of 10,645 acres, including the 2,007 acre Horseshoe Lake. Horseshoe is an oxbow lake, a remnant of river channel that was abandoned as the river migrated laterally through its floodplain. The primary sources of water and sediment to this lake are seasonal flooding by the river, and a continuous water supply from hillside tributary streams (Black and Pigeon Roost Creeks). Black Creek drains an area of 9.9 square miles, and Pigeon Roost Creek drains 3.8 square miles. Both streams are subject to flash flooding during intense rainfall. Backwater flooding from the Mississippi River floods Horseshoe Lake on an average of two out of every three years. Oxbow-lake hydrologic characteristics such as source and amount of recharge, flooding frequency, and storage capacity influence the flora and fauna of the area and the type of habitat available for biological communities inhabiting the wetland.

PROJECT SCOPING

12. The sponsor (Illinois Department of Natural Resources) has sponsored numerous studies/reports regarding the deteriorating condition of Horseshoe Lake. Considerable coordination was done with the scientific community, as well as the local interests. Initial analysis of the available scientific data indicated that sedimentation was a problem in the lake and an initial recommended plan was selected that focused on reducing sediment coming into the lake. Upon further sedimentation analysis and additional surveys, it became apparent that a proposed sediment trap would not provide a cost effective solution, and in fact, that most of the lake actually had sufficient depth to support a fisheries habitat. Armed with this knowledge, the study changed focus and the project was re-scoped with three main focuses: 1) improved fisheries habitat, 2) cypress/tupelo restoration/regeneration, and 3) improved waterfowl habitat.

PROBLEMS AND OPPORTUNITIES

Problems

13. This area has contained an abundance of aquatic resources for more than a 1000 years. These resources have been severely impacted as the result the introduction of a large population of exotic invasive and rough fish (bighead carp, silver carp, black carp, grass carp, common carp, buffalo, and gar) during the floods of 1993 and 1995. Effects of these fish introduced through flood events have hindered aquatic plant growth and degraded fisheries habitat. The foraging activity of bottom feeding fish creates turbidity, which prevents sunlight from reaching far enough into the water column to support plant growth. In addition, the turbidity makes it difficult for the targeted species (bass and crappie) to see their prey and to spawn. The turbidity also increases the potential for higher water temperature. Warmer water retains less oxygen and thereby provides a reduced dissolved oxygen level for the target species.

14. Since the flood of 1993 there has been a noticeable decline of habitat for invertebrates, hydrophytic vegetation, amphibians, reptiles, birds, fish, and mammals of which some species are listed as state or federally threatened and endangered. The restoration of a quality wetland ecosystem at this project requires water level management and reduction of exotic invasive and rough fish.

15. Present conditions in and around the proposed project areas only provides limited habitat value for most species associated with marsh habitat. Forested wetlands that once existed in the project areas have been severely impacted by long periods of inundation due to the lack of adequate water control.

16. There is a need to create conditions favorable for typical wetland plant communities to naturally re-establish by providing independent water control in the Miller City and Black Creek Delta management area. Numerous types of shorebirds, wading birds, waterfowl, and water birds belonging to general families such as ducks, mergansers, cormorants, terns, herons, bitterns, rails, coots, avocets, plovers, sandpipers and phalaropes will be attracted to the mudflats, shallows, and marshy fringes of the proposed wetlands which are limited and unmanageable at the present time. Other types of birds associated with wetland areas are kingfishers, swallows, wrens, thrushes, and wood warblers, which would also find food and refuge in these same wetland habitats. In addition, a variety of frogs, toads, salamanders, turtles, snakes and mammals such as muskrat, beaver, and mink would utilize the moist soil/mudflat wetland areas.

17. Many of the mature trees were damaged or killed due to the 1993 and 1995 flooding events. Regeneration of cypress-tupelo has not occurred for over 50 years (as a result of spillway construction that provided higher stable water levels) and is a concern with all stakeholders. Lake elevations due to the previously raised spillway inhibit cypress and tupelo regeneration. The stable water levels in the cypress/tupelo forest area submerge the tree roots and the roots subsequently die from lack of oxygen.

18. Adequate resources are needed to provide for a large overwintering duck and Canada goose population. Although not part of this Section 206 project, row crops will be planted and managed during the winter months on the existing island portion of Horseshoe Lake to provide a high-energy food source for waterfowl as well as other wildlife species.

Opportunities

19. The proposed project features are integral components of a water control system that will provide the opportunity to restore and improve conditions for hydrophytic plants, allow moist soil management and cypress/tupelo restoration, will facilitate the restoration/establishment of submergent aquatic plants, exotic invasive and rough fish control, and increased substrate shear strength.

20. The proposed project features will provide opportunities at Horseshoe Lake to

- create better water management that will enhance the availability and quality of habitat
    - seasonal wetlands
    - wetland areas
    - shore-bird habitat
    - reptile/amphibian habitat
    - fish habitat
- increase habitat diversity
- cypress/tupelo restoration
- increase recreational opportunities.

PROJECT GOALS

GENERAL HABITAT GOALS

21. The general goal for Horseshoe Lake is to improve fisheries, terrestrial, waterfowl, and the cypress swamp resources. The water level management capability and the reduction/elimination of the exotic invasive and rough fish population would allow this lake to more fully provide suitable habitat and cypress/tupelo regeneration conditions.

SPECIFIC HABITAT GOALS

22. The creation of a mosaic of habitat types would allow a diversity of organisms representing different trophic levels to coexist and provide a richer more continuous food source for mobile fauna. Specific habitat goals to accomplish this include

- moist soil production capability
- creation of conditions to allow cypress/tupelo regeneration
- reestablishment of subaquatic vegetation
- controllable water elevations
- habitat predictability for fish, birds, mammals, reptiles, invertebrates, amphibians
- reduction/elimination of exotic invasive and rough fish population

PLAN FORMULATION

EVALUATION CRITERIA

23. The sponsor and other local interests studied the problems at Horseshoe Lake for several years prior to requesting a Section 206 study. This study determined that currently Horseshoe Lake suffers from a decline in forest and fisheries. Two main factors have contributed to this decline: 1) construction of the dam in 1939 which resulted in higher stable water levels, and 2) the introduction of exotic invasive and rough fish species during the floods of 1993 and 1995. The stable water levels in the cypress/tupelo forest area submerge the tree roots and the roots subsequently die from lack of oxygen. The foraging activity of the bottom feeding fish creates turbidity, which prevents sunlight from reaching far enough into the water column to support plant growth. In addition, the turbidity makes it difficult for the targeted species (bass and crappie) to see their prey and to spawn. The turbidity also increases the potential for higher water temperature. Warmer water retains less oxygen and thereby provides a reduced dissolved oxygen level for the target species. Improved water level management is needed to improve the conditions at Horseshoe Lake. Measures and plans were developed to address the specific problems encountered at the lake and evaluated on how well the plans addressed those problems. Plans are also evaluated for the planning test criteria of completeness, effectiveness, efficiency, and acceptability (see Section EVALUATION OF ALTERNATIVES).

CONSTRAINTS AND ASSUMPTIONS

24. The following constraints and assumptions apply to the plan formulation effort.

- Ensure the lake is at least partially re-watered by 15 October for waterfowl migration (2.5 feet deep in main arms of lake and 1 foot deep in the Miller City/Black Creek Delta areas).
- Assume a 60-day re-watering time to achieve above condition.
- Assume 20% of the lake will need to be treated with the chemical Rotenone for complete removal of all exotic invasive and rough fish after a 30-60 day complete drawdown of the entire lake (treatment for pockets of water remaining that contain exotic invasive or rough fish).
- Desirable species of fish must be restocked in the fisheries portion of the lake.

ALTERNATIVES CONSIDERED

25. Five plans were considered in detail and are described in subsequent paragraphs. Plans (other than the no action plan) generally address the need for improved water management within the lake. While the lake has two existing causeways (sectioning the lake into two distinct areas), the alternatives considered in detail added one or more causeways to further compartmentalize the lake into areas that could be managed for specific habitat (fisheries, moist soil, and cypress/tupelo trees). In order to facilitate the water management within the compartments, unwatering (pumps) and/or watering (wells) features are also included. In all action alternatives the lake is drawn down primarily to address the exotic invasive and rough fish population; however, the drawdown will facilitate construction of the causeways and is also expected to provide some consolidation of the lakebed.

No-Action Plan

26. The no-action alternative would provide limited habitat value for most species associated with marsh, aquatic and hydrophytic vegetation habitat. From 1939 to 1993, the lake was primarily managed as a sport fishery and as an overwintering area for Canada geese. As stated previously, since the 1993 and 1995 floods four problems have been manifested: 1) exotic invasive and rough fish species are present, 2) turbidity has increased, 3) submergent aquatic vegetation is no longer present, and 4) there has been a severe decline in existing cypress/tupelo community. These problems will continue to exist without modification of existing project characteristics and functions.

Alternative 1

27. See Figure 3. The entire lake would be initially drawn down to facilitate construction and assist in the removal of the existing exotic invasive and rough fish population. It is anticipated that limited pools of water would remain that contain trapped fish. These areas would be chemically treated to eliminate the remaining fish. The lake would be drawn down initially by opening the spillway gates. Obstructions in a portion of Lake Creek (which water exiting through the spillway drains into) will be cleared to facilitate the drawdown. Since the lake depth in the area of the spillway is generally shallower than the area further north, a shallow channel would be constructed on the east side of the lake above the spillway to facilitate drawdown of the remainder of the lake. An island (.4-acre with cypress plantings) will be created near the channel using the excavated material.

28. Two causeways will be constructed across the main arms of the lake above the nature preserve area. This would compartmentalize the lake into 4 areas – 1) Miller City Arm, 2) Black Creek Delta, 3) the area east of the existing island causeway and down the east arm of the lake to the second new causeway, and 4) the area between the new causeways and the spillway. In order to maintain lake connectivity, boat passages (and footbridges) would be part of the new causeways. The existing culvert through the Miller City Arm causeway would be replaced to facilitate water level management.

29. Wells would be installed in order to re-water the lake for waterfowl in case there was not sufficient rainfall to refill the lake. Once the lake is refilled it would be restocked with desirable fish species, including predatory fish to address future accidental reintroduction of exotic invasive and rough fish into the lake. In this alternative, any unwatering of compartments could only be accomplished by gravity flow.

30. This alternative does not provide additional plant (cypress/tupelo) or wildlife benefits over the no-action alternative.

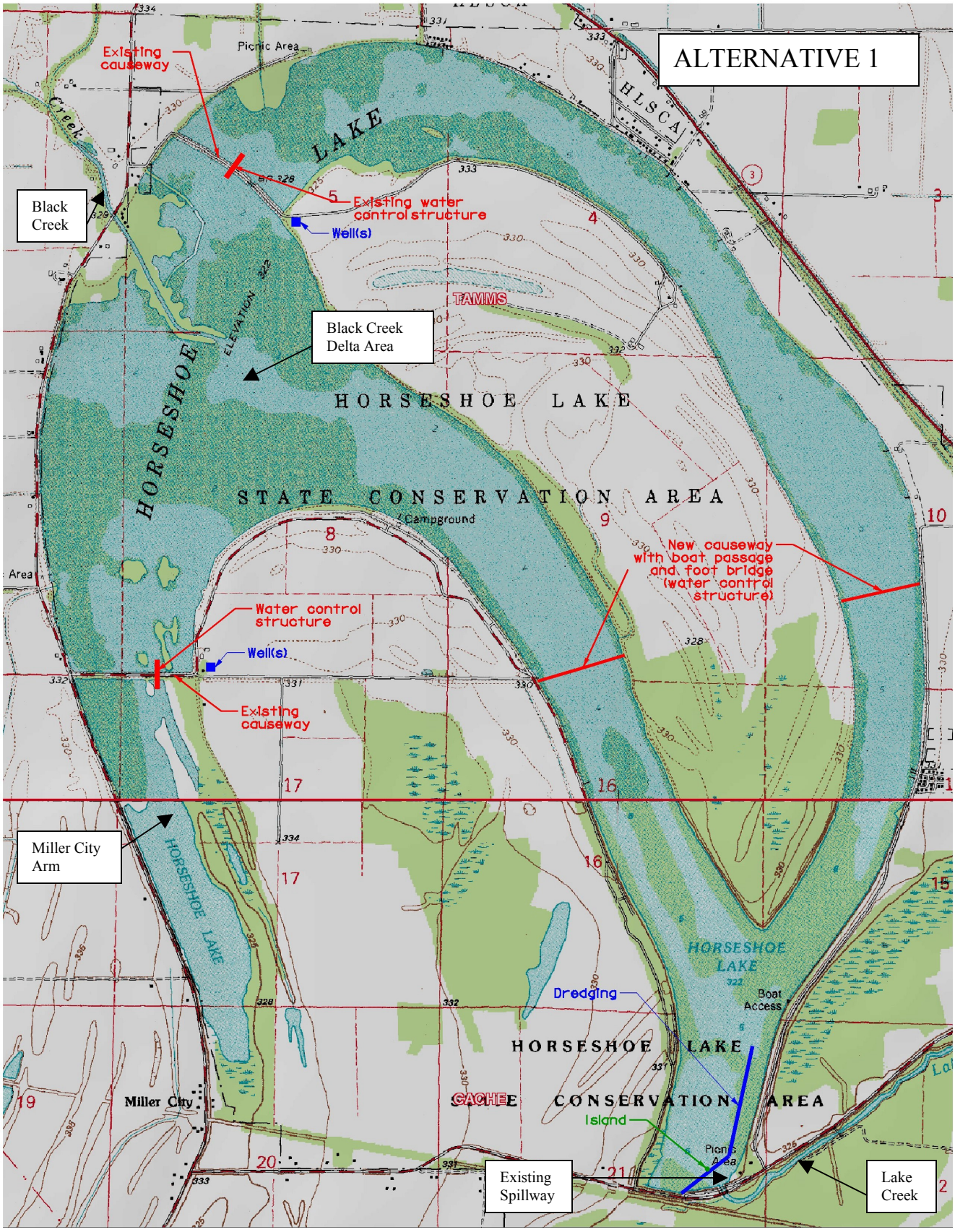


Figure 3. Alternative 1 Plan Features

Alternative 2

31. See Figure 4. The entire lake would be initially drawn down to facilitate construction and assist in the removal of the existing exotic invasive and rough fish population. It is anticipated that limited pools of water would remain that contain trapped fish. These areas would be chemically treated to eliminate the remaining fish. The lake would be drawn down initially by opening the spillway gates. Obstructions in a portion of Lake Creek (which water exiting through the spillway drains into) will be cleared to facilitate the drawdown. Since the lake depth in the area of the spillway is generally shallower than the area further north, a shallow channel would be constructed on the east side of the lake above the spillway to facilitate drawdown of the remainder of the lake. An island (.4-acre with cypress plantings) will be created near the channel using the excavated material.

32. One causeway would be constructed in the middle arm of the lake toward the north end of the existing island. This new causeway would have a gated culvert and a boat pullover. A footpath would run along the causeway. A permanent unwatering pump would be installed at the new causeway to allow the Black Creek Delta/Miller City Arm compartments to be dewatered. The Miller City Arm culvert will be replaced with a water control structure to provide for independent management of this unit, resulting in dividing the lake into three management compartments. The largest compartment (east of the existing island causeway including the east arm of the lake south to the spillway, and north along the middle arm to the new causeway) would be managed for fisheries (this area contains the deepest part of the lake). The second compartment would be the Miller City Arm and the third compartment (Black Creek Delta) would be the northeast area of the lake between the three causeways. The second and third compartments would be managed for moist soil, waterfowl, and cypress/tupelo restoration/ regeneration using water level management techniques.

33. Deep wells will be installed to re-water the lake for waterfowl in case there is insufficient rainfall and to allow annual water level management of the moist soil management units for migrating and over wintering waterfowl habitat. Deep wells will also be used to supplement water volume in the fisheries area during dry periods or periods with a high evaporation rate (typically June-August). Once the lake is refilled it would be restocked with desirable fish species, including predatory fish to address future accidental reintroduction of exotic invasive and rough fish into the lake.

34. This alternative provides additional fish, wildlife, and plant (cypress/tupelo) benefits over the no-action plan.

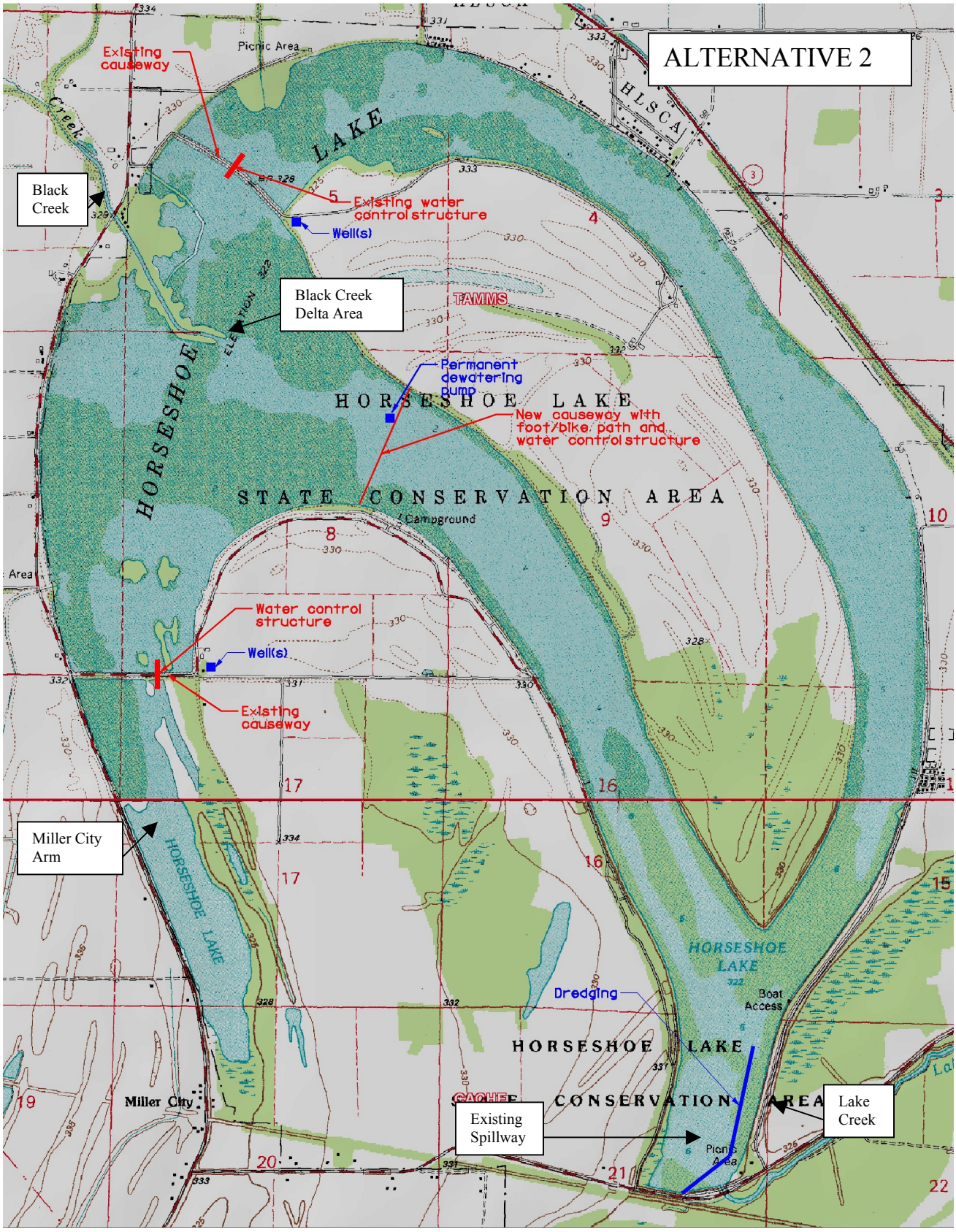


Figure 4. Alternative 2 Plan Features

Alternative 3

35. See Figure 5. The entire lake would be initially drawn down to facilitate construction and assist in the removal of the existing exotic invasive and rough fish population. It is anticipated that limited pools of water would remain that contain trapped fish. These areas would be chemically treated to eliminate the remaining fish. The lake would be drawn down initially by opening the spillway gates. Obstructions in a portion of Lake Creek (which water exiting through the spillway drains into) will be cleared to facilitate the drawdown. Since the lake depth in the area of the spillway is generally shallower than the area further north, a shallow channel would be constructed on the east side of the lake above the spillway to facilitate drawdown of the remainder of the lake. An island (.4-acre with cypress plantings) will be created near the channel using the excavated material.

36. One causeway would be constructed in the middle arm of the lake toward the north end of the existing island as in Alternative 2. This new causeway would have a gated pipe, a boat pullover and footpath to provide access for hikers and bikers across this new causeway. The Miller City Arm culvert will be replaced with a water control structure to provide for independent management of this unit. A permanent unwatering pump would be installed at the new middle arm causeway to allow the Black Creek Delta/Miller City Arm compartments to be dewatered. The Miller City Arm compartment and the Black Creek Delta compartment (formed by the new middle arm causeway and the two existing causeways) will be managed for moist soil, waterfowl, and cypress/tupelo restoration/regeneration using water level management techniques.

37. An additional causeway and portable unwatering pump will be located on the East arm (same location as in Alternate 1) with a boat passage as well as a footbridge. A complete drawdown in this compartment could not be achieved throughout the growing season unless a third causeway from the Pigeon Roost Creek delta to the existing island causeway at the north end of the existing island were to be constructed. This third causeway would be constructed to redirect the flow from Pigeon Roost Creek away from the East arm to facilitate independent water depth management and substrate consolidation. The portable unwatering pump would allow separate fisheries management between the Pigeon Roost Arm and the spillway area of the lake.

38. Deep wells will be installed to re-water the lake for waterfowl in case there is insufficient rainfall and to allow annual water level management of the moist soil management units for migrating and over wintering waterfowl. Deep wells will also be used to supplement water volume in the fisheries area during dry periods or periods with a high evaporation rate (typically June-August). Once the lake is refilled it would be restocked with desirable fish species, including predatory fish to address future accidental reintroduction of exotic invasive and rough fish into the lake.

39. This alternative provides additional fish, wildlife, and plant (cypress/tupelo) benefits over the no-action alternative.

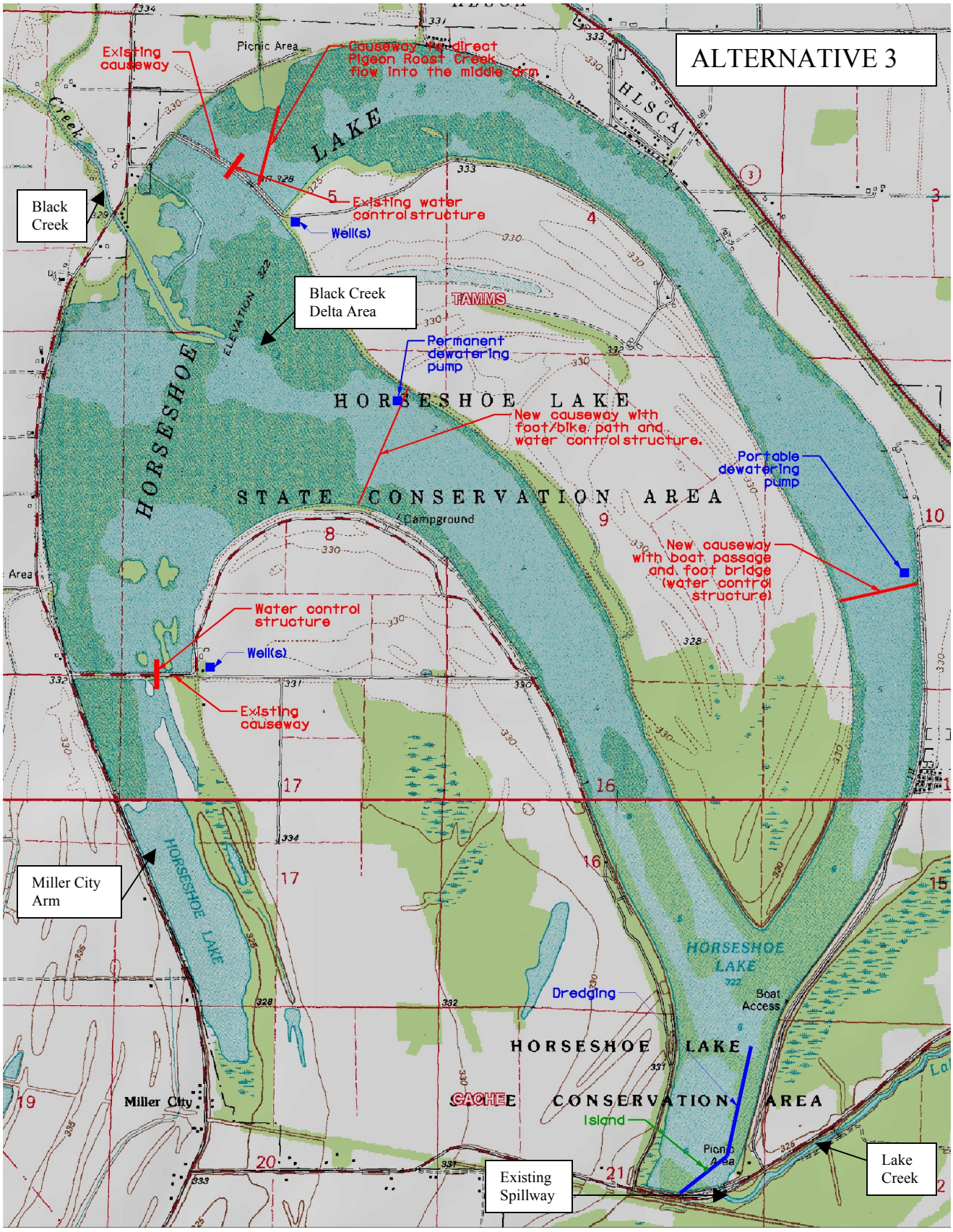


Figure 5. Alternative 3 Plan Features

Alternative 4

40. See Figure 6. This alternative is included to evaluate a less structural solution at Horseshoe Lake. The entire lake would be initially drawn down to facilitate construction and assist in the removal of the existing exotic invasive and rough fish population. It is anticipated that limited pools of water would remain that contain trapped fish. These areas would be chemically treated to eliminate the remaining fish. The lake would be drawn down initially by opening the spillway gates. Obstructions in a portion of Lake Creek (which water exiting through the spillway drains into) will be cleared to facilitate the drawdown. Since the lake depth in the area of the spillway is generally shallower than the area further north, a shallow channel would be constructed on the east side of the lake above the spillway to facilitate drawdown of the remainder of the lake. An island (.4-acre with cypress plantings) will be created near the channel using the excavated material.

41. Deep wells will be installed to re-water the lake for overwintering waterfowl in case there is insufficient rainfall and to supplement the water level in the fisheries area during dry periods or periods with a high evaporation rate (typically June-August). Once the lake is refilled it would be restocked with desirable fish species, including predatory fish to address future accidental reintroduction of exotic invasive and rough fish into the lake. Moist soil management is not a consideration under this alternative.

42. This alternative provides additional fish benefits, but no additional wildlife or plant (cypress/tupelo) benefits over the no-action alternative.

Plans Considered but Later Dropped

Miller City Arm Ditch

43. In order to look for non-structural option for water level management, a ditch from the southern end of the Miller City Arm to Lake Creek was considered. As the southern end of the Miller City Arm is at high ground, this plan was dropped due to the topography.

Island Creation and Tree Plantings

44. Prior to obtaining updated survey information in the lake, it was felt that additional deepwater habitat was needed. Excavation of lake potholes for fisheries habitat and adjacent island building with the excavated material was also considered. Islands would provide areas for cypress/tupelo growth. This measure was expensive for the relatively small area impacted, and once survey data showed sufficient fisheries depth in the middle and east arms of the lake, this measure was dropped.

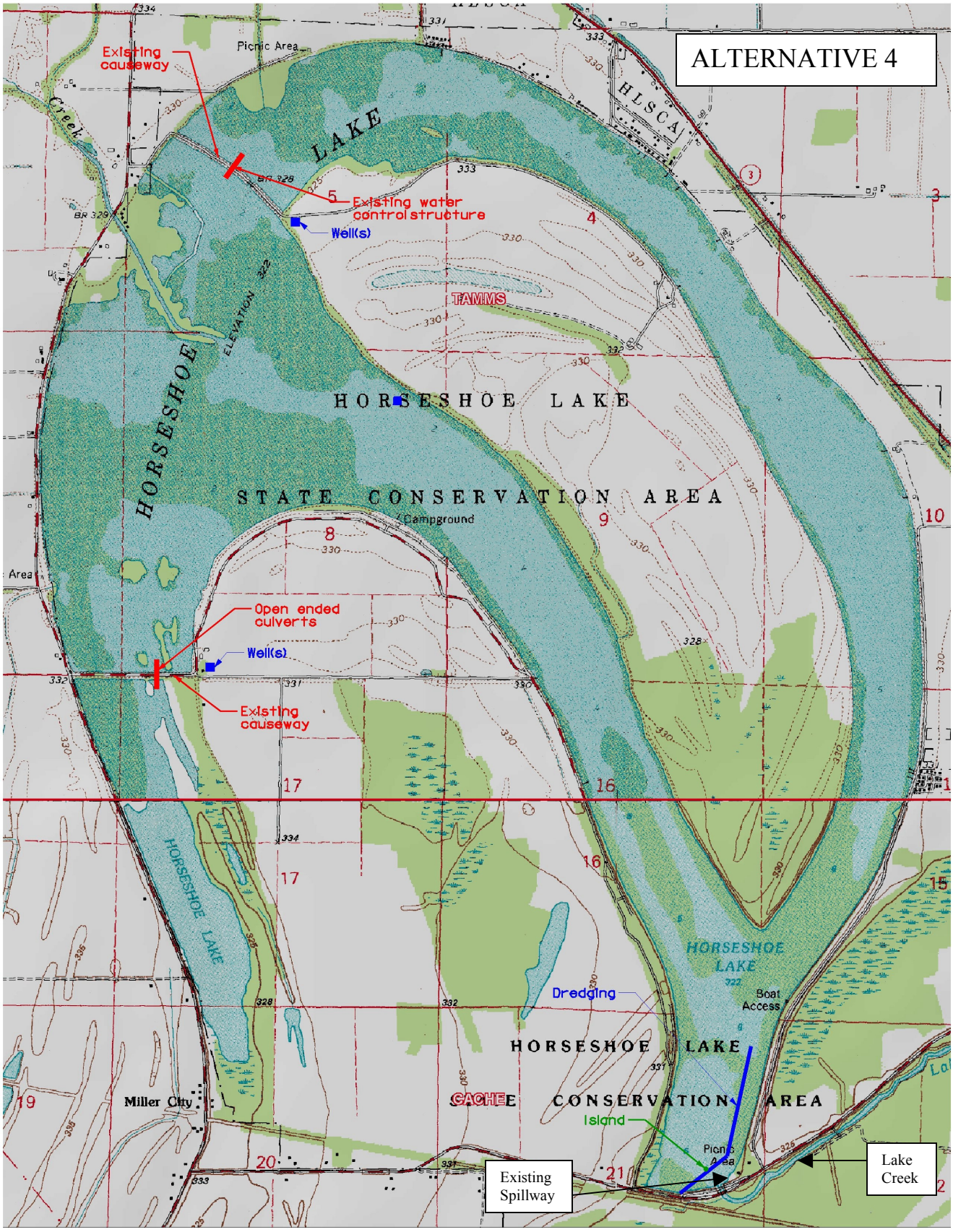


Figure 6. Alternative 4 Plan Features

EVALUATION OF ALTERNATIVES

ENGINEERING ANALYSES

45. Engineering analyses investigated various causeway locations and water management scenarios, and their associated pumping and watering requirements. A more thorough discussion of the engineering analyses is included in Appendices A through D.

Lake Drawdown

46. During the drawdown, geotechnical analysis suggests that four inches of consolidation of the lake bottom can be expected.

Wells

47. Horseshoe Lake has been an important site in southern Illinois for migrating waterfowl. In order to eliminate the risk of rainfall not being sufficient to rewater the lake for the fall waterfowl season, wells are planned to ensure autumn habitat for the waterfowl. Although it is likely that sufficient rainfall may occur, the area's significance for the migrating waterfowl makes it unacceptable to not ensure the lake can be rewatered in the fall. Wells could also be used to replenish evaporation losses in the lake during the summer months to enhance the fisheries habitat. Hydraulic analyses were conducted to evaluate requirements to rewater the lake for waterfowl season following a drawdown should adequate rainfall not occur, unwatering and rewatering requirements of the Miller City/Black Creek Delta area for moist soil management, and supplemental watering for the fisheries area during the summer high evaporation period. The initial drawdown (for fish control, construction, and lake bed consolidation) would commence following waterfowl season. Refilling by wells (if needed) would begin in September. The potentially annual unwatering of the Miller City/Black Creek Delta area would begin in June. Rewatering of this area would be started in September. Well capacity of 17,000 gpm and unwatering pump capacity of 14,000 gpm was determined for these needs.

Excavation

48. The area of the lake near the spillway is shallower than the adjacent area to the north. After an initial drawdown to dewater the spillway area, excavation will be performed near the existing lake spillway to allow drainage of the remainder of the lake. Surveys indicate that excavation will be required beginning at the existing spillway and extend approximately 3000-feet upstream. The required depth is approximately 2-feet and the resulting ditch will be approximately 12-feet wide. Dredged materials will be used to construct a small (.4-acre) island in the area adjacent to the excavation. Trees will be planted on this island.

Lake Creek Cleanout

49. Water exits the southern end of Horseshoe Lake through the spillway into Lake Creek. There are a number of beaver dams in Lake Creek that will be cleaned out to facilitate drainage of the Horseshoe Lake drawdown.

Causeway

50. Causeway design includes a 10-foot crown and 1V on 4H side slopes protected on both sides by stone. Causeway construction would occur during the period while the lake is drained. Soil to construct the causeway will come from the lake bed adjacent to the causeway alignment. Sediment and organic material in the lake bed must be removed to reach the underlying clay foundation material. The causeway will have a crushed stone surface to allow all weather access. A water control structure will be constructed in the causeway to allow for gravity flow between the two management units.

Unwatering Pump

51. An unwatering pump on the new causeway will allow for water control between the management units. The causeway crown in vicinity of the unwatering pump will be wider and higher to allow for ease in setting the pump drive unit and to allow for soil over the discharge pipe. Based on hydraulic analysis, a 14,000 gpm pump would be required to dewater the Miller City/Black Creek Delta area (30-day timeframe in June-July).

Culvert modifications in the Miller City Arm causeway

52. The surveys indicate the invert elevation of the existing culverts will not allow complete draining of the upper end of the Miller City Arm. The culverts will have to be excavated and reinstalled to the proper invert, the concrete sill will have to be modified, and gates will be added to facilitate water level control.

ENVIRONMENTAL OUTPUTS

53. Habitat conditions are not usually static. Either through natural processes or human activity, habitat generally evolves and may change in quality and/or quantity. Imbedded in each cover type evaluation, change has been added to the model. To assess the change over the period of analysis, target years have been identified. At each target year, a change in the habitat variables may be noticed. Noticeable changes can be characterized by a change in habitat benefit output.

54. Target years of 0 (baseline conditions), 1, 10, 25 and 50 (future “without-project” and future “with-project” conditions) are sufficient to analyze habitat units (HUs) and characterize habitat changes over the estimated project life. Table 1 shows the estimated average annual habitat units for the five plans considered in detail. Detailed discussion and analysis are provided in the Environmental Assessment.

Table 1. Estimated Average Annual Habitat Units Alternatives Considered in Detail

Alternative	Acres	PHAG INDEX	PHAG Habitat Units	Acres	WHAG Index	WHAG Habitat Units	Acres	AHAG Index	AHAG Habitat Units	Total Habitat Units
No Action	919	.1	91.9	0		0	1944	.1	194.4	286.3
Alternative 1	919	.1	91.9	0		0	1159	.65	753.3	923.3
							781	.1	78.1	
Alternative 2	532	.1	53.2	394	.80	315.2	1160	.65	753.9	1754.9
	387	.775	299.9	387	.86	332.7				
Alternative 3	532	.1	53.2	394	.80	315.2	1159	.65	753.3	1754.4
	387	.775	299.9	387	.86	332.7				
Alternative 4	919	.1	91.9	0		0	1163	.65	755.9	925.9
							781	.1	78.1	

NOTES:
1. PHAG, WHAG, and AHAG stand for Plant Habitat Appraisal Guide, Wildlife Habitat Appraisal Guide, and Aquatic Habitat Appraisal Guide.
2. The PHAG, WHAG, and AHAG indices are determined based on an area's habitat suitability for the targeted species.
3. Plant, Wildlife, or Aquatic Habitat Units are determined by multiplying the number of acres under consideration times the corresponding index number.
4. Total Habitat Units are the sum of the plant, wildlife, and aquatic habitat units for a particular alternative.
5. Zero acres indicates no area is providing significant benefits for the targeted species in the particular alternative.

PROJECT COSTS

55. Preliminary cost estimates were developed for each alternative (including Operation, Maintenance, and Replacement (OM&R) costs) to facilitate the incremental cost analysis and are provided in Table 2. A more detailed cost breakdown can be found in Appendix F. Preliminary first costs for the evaluated plans ranged from $1,203,300 to $4,098,000. (*Note: A more refined cost estimate was later developed for the recommended plan incorporating the sponsor's wishes to include recreation features.*) Average annual costs were based on an expected project life of 50 years, a Federal discount rate of 5.875 percent, and August 2003 price levels. Average annual costs include first costs, operation and maintenance costs for pumping costs, and planned maintenance and rehabilitation costs (at year 25) for the pumps.

Table 2. Preliminary Project Costs

Plans Considered in Detail	PROJECT COSTS ($1000s)											
	Mobilization and Demobilization	Causeway Work	Drainage Way / Island	Lake Creek Clearing	Water Wells	Unwatering Pump	Fish Management	Islands/Trees	Construction Cost (w/ 25% contingency)	Planning, Engineering, & Design	Construction Management (10%)	Total
No Action												0
Alternative 1	135	1,339.4	16.2	8.4	1,020	0	308.5	0	3,530	820	353	4,703
Alternative 2	114	800.9	16.2	8.4	1,020	120	308.5	0	2,980	820	298	4,098
Alternative 3	170	1,865.6	16.2	8.4	1,020	180	308.5	0	4,460	820	446	5,726
Alternative 4	19	50	16.2	8.4	0	0	308.5	0	503	650	500	1,203.3

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Annual O, M &R	22.3	35.5	35.5	22.3
Replacement Costs	310	440	490	310
Annualized Costs (including first costs)	320.2	297.6	399.8	102.0

Planning Evaluation Criteria

56. Table 3 rates the alternative plans against the planning criteria of completeness, effectiveness, efficiency, and acceptability. These criteria are defined as

> Completeness – the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives.
>
> Effectiveness – the extent to which the alternative plans contribute to achieve the planning objectives.
>
> Efficiency – the extent to which an alternative plan is the most cost effective means of achieving the objectives.
>
> Acceptability – the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies.

57. All plans (other than the no-action plan) were rated high for completeness. Differences in effectiveness were based on quantity/type of habitat provided. Plans that provided benefits for fish, wildlife, and plants rated higher than those that only provided for some of the categories. Results of the incremental cost analysis were used to rate the efficiency of a plan. Based on the above criteria, all (action) plans were considered to achieve a high level of acceptability.

Table 3. Planning Criteria Evaluation for Alternative Plans

MANAGEMENT AREAS	PLANNING EVALUATION CRITERIA				
	COMPLETENESS	EFFECTIVENESS	EFFICIENCY	ACCEPTABILITY	OVERALL
No Action	L	L	L	L	L
Alternative 1	H	L	L	H	M
Alternative 2	H	H	M	H	H
Alternative 3	H	H	L	H	M
Alternative 4	H	L	H	H	M

L – Low Ranking M – Medium Ranking H – High Ranking

INCREMENTAL COST ANALYSIS FOR HORSESHOE LAKE

58. Important assumptions used in the ICA (Incremental Cost Analysis) of potential alternatives for Horseshoe Lake are (1) all appropriate benefits and costs are expressed in August 2003 price levels unless otherwise noted; (2) the project discount rate for the evaluation of benefits and costs is 5.875 percent; (3) the project period of evaluation (life) is established at 50 years; (4) resources have alternative uses and consequently, opportunity costs; (5) Individuals are risk neutral and rational economic agents.

59. Table 4 presents the First Cost and Average Annual Cost associated with each of the Horseshoe Lake project alternatives. Average Annual Cost is computed using a project discount rate of 5.875 percent and a 50-year project life, and includes all relevant Operation, Maintenance and Replacement costs (O&M&R).

Table 4. First Cost and Average Annual Cost

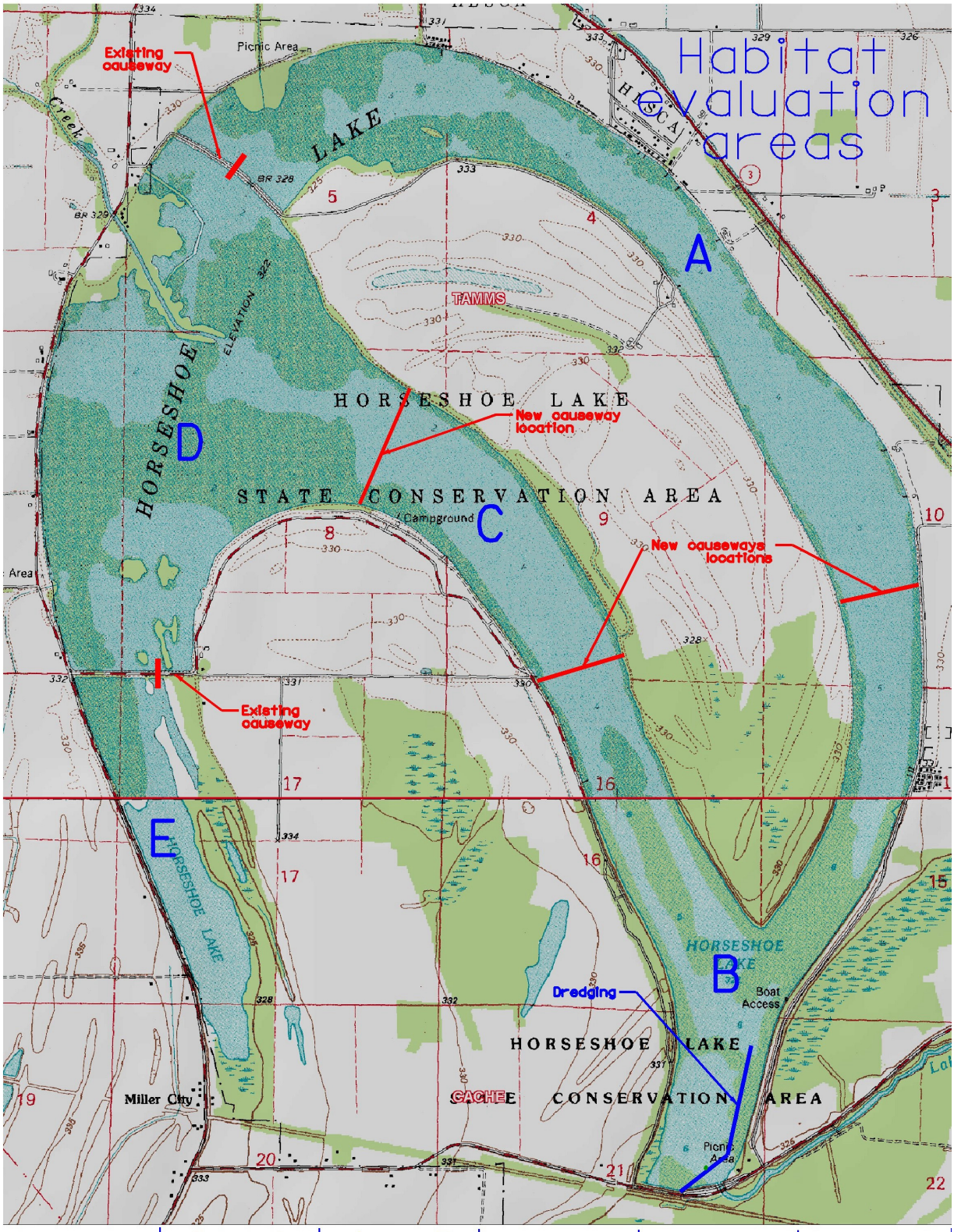
Alternatives	First Cost	Replacement Cost	Average Annual O, M & R Cost	Average Annual Cost
1	$4,703,000	$310,000	$22,345	$320,168
2	$4,098,000	$440,000	$35,505	$297,557
3	$5,726,000	$490,000	$35,505	$399,794
4	$1,203,300	$310,000	$22,345	$101,996

60. Table 5 presents the estimated Average Annual Habitat Units generated by the Alternatives for selected target species. The estimated average annual habitat units displayed in Table B are computed under both the future With and Without Project conditions. The total Habitat Appraisal Guide (HAG) habitat units are employed in conducting the incremental cost analysis.

Table 5. Estimated Average Annual Habitat Units

Area[1]	**Description**	**Existing**[2] HUs[3] *Index*	**Alt. 1**[2] HUs *Index*	**Alt. 2**[2] HUs *Index*	**Alt. 3**[2] HUs *Index*	**Alt. 4**[2] HUs *index*	**Species**	**Acres**
A	Lake/cypress area	50.3 *.10*	325.6 *.65*	326.9 *.65*	325.6 *.65*	326.9 *.65*	fish	503 (present, Alt. 2 & 4) 501 (Alt. 1 & Alt. 3)
B/C	Lake/cypress area	66.0 *.10*	427.7 *.65*	427.0 *.65*	427.7 *.65*	429.0 *.65*	fish	660 (present & Alt. 4) 658 (Alt. 1 & Alt. 3) 657 (Alt. 2)
D	Lake/cypress area	64.2 *.10*	64.2 *.10*			64.2 *.10*	fish	642
	Non forested wetland			231.2 *.80*	231.2 *.80*		wildlife	289
	Forested wetland			303.5 *.86*	303.5 *.86*		wildlife	353
E	Lake/cypress area	13.9 *.10*	13.9 *.10*			13.9 *.10*	fish	139
	Non-forested wetland			84.0 *.80*	84.0 *.80*		wildlife	105
	Forested wetland			29.2 .86	29.2 .86		wildlife	34
Total Fish and Wildlife Habitat Units		*194.4*	*831.4*	*1401.8*	*1401.3*	*834.0*		
A & B/C	Cypress	53.2 *.10*	53.2 *.10*	53.2 *.10*	53.2 *.10*	53.2 *.10*	plant	532
D&E	Cypress	38.7 *.10*	38.7 *.10*	299.9 *.775*	299.9 *.775*	38.7 *.10*	plant	387
Total Cypress Habitat Units		*91.9*	*91.9*	*353.1*	*353.1*	*91.9*		
Total Habitat Units (Fish and Wildlife plus Cypress)		**286.3**	**923.3**	**1754.9**	**1754.4**	**925.9**		**1,944**[4] **acres in project area**

[1] See Figure 7 for map designating areas.
[2] See pages 8 through 15 for a complete description of alternatives and measures.
[3] HUs = Habitat Units = (Index) x (Acres)
[4] 1,944 acres = 503 (A) + 660 (B/C) + 642 (D) + 139 (E)



	Area A	Area B	Area C	Area D	Area E
Total area	503 ac	468 ac	192 ac	642 ac	139 ac
Open water	282 ac	230 ac	143 ac	289 ac	105 ac
Cypress	245 ac	238 ac	49 ac	353 ac	34 ac

Figure 7. Habitat Evaluation Areas

61. Table 6 presents the Future With and Without Project Average Annual Habitat Units (AAHUs) generated by the Alternatives as well as the net difference, or increase in AAHUs for each Alternative. For example, for Alternative 1, the net increase in AAHUs is computed as:

> 923.3 HUs generated under Alternative 1 MINUS 286.3 AAHUs generated under the Without Project condition EQUALS 637.0 AAHUs, which is the net difference, or increase in future With Project AAHUs generated under Alternative 1.

Table 6. Average Annual Habitat Units (Future With and Without Project)

Condition	**No-Action Alternative AAUHs**	**Alternative 1 AAHUs**	**Alternative 2 AAHUs**	**Alternative 3 AAHUs**	**Alternative 4 AAHUs**
Without Project	286.3				
With Project		923.3	1,754.9	1,754.4	925.9
Difference		637.0	1,468.6	1,468.1	639.6

62. Table 7 presents the Plan Evaluation and Incremental Cost Analysis for the Alternatives, in accordance with IWR Report #95-R-1, Evaluation of Environmental Investments Procedures Manual. Interim: Cost Effectiveness and Incremental Cost Analyses (May 1995). Average Annual Output (HUs), Average Annual Cost (comprising the HAG Total Cost Curve) and Average Annual Incremental Cost are generated by the Alternatives.

63. The first step, after all Alternatives (i.e., Plans) have been sorted from lowest to highest output (AAHUs), is to identify any Alternatives that are *inefficient in production*. I*nefficient in production* is defined as those Alternatives where the same output level can be provided at a lesser cost by another Alternative. For this incremental analysis, there are no Alternatives that are *inefficient in production*. Similarly, Alternative 3 is also ineffective. See Table 7.

64. The next step is to identify any Alternatives that are *ineffective in production*. I*neffective in production* is defined as those Alternatives where greater output can be produced at a lesser or equal cost by another Alternative. For example, Alternative 4 provides greater output than Alternative 1 (639.6 HUs compared to 637.0 HUs), yet Alternative 4 provides the output at a lesser cost ($101,996 compared to $320,168). Therefore, Alternative 1 is *ineffective in production*.

65. Any Alternatives either *inefficient* or *ineffective in production* are subsequently eliminated, and remaining Alternatives are again sorted from lowest to highest Output (habitat units). For each Alternative, an Average Cost per Output is computed as :

> Average Annual Cost / Average Annual Output.

66. Finally, for each Alternative, two incremental measures are computed (1) incremental output is computed as the additional increase in output from the previous ranked Alternative; (2) incremental cost is computed as the additional increase in cost from the previous ranked Alternative. The incremental difference is a measure of the difference in environmental outputs of the alternatives. Incremental Cost per Incremental Output is computed as:

incremental cost / incremental output.

For example, for Alternative 2, the incremental cost per incremental output is computed as

($297,557-$101,996) / (1,468.6-639.6) = $235.9.

67. Since the incremental cost per incremental output for Alternative 4 ($159.5 per HU) is less than the incremental cost per incremental output for Alternative 2 ($235.9 per HU), then Alternative 4 is the incrementally optimal solution, generating an additional 639.6 HUs at a first cost of $1,203,300 and an average annual cost of $101,996.

68. However, the incrementally preferred solution is Alternative 2, generating an additional 1,468.6 HUs at a first cost of $4,098,000 and an average annual cost of $297,557. Although the incrementally optimal solution is Alternative 4, that plan does not address improvements to the wildlife and plant habitat. Because of the significance of the cypress/tupelo swamp and the waterfowl habitat in this area, Alternative 2 is selected as a recommended plan.

Table 7. Plan Evaluation and Incremental Cost Analysis (Average Annual Dollars)

Alternatives	**Output (HUs)**	**Cost**			
1	*637.0*	*$320,168*	*Ineffective*		
4	639.6	$101,996			
3	*1,468.1*	*$399,794*	*Ineffective*		
2	1,468.6	$297,557			
Alternatives	**Output (HUs)**	**Cost**			
4	639.6	$101,996			
2	1,468.6	$297,557			
Alternatives	**Output (HUs)**	**Cost**	**Average Cost per Output (HUs)**		
4	639.6	$101,996	$159.5		
2	1,468.6	$297,557	$202.6		
Alternatives	**Output (HUs)**	**Incremental Output (HUs)**	**Cost**	**Incremental Cost**	**Incremental Cost per Incremental Output (HUs)**
4	639.6	639.6	$101,996	$101,996	$159.5
2	1,468.6	829.0	$297,557	$195,560	$235.9

RECOMMENDED PLAN

69. Although the incrementally optimal solution is Alternative 4, that plan does not address improvements to the wildlife and plant habitat. Because of the significance of the cypress/tupelo swamp and the waterfowl habitat in this area, Alternative 2 is selected as a recommended plan. The sponsor desires to include recreational features as part of this project. Specifically, one concrete boat ramp will be added, two existing gravel boat ramps will be replaced, and six existing concrete boat ramps will be modified (lengthened). A courtesy dock will be installed at each of the nine boat ramp locations. Costs for these features (estimated to be $311,400 including construction, planning, engineering, design, and construction management) is within the 10% of project cost limit. The recreation feature costs will be cost shared 50% Federal/50% non-federal. Features of the recommended plan, including the recreation features, are shown on Figure 8.

70. Estimated costs for the recommended plan features are shown in Table 8. Additional detail can be found in Appendix F. Table 9 shows the Federal/non-federal allocation for the recommended plan's first costs.

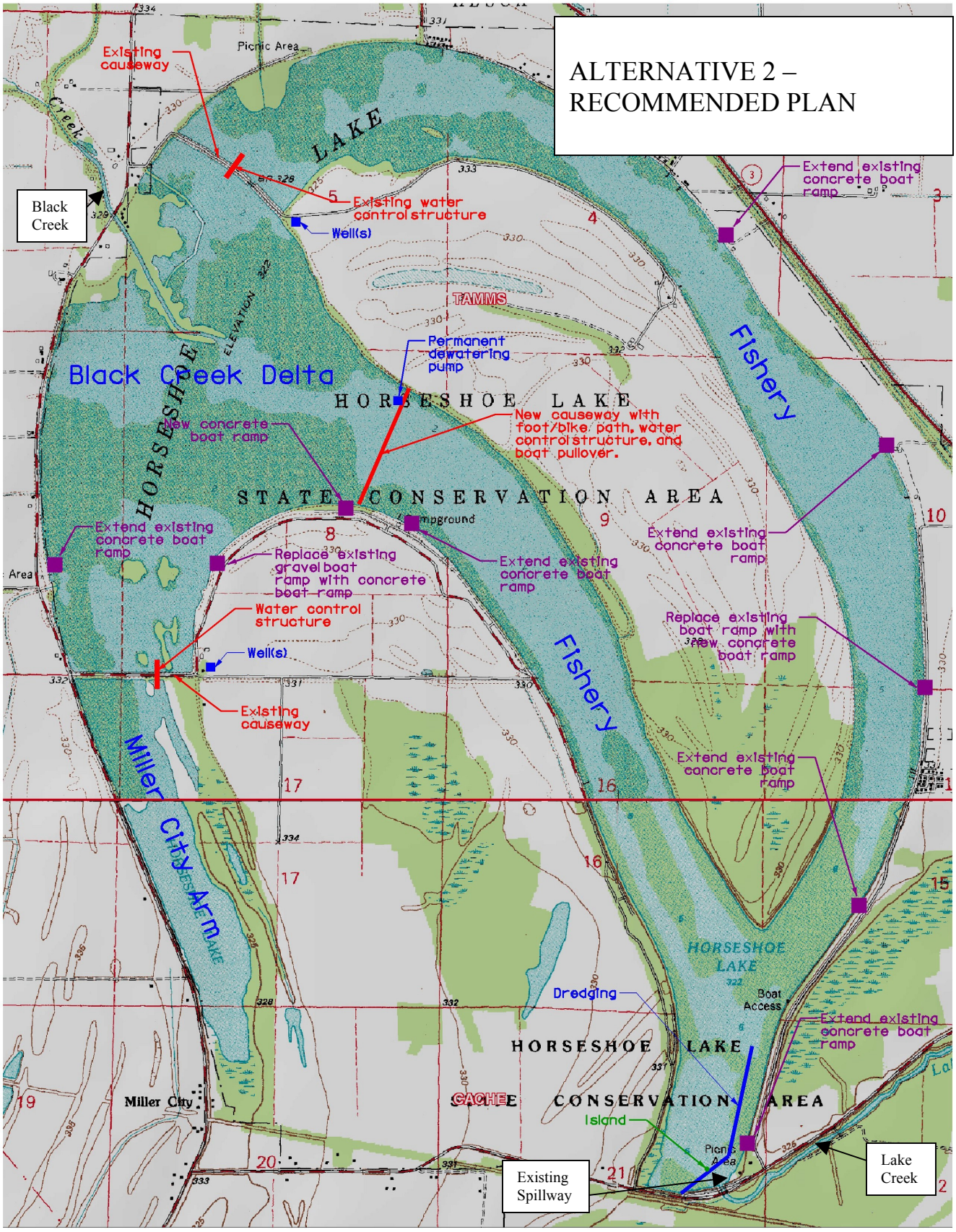


Figure 8. Alternative 2 Recommended Plan Features

Table 8. Recommended Plan Initial Costs

Alternative 2 - Recommended Plan Estimated Initial Costs ($)	
Mobilization and Demobilization	154,000
Causeway	922,000
Wells	1,292,000
Unwatering Pump	150,000
Fish Treatment	386,000
Lake Creek Cleanout	10,000
Drainage way cleanout/Island	42,000
Land Costs	0
Subtotal- Constructed Facilities (non-recreational)	*2,956,000*
Boat Ramps	105,000
Courtesy Docks	169,000
Subtotal- Constructed Facilities (recreational)	*274,000*
Construction Total	3,230,000
Planning, Engineering, and Design	820,000
Construction Management	323,000
Total Cost	$4,373,000

Table 9. Summary of Estimated First Costs and Allocation

Item	Allocation of Estimated First Costs		
	Federal Cost ($)	**Non-Federal Cost ($)**	**Total**
Constructed Facilities (non-recreational)	1,921,400	1,034,600	$2,956,000
Planning, Engineering and Design	526,500	283,500	$810,000
Construction Management	192,100	103,500	$295,600
Total (non-recreational)	***2,640,000***	***1,421,600***	***$4,061,600***
Work-in-Kind	-	73,200	$73,200
Non-Federal Cash Required	-	1,348,400	$1,348,400
Recreational Features	137,000	137,000	$274,000
Planning, Engineering and Design	5000	5000	$10,000
Construction Management	13,700	13,700	$27,400
Total (recreational)	***155,700***	***155,700***	***$311,400***
TOTAL PROJECT COST			*$4,373,000*
Total Federal Cost	*2,795,700*	-	*$2,795,700*
Total Non-Federal Cost		*1,577,300*	*$1,577,300*
Total Non-Federal Work-in-Kind	-	73,200	$73,200
Total Non-Federal Cash Required	-	1,504,100	$1,504,100

PROJECT IMPACTS

71. Modifications would improve the water management capability to 800 acres of wetland habitat and is integral to the long-term restoration of cypress/tupelo at Horseshoe Lake. The water control system and levees, coupled with vegetation management, will allow for the restoration of more natural hydric and vegetative conditions. Waterfowl will benefit from the effects of improved water control on feeding (seeds and tubers available during fall migration/overwintering, invertebrates available during spring migration), overwintering, and resting habitat thereby supporting the North American Waterfowl Management Plan. The area is expected to accommodate a future peak spring use of 20,000 ducks and 100,000 geese with timely seasonal flooding and associated row crop areas.

72. The improvements in the wooded wetlands, marsh/moist soil and fisheries compartment (aquatic vegetation and exotic invasive and rough fish species control) will contribute significantly to the plant, fish and animal species diversity within/on these areas. Shorebirds, wading birds, raptors, songbirds, reptiles, and amphibians will all benefit from the wetland improvement.

73. The project modification will provide a predictable water regime and food availability to meet the life requirement of wetland flora and fauna.

74. Detailed discussions on the baseline conditions, methodologies and analyses are in the Environmental Assessment.

FISH AND WILDLIFE HABITAT

75. The lake will be drained before construction activities begin thus circulation and drainage patterns will be completely altered during this timeframe. However the proper drainage patterns will return to normal following construction in areas A, B and C. Areas D and E will remain altered from the present situation and water levels will change in depth according to management activity and watershed runoff.

TOPOGRAPHY

76. The present topography is a gradual rise from the lower elevations of the lake to floodplain habitat with little diversity of elevational heights within the management unit. Water level management will be used to provide a diversity of topography within the present impoundment area (Miller City/ Black Creek Delta area) to create conditions favorable for emergent, submergent and woody plant growth. The project area will also be manipulated to provide sustainable habitat for fish, wildlife and hydrophytic plants.

CULTURAL RESOURCES

77. The prehistoric record of Horseshoe Lake consists primarily of survey data augmented by a few small test excavations. The survey data provides a record of human habitation ranging from

the mid-Holocene, prior to 3,000 BC, through the Mississippian Period. Several lithic artifacts were found in and near the test excavation sites. Archaeological surveys were preformed at all locations where construction activities will occur and avoidance of any site of significance will be implemented.

78. Due to wet conditions, the lake was not an object of early Euro-American settlement directed at farming. Logging and saw milling were important early, and only late in the 19th Century had land clearing and draining progressed enough for widespread farming to begin. Concern over preservation of the lake feature and its wildlife resources ultimately lead to state acquisition and designation as a conservation area.

79. Archaeological investigations on the land surrounding Horseshoe Lake reveal that the area was intensively occupied by various Native American groups for at least 3000 years. Planned dredging activities, related to causeway construction and silt removal from the existing lake, have the potential to reveal well preserved examples of prehistoric, Native American watercraft (wooded canoes). Previous, construction-related mechanical excavations at various construction sites in the Lower Mississippi River Valley have uncovered several examples of such watercraft, preserved in near excellent condition. Such preservation is possible because the wooden canoes were apparently rapidly buried under extremely fine river silty clays. Burial within such sediment results in an oxygen-free (anaerobic) condition which prevents decay of certain organic compounds - like wooden canoes.

80. A professional archaeologist will be required to be on site during sediment removal activities adjacent to the shoreline to inspect the woody debris encountered during the excavations. The equipment operators and the Corps inspectors should also be alerted to the possibility that the wooden objects uncovered, could in fact, be prehistoric tools, the remains of Native American watercraft, or associated tools like a canoe paddle, etc.

WETLANDS

81. The primary objective is to implement functional design that will allow land managers to vary water levels in the project area D and E to maximize the development of woody and herbaceous wetlands to support waterfowl, shorebirds, wading birds, raptors, songbirds, reptiles, and amphibians, and manage areas A, B and C as an year around fisheries.

THREATENED AND ENDANGERED SPECIES

82. ***Federal Species.*** The Horseshoe Lake Conservation Area is within the range of eight federally listed threatened and endangered species (See Appendix G for the USFWS Coordination Act Report). Those species include: Gray bat *(Myotis grisescens*), Indiana bat *(Myotis sodalis*), Least tern (*Sterna antillarum*), Orange-footed pearly mussel (*Plethobasis cooperianus)*, Pallid sturgeon *(Scaphirhynchus albus*), Pink mucket pearly mussel *(Lampsillis abrupta*), Bald eagle *(Haliaeetus leucocephalus*) and Decurrent false aster *(Boltonia decurrens*). There is no designated critical habitat in the project area at this time. Populations of or suitable habitat for gray bats, least terns, orange-footed pearly mussels, pallid sturgeon, pink mucket pearly mussels or decurrent false asters are not known to occur in the project area. Indiana bats

have been observed in the area and occur through out the State of Illinois. Bald eagles use the area for overwintering from October through March as well as for nesting and brood rearing activities from March through July.

83. ***State Species.*** Several state endangered or state threatened plant and animal species have been located in the Horseshoe Lake Conservation Area (Burr et al. 1996). The Miller City Arm study site contains seven plants, two birds, one amphibian, one mammal, and one crustacean species that are on the endangered or threatened list. The seven endangered plant species are located in wet-mesic floodplain forest and in an emergent marsh (*Iris fulva, Trepocarpus aethusae, Scirpus hallii, Melothria pendula, Clematis crispa*, *Leptochloa panicoides* and *Carex intumescens).* One mammal (Rice rat, *Oryzomys palustris*) and one crustacean (Oxbow crayfish, *Orconectes lancifer)* are only found in the Horseshoe Lake area.

84. The spillway study site contained the following species on the threatened or endangered species list: six plant species (*Leptochloa panicoides, Clematis crispa, Iris fulva, Styrax americana, Carex intumescens* and *Melothria pendula*), one amphibian (Illinois chorus frog, *Pseudacris streckeri illinoensis*), six birds (Great egret*, Casmerodius albus*, Yellow-crowned night heron, *Nyctanassa violacea*, Little blue heron, *Egretta caerulea*, Snowy egret*, Egretta thula*, Red-shouldered hawk*, Buteo jamaicensis*, and Mississippi kite, *Ictinia mississippiensis*), one mammal (rice rat), and one crustacean (oxbow crayfish).

85. Four threatened or endangered fish species (Cypress minnow, *Hybognathus hayi*, Bigeye shiner, *Notropis boops*, Bantam sunfish, *Lepomis symmetricus*, and Redspotted sunfish, *Lepomis miniatus*) have suitable habitat available and have been collected in the Horseshoe Lake area but none were captured in the 1996 sampling (Burr et al. 1996).

86. The Indiana bat utilizes trees with rough or exfoliating bark to roost and to form maternity colonies. Should the felling of trees greater than 9 inches diameter at breast height be necessary this activity will be conducted between October 1 and March 31 to minimize any impact to the species**.** Eagles use perch trees at night for roosting and during the day for foraging. There is a potential that construction activities could disturb eagles using night roosts or for sporadically feeding or perching in trees however this is expected to be short term.

87. Bald eagles build their nests in large trees near water and begin egg laying in mid March. Incubation of the eggs takes approximately 35 days and eaglet growth requires eight weeks before the first flight. The nesting cycle from the time the parents build the nest and the young are on their own, takes about 20 weeks. During the nest building, egg laying and incubation period (March-April) disturbance can have an impact on the reproductive effort. Once the eggs hatch the adult birds are highly protective and very unlikely to abandon the young. All construction activity shall be located 500 yards or more from any active nest during the March through June period to minimize disturbance.

AQUATIC RESOURCES

88. The aquatic resource within the area is open water, emergent and submergent wetlands. The hydrologic regime of permanently flooded, semi permanently flooded, seasonally flooded and

temporarily flooded areas provide habitat for fish, invertebrates, hydrophytic vegetation, amphibians, reptiles, birds and mammals. The present assumption is that pumps capable of watering and unwatering the management unit will provide water conditions that are predictable and controlled most years thus increasing the usable habitat for fish, wildlife and hydrophytic plants.

FISH AND WILDLIFE HABITAT

89. Fish and wildlife habitat will be impacted during construction due to the complete drawdown of the lake to remove exotic invasive and rough fish and to consolidate the lake bottom sediment. Aquatic habitat values will be enhanced after project completion due to removal of bottom feeding fish species and the increase in substrate shear strength. The entire area will be reflooded for the fall and winter migratory bird use.

TERRESTRIAL RESOURCES

90. A bottomland hardwood forest vegetative type is dominant along the lake shoreline with an inclusion of maple-cottonwood-willow-cypress/tupelo vegetative type along the immediate edge of the permanent pool elevation. An ash-willow-buttonbush type occurs within depressions of the moist soil/row crop dominated areas in nearby floodplain areas. Mammals, reptiles, neo-tropical migrants, waterfowl and endemic bird species have been observed using this area for life requirements. Regeneration of cypress/tupelo has not occurred within the lake portion since completion of the Lake dam in the 1939.

91. There are no expected adverse ecological impacts from the above management activity.

PRIME FARMLAND

92. Not applicable.

AESTHETICS OF THE AREA

93. This area is considered to have a high aesthetic value due to the fact it is an ancient oxbow lake formed by the Mississippi River that serves as an over wintering area for migratory waterfowl and also contains a cypress swamp that is reminiscent of what can be found in the Louisiana bayou country.

SOCIO-ECONOMIC RESOURCES

94. The area experiences high use by the general public for fishing, sightseeing, and waterfowl related resources. Horseshoe Lake has an economic impact on the local economy during the entire calendar year due to hunting, fishing and hiking activities. The surrounding area is primarily rural, and as such, has experienced the typical pattern of a population decline, i.e. people leaving to seek employment in large cities.

AIR QUALITY

95. Air quality would be considered good at this site throughout the year due to the location and distance from any large metropolitan area.

CUMULATIVE IMPACTS

Summary of secondary and cumulative effects

96. The assessment of cumulative impacts takes into consideration the effects upon an ecosystem of past, present, and reasonably foreseeable future projects. Every application must be considered on its own merits and its impacts on the environment must be assessed in light of historical permitting activity along with anticipated future activities in the area. Although a particular project may constitute a minor impact in itself, the cumulative effects of a large number of such projects could cause a significant impairment of water resources and interfere with the productivity and water quality of existing aquatic ecosystems.

97. The individual and cumulative impacts on the ecosystem by this permit (activity) were determined to be minimal. All current and future permit proposals will be evaluated in a manner similar to this application.

98. The project features will improve the site's habitat diversity with the reintroduction of a sustainable forested and non-forested wetland. This project is expected to reduce some of the cumulative impacts to this unique ecosystem from past actions and management activities.

Table 10. Relationship of Plan to Environmental Requirements

ENVIRONMENTAL ACTS	**Compliance[1]**
Archeological and Historic Preservation Act of 1974 (16 USC 469-469c)	FC
Bald Eagle Protection Act, (16 USC 668)	FC
Clean Air Act, as Amended,(42 U.S.C. 7401-7671g)	FC
Clean Water Act, as Amended, (33 U.S.C. 1251, et seq.)	PC[5]
Comprehensive Environmental Response, Compensation, and Liability Act, (CERCLA) (42 USC 9601-9675)	FC
Endangered Species Act, as Amended,(16 USC 1531, et seq.)	FC
Farmland Protection Policy Act, (7 U.S.C. 4201, et seq.)	FC
Fish and Wildlife Coordination Act,(16 U.S.C. 661-666c)	PC[3]
Food Security Act of 1985, (16 USC & 3801-3862)	FC
National Environmental Policy Act (NEPA), (42 U.S.C. 4321-4347)	PC[3]
National Historic Preservation Act, as Amended,(16 US.C. 470, et seq.)	PC[2]
Noise Pollution and Abatement Act, (42 USC 4901- 4918)	
Resource, Conservation and Rehabilitation Act (2 USC 6901-6987)	FC
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	FC
Water Resources Development Acts of 1986 and 1990	FC
EXECUTIVE ORDERS	
Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, E.O. 12898	FC
Floodplain Management (EO 11988 as amended by EO 121458)	PC[4]
Protection and Enhancement of the Cultural Environment (EO. 11593)	FC
Protection of Wetlands, E.O. 11990	FC
Protection and Enhancement of Environmental Quality, E.O 11514	FC

[1] Definitions: FC - Full Compliance PC - Partial Compliance NA - Not Applicable
[2] Full compliance will be attained after review and comment on Archaeological survey data by the State Historic Preservation Officer.
[3] Full compliance will be attained after complete coordination with the U.S. Fish and Wildlife Service and/or Natural Resource Conservation Service.
[4] Full compliance will be attained after complete coordination with the Illinois EPA
[5] Compliance will be attained upon completion of public 404 reviews and subsequent 401 water quality certification.

OPERATION AND MAINTENANCE

99. Operation and maintenance of the proposed project is the responsibility of the local sponsor. These activities could include vegetation control on the berm slopes, erosion control on slopes, replacement of riprap as required, operation and maintenance of the pumps and water control structures, and an expected rehabilitation of pumps at year 25 of the project life.

FEDERAL RESPONSIBILITIES

100. Section 206 of WRDA 1996 allows the Corps of Engineers to study, design and construct restoration projects in aquatic ecosystems that have not already been specifically authorized by Congress. As required by Section 206 of Public Law 104-303, as amended, the Federal share of the costs of the project shall be 65%, except for recreational features which shall be cost shared at 50%. Federal responsibilities for the selected plan include 65% of costs for project planning, design, and construction of a drainage way and island, one new causeway section and improvement to the Miller City Arm causeway culverts, watering wells, an unwatering pump, water control structures, creek cleanout, and lake restocking, and 50% of planning, design, and construction of the boat ramps and courtesy docks.

NON-FEDERAL RESPONSIBILITIES

101. The local sponsor for this project is the Illinois Department of Natural Resources. This section describes the sponsor's required responsibilities in order to implement the plan in conjunction with the Federal Government. A detailed description of the project is contained in the draft Project Cooperation Agreement. The draft Project Cooperation Agreement will be coordinated with and reviewed and approved by the Illinois Department of Natural Resources. The Project Cooperation Agreement will be signed and executed prior to project implementation. A letter of intent from the local sponsor is included in Appendix I.

102. The feasibility phase study and plans and specifications costs shall be included as part of the total project costs to be shared 65 percent Federal and 35 percent non-Federal, except for recreational features which shall be cost shared at 50%.

103. In meeting this responsibility, the non-Federal sponsor shall provide all lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas (LER) required for the project modification which are not otherwise available due to the construction of the existing project. The real estate required for the entire contract is 19.16 acres. IDNR owns all this property in fee. IDNR will not request credit for this land since it was purchased with federal funds by the State Illinois in the 1920's. To construct, operate and maintain the project 5.31 acres are required in permanent easement for the causeway, wells, the creation of an island from dredged material and a culvert, and 13.85 acres of temporary easement for borrow, construction and access. The project will be completed under one contract. No privately owned lands will be affected. See Appendix E for the project's Real Estate Plan.

104. Further, the non-Federal sponsor shall accomplish, or arrange for accomplishment at no cost to the Government, all relocations determined by the Government to be necessary for implementation of the project modification. At this point, no relocations have been identified within the project area.

105. If the value of the LER plus work-in-kind does not equal or exceed 35 percent of the project cost, the sponsor must pay in cash the additional amount necessary so the sponsor's total contribution equals 35 percent of the project cost. The estimated cash requirement for the Horseshoe Lake project is $1,504,100.

106. If the value of the LER contributions alone exceeds 35 percent of the total project costs, the Government shall reimburse the sponsor for the excess amount.

107. The non-Federal sponsor shall not receive any credit for LER previously provided as an item of cooperation for another Federal project. The non-Federal sponsor also shall not receive credit of the value of LER or other items to the extent that they are provided using Federal funds unless the Federal granting agency verifies in writing that such credit is expressly authorized by statute.

a. Work-in-kind The entire non-Federal share of the total project cost may be credited work-in-kind. The work-in-kind when combined with the non-Federal provision of LER cannot exceed 35 percent of project costs.

b. Work-in-kind must be provided by the non-Federal project sponsor and can be accomplished by the staff of the non-Federal sponsor or by contract administered by the non-Federal sponsor.

c. Items eligible for work-in-kind as part of the non-Federal sponsor's share include post-feasibility phase design, including plans and specifications, provision of materials, and project construction.

d. With regard to work-in-kind, the non-Federal sponsor will comply with applicable Federal and state laws and regulations, including the requirements to secure competitive bids for all work to be performed by contract. Efforts credited as work-in-kind will be subject to audit.

e. The local sponsor desires to provide work-in-kind to satisfy a portion of their cost-sharing requirements. The sponsor will perform the rotenone treatment to eradicate the exotic invasive and rough fish population as work-in-kind. The cost estimate for this work is $73,200.

108. Contributions of cash, funds, materials, and services from other than the non-Federal sponsor may be accepted for the project modification under the provisions of Section 203 of WRDA of 1992. However, such contributions by other than the non-Federal sponsor including work by volunteers, will not be credited to the non-Federal share of the project, but rather be applied to the entire project and, therefore, reduce both the Federal and non-Federal share of the project cost.

109. Program funds will not be provided to local interests or be used to reimburse local interests for conducting studies or constructing projects nor shall contributions be made for features or benefits of projects constructed by another agency or by local interests. Local interests will not be reimbursed for work undertaken by them on an approved project except as approved by inclusion in the Project Cooperation Agreement.

110. By regulation (EC 1105-2-314), the non-Federal sponsor shall not use Federal funds to meet its share of the total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute. The Depart of the Interior has been consulted, and Federal Aid in Wildlife Restoration Act (Pittman-Robertson), Federal Aid in

Sport Fisheries Restoration Act (Dingel-Johnson) funds, and North American Wetlands Conservation Act funds (Mitchell Bill) may not be used by states as the non-Federal share of Section 1135 ecosystem restoration projects.

111. In addition, the local sponsor shall:

a. Pay 100 percent of project operation, maintenance, repair, rehabilitation, and replacement costs.

b. Hold and save the United States free from damages due to the construction and operation and maintenance of the project except where such damages are due to the fault or negligence of the United States or its contractors.

c. Comply with the provisions of the Uniform Relocations Assistance and Real property Acquisition Policies Act of 1970, Public Law 91-646.

d. Comply with provisions of Section 221, Public Law 91-611.

e. Comply with provisions of Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352.

SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

PUBLIC COORDINATION

112. Several measures were undertaken during the ecosystem restoration study to ensure public involvement. These measures include distribution of the draft Ecosystem Restoration Report to various individuals, private organizations and state and Federal agencies. In addition, a public meeting will be held during the review period of the draft report.

VIEWS OF FEDERAL AGENCIES

113. Coordination was conducted with the U.S. Fish and Wildlife Service. That agency has provided a draft Coordination Act Report, included in Appendix G. Federal agency responses to the draft report will be included in Appendix K of the final ecosystem restoration report.

VIEWS OF NON-FEDERAL AGENCIES AND OTHERS

114. Meetings with the non-Federal sponsor and local constituents were held during the preparation of this ecosystem restoration report. These meetings proved helpful to determine the desires of the sponsor and whether Federal actions under the Section 206 program could satisfy these desires. The State Historic Preservation Officer was coordinated with. Comments received on the draft Ecosystem Restoration Report, Environmental Analysis and Finding of No Significant Impact will be included in Appendix K of the final report.

FINDINGS AND CONCLUSIONS

115. Implementation of the proposed measures at Horseshoe Lake would result in positive benefits by allowing more control over water levels within the management areas, reduction of the exotic invasive and rough fish population, and improvement in the water quality in the lake. The long-term benefits of this proposed habitat restoration project outweigh the minor and temporary adverse impacts associated with project construction. The local sponsor has indicated that it wishes to pursue the project at this time.

RECOMMENDATION

116. I recommend that the aquatic ecosystem restoration plan for Horseshoe Lake Conservation Area, Alexander County, Illinois, as discussed in this report be approved for implementation as a Federal project under authority of Section 206 of WRDA of 1996, as amended, at a total project cost of $4,373,000, provided that, prior to construction, local interests provide the assurances of local cooperation as stated previously.

117. The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the state programs or the formulation of a national Civil Works construction program. Consequently, the recommendations may be modified prior to approval and implementation funding.

C. Kevin Williams
Colonel, U.S. Army
District Engineer

Table 11. Study and Internal Technical Review (ITR) Team Members

Discipline	Study Team	ITR Team
Civil	Ted Moore	Jay Fowler
Construction		Bruce Douglas
Cost Estimates	Greg Dyn	Dawayne Sanders
Cultural	Terry Norris	Suzanne Harris
Economics	Dave Kelly	Richard Andersen
Environmental	Ken Dalrymple	Teri Allen
Geotechnical	Marilyn Kwentus, Moe Dirnberger	Joe Schwenk
Hydraulics	Ray Kopksy	Dennis Stephens
Legal	Jeff Asbed	
Mechanical	Walter Wagner	Steve Farkas
Regulatory	Sue Horneman	Chuck Frerker
Structural	John Zacher	Tom Quigley
Plan Formulation	Tamara Atchley	Michelle Brown
Real Estate	Angela Sanders	Harry Hamell
Value Engineering	Eugene Degenhardt	
Water Quality	Kevin Slattery	
Sponsor's Primary Team Members		
Gary Stratton	Project Manager, Forester	
Shawn Hirst	Fisheries Biologist	
Chris Bickers	Fisheries Biologist	
Dan Woolard	Wildlife Biologist	
Jerry Pirtle	Forester	

Table 12. Proposed Schedule of Accomplishments

Milestone	Date
Public Review of Draft Ecosystem Restoration Report	SEP 03
Ecosystem Report Approval	NOV 03
Begin Final Design	NOV 03
Award Construction Contract	AUG 04
Begin Construction	SEP 04